11/12/09 IAP08Rec'd PCT 10 NOV 2009

PTO-1390 (Rev. 09-08)
Approved for use through 2/28/2010. OMB 0651-0021
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TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A SUBMISSION UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER 6081/81072	
U.S. APPLICATION NO. (If known, see 37 CFR 1.5) 12/451436	
INTERNATIONAL APPLICATION NO. PCT/NZ2008/000103	INTERNATIONAL FILING DATE May 9, 2008
PRIORITY DATE CLAIMED May 10, 2007, July 20, 2007	

TITLE OF INVENTION
MULTI POWER SOURCED ELECTRIC VEHICLE

APPLICANT(S) FOR DO/EO/US
Grant Anthony COVIC and John Talbot BOYS

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☑ This is a **FIRST** submission of items concerning a submission under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a submission under 35 U.S.C. 371.
3. ☐ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.
4. ☑ The US has been elected (Article 31).
5. ☑ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ☑ is attached hereto (required only if not communicated by the International Bureau).
   b. ☐ has been communicated by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. ☐ is attached hereto.
   b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. ☐ are attached hereto (required only if not communicated by the International Bureau).
   b. ☐ have been communicated by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☐ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11 to 20 below concern document(s) or information included:

11. ☑ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☑ A preliminary amendment.
14. ☐ An Application Data Sheet under 37 CFR 1.76.
15. ☐ A substitute specification.
16. ☐ A power of attorney and/or change of address letter.
17. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13*ter*.3 and 37 CFR 1.821- 1.825.
18. ☐ A second copy of the published International Application under 35 U.S.C. 154(d)(4).
19. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).

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U.S. APPLICATION NO. (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
12/451436	PCT/NZ2008/000103	6081/81072

20. Other items or information:

The following fees have been submitted	CALCULATIONS	PTO USE ONLY
21. ☑ Basic national fee (37 CFR 1.492(a)) **$330**	$ 330.00	
22. ☑ Examination fee (37 CFR 1.492(c)) If the written opinion prepared by ISA/US or the international preliminary examination report prepared by IPEA/US indicates all claims satisfy provisions of PCT Article 33(1)-(4) ..... **$0** All other situations **$220**	$ 220.00	
23. ☑ Search fee (37 CFR 1.492(b)) If the written opinion of the ISA/US or the International preliminary examination report prepared by IPEA/US indicates all claims satisfy provisions of PCT Article 33(1)-(4) ..... **$0** Search fee (37 CFR 1.445(a)(2)) has been paid on the international application to the USPTO as an International Searching Authority ..... **$100** International Search Report prepared by an ISA other than the US and provided to the Office or previously communicated to the US by the IB ..... **$430** All other situations **$540**	$ 540.00	
TOTAL OF 21, 22 and 23 =	1,090.00	
☐ Additional fee for specification and drawings filed in paper over 100 sheets (excluding sequence listing in compliance with 37 CFR 1.821(c) or (e) in an electronic medium or computer program listing in an electronic medium) (37 CFR 1.492(j)). The fee is **$270** for each additional 50 sheets of paper or fraction thereof.		

Total Sheets	Extra Sheets	Number of each additional 50 or fraction thereof (round up to a whole number)	RATE	
- 100 =	/50 =		x $270	$

Surcharge of **$130.00** for furnishing any of the search fee, examination fee, or the oath or declaration after the date of commencement of the national stage (37 CFR 1.492(h)).	$	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	$	
Total claims	21 - 20 =	1	x $ 52	$ 52.00	
Independent claims	6 - 3 =	3	x $220	$ 660.00	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ $390	$	
			TOTAL OF ABOVE CALCULATIONS =	$ 712.00	
☐ Applicant claims small entity status. See 37 CFR 1.27. Fees above are reduced by ½.					
			SUBTOTAL =	$ 1,802.00	
Processing fee of **$130.00** for furnishing the English translation later than 30 months from the earliest claimed priority date (37 CFR 1.492(i)). +				$	
			TOTAL NATIONAL FEE =	$	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +				$	
			TOTAL FEES ENCLOSED =	$ 1,802.00	
			Amount to be refunded:	$	
			Amount to be charged	$	

PTO-1390 (Rev. 09-08)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

12/451436

a. ☑ A check in the amount of $ 1,802.00 to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. _____ in the amount of $ _____ to cover the above fees.

c. ☑ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 03-3125.

d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038. The PTO-2038 should only be mailed or faxed to the USPTO. However, when paying the basic national fee, the PTO-2038 may NOT be faxed to the USPTO.

ADVISORY: If filing by EFS-Web, do **NOT** attach the PTO-2038 form as a PDF along with your EFS-Web submission. Please be advised that this is **not** recommended and by doing so your **credit card information may be displayed via PAIR**. To protect your information, it is recommended paying fees online by using the electronic payment method.

NOTE: Where an appropriate time limit under 37 CFR 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the International Application to pending status.

SEND ALL CORRESPONDENCE TO:

Richard F. Jaworski
c/o Cooper & Dunham LLP
30 Rockefeller Plaza
New York, NY 10112

SIGNATURE

Richard F. Jaworski
NAME

33,515
REGISTRATION NUMBER

Dkt. 6081/81072

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

12/451436

Application of : Grant Anthony COVIC et al.

Serial No. : Not Yet Assigned

Date Filed : Concurrently Herewith

For : MULTI POWER SOURCED ELECTRIC VEHICLE

30 Rockefeller Plaza
New York, N.Y. 10112

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

EXPRESS MAIL
LETTER OF TRANSMITTAL

Express Mail mailing label number: EM292935577US

Date of Deposit: November 10, 2009

We hereby certify that the above-identified application consisting of a 30-page specification, cover page, 21 claims, 5 sheets of drawings (Figs. 1-7), Transmittal Letter, copy of PCT Publication No. WO 2008/140333, copy of PCT Written Opinion on International Search Report, copy of International Preliminary Report on Patentablility, Preliminary Amendment, Information Disclosure Statement, Form PTO-1449 and copies of cited references and check for $1,802.00 filing fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Mail Room Employee
Depositing Express Mail Material

Attorney for Applicant:
RICHARD F. JAWORSKI, Reg. No. 33,515
Cooper & Dunham LLP
Tel: (212) 278-0400

Dkt. 6081/81072

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of : Grant Anthony COVIC et al.

Serial No. : Not Yet Assigned

Date Filed : Concurrently Herewith

For : MULTI POWER SOURCED ELECTRIC VEHICLE

30 Rockefeller Plaza
New York, N.Y. 10112

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

PRELIMINARY AMENDMENT

Sir:

Prior to examination on the merits, please amend the above-identified application as follows:

Amendments to the claims are reflected in the listing of claims which begin on page 2 of this paper.

Remarks begin on page 7 of this paper.

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claims 1-71 (presently canceled)

72. (new) An inductive power transfer pad comprising:

one or more ferromagnetic slabs;

a coil having at least one turn of a conductor, the coil being arranged in a plane substantially parallel to that of said ferromagnetic slabs; and

a shield member arranged around both said coil and said ferromagnetic slab(s) for channeling electromagnetic flux when in use.

73. (new) The inductive power transfer pad as claimed in claim 72, wherein each ferromagnetic slab is arranged such that its length extends radially from a common point but spaced apart therefrom.

74. (new) The inductive power transfer pad as claimed in claim 73, wherein the coil is positioned to wind around the common point such that it passes each slab at approximately the center of the length of each slab.

75. (new) The inductive power transfer pad as claimed in claim 72, wherein:

a subset of the ferromagnetic slabs extend radially from a common point but are spaced apart therefrom;

a further subset of the ferromagnetic slabs extend radially from a different common point but are spaced apart therefrom;

a still further subset of the ferromagnetic slabs are aligned perpendicularly to the direction of an imaginary straight line connecting the said common points, whereby the still further subset of ferromagnetic slabs are positioned equidistantly from the imaginary line but spaced equally along its length and equally on each side of the imaginary line.

76. (new) The inductive power transfer pad as claimed in claim 72, wherein the pad comprises a substantially rigid backplate.

77. (new) The inductive power transfer pad as claimed in claim 76, wherein the plane of the backplate is substantially parallel to the planes of each of the ferromagnetic slabs and the coil, the plane of each of the ferromagnetic slabs being located between the plane of the backplate and the plane of the coil.

78. (new) The inductive power transfer pad as claimed in claim 76, wherein each ferromagnetic slab is spaced apart from the backplate by a thermally conductive and mechanically insulating material.

79. (new) The inductive power transfer pad as claimed in claim 76, wherein the backplate is formed from a material which substantially inhibits the passage of magnetic flux therethrough.

80. (new) The inductive power transfer pad as claimed in claim 72, wherein the shield member forms side walls around the pad.

81. (new) The inductive power transfer pad as claimed in claim 80, wherein the shield member extends from the backplate and is integrally formed therewith.

82. (new) The inductive power transfer pad as claimed in claim 72, wherein the one or more ferromagnetic slabs are ferrite.

83. (new) An inductive power transfer system comprising two inductive power transfer pads as claimed in claim72, wherein the two inductive power transfer pads are used in combination, one of the pads being used as a pickup pad and the other pad as a charging pad.

84. (new) An apparatus for charging a battery of an electric or a hybrid electric vehicle, the apparatus comprising:

first means for selectively coupling the battery to a high power electrical supply; and

second means for selectively coupling the battery to a lower power electrical supply, wherein the second means for coupling comprises a pickup pad electrically coupled to the battery, wherein power is transferred to the pickup pad from a charging pad by inductive power transfer.

85. (new) A system for distributing energy between at least one battery of an electric or hybrid electric vehicle and an electricity network or subnetwork having at least one generator, the system comprising:

a connector for coupling the network with the at least one battery; and

a controller for monitoring a frequency of power supplied by the network, the controller controlling power transfer between the at least one generator and the at least one battery dependent on the frequency.

86. (new) The system for distributing energy as claimed in claim 85, wherein the network and the at least one battery are coupled by inductive power transfer.

87. (new) The system for distributing energy as claimed in claim 85, wherein the system is adapted to charge the at least one battery from the network.

88. (new) The system for distributing energy as claimed in claim 85, wherein the system is adapter to distribute power to the network from the at least one battery.

89. (new) The system for distributing energy as claimed in claim 85, wherein the controller is configured to vary the power transfer so as to optimize the load factor.

90. (new) A controller for controlling the supply of power between an electricity network or subnetwork having at least one generator and at least one battery of at least one electric or hybrid electric vehicle, the controller being adapted to monitor a frequency of power supplied by the network and control power transfer between the network and the at least one battery dependent on the frequency.

91. (new) The controller as claimed in claim 90, wherein power is transferred between the network and the at least one battery by inductive power transfer.

92. (new) A method for determining a load demand on an electricity network , the method comprising:

changing a control parameter for controlling supply of power to and/or from the network;

detecting a change in load demand as a result of changing the control parameter; and

using the detected change in load demand to determine the load demand of the network.

REMARKS

The claims have been replaced with a new set of claims that are believed to be in better form in accordance with U.S. practice. Claims 72-92 are in the case. No new matter has been added.

The Office is hereby authorized to charge any additional fees which may be required in connection with this amendment and to credit any overpayment to our Deposit Account No. 03-3125.

If petition for an extension of time is required to make this response timely, this paper should be considered to be such a petition, and the Commissioner is authorized to charge the requisite fees to our Deposit Account No. 03-3125.

If a telephone interview could advance the prosecution of this application, the Examiner is respectfully requested to call the undersigned attorney.

Entry of this amendment and allowance of this application are respectfully requested.

Respectfully submitted,

RICHARD F. JAWORSKI
Reg. No. 33,515
Attorney for Applicant
Cooper & Dunham LLP
Tel.: (212) 278-0400

PATENT COOPERATION TREATY

From the:
INTERNATIONAL SEARCHING AUTHORITY

To:

Baldwins
PO Box 5999
Wellesley Street
Auckland
NEW ZEALAND

PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)*	13 NOV 2009
Applicant's or agent's file reference	FOR FURTHER ACTION
JL507346PCT	See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/NZ2008/000103	9 May 2008	10 May 2007

International Patent Classification (IPC) or both national classification and IPC
Int. Cl.

H02J 7/00 (2006.01)

Applicant
AUCKLAND UNISERVICES LIMITED et al

1. This opinion contains indications relating to the following items:

- [X] Box No. I Basis of the opinion
- [ ] Box No. II Priority
- [ ] Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- [X] Box No. IV Lack of unity of invention
- [X] Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- [ ] Box No. VI Certain documents cited
- [ ] Box No. VII Certain defects in the international application
- [ ] Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA	Date of completion of this opinion	Authorized Officer
AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. +61 2 6283 7999	15 October 2008	JAMES WILLIAMS AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No. +61 2 6283 2599

Form PCT/ISA/237 (Cover sheet) (April 2007)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/NZ2008/000103

Box No. I Basis of this opinion

1. With regard to the language, this opinion has been established on the basis of:

   [X] The international application in the language in which it was filed

   [ ] A translation of the international application into, , which is the language of a translation furnished for the purposes of international search (under Rules 12.3(a) and 23.1(b)).

2. [ ] This opinion has been established taking into account the rectification of an obvious mistake authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a))

3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, this opinion has been established on the basis of:

   a. type of material

      [ ] a sequence listing
      [ ] table(s) related to the sequence listing

   b. format of material

      [ ] on paper
      [ ] in electronic form

   c. time of filing/furnishing

      [ ] contained in the international application as filed.
      [ ] filed together with the international application in electronic form.
      [ ] furnished subsequently to this Authority for the purposes of search.

4. [ ] In addition, in the case that more than one version or copy of a sequence listing and/or table(s) relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/NZ2008/000103

Box No. IV Lack of unity of invention

1. [X] In response to the invitation (Form PCT/ISA/206) to pay additional fees the applicant has, within the applicable time limit:

   [ ] paid additional fees

   [ ] paid additional fees under protest and, where applicable, the protest fee

   [ ] paid additional fees under protest but the applicable protest fee was not paid

   [X] not paid additional fees

2. [ ] This Authority found that the requirement of unity of invention is not complied with and chose not to invite the applicant to pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rule 13.1, 13.2 and 13.3 is

   [ ] complied with

   [X] not complied with for the following reasons:

This International Application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept.

In assessing whether there is more than one invention claimed, I have given consideration to those features which can be considered to potentially distinguish the claimed combination of features from the prior art. Where different claims have different distinguishing features they define different inventions.

This International Searching Authority has found that there are different inventions as follows:

- Claims 1-31 directed to an inductive power transfer padIt is considered that a shield member arranged around the coil and the ferromagnetic slabs for channelling electromagnetic flux when in usecomprises a first distinguishing feature.
- Claims 32-63 directed to an apparatus or method for charging a battery of an electric or hybrid vehicleIt is considered that the use of controlled inductive power transfercomprises a second distinguishing feature.
- Claims 64-65 directed to a system or method for supplying power to an electricity network. It is considered that coupling the batteries to the network through controlled inductive power transfer comprises a third distinguishing feature.
- Claims 66-67 directed to a system or method for controlling load demand in an electricity network. It is considered that increasing or reducing the power consumed by the load dependent on the frequency of power supplied by the network comprises a fourth distinguishing feature.

4. Consequently, this opinion has been established in respect of the following parts of the international application:

   [ ] all parts

   [X] the parts relating to claims Nos. **1-31**

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/NZ2008/000103

Box No. V **Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims	2, 5, 7-18, 20-31	YES
	Claims	1 ,3, 4, 6, 19	NO
Inventive step (IS)	Claims	7, 9, 10, 11, 14	YES
	Claims	1-6, 8, 12-13, 15-31	NO
Industrial applicability (IA)	Claims	1-31	YES
	Claims	NONE	NO

2. Citations and explanations:

D1: WO 2005/024865

D2: US 5,528,113

D1 discloses an inductive power transfer unit having flux shields. A flux generating unit extending in two dimensions over a support surface generates flux at or in proximity to a power transfer surface of the unit so that a secondary device placed on or in proximity to the power transfer surface can receive power inductively from the unit. A flux shield made of electrically –conductive material is interposed between the flux generating unit and the support surface. The shield may have one or more portions which extend over one or more faces of the inductive power transfer unit or which extend between the side faces and the flux generating unit. The flux generating unit comprises a coil shaped into a flat solenoid wound around a former of in the form of a thin sheet of magnetic material.

D2 discloses inductive power pick-up coils in which one or more large flat horizontal ferrite cores are used to concentrate the horizontal component of magnetic flux from an extended volume into one or more secondary or pick-up coils. One or more pick-up windings are wound about each core. Each core comprises an array of individual strips of ferrite held in close contact. D2 further discloses an aluminium backplate.

None of the citations discloses the ferromagnetic slabs extending radially from a common point and spaced apart from that point.

Novelty

D1 discloses a coil, a ferromagnetic slab and a shield member arranged around the coil and the slab (Abstract, page 1, lines 20-24, figure 7, page 10, lines 6-19).

D1 discloses all of the features of claims 1,3,4,6 and 19.
Therefore the subject matter of these claims is not new and does not meet the requirements of Article 33(2) of the PCT with regard to novelty.

None of the cited documents explicitly disclose the specific combination of features claimed and hence claims 2, 5, 7-18, and 20-31 meet the requirements of Article 33(2) of the PCT with regard to novelty.

Please see Supplemental Box 1

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International Application No.
PCT/NZ2008/000103

Supplemental Box 1

In case the space in any of the preceding boxes is not sufficient.

Continuation of: Box V

Inventive Step

Claims 1, 3, 4, 6 and 19 do not involve an inventive step for the reasons given under Novelty and in addition they would lack inventive step in light of the disclosure of D2 when read with D1.

The use of litz wire does not bring any technical advantage to the invention and is well known in the art of the manufacture of electrical coils and is disclosed in D2 column 7, lines 32-34. Therefore the subject matter of claim 2 is obvious and does not meet the requirements of Article 33(3) of the PCT with regard to inventive step.

The use of ferrite as the material used in magnetic coils is well known in the art and is disclosed in D2 column 6, lines 58-62. Therefore the subject matter of claim 5 is obvious and does not meet the requirements of Article 33(3) of the PCT with regard to inventive step in light of D1 and D2 read together.

Claim 8 does not define the relation of the ferromagnetic slabs other than they are spaced apart from adjacent slabs by substantially the same angle. This includes parallel as disclosed in D2. Therefore the subject matter of claim 8 is obvious and does not meet the requirements of Article 33(3) of the PCT with regard to inventive step in light of D1 and D2 read together.

D2 column 10, lines 35-44 disoloses the use of plastics and woods as core mounting plates, D2 column 7, lines 35-39 further discloses thermal coupling between the coils and the backplate for dissipation of heat. It would be obvious to a person skilled in the art to use this method if a thermal problem arose in the ferrite slabs. Mechanical insulating in the form of foam or rubber is also well known in the art. Therefore the subject matter of claims 15-16 is obvious and does not meet the requirements of Article 33(3) of the PCT with regard to inventive step in light of D1 and D2 read together.

D2 column 10, lines 46-54 discloses the use of an aluminium backplate for restricting the flux to the area of the coils. Therefore the subject matter of claims12,13, 17 and 18 is obvious and does not meet the requirements of Article 33(3) of the PCT with regard to inventive step in light of D1 and D2 read together.

D2 column 10, lines 8-20 discloses channels for holding the ferrite slabs and associated coils. Therefore the subject matter of claims 22-25 is obvious and does not meet the requirements of Article 33(3) of the PCT with regard to inventive step in light of D1 and D2 read together.

The use of a cover plate would be obvious to protect the IPT. In order to not interfere with the functioning of the inductive transfer of energy the cover plate must be magnetically transparent. The use of non-toxic plastic has no material effect on the functioning of the invention. Therefore the subject matter of claims 26-28 is obvious and does not meet the requirements of Article 33(3) of the PCT with regard to inventive step.

Please see Supplemental Box 2

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International Application No.

PCT/NZ2008/000103

Supplemental Box 2

In case the space in any of the preceding boxes is not sufficient.

Continuation of: Box V

Inductive power transfer relies on the analogous transmission and reception of the induced magnetic energy through coils and it would be obvious to a person skilled in the art to use the same technology for both a pick-up pad and a charging pad which is connected to a power supply as the source of energy. Therefore the subject matter of claim 29-31 is obvious and does not meet the requirements of Article 33(3) of the PCT with regard to inventive step.

In order to effectively shield the IPT and to have mechanical stability it would be obvious to a person skilled in the art to couple the shield to the backplane. Therefore the subject matter of claim 21 is obvious and does not meet the requirements of Article 33(3) of the PCT with regard to inventive step.

None of the citations discloses the ferromagnetic slabs extending radially from a common point and spaced apart from that point.

Therefore the subject matter of claims 7 and 9 is not obvious and meets the requirements of Article 33(3) of the PCT with regard to inventive step.

None of the citations discloses the coil being arranged in a plane substantially parallel to that of the ferromagnetic slabs.
Therefore the subject matter of claims 10 and 14 is not obvious and meets the requirements of Article 33(3) of the PCT with regard to inventive step.

Industrial Applicability

Claims 1-31 meet the criteria set out in PCT Article 33(4), and thus have industrial applicability because the subject matter claimed clearly can be made or used in industry.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	FOR FURTHER ACTION	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
JL507346PCT		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/NZ2008/000103	9 May 2008	10 May 2007

Applicant

AUCKLAND UNISERVICES LIMITED et al

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 4 sheets.

[ ] It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

a. With regard to the language, the international search was carried out on the basis of:

[X] The international application in the language in which it was filed.

[ ] A translation of the international application into , which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

b. [ ] This international search report has been established taking into account the rectification of an obvious mistake authorized by or notified to this Authority under Rule 91 (Rule 43.6*bis*(a)).

c. [ ] With regard to any nucleotide and/or amino acid sequence disclosed in the international application, see Box No. I.

2. [ ] Certain claims were found unsearchable (See Box No. II).

3. [X] Unity of invention is lacking (See Box No. III).

4. With regard to the title,

[X] the text is approved as submitted by the applicant.

[ ] the text has been established by this Authority to read as follows:

5. With regard to the abstract,

[X] the text is approved as submitted by the applicant.

[ ] the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the drawings,

a. the figure of the drawings to be published with the abstract is Figure No. 4

[X] as suggested by the applicant.

[ ] as selected by this Authority, because the applicant failed to suggest a figure.

[ ] as selected by this Authority, because this figure better characterizes the invention.

b. [ ] none of the figures is to be published with the abstract.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NZ2008/000103

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Group 1: Claims 1-31 directed to an inductive power transfer pad

Group 2 :Claims 32-63 directed to an apparatus or method for charging a battery of an electric or hybrid vehicle

Group 3 :Claims 64-65 directed to a system or method for supplying power to an electricity network

Group 4: Claims 66-67 directed to a system or method for controlling load demand in an electricity network

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2 ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-31

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NZ2008/000103

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

H02J 7/00 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPI & Google Patent: inductive, power, transfer, pad, shield and similar terms

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	WO 2005/024865 A2 (SPLASHPOWER LIMITED) 17 March 2005 (Abstract, page 1, lines 20-24, figure 7, page 10, lines 6-19).	1,3,4,19 1-6,8,12-13,15-31
Y	US 5,528,113 A (BOYS et al) 18 June 1996 whole document	1-6,8,12-13,15-31
A	WO 2006/101285 A1 (HANRIM POSTECH CO., LTD.) 28 September 2006 whole document	

☐ Further documents are listed in the continuation of Box C ☒ See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"B" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 October 2008	13 NOV 2008

Name and mailing address of the ISA/AU	Authorized officer
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Form PCT/ISA/210 (second sheet) (July 2008)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/NZ2008/000103

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
WO	2005024865	EP	1665299	US	2007064406		
US	5528113	AU	80064/94	AU	80065/94	EP	0727105
		JP	7170681	NZ	274938	NZ	274939
		US	5821638	WO	9511544	WO	9511545
WO	2006101285	CN	1826715	EP	1882292	US	2008094027

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX

Dkt. 6081/81072

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of : Grant Anthony COVIC et al.

Serial No. : Not Yet Assigned

Date Filed : Concurrently Herewith

For : MULTI POWER SOURCED ELECTRIC VEHICLE

30 Rockefeller Plaza
New York, N.Y. 10112

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

INFORMATION DISCLOSURE STATEMENT

Sir:

The information listed in the attached form PTO-1449 is brought to the attention of the Examiner. In accordance with 37 C.F.R. §1.92(a)(2)(ii), copies of U.S. Patents listed herein need not be provided.

It is respectfully requested that the information cited in annexed Form PTO-1449 be considered by the Examiner in connection with the above-identified patent application, and that such art be made of record in said application.

The enclosed items were cited in a search report in connection with PCT Application No. PCT/NZ2008/000103 which corresponds to the above-identified application. A copy of the search report is enclosed.

The citation of the listed items is not a representation that they constitute a complete or exhaustive listing of the relevant art or that these items are prior art. The items listed are submitted

in good faith, but are not intended to substitute for the Examiner's search. It is hoped, however, that in addition to apprising the Examiner of the particular items, they will assist in identifying fields of search and in making as full and complete a search as possible.

The filing of this Information Disclosure Statement is not an admission that the information cited herein is, or is considered to be, material to patentability as defined in 37 C.F.R. §1.56(b).

This Information Disclosure Statement is being filed concurrently with this application.

The Office is hereby authorized to charge any additional fees which may be required for consideration of this Information Disclosure Statement and to credit any overpayment to our Deposit Account No. 03-3125.

Early and favorable consideration of the case is respectfully requested.

Respectfully submitted,

RICHARD F. JAWORSKI
Registration No. 33,515
Attorney for Applicant
Cooper & Dunham LLP
Tel. (212) 278-0400

Form PTO-1449 — U.S. Department of Commerce, Patent and Trademark Office

INFORMATION DISCLOSURE CITATION BY APPLICANT (Use several sheets if necessary)

Atty. Docket No.	Serial No.
6081/81072	Not Yet Assigned
Applicant: Grant Anthony Covic et al.	
Filing Date: Concurrently Herewith	Group:

U.S. PATENT DOCUMENTS

Examiner Initial		Document Number	Date	Name	Class	Subclass	Filing Date if Appropriate
	AA	5 5 2 8 1 1 3	June 18, 1996	Boys et al.			
	AB	5 7 1 0 5 0 2	January 20, 1998	Poumey			
	AC	5 8 2 1 6 3 8	October 13, 1998	Boys et al.			
	AD	6 9 3 4 1 6 7	August 23, 2005	Jang et al.			
	AE						
	AF						
	AG						
	AH						
	AI						
	AJ						
	AK						
	AL						
	AM						
	AN						
	AO						
	AP						

FOREIGN PATENT DOCUMENTS

		Document Number	Date	Country	Class	Subclass	Translation Yes	Translation No
		WO 2005 024865	March 17, 2005	PCT				
		WO 2006 101285	September 28, 2006	PCT				

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

B	
B	
B	
A,D	

EXAMINER | DATE CONSIDERED

***EXAMINER:** Initial if reference considered, whether or not citation is in conformance with MPEP 609: Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

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PCT

(10) International Publication Number
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(26) Publication Language: English

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0320960.8 8 September 2003 (08.09.2003) GB

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(74) Agent: **HITCHING, Peter, Matthew**; Haseltine Lake, Imperial House, 15-19 Kingsway, London WC2B 6UD (GB).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

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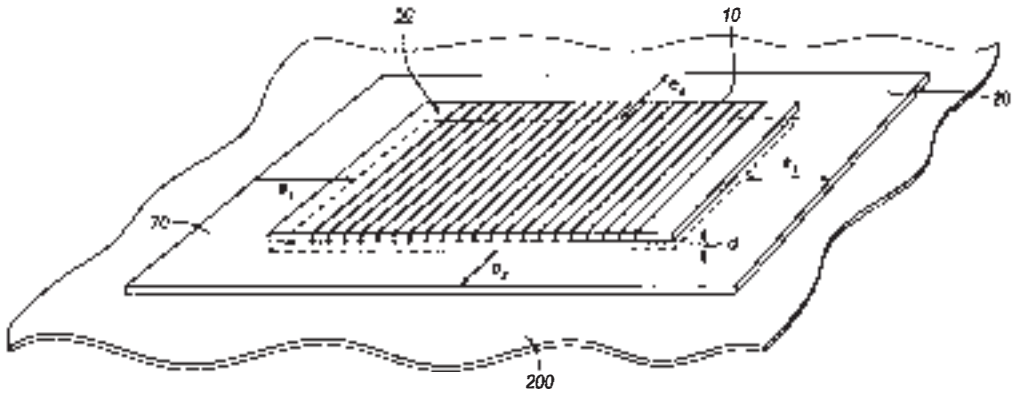
Published:
— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: INDUCTIVE POWER TRANSFER UNITS HAVING FLUX SHIELDS



(57) Abstract: An inductive power transfer unit is adapted to be placed when in use on a support surface (200). A flux generating unit (50) extends in two dimensions over the support surface, and generates flux at or in proximity to a power transfer surface of the unit so that a secondary device placed on or in proximity to the power transfer surface can receive power inductively from the unit. A flux shield (70), made of electrically-conductive material, is interposed between the flux generating unit and the support surface, the shield extending outwards (e_1 - e_4) beyond at least one edge of the flux generating unit. Alternatively, the flux shield may have one or more portions which extend over one or more side faces of the inductive power transfer unit or which extend between the side face(s) and the flux generating unit. The flux shield may be supplied as a removable accessory which attaches to the outside of the inductive power transfer unit.

WO 2005/024865 A2

INDUCTIVE POWER TRANSFER UNITS HAVING FLUX SHIELDS

This invention relates to inductive power transfer units having flux shields.

Inductive power transfer units, as described for example in the present applicant's published International patent publication no. WO-A-03/096512, the entire contents of which is hereby incorporated into the present application by reference, seek to provide a flat or curved power transfer surface over which a substantially horizontal alternating magnetic field flows. This field couples into any secondary devices placed upon the power transfer surface. In some variants this field may rotate in the plane of the surface to provide complete freedom of positioning for any secondary device placed on the surface to receive power. The secondary devices are, for example, built into portable electrical or electronic devices or rechargeable batteries which can be removed from the surface when not receiving power.

Depending on the design of the flux generating unit (magnetic assembly) of such power transfer units, they may also emit flux in directions other than desired horizontal surface field. For example a "squashed solenoid" design of flux generating unit emits flux symmetrically above and below it.

In Figure 1, a flux generating unit 50 comprises a coil 10 shaped into a flat solenoid wound around a former 20. The former 20 is in the form of a thin sheet of magnetic material. This results in a substantially horizontal field across the upper surface of the flux generating unit, but also an equal field across the lower surface. The field lines of both fields extend generally in parallel with one another over the respective surfaces, substantially perpendicularly to the coil windings. A secondary device 60 is shown in place over the upper surface.

Figure 2 shows a similar arrangement to that of Figure 1, but with an additional coil 11 wound, in an orthogonal direction to the winding direction of the coil 10, around the former 20. By driving the two coils 10 and 11 in a suitable manner, the flux generating unit may create a field which is substantially horizontal over the power

transfer surface (upper surface) and which rotates in the plane of that surface. In typical usage, the flux above the upper surface provides the functionality that the user desires (powering the secondary device 60), but the flux present at other surfaces may not be useful and can cause undesired effects.

Figure 3 shows a side view Finite Element analysis of the flux lines generated by the flux generating unit 50 in Figure 1 at an instant in time. The lines travel through the centre of the solenoid and then divide to return over and under it through the air. A secondary device 60 is shown placed on top of the unit 50.

One undesired effect occurs particularly when the primary unit is placed upon a ferrous metal surface, for example a mild steel desk or part of a vehicle chassis. The permeability of mild steel is sufficiently high that it provides a return path for the flux which is of considerably lower reluctance than the alternative path through air. Therefore the flux is "sucked" down into the metal desk. Figure 4 shows another Finite Element analysis view when a metal desk 200 is brought under the flux generating unit. The high permeability of the metal offers the flux lines a much lower-reluctance path than air to return from one end of the flux generating unit 50 to the other, and so they travel within the desk rather than through the air. This is undesirable for two reasons:

- A significant proportion of the flux generated by the inductive power transfer unit (primary unit) is flowing into the metal desk instead of flowing into any secondary devices on the upper surface of the unit, therefore the system becomes less efficient (consumes the more power) and the power received by the secondary device varies.
- The flux flowing through the metal desk causes core losses, for example via hysteresis and / or eddy current loss , which cause it to heat up.

It is known that when conductive materials, for example copper or aluminium, are placed into an alternating magnetic field, the field induces eddy-currents to circulate within them. The eddy currents then act to generate a second field which - in the limit of a perfect conductor - is equal and opposite to the imposed field, and cancels

it out at the surface of the conductor. Therefore these conductive materials can be seen as "flux-shields" – the lines of flux in any magnetic system are excluded from them. This may be used to shield one part of a system from a magnetic field and consequently concentrate the field in another part. GB-A-2389720, which is a document published after the priority date of the present application but having an earlier priority date, discloses a flux generating unit in the form of a printed circuit board having an array of spiral conductive tracks for generating flux above the upper surface of the unit. A ferrite sheet is placed under the board, and a conductive sheet is placed under the ferrite sheet, to provide a flux shield. The ferrite sheet and conductive sheet are of the same dimensions, parallel to the sheets, as the board.

According to a first aspect of the present invention there is provided an inductive power transfer unit, adapted to be placed when in use on a support surface, comprising: a flux generating means which, when the unit is placed on the support surface, extends in two dimensions over the support surface, said flux generating means being operable to generate flux at or in proximity to a power transfer surface of the unit so that a secondary device placed on or in proximity to the power transfer surface can receive power inductively from the unit; and a flux shield, made of electrically-conductive material, arranged so that when the unit is placed on the support surface, the shield is interposed between the flux generating means and the support surface, the shield extending outwardly beyond at least one edge of the flux generating means.

According to a second aspect of the present invention there is provided an inductive power transfer unit, adapted to be placed when in use on a support surface, comprising: a flux generating means which, when the unit is placed on the support surface, extends in two dimensions over the support surface, said flux generating means being operable to generate flux at or in proximity to a power transfer surface of the unit so that a secondary device placed on or in proximity to the power transfer surface can receive power inductively from the unit; and a flux shield, made of electrically-conductive material, having one or more portions which extend over one

or more side faces of the unit or which extend between said one or more side faces and said flux generating means.

In cases where the flux generating unit operates by creating a field which alternates back and forth in one linear dimension, the conductive shield will have induced in it an equal and opposite alternating linear field, which acts to cancel the field near the shield. In cases where the unit operates by creating a rotating field in the plane of its laminar surface, the conductive shield has induced in it a field which also rotates, again cancelling the field.

Such power transfer units are advantageous because they allow the flux to be concentrated in directions in which it is useful, improving the flux-efficiency of the unit, and to be shielded from directions where it can cause side-effects, for example by coupling into a metal desk under the unit.

In addition, the flux shield increases the coupling between the flux generating unit and the secondary device(s) by forcing most of the flux to go over the power transfer surface. Therefore less drive current is needed in the flux generating unit to create a given flux density in the secondary device(s). Accordingly, provided that losses in the flux shield are minimised, the system as a whole becomes more efficient.

To ensure that the apparatus runs cool and is power-efficient, I^2R losses (losses caused by circulating currents dissipating as heat) in the conductive shield must be kept small:

- The conductive shield is advantageously made of a highly conductive material, for example copper or aluminium sheet of sufficient thickness to ensure that the eddy-currents induced therein do not suffer from excessive resistance and therefore create heat. The flux density, and therefore the eddy currents, may vary across different parts of the apparatus, and therefore the necessary thickness, or material, may also vary.
- The spacing between the shield and the electrically-driven conductors of the flux generating unit can be optimised. The larger it is (i.e. the greater the

spacing between it and the electrically-driven conductors), the lower the current-density induced in the conductive shield, and therefore the lower the heating. However this must be traded-off against the larger the overall dimensions necessary, which may be less ergonomic.

In addition, the conductive shield must not itself be substantially ferrous, otherwise it may provide a low-reluctance path which "shorts" the intended flux path.

In one embodiment of the present invention, the conductive shield extends in a substantially continuous sheet substantially over all but one face of the flux generating unit, such that only the face substantially exposed is the laminar surface intended for power delivery to secondary devices. For example, if the generating unit is a substantially flat rectangular shape, the shield may extend to cover the bottom and four sides of the unit. As another example, if the flux generating unit is a substantially flat cylinder, the shield may extend to cover the bottom and cylindrical side of the unit. The advantage of such an arrangement is that it increases still further, compared to a flat sheet, the path that flux would have to travel in order to travel through a metal object underneath the flux generating unit.

In another embodiment of the present invention, the conductive shield may enclose all but a part of one or more faces of the flux generating unit. For example, if the flux generating unit is a substantially flat rectangular shape, the shield may cover the bottom, sides and outer part of the top of the flux generating unit. This may be advantageous in controlling the flux pattern at the edge of the top of the flux generating unit.

The conductive shield may form part of an enclosure of the inductive power transfer unit, for example a formed or cast aluminium or magnesium casing. This may be advantageous in reducing cost.

According to a third aspect of the present invention there is provided an inductive power transfer unit comprising: a power transfer surface on or in proximity to which

a secondary device can be placed to receive power inductively from the unit; flux generating means arranged to generate flux at or in proximity to said power transfer surface; and flux shield attachment means arranged for attaching a flux shield to the unit such that the attached shield is arranged at one or more external surfaces of the unit other than said power transfer surface, or is arranged between said one or more external surfaces and said flux generating means, so that the shield serves to shield objects outside the unit, adjacent to said one or more external surfaces, from flux generated by the flux generating means.

According to a fourth aspect of the present invention there is provided an accessory, adapted to be attached to the outside of an inductive power transfer unit, the unit having a power transfer surface on or in proximity to which a secondary device can be placed to receive power inductively from the unit and also having flux generating means arranged to generate flux at or in proximity to the power transfer surface, and the accessory comprising: means which co-operate with the unit to attach the accessory to the outside of the unit in a predetermined working disposition; and a flux shield, made of electrically-conductive material, which, when the accessory is in its said working disposition, extends at or in proximity to one or more external surfaces of the unit other than said power transfer surface so as to shield objects outside the unit, adjacent to said one or more external surfaces, from flux generated by the flux generating means.

In the third and fourth aspects of the invention the conductive shield is supplied to the user as a separate accessory to be placed under or around the power transfer unit. Optionally it may be provided as a retainable accessory, for example a clip-on cover. This is advantageous as it allows the bill of materials for the power transfer unit to be kept to an absolute minimum, yet allows users to purchase the accessory if the unit is to be used in a location where it may be necessary to constrain its field, for example on a ferrous metal desk.

In one embodiment the flux generating unit comprises at least one means for generating an electromagnetic field, the means being distributed in two dimensions

across a predetermined area in or parallel to the power transfer surface so as to define at least one power transfer area of the power transfer surface that is substantially coextensive with the predetermined area, the charging area having a width and a length on the power transfer-surface. Preferably the means is configured such that, when a predetermined current is supplied thereto and the primary unit is effectively in electromagnetic isolation, an electromagnetic field generated by the means has electromagnetic field lines that, when averaged over any quarter length part of the power transfer area measured parallel to a direction of the field lines, subtend an angle of 45° or less to the power transfer surface in proximity thereto and are distributed in two dimensions thereover. Preferably the means has a height measured substantially perpendicular to the power transfer area that is less than either of the width or the length of the power transfer area. The height is more preferably less than one fifth, or less than one tenth, of either the width or height, so that the inductive power transfer unit as a whole is in the form of a flat bed or platform. When a secondary device, including at least one electrical conductor, is placed on or in proximity to a power transfer area of the inductive power transfer unit, the electromagnetic field lines couple with the at least one conductor of the secondary device and induce a current to flow therein. The conductive sheet or shield is arranged on or in the power transfer unit at a location other than the side on which the power transfer area is located.

In the context of the present application, the word "laminar" defines a geometry in the form of a thin sheet or lamina. The thin sheet or lamina may be substantially flat, or may be curved.

It is to be appreciated that the conductive sheet or shield may be generally laminar, or may include one or more edge portions that are directed towards the power transfer surface.

The conductive sheet or shield may be exposed on the side of the power transfer unit opposed to the power transfer surface, or may be covered with a layer of dielectric or other material, for example by part of a casing of the unit.

For a better understanding of the present invention and to show how it may be carried into effect, reference shall now be made, by way of example, to the accompanying drawings, in which:

FIGURE 1 is a perspective view showing an example of a flux generating unit suitable for use in embodiments of the present invention.

FIGURE 2 is a perspective view showing another example of a flux generating unit suitable for use in embodiments of the present invention.

FIGURE 3 shows a side view of the flux generating unit of Figure 1 for illustrating flux lines generated thereby.

FIGURE 4 is a view corresponding to Figure 3 but illustrating flux lines generated when a metal desk is present under the arrangement.

FIGURE 5 is a perspective view showing parts of an inductive power transfer unit according to a first embodiment of the present invention.

FIGURE 6 shows a side view of the unit of Figure 5 for illustrating flux lines generated thereby when the unit is placed on a metal desk.

FIGURE 7 is a perspective view showing parts of an inductive power transfer unit according to a second embodiment of the present invention.

FIGURE 8 shows a side view of the unit of Figure 7 for illustrating flux lines generated thereby when the unit is placed on a metal desk.

FIGURE 9 is a side view of an inductive power transfer unit and an accessory therefor according to a third embodiment of the present invention.

Figure 5 shows parts of an inductive power transfer unit according to a first embodiment of the present invention. In this embodiment, a flux generating unit 50 has the same general construction as the flux generating unit described in the introduction with reference to Figure 1. Of course a flux generating unit 50' as shown in Figure 2 can be used in this (and other) embodiments of the invention, instead. Similarly, any of the flux generating units described in WO-A-03/096512 can be used in embodiments of the present invention.

The flux generating unit 50 comprises a coil 10 wound around a former 20. The former 20 is in the form of a thin sheet of magnetic material. When the inductive power transfer unit is placed on a support surface 200, the flux generating unit 50 extends in two dimensions over the support surface.

A flux shield 70, made of electrically-conductive material such as copper, is interposed between the flux generating unit 50 and the support surface 200. As shown in Figure 5, the shield 70 extends outwardly by distances e_1 to e_4 beyond each edge of the flux generating unit 50. The distance e_1 is for example 50mm. The distance e_2 is for example 50mm. The distance e_3 is for example 50mm. The distance e_4 is for example 50mm.

In this embodiment, the flux shield 70 is in the form of a flat sheet which extends generally in parallel with the support surface. There is a gap of size d between the sheet and the electrical conductors of the coil 10 extending over the lower surface of the former 20. d is 4mm, for example.

Figure 6 shows a Finite Element analysis view of the unit of Figure 5. The support surface 200 is assumed to be a metal desk. The shield 70 forces any flux lines flowing through the metal desk to travel around the shield, increasing the path length and thus the effective reluctance of the "desk" path. As a result, the presence of the desk has less effect, since more flux lines travel over the unit instead of going through the desk.

Although the flux shield 70 has extensions beyond all edges of the unit 50 in the Figure 5 example, it will be appreciated that a worthwhile flux-shielding effect can also be obtained even if the flux shield extends beyond one edge or only extends beyond a pair of opposite edges.

Figure 7 shows parts of an inductive power transfer unit according to a second embodiment of the present invention. In this embodiment a flux shield 80 having 5 sides (base 82 and side walls 84, 86, 88 and 90) is provided. The base 82 of the flux shield 80 extends between the lower surface of the flux generating unit 50 and the support surface 200. Because the flux shield 80 has side walls in this embodiment, the base 82 need not extend out beyond the edges of the flux generating unit 50 by as far as the distances e_1 to e_4 in the Figure 5 embodiment. For example, e_1 to e_4 may each be 4mm. This can enable the overall dimensions of the power transfer unit to be reduced while keeping the effective reluctance of the desk path high. The height of the side walls 84, 86, 88 and 90 is exaggerated in Figure 7 for clarity. In practice, the side walls need not extend above the upper surface of the flux generating unit 50.

The flux shield 80 may be formed from a flat sheet of conductive material which is cut and folded up at the edges to form a tray-form member.

Figure 8 shows a finite element analysis view of the unit of Figure 7.

Figure 9 shows parts of an inductive power transfer unit 400 according to a third embodiment of the present invention. In this embodiment a flux generating unit 50, similar to the flux generating units described with reference to the first and second embodiments, is contained in a casing 410 of the unit 400. An upper surface of the casing 410 provides the power transfer surface in this embodiment, and a secondary device 60 is placed directly on the surface to receive power inductively from the flux generating unit 50.

In each of the four side walls of the casing 410 a small circular recess 420 is formed.

In this embodiment the flux shield 90 is an accessory which is adapted to be attached to the outside of the inductive power transfer unit 400. The flux shield 90, which is similar in form to the flux shield 80 shown in Figure 7, has circular projections 95 formed on the inner surfaces of the upstanding side walls of the flux shield 90. The projections 95 engage respectively with the recesses 420 in the casing of the inductive power transfer unit 400. In this way, the unit 400 can be inserted into the flux shield 90 due to the resilience of the materials of the flux shield 90 and/or casing 410. The projections and recesses serve to hold the flux shield 90 on the outside of the unit 400 in such a way that the flux shield shields objects outside the unit, adjacent to the external surfaces of the unit, from flux generated by the flux generating unit 50.

The provision of a removable flux shield has several advantages. In some applications, the flux shield is unnecessary. For example, the shield is unnecessary if the support surface on which the unit will be placed is non-metallic. In this way, the unit can be made as small as possible and at the lowest possible cost. Any user who intends to use the unit on a metallic support surface can purchase the flux shield as an optional accessory.

When the flux shield is in the form of a removable accessory, it is not necessary for the flux shield to have the form of the first embodiment or second embodiment described above. For example, the flux shield need not extend outwardly beyond the edges of the flux generating unit 50; it could be coterminous with the planar area of the flux generating unit 50 or even smaller than the planar area thereof. For example, a flat sheet-form conductive shield could be built into the base of a tray-form plastics housing of the accessory.

Any suitable way of attaching the flux shield to the outside of the inductive power transfer unit may be used. Although snap-fitting is particularly convenient, the flux shield may be attached to the unit using screws or Velcro ®. Equally, there could simply be a tight fit between the flux shield and the casing of the unit.

By way of example only, there now follows a set of test results for embodiments of this invention. In the test set up the flux generating unit 50 measured approximately 175x125x9mm. The flux shield 70 or 80 was made from a 0.6mm thick sheet of copper. The metal desk 200 was a sheet of metal 500mm x 500mm x 0.6mm thick (magnetically, this is effectively an infinite plane).

The current through the flux generating unit 50 was adjusted so that the power delivered to a secondary device 60 was the same at the start of each test. A control loop then held the current constant during the rest of each test.

The power received by the secondary device was monitored and the extra power drawn from the charger was monitored.

The results were as follows:

Test Condition	Power seen by secondary device	Extra power needed from charger
1a. No flux shield	100%	0W
1b. As 1a with steel under	*123%*	*11W*
2a. Flux shield sheet (Figure 5) immediately under magnetic assembly	100%	1.5W
2b. Flux shield moved 4mm from assembly	100%	0.7W
2c. As 2b with steel under	*110%*	*4.6W*
3a. Flux shield box (Figure 7)around bottom and edges (4mm gap)	100%	1.5W
3b. As 3a with steel under	*108%*	*2.2W*

Test 1 shows the case without any flux shield. The flux lines will initially be approximately as shown in Figure 3. Introducing a metal sheet under the assembly causes the flux to travel down and through the sheet, in preference to travelling up and over the top, as shown in Figure 4. The control loop in the generator is forced to expend 11W to keep its coil current constant, which is not optimal since it is inefficient and will cause the metal to warm up. In addition, the secondary device sees a rise in the power it receives to 123%, because eddy currents in the metal desk do act as a poor flux excluder even as they consume large amounts of generator

power – and this is not optimal either.

Test 2 shows the case with a flat flux shielding sheet underneath as in the first embodiment. A large (190mm. x 140mm x 0.6mm) copper sheet flux shield immediately under the magnetic assembly (test 2a) causes the generator to have to supply an additional 1.5W, presumably because it starts to short the coil turns in the assembly. Moving this 4mm away from the assembly (i.e. d = 4mm in Figure 5) reduces this drain to 0.7W (test 2b). Now introducing a metal sheet only causes the generator to have to supply 4.6W (i.e. an additional 3.9W), and the power into the secondary device now only changes to 110% (test 2c). This is shown in Figure 6. So the flux shield has reduced each of the two side-effects by more than half.

Test 3 shows the case where the edges of the flux shield are brought up around the edges of the magnetic assembly, as in the second embodiment shown in Figure 7. The shield is kept 4mm away from the magnetic assembly on all sides (test 3a) to avoid the phenomenon seen in Test 2a. The generator must supply an additional 1.5W to overcome the losses of the eddy currents in the shield. Now introducing a metal sheet (test 3b) only causes the generator to have to supply an extra 2.2W (i.e. an additional 0.7W), and the power seen by the secondary device now only changes to 108%.

In conclusion, these test results clearly demonstrate the two key advantages of a flux shield in reducing the side effects of metal objects: less power delivered into the steel by the generator, and less variation in the power seen by the secondary device.

A shield extending completely around the magnetic assembly, except over the desired power transfer surface, can reduce the effect of metal desks on the generator by more than an order of magnitude, and on the secondary device by more than half. In the example shown the price to pay for this advantage is an extra 1.54W of quiescent power delivered by the generator, to overcome losses in the eddy-currents in the flux shield.

The preferred features of the invention are applicable to all aspects of the invention and may be used in any possible combination.

Throughout the description and claims of this specification, the words "comprise" and "contain" and variations of the words, for example "comprising" and "comprises", mean "including but not limited to", and are not intended to (and do not) exclude other components, integers, moieties, additives or steps.

CLAIMS

1. An inductive power transfer unit, adapted to be placed when in use on a support surface, comprising:

a flux generating means which, when the unit is placed on the support surface, extends in two dimensions over the support surface, said flux generating means being operable to generate flux at or in proximity to a power transfer surface of the unit so that a secondary device placed on or in proximity to the power transfer surface can receive power inductively from the unit; and

a flux shield, made of electrically-conductive material, arranged so that when the unit is placed on the support surface, the shield is interposed between the flux generating means and the support surface, the shield extending outwardly beyond at least one edge of the flux generating means.

2. A unit as claimed in claim 1, wherein said flux shield is in the form of a flat sheet which extends generally in parallel with the support surface.

3. A unit as claimed in claim 1 or 2; wherein said flux shield extends outwardly beyond each edge of the flux generating means.

4. An inductive power transfer unit, adapted to be placed when in use on a support surface, comprising:

a flux generating means which, when the unit is placed on the support surface, extends in two dimensions over the support surface, said flux generating means being operable to generate flux at or in proximity to a power transfer surface of the unit so that a secondary device placed on or in proximity to the power transfer surface can receive power inductively from the unit; and

a flux shield, made of electrically-conductive material, having one or more portions which extend over one or more side faces of the unit or which extend between said one or more side faces and said flux generating means.

5. A unit as claimed in any preceding claim, wherein said flux shield also extends over an outer peripheral portion of said power transfer surface or between said outer peripheral portion and said flux generating means.

6. A unit as claimed in any preceding claim, wherein said flux shield extends substantially continuously around said flux generating means except for a part thereof adjacent to said power transfer surface.

7. A unit as claimed in any preceding claim, wherein said flux shield provides at least part of a casing of the unit.

8. A unit as claimed in any preceding claim, wherein at least part of an outer surface of the flux shield is covered with a dielectric or other material.

9. A unit as claimed in any preceding claim, wherein a gap between said flux shield and electrical conductors of said flux generating means is set so that flux shielding is achieved without the flux shield unduly increasing power consumption of the flux generating means.

10. A unit as claimed in any preceding claim, wherein said flux shield varies in thickness from one part to another.

11. A unit as claimed in any preceding claim, wherein different parts of the flux shield are made from different respective materials.

12. A unit as claimed in any preceding claim, wherein the flux shield is attached removably to the unit.

13. An inductive power transfer unit comprising:

a power transfer surface on or in proximity to which a secondary device can be placed to receive power inductively from the unit;

flux generating means arranged to generate flux at or in proximity to said power transfer surface; and

flux shield attachment means arranged for attaching a flux shield to the unit such that the attached shield is arranged at one or more external surfaces of the unit other than said power transfer surface, or is arranged between said one or more external surfaces and said flux generating means, so that the shield serves to shield objects outside the unit, adjacent to said one or more external surfaces, from flux generated by the flux generating means.

14. An accessory, adapted to be attached to the outside of an inductive power transfer unit, the unit having a power transfer surface on or in proximity to which a secondary device can be placed to receive power inductively from the unit and also having flux generating means arranged to generate flux at or in proximity to the power transfer surface, and the accessory comprising:

means which co-operate with the unit to attach the accessory to the outside of the unit in a predetermined working disposition; and

a flux shield, made of electrically-conductive material, which, when the accessory is in its said working disposition, extends at or in proximity to one or more external surfaces of the unit other than said power transfer surface so as to shield objects outside the unit, adjacent to said one or more external surfaces, from flux generated by the flux generating means.

15. An accessory as claimed in claim 14, adapted to be attached removably to the outside of the unit.

16. An accessory as claimed in claim 14 or 15, being a clip-on cover for the unit.

17. An accessory as claimed in any one of claims 14 to 16, wherein, when the accessory is attached to the unit in its working disposition and the accessory is placed on a support surface, the flux generating means of the unit extend in two dimensions over the support surface with the flux shield of the accessory interposed between the

flux generating means and the support surface, and the flux shield extends outwardly beyond at least one edge of the flux generating means.

18. An accessory as claimed in claim 17, wherein said flux shield is in the form of a flat sheet which extends generally in parallel with the support surface.

19. An accessory as claimed in claim 17 or 18, wherein said flux shield extends outwardly beyond each edge of the flux generating means.

20. An accessory as claimed in any one of claims 14 to 19, wherein when said accessory is attached to the unit in its said working disposition said flux shield also extends over one or more side faces of the unit.

21. An accessory as claimed in any one of claims 14 to 20, wherein when said accessory is attached to the unit in its said working disposition said flux shield also extends over an outer peripheral portion of said power transfer surface of the unit.

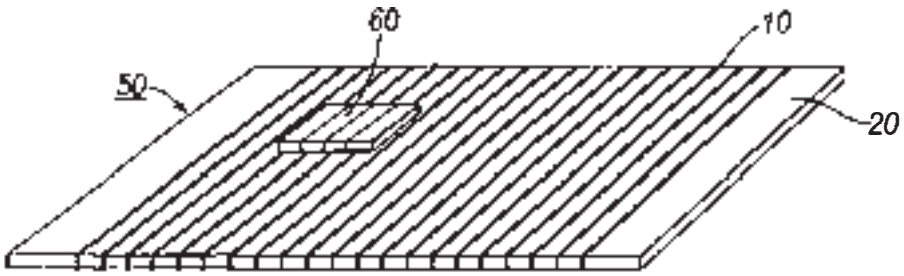


Fig.1

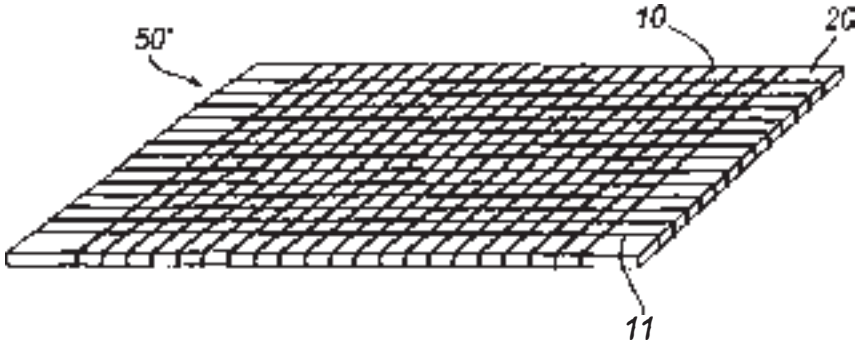


Fig.2

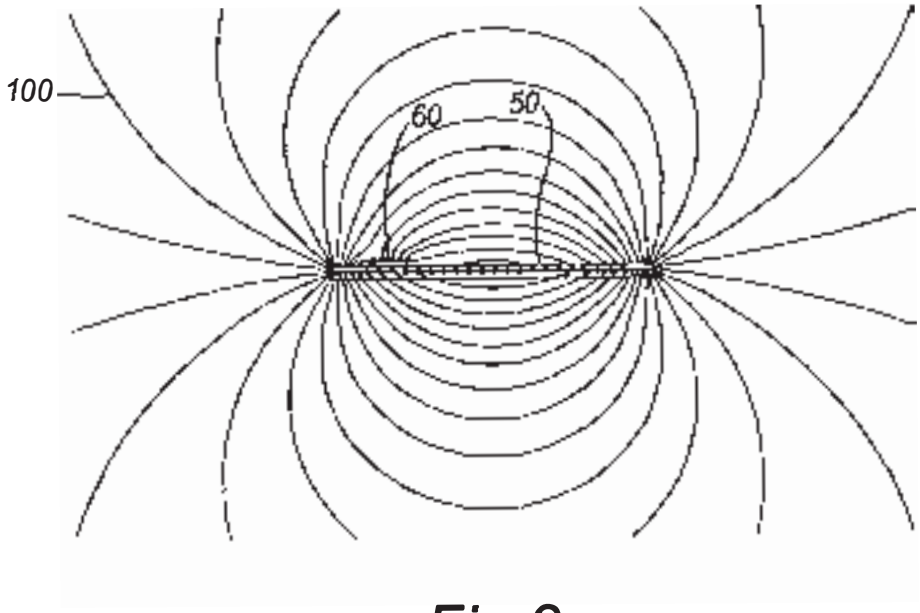


Fig.3

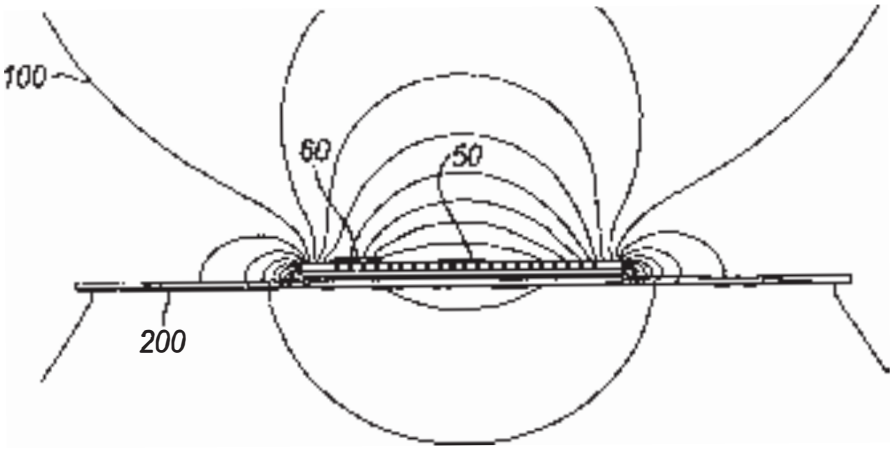


Fig.4

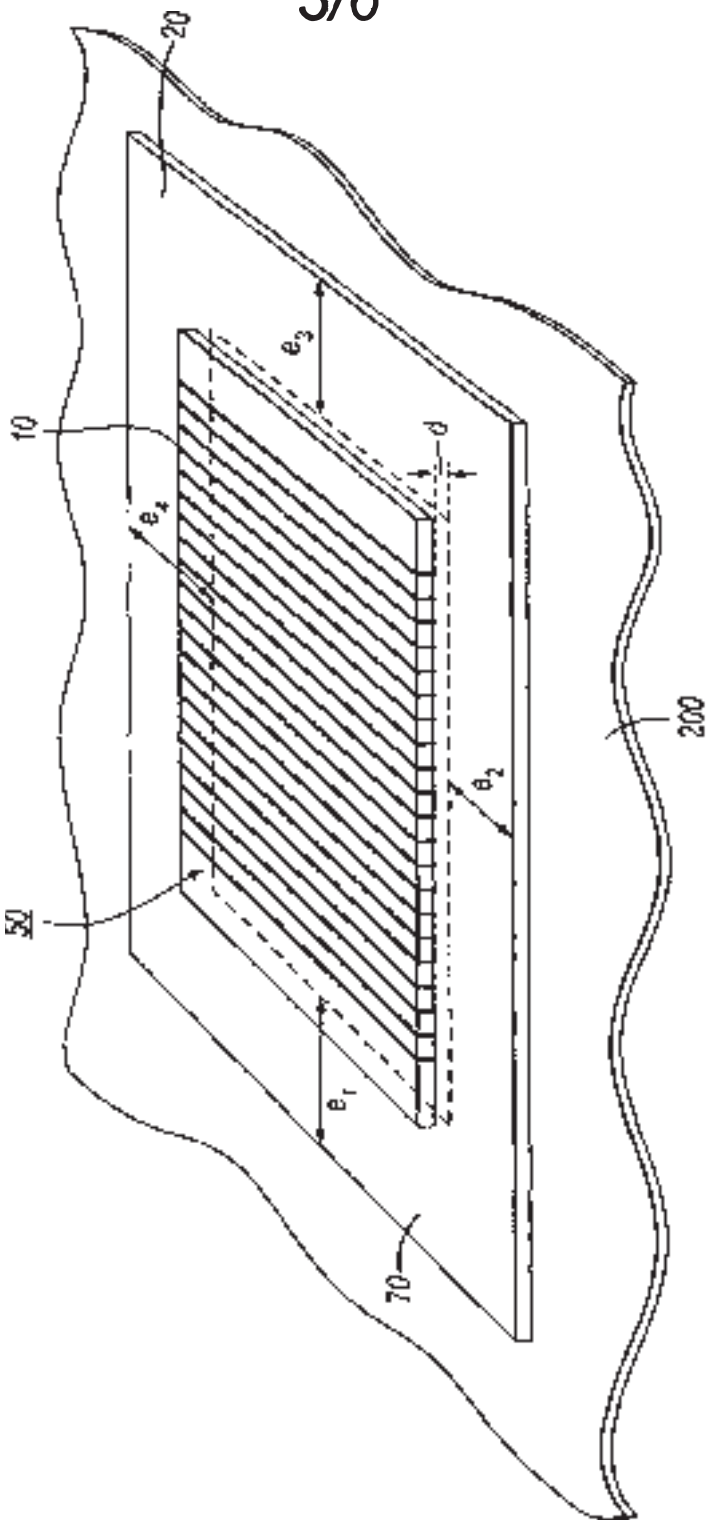


Fig.5

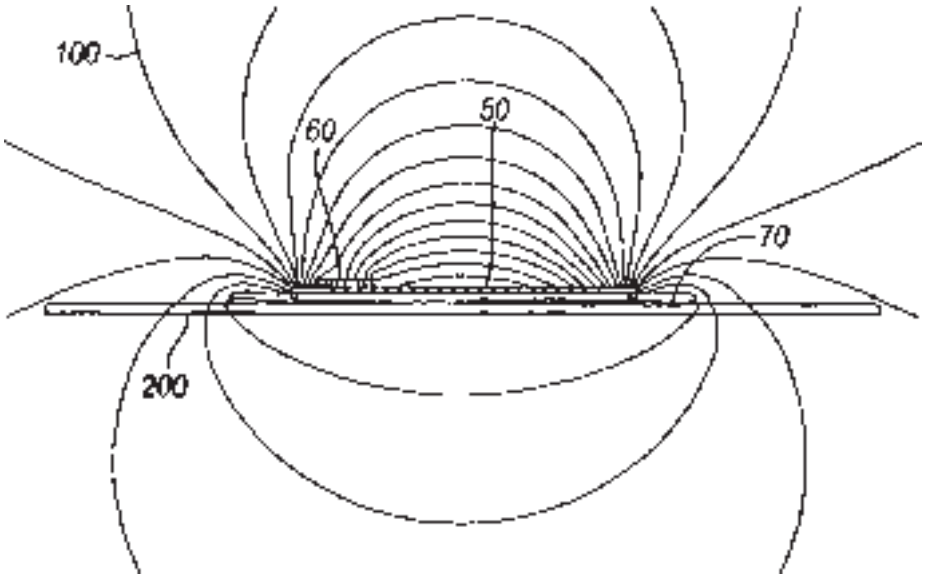


Fig.6

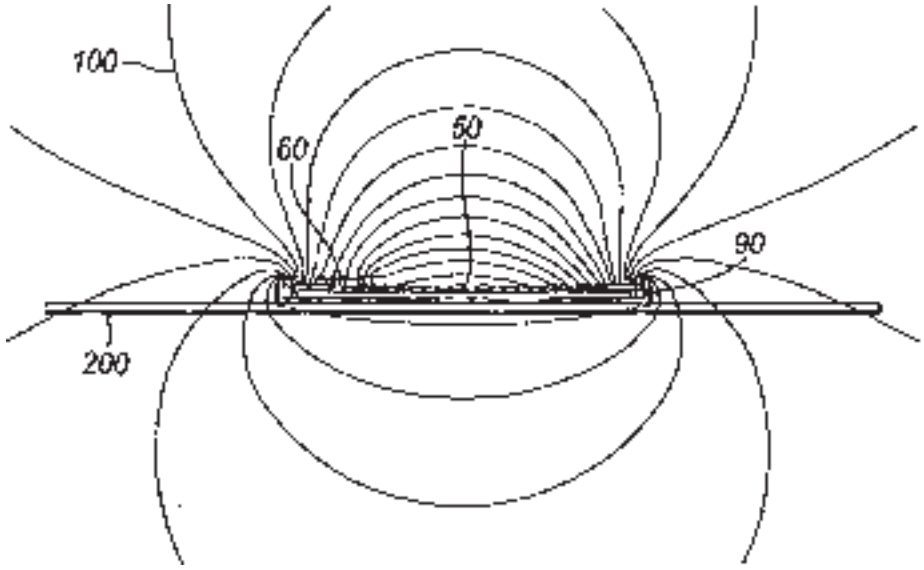


Fig.8

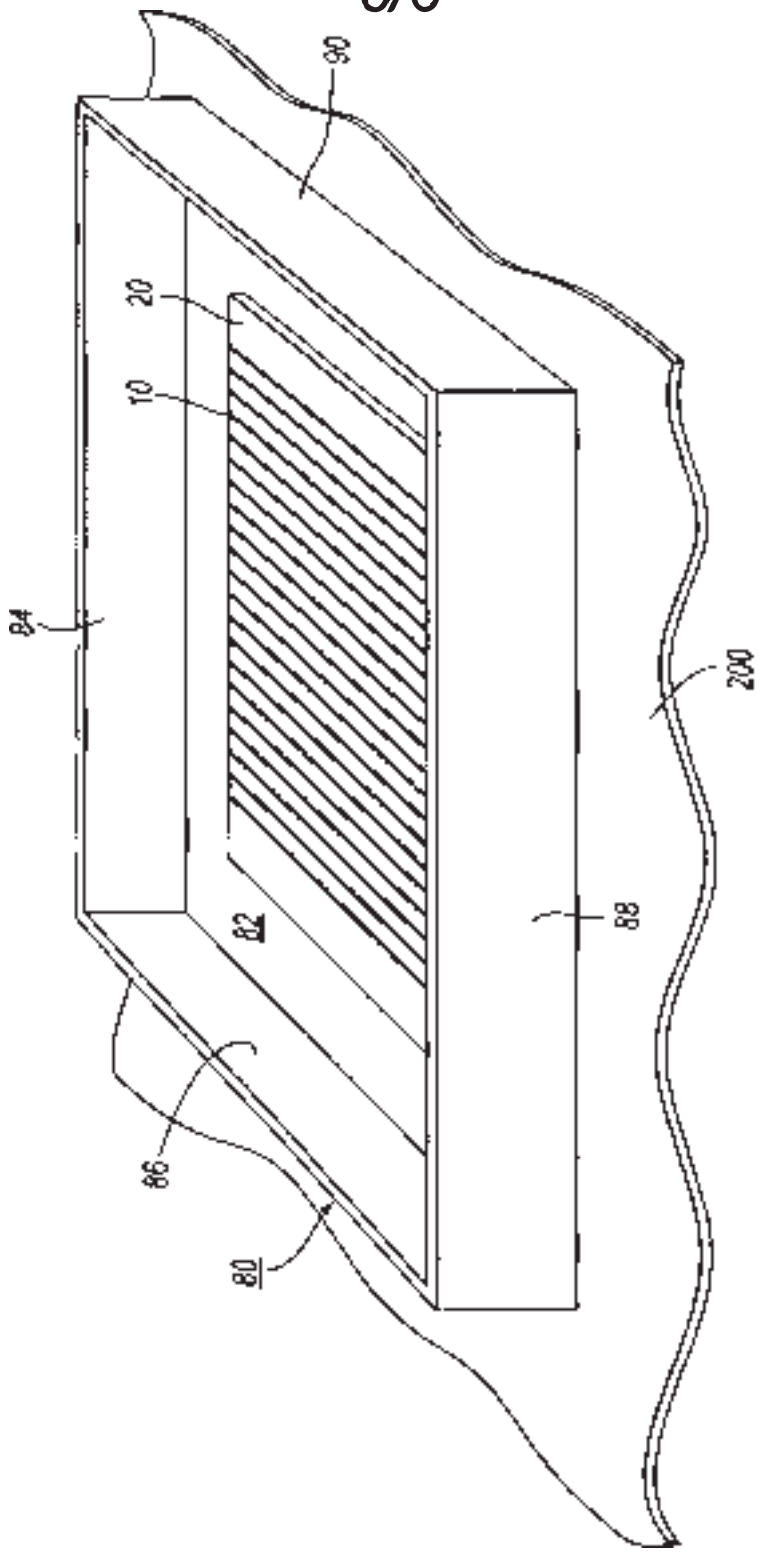


Fig.7

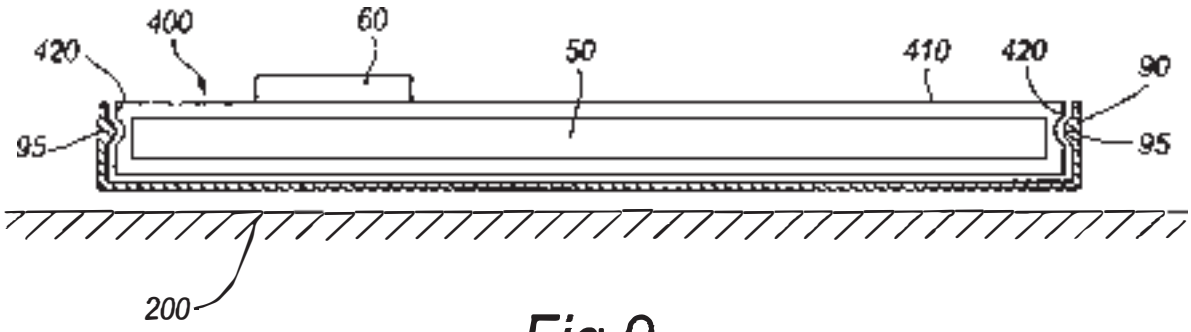


Fig.9

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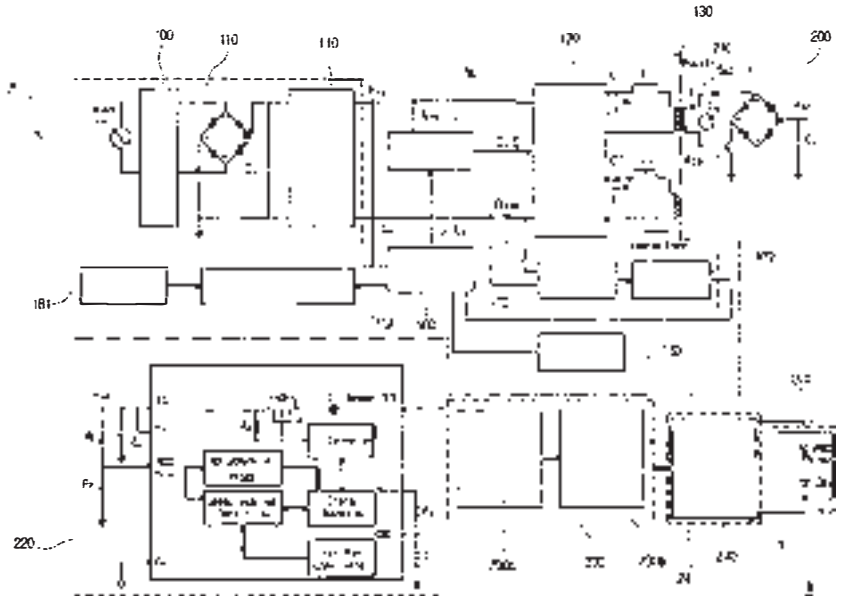
(54) Title: NO POINT OF CONTACT CHARGING SYSTEM



(57) Abstract: Disclosed herein is a non-contact charging system. The non-contact charging system detects a portable terminal, a battery pack or a foreign object that is placed on the pad of a non-contact charger, and effectively monitors and controls its charging state through the detection, thus preventing such a foreign object placed on the pad from being heated by induction heating, and further causes anions to be generated during the charging of the portable terminal or the battery pack, thus sterilizing bacteria on a terminal and keeping ambient air thereof fresh.

WO 2006/101285 A1

Description

NO POINT OF CONTACT CHARGING SYSTEM

Technical Field

[1] The present invention relates, in general, to a no point of contact charging system and, more particularly, to a no point of contact charging system, which detects a portable terminal, a battery pack or a foreign object that is placed on the pad of a non-contact charger, and effectively monitors and controls its charging state through the detection, thus preventing such a foreign object placed on the pad, from being heated by induction heating, and which causes anions to be generated during the charging of the portable terminal or the battery pack, thus destroying bacteria on a terminal and keeping nearby ambient air fresh.

Background Art

[2] Generally, as communication and information processing technology are developed, the use of portable devices, such as mobile phones, that are convenient to carry is gradually increasing. With the development of technology, there is a trend in which new model terminals, the efficiency of which is improved, are being frequently popularized.

[3] For the charging of such a portable device, a contact type charging scheme, or a non-contact charging scheme, which charges a battery using magnetic coupling without electrical contact, in order to solve the problems of the contact type charging scheme that result form the exposure of the contact terminals to the outside, is being used.

[4] In relation to technology corresponding to such a non-contact charger, a scheme that performs charging by wireless communication between a battery pack and a charging device using a magnetic body core, such as unexamined Korean Pat. No. 2002-0035242 previously filed, entitled "Contactless Type Charging Device Of Storage Battery For Mobile Device Using Induction Coupling," and a scheme that solves the problem of the magnetic body core using a transformer in which a wire is formed on a printed circuit substrate, such as previously filed unexamined Korean Pat. No. 2002-0057469, entitled "Coreless Ultra Thin Type Printed Circuit Substrate Transformer And Non-contact Battery Charger Using Printed Circuit Substrate Transformer," have been proposed.

[5] The present applicant proposed technology that constructs a wireless charging pad for performing a non-contact charging function, is configured such that the battery pack of a portable device is placed on the wireless charging pad for performing a non-contact charging function and, therefore, allows non-contact charging to be performed

through "Wireless Charging Pad And Battery Pack Employing Radio Frequency Identification Technology (previously filed Korean Appl. No. 2004-48286)."

[6] However, when detecting the portable device or the battery pack placed on the non-contact charging pad, the conventional technology depends on a scheme for transmitting Radio Frequency (RF) carrier signals to the outside through a reader antenna, and then detecting whether return signals exist, so that it is problematic in that the detection of the battery pack and the monitoring and controlling of the charging state through the detection are limitedly performed.

[7] Furthermore, in the case in which a coin, a metal pen, a pair of scissors or the like (hereinafter referred to as a foreign object), other than the battery pack or the portable device, are placed on the non-contact charging pad, power transmission is continuously performed, so that a problem occurs in that the foreign object placed on the non-contact charging pad is heated by induction heating.

[8] Furthermore, the non-contact charging pad only has a function of charging terminals or battery packs, so that a problem occurs in that the efficiency thereof is lowered.

Disclosure of Invention

Technical Problem

[9] Accordingly, the present invention has been made keeping in mind the above problems occurring in the prior art, and an object of the present invention is to provide a non-contact charging system that detects a portable terminal, a battery pack or a foreign object placed on a non-contact charging pad according to a type, and monitors and controls its charging state through the detection, thus preventing such a foreign object placed on the pad from being heated to high temperature.

[10] Another object of the present invention is to provide a non-contact charging system, in which a function of sterilizing a terminal is provided to a non-contact charging pad and causes anions to be generated therefrom, thus enabling sanitary use of the terminal and keeping ambient air nearby thereof fresh.

[11] A further object of the present invention is to provide a non-contact charging system, in which a primary core unit included in a non-contact charging pad is provided in a form such that the center portion thereof may be passed through, so that the structure thereof is simplified, charging is available at a defined location and, therefore, the usage efficiency thereof can be increased.

Technical Solution

[12] In order to accomplish the above objects, the present invention provides a non-contact charging system having a battery pack (B) charged by an induced electromotive force generated from a non-contact charger (A) supplied with power,

wherein the non-contact charger (A) includes an electromagnetic wave filter (100) connected to a power input terminal to block electromagnetic waves caused by Alternating Current (AC) power; a primary rectification circuit (110) for rectifying the AC power, the electromagnetic waves of which are blocked, to Direct Current (DC) power; a flyback converter (110') for storing power transferred from the primary rectification circuit (110) while a contained transistor is turned on, and applying an input voltage to a gate driver (160), a central processing unit (180) and an ion generation unit (182) and applying a driving voltage to a series resonance type converter (120) when the contained transistor is turned off; a current detection unit (170) interposed between the flyback converter (110') and the series resonance type converter (120) to detect variation in current resulting from the approach of the battery pack (B), and outputting a comparison current depending on variation in current; a central processing unit (180) for detecting the approach of the battery pack (B) using the comparison current input from the current detection unit (170), controlling the gate drive (160) according not only to whether the battery pack (B) approaches but also to the current of a temperature protection circuit unit (183) to stop the switching of the gate drive (160) when abnormal operation occurs or a temperature of a foreign object placed on the non-contact charging pad exceeds a predetermined temperature; a gate driver (160) for outputting gate signals under control of the central processing unit (180); the series resonance type converter (120) for adjusting the waveforms of voltage and current applied to a primary core unit (130) in response to the gate signals input from the gate driver (160); and the primary core unit (130) switched by the series resonance type converter (120) to generate the induced electromotive force.

[13] The gate driver (160) allows two switching devices, which are provided in the series resonance type converter (120), to be alternately turned on in response to the gate signals output under the control of the central processing unit (180), thus adjusting the waveforms of the input voltage and current through charging and discharging parallel capacitors coupled to respective switching devices.

[14] The current detection unit (170) is connected to both ends of a resistor connected to an output terminal of the flyback converter (110') and an input terminal of the series resonance type converter (120), includes a differential amplifier (171) to which signals output from both ends of the resistor are input, and a comparator/low frequency filter (172) which is coupled to an output terminal of the differential amplifier (171), and detects variation in current by comparing the output voltage of the differential amplifier (171) with a predetermined reference voltage, filters out a comparison current depending on variation in current, and outputs the comparison current.

[15] The central processing unit (180) is configured to process information fed back from a dust and odor sensor (181) and switch the operation mode of the ion generation

unit (182).

[16] The primary core unit (130) is configured such that coils (Pcoil1 and Pcoil2) are wound around a plate core member (131) in which a central opening (132) is formed.

[17] The plate core member (131) is formed in a polygonal shape, a circular shape, or elliptical shape, and is configured such that pieces of amorphous metal or ferrite material are attached thereto.

[18] The coils (Pcoil1 and Pcoil2) are wound around the plate core member (131) in series or in parallel.

[19] The battery pack (B) includes a secondary core unit (210) configured to induce power through the primary core unit (130); a secondary rectification circuit unit (200) coupled to the coil (Scoil1) of the secondary core unit (120) to rectify the induced power; a charging control unit (230) comprising a charging adjustment circuit (230a) for supplying a fuel gauge (230b) with power rectified by the secondary rectification circuit (200), and applying voltage to a Radio Frequency Identification (RFID) control unit in response to the output of the secondary rectification circuit 200, and the fuel gauge (210b) for supplying a battery BAT through a protection circuit (240) with power supplied from the charging adjustment circuit (230a), and generating charging state information and periodically records the information while monitoring the charging state of the battery BAT; and a protection circuit unit (240) coupled between the charging control unit (230) and the battery (BAT) to control whether to perform charging or discharging depending on a charged state of the battery (BAT).

[20] A shield plate (260) having a film shape is interposed between the secondary core unit (210) of the battery pack (B) and a battery case (250), and the protection circuit unit (240) is surrounded by a shield member (241).

[21] The charging control unit (230) is formed by integrating circuits optimized to perform both a charging control function of controlling the charging and discharging of the battery (BAT) using the power rectified by the secondary rectification circuit (200), and a fuel gauge function of generating the charge state information and periodically recording the generated information while monitoring the charging state of the battery (B).

[22] The foreign object detection unit (220) detects instantaneous power at the same time that the batter pack (B) containing the secondary core unit (210) is placed on the wireless charger (A) and allows a no load state to be maintained by maintaining a switch (Q3) in an OFF state for a certain period of time, and allows the no load state to be switched into a load state by maintaining the switch (Q3) in an ON state after the no load state has been maintained for the period of time, thereby informing the primary coil through load modulation that the battery pack (B) containing the secondary core unit (210) has been placed on the non-contact charger (A) and, at the same time,

applying power to a charging control unit (230).

Advantageous Effects

[23] In accordance with the present invention, components for detecting a portable terminal, a battery pack or a foreign object that is placed on the pad of a non-contact charger, and effectively monitoring and controlling its charging state through the detection are added, so that the efficiency of the entire circuit is improved, and the foreign object can be prevented from being heated by induction heating.

[24] Furthermore, a function of sterilizing a terminal is provided to a non-contact charging pad and also anions are generated therefrom, so that the terminal can be sanitarily used and nearby ambient air thereof can be kept fresh.

[25] Furthermore, a primary core unit included in a non-contact charging pad is provided in a form such that the center portion thereof may be passed through, so that the structure thereof is simplified, charging is available at a defined location and, therefore, the usage efficiency thereof can be increased.

Brief Description of the Drawings

[26] FIG. 1 is a block diagram showing the construction of a non-contact charging system according to the present invention;

[27] FIGS. 2 and 3 are perspective views showing a primary core unit disposed in the non-contact charging system according to the present invention;

[28] FIGS. 4, 5 and 6 are perspective views showing the use of the primary core unit disposed in the non-contact charging system according to the present invention;

[29] FIG. 7 is a view showing a direction of rotation of a magnetic field depending on each mode of operation in a series resonance type converter provided in the non-contact charging system according to the present invention;

[30] FIG. 8 is a perspective view showing the construction of a battery pack provided in the non-contact charging system according to the present invention;

[31] FIG. 9 is a diagram illustrating an algorithm that executes when a battery pack, in which a secondary core unit is contained, is placed on the non-contact charging system according to the present invention;

[32] FIG. 10 is a diagram illustrating an algorithm that execute when a foreign object made of metal is placed on the non-contact charging system according to the present invention; and

[33] FIG. 11 is a diagram illustrating the algorithm and state of the non-contact charging system according to the present invention.

Best Mode for Carrying Out the Invention

[34] An embodiment of the present invention is described in detail with reference to the accompanying drawings below.

[35] When it is determined that details of well-known functions or constructions related to descriptions of the present invention may unnecessarily make the gist of the present invention unclear, the details will be omitted.

[36] FIG. 1 is a block diagram showing the construction of a non-contact charging system according to the present invention.

[37] The non-contact charging system according to the present invention includes a battery pack B charged by an induced electromotive force that is generated in a non-contact charger A supplied with power.

[38] The non-contact charger A, as shown in FIG. 1, blocks electromagnetic waves caused by Alternating Current (AC) power (110/220 V) input using an electromagnetic wave filter 100 that is connected to the power input terminal of a wireless charging pad, and a primary rectification circuit 110 rectifies the AC power, the electromagnetic waves of which are blocked, to create DC power. A flyback converter 110' contains a transistor, stores power transferred from the primary rectification circuit 110 while the contained transistor is turned on. In contrast, the flyback converter 110' simultaneously applies an input voltage to a gate driver 160, a central processing unit 180 and an ion generation unit 182 and a driving voltage to a series resonance type converter 120 when the contained transistor is turned off.

[39] A current detection unit 170 is interposed between the flyback converter 110' and the series resonance type converter 120, detects variation in current resulting from the approach of the battery pack B, and outputs a comparison current depending on variation in the current.

[40] For this purpose, the current detection unit 170 is connected to both ends of a resistor connected to the output terminal of the flyback converter 110' and the input terminal of the series resonance type converter 120, has a differential amplifier 171, to which signals output from both ends of the resistor are input, and a comparator/ low-frequency filter 172, coupled to the output terminal of the differential amplifier 171. The current detection unit 170 detects variation in current by comparing the output voltage of the differential amplifier 171 with a predetermined reference voltage, filters out a comparison current depending on the amount of variation in current, and outputs the result.

[41] The central processing unit 180 detects the approach of the battery pack B using the comparison current input from the current detection unit 170, controls the gate drive 160 depending not only on whether a battery pack B approaches but also on the current of a temperature protection circuit unit 183 for stopping the switching of the gate drive 160 when abnormal operation occurs or the temperature of a foreign object placed on the non-contact charging pad exceeds a predetermined temperature. Furthermore, the central processing unit 180 performs the determination of information fed back from a

dust and odor sensor 181 and switches the operation mode of the ion generation unit 182.

[42] The gate driver 160 outputs gate signals under the control of the central processing unit 180, and the series resonance type converter 120 adjusts the waveforms of voltage and current applied to the primary core unit 130 in response to the gate signals input from the gate driver 160.

[43] For this purpose, the gate driver 160 allows two switching devices, which are provided in the series resonance type converter 120, to be alternately turned on in response to the gate signals output by the control of the central processing unit 180, and allows the waveforms of the input voltage and current to be adjusted by charging and discharging parallel capacitors coupled to respective switching devices.

[44] The series resonance type converter 120 is configured to adjust the waveforms of the voltage and the current applied to the primary core unit 130 by the gate signals. The primary core unit 130 is configured to be switched by the series resonance type converter 120 and, therefore, generate an induced electromotive force.

[45] FIGS. 2 and 3 are perspective views showing a primary core unit disposed in the non-contact charging system according to the present invention, and FIGS. 4, 5 and 6 are perspective views showing the use of the primary core unit disposed in the non-contact charging system according to the present invention.

[46] As shown in the drawings, the primary core unit 130 is configured such that coils Pcoil1 and Pcoil2 are wound around a plate core member 131 in which a central opening 132 is formed, and is configured such that pieces of amorphous metal or ferrite material, such as Cobalt Co, Iron Fe, Nickel Ni, Boron B or Silicon Si, having high magnetic permeability (> 80,000) and an unbroken characteristic, are attached thereto. Although the plate core member 131 is formed in a polygonal shape, it may be formed in either circular or elliptical shapes in addition to the polygonal shape. The central opening 132 is configured such that a function, which is capable both of reducing the amount of material used and of maximizing the area for radiating heat, is provided.

[47] The coils Pcoil1 and Pcoil2 are configured to be wound around the plate core member 131 in series or in parallel, and it is preferable to use a single wire, a paired wire, a Litz wire or a copper foil. The start points of the coils Pcoil1 and Pcoil2 are formed by winding the coils in the same directions, and the ends of the coils Pcoil1 and Pcoil2 are configured to be matched with Lr and Lr', respectively, and to be switched using two series resonance type converters.

[48] In this case, driven switching adjusts the phase of a signal Q1 and the phase of a signal Q2, thus inducing LC resonance, so that energy is stored in a secondary coil.

[49] Furthermore, the switching patterns of the coils Pcoil1 and Pcoil2 are alternately

generated, so that a magnetic field shown in FIG. 7 rotates 360°, and induced energy can be stored regardless of the location of the secondary coil wound in a single direction.

[50] Meanwhile, when the primary core unit 130 having the construction shown in FIGS. 4 and 5 is placed on one or both sides of a circuit 134 and is then used, a plurality of portable terminals or battery packs may be charged at the same time, so that the efficiency thereof can be increased.

[51] Furthermore, as shown in FIG. 6, primary core units 130 and 130' can be placed on one side of the circuit 134 in series or parallel.

[52] In the battery pack B, as shown in FIG. 1, resonance is induced while power generated from the primary coil passes a resonance capacitor Cs through the coil Scoil1 of the secondary core unit 120, and a sinusoidal AC generated by the resonance is rectified into a Direct Current (DC) by the secondary rectification circuit 200.

[53] Power rectified by the secondary rectification circuit 200 is supplied to a foreign object detection unit 220, and the supplied power is applied to a charging adjustment circuit 230a in response to the output of the foreign object detection unit 220.

[54] In this case, the foreign object detection unit 220 detects power at the moment at which the battery pack B that contains the secondary core unit 210, that is, a secondary module, is placed on the non-contact charger A, and is maintained in a no load state (the current of the current detection unit is smaller than a no load reference value) by maintaining a switch Q3 in an OFF state for a predetermined time (several tens of ms). When a predetermined period of time has lapsed after the no load state, the foreign object detection unit 220 is switched into a load state (the current of the current detection unit is larger than the no load reference value) by maintaining the switch Q3 in an ON state, and informs the primary coil through load modulation that the battery pack B containing the secondary core unit 210 has been placed on the non-contact charger A and, at the same time, applies power to a charging control unit 230.

[55] Subsequently, the current of the current detection unit 170 becomes smaller than the reference value of the no load state when the charging is completed and, at the same time, the secondary core unit 210 enters the no load state again, so that a fully-charging state is indicated by a Light Emitting Diode (LED) or a Liquid Crystal Display (LCD).

[56] The charging control unit 230 includes the charging adjustment circuit 230a and a fuel gauge 230b, and performs both charging adjustment and fuel gauge functions. The charging adjustment circuit 230a supplies the fuel gauge 230b with power rectified by the secondary rectification circuit 200, and applies voltage to a RFID control unit (not shown) in response to the output of the secondary rectification circuit 200. The fuel gauge 230b supplies a battery BAT through a protection circuit 240 with power supplied from the charging adjustment circuit 230a, generates charging state in-

formation and periodically records the information in the RFID control unit (not shown) while monitoring the charging state of the battery BAT. The protection unit is coupled between the charging control unit 230 and the battery BAT, and adjusts the charging and discharging of the battery BAT depending on whether the battery BAT is to be charged or discharged.

[57] In the RFID control unit (not shown), the RFID information of the battery BAT is stored and, at the same time, the charging state information is periodically recorded. When receiving an RF carrier, the RFID control unit generates RFID data, including the stored RFID and charging state information of the battery BAT, in response to the received RF carrier, modulates the RFID data, and wirelessly transmits the modulated RFID data through a tag antenna. The battery BAT is charged depending on the adjustment of the protection circuit unit 240.

[58] The charging control unit 230 is formed by integrating circuits optimized to perform both the charging control function of controlling the charging and discharging of the battery BAT using the power rectified by the secondary rectification circuit 200, and the fuel gauge function of generating the charge state information and periodically recording the generated information while monitoring the charging state of the battery B.

[59] FIG. 8 is a perspective view showing the construction of the battery pack provided in the non-contact charging system according to the present invention. As shown in FIG. 8, the battery pack B is configured such that a shield plate 260 having a film shape is interposed between the secondary core unit 210 and a battery case 250, thus preventing the temperature of the battery BAT from increasing due to an induced electromotive force generated by the induction of an electromagnetic field and, therefore, enhancing the stability of the battery pack B, and is also configured such that sufficient electromotive force is generated by reducing the interference of the electromagnetic field caused by the induced electromotive force, thus enhancing the charging rate.

[60] Furthermore, when a shield member 241 that is capable of blocking the electromagnetic field is provided so as to surround the protection circuit unit 240, it is prevented from affecting different components provided inside the protection circuit unit 240. The shield member 241 is formed in a box form so as to surround the protection circuit unit 240. It is preferred that the entire protection circuit unit 240 is formed by molding.

[61] An example of a process of charging the battery pack B using the wireless charging pad is described with reference to FIGS. 9 to 11 below.

[62] FIG. 9 is a diagram illustrating an algorithm that executes when a battery pack, in which a secondary core unit is contained, is placed in the non-contact charging system according to the present invention. FIG. 10 is a diagram illustrating an algorithm that

executes when a foreign object, which is made of metal, is placed on the non-contact charging system according to the present invention. FIG. 11 is a diagram illustrating the algorithm and states of the non-contact charging system according to the present invention.

[63] First, the foreign detection unit 220 detects instantaneous power at the same time that a battery pack B is placed on the wireless charging pad, and allows a no load state to be maintained by maintaining the switch Q3 in an OFF state for a certain period of time.

[64] Thereafter, the foreign detection unit 220 maintains the state at which the current of the current detection unit 170 becomes smaller than the no load reference value for the period of time, and then allows the no load state to be switched into a load state by maintaining the switch Q3 in an ON state. At this time, the current of the current detection unit 170 becomes larger than the no load reference value, so that the foreign object detection unit 220 informs the primary coil through load modulation that a battery pack B containing a secondary core unit 210 has been placed on the non-contact charger A and, at the same time, applies power to the charging control unit 230.

[65] Thereafter, the current of the current detection unit 170 becomes smaller than the reference value of the no load state when the charging is completed and, at the same time, the secondary core unit 210 enters the no load state, so that a fully-charging state is indicated by a LED or a LCD.

[66] Meanwhile, the power is applied to the charging control unit 230, and the operation mode of the ion generation unit 182 is switched by allowing the central processing unit 180 to determine information fed back from the odor sensor 181, so that a plurality of ions generated by the ion generation unit 182, are spread to the area around the wireless charging pad. Accordingly, the bacteria on the battery pack can be destroyed and, at the same time, the ambient air near the wireless charging pad can be purified.

[67] Meanwhile, the switch Q3 is maintained in an OFF state for a certain period of time and the no load state is maintained by detecting instantaneous power at the same time that a batter pack B is placed on the wireless charging pad, and a current below the reference value is supplied and is then blocked by the central processing unit 180 to which the currents of the current detection unit 170 and the temperature protection circuit unit 183 are applied, so that damage caused by overheating is prevented.

[68] The above-described present invention can be variously modified according to the demand of those skilled in the art within the range without departing from the fundamental concept of the present invention.

Claims

[1] A non-contact charging system having a battery pack (B) charged by an induced electromotive force generated from a non-contact charger (A) supplied with power, wherein the non-contact charger (A) comprises: an electromagnetic wave filter (100) connected to a power input terminal to block electromagnetic waves caused by Alternating Current (AC) power; a primary rectification circuit (110) for rectifying the AC power, the electromagnetic waves of which are blocked, to Direct Current (DC) power; a flyback converter (110') for storing power transferred from the primary rectification circuit (110) while a contained transistor is turned on, and applying an input voltage to a gate driver (160), a central processing unit (180) and an ion generation unit (182) and applying a driving voltage to a series resonance type converter (120) when the contained transistor is turned off; a current detection unit (170) interposed between the flyback converter (110') and the series resonance type converter (120) to detect variation in current resulting from approach of the battery pack (B), and outputting a comparison current depending on variation in current; a central processing unit (180) for detecting the approach of the battery pack (B) using the comparison current input from the current detection unit (170), controlling the gate drive (160) according not only to whether the battery pack (B) approaches but also to the current of a temperature protection circuit unit (183) to stop the switching of the gate drive (160) when abnormal operation occurs or the temperature of a foreign object placed on the non-contact charging pad exceeds a predetermined temperature; a gate driver (160) for outputting gate signals under the control of the central processing unit (180); the series resonance type converter (120) for adjusting the waveforms of voltage and current applied to a primary core unit (130) in response to the gate signals input from the gate driver (160); and the primary core unit (130) switched by the series resonance type converter (120) to generate the induced electromotive force.

[2] The non-contact charging system according to claim 1, wherein the gate driver (160) allows two switching devices, which are provided in the series resonance type converter (120), to be alternately turned on in response to the gate signals output under control of the central processing unit (180), thus adjusting the waveforms of the input voltage and current through charging and discharging parallel capacitors coupled to respective switching devices.

[3] The non-contact charging system according to claim 1, wherein the current detection unit (170) is connected to both ends of a resistor connected to an output terminal of the flyback converter (110') and an input terminal of the series

resonance type converter (120), comprises a differential amplifier (171) to which signals output from both ends of the resistor are input, and a comparator/low frequency filter (172) which is coupled to an output terminal of the differential amplifier (171), and detects variation in current by comparing the output voltage of the differential amplifier (171) with a predetermined reference voltage, filters out a comparison current depending on variation in current, and outputs the comparison current.

[4] The non-contact charging system according to claim 1, wherein the central processing unit (180) is configured to process information fed back from a dust and odor sensor (181) and switch an operation mode of the ion generation unit (182).

[5] The non-contact charging system according to claim 1, wherein the primary core unit (130) is configured such that coils (Pcoil1 and Pcoil2) are wound around a plate core member (131) in which a central opening (132) is formed.

[6] The non-contact charging system according to claim 5, wherein the plate core member (131) is formed in a polygonal shape, a circular shape, or elliptical shape, and is configured such that pieces of amorphous metal or ferrite material are attached thereto.

[7] The non-contact charging system according to claim 5, wherein the coils (Pcoil1 and Pcoil2) are wound around the plate core member (131) in series or in parallel.

[8] The non-contact charging system according to claim 1, wherein the battery pack (B) comprises:

a secondary core unit (210) configured to induce power through the primary core unit (130); a secondary rectification circuit unit (200) coupled to a coil (Scoil1) of the secondary core unit (120) to rectify the induced power; a charging control unit (230) comprising a charging adjustment circuit (230a) for supplying a fuel gauge (230b) with power rectified by the secondary rectification circuit (200), and applying voltage to a Radio Frequency Identification (RFID) control unit in response to the output of the secondary rectification circuit (200), and the fuel gauge (210b) for supplying a battery BAT through a protection circuit (240) with power supplied from the charging adjustment circuit (230a), and generating charging state information and periodically records the information while monitoring the charging state of the battery BAT; and a protection circuit unit (240) coupled between the charging control unit (230) and the battery (BAT) to control whether to perform charging or discharging depending on a charged state of the battery (BAT).

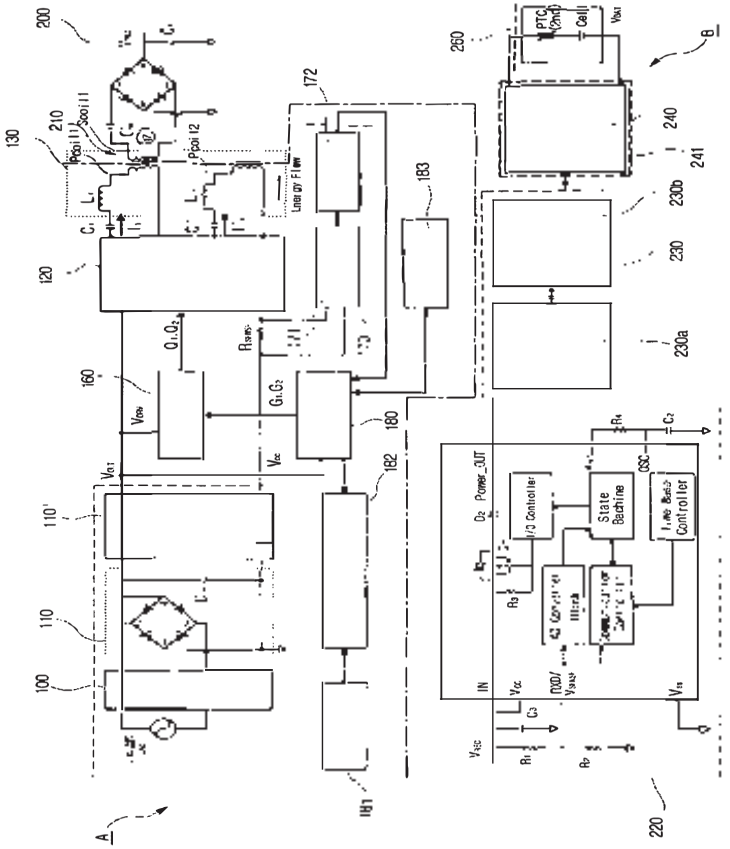
[9] The non-contact charging system according to claim 8, wherein a shield plate

(260) having a film shape is interposed between the secondary core unit (210) of the battery pack (B) and a battery case (250), and the protection circuit unit (240) is surrounded by a shield member (241).

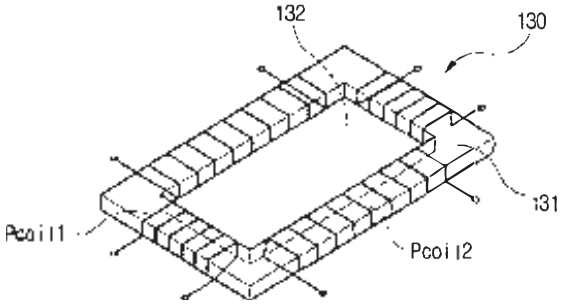
[10] The non-contact charging system according to claim 8, wherein the charging control unit (230) is formed by integrating circuits optimized to perform both a charging control function of controlling the charging and discharging of the battery (BAT) using the power rectified by the secondary rectification circuit (200), and a fuel gauge function of generating the charge state information and periodically recording the generated information while monitoring the charging state of the battery (B).

[11] The non-contact charging system according to claim 8, wherein the foreign object detection unit (220) detects instantaneous power at the same time that the batter pack (B) containing the secondary core unit (210) is placed on the wireless charger (A) and allows a no load state to be maintained by maintaining a switch (Q3) in an OFF state for a certain period of time, and allows the no load state to be switched into a load state by maintaining the switch (Q3) in an ON state after the no load state has been maintained for the period of time, thereby informing the primary coil through load modulation that the battery pack (B) containing the secondary core unit (210) has been placed on the non-contact charger (A) and, at the same time, applying power to a charging control unit (230).

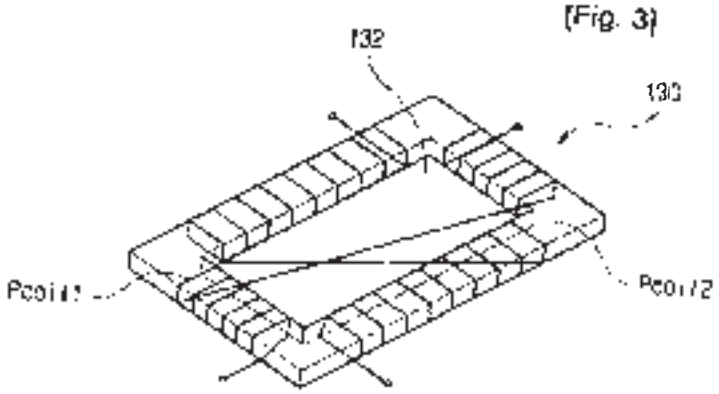
[Fig. 1]



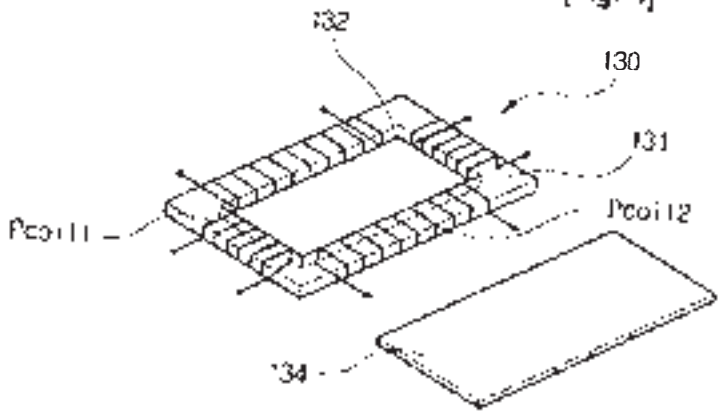
[Fig. 2]



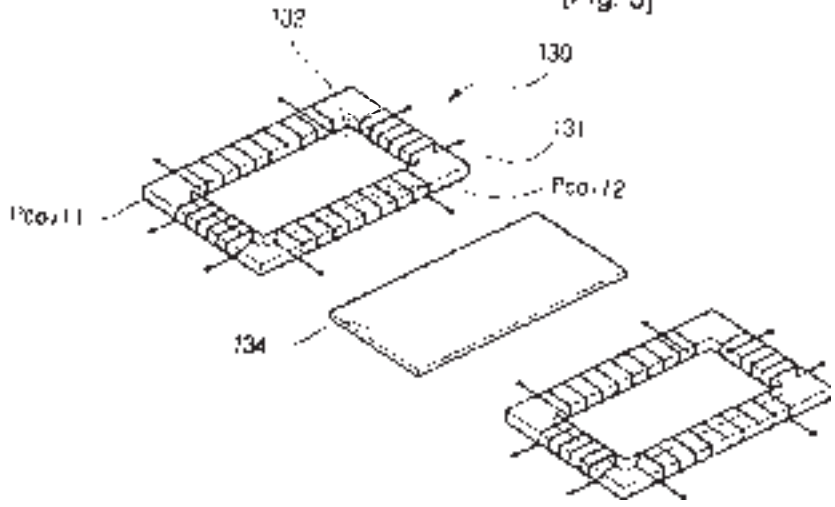
[Fig. 3]



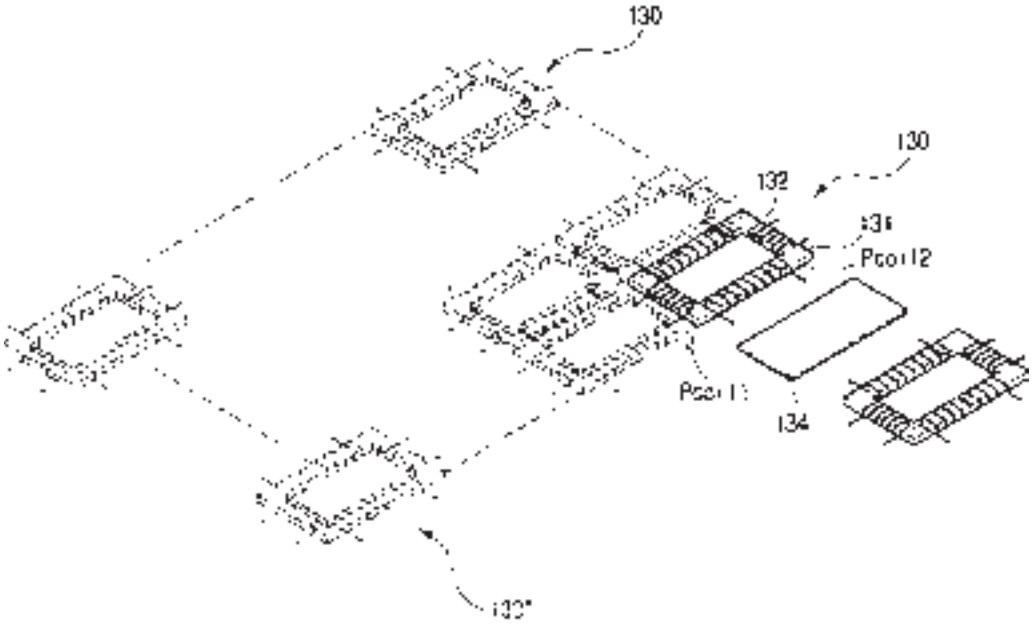
[Fig. 4]



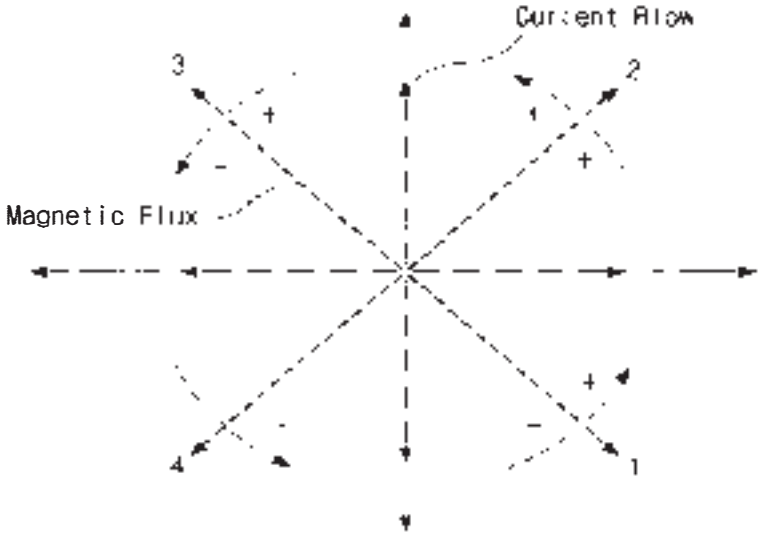
[Fig. 5]



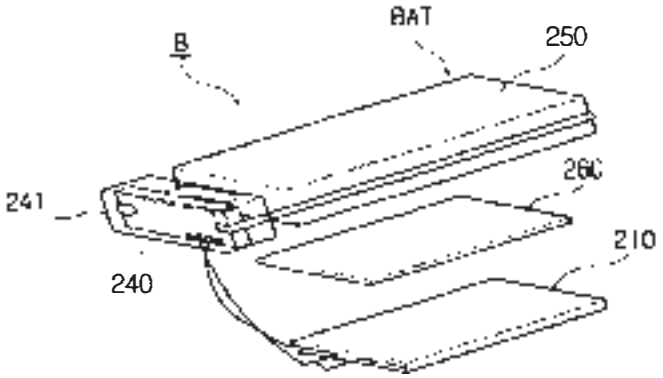
[Fig. 6]



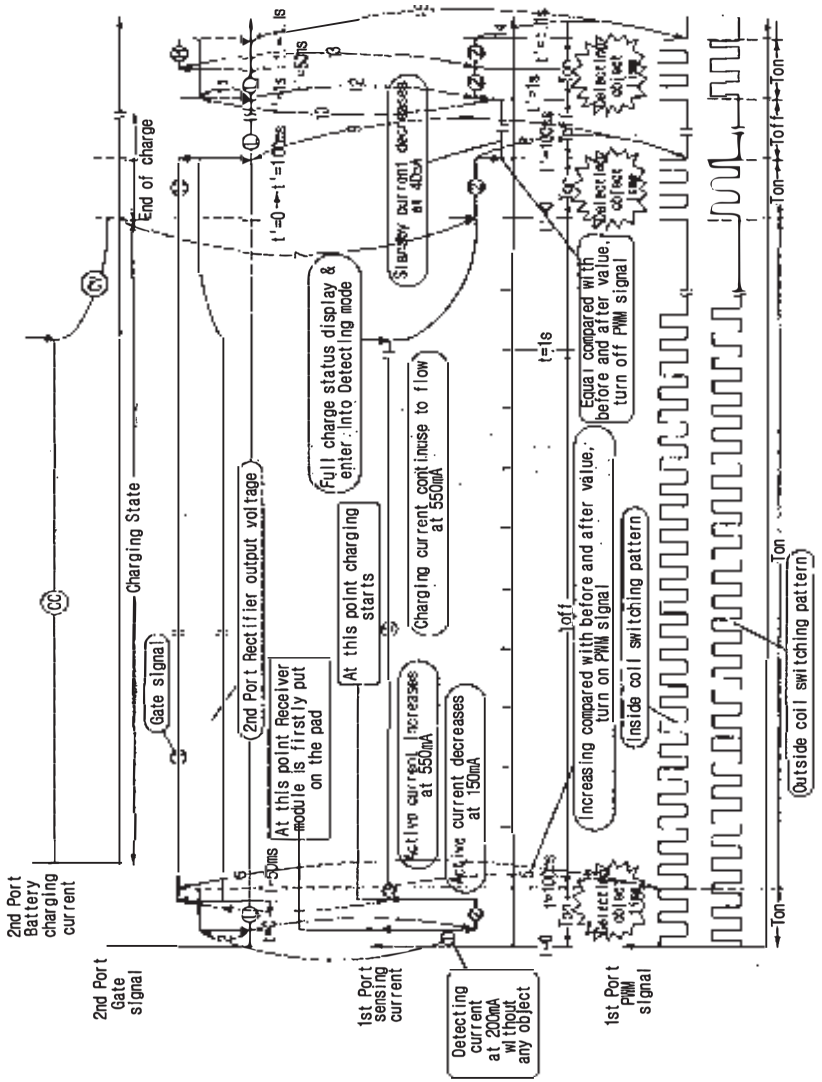
[Fig. 7]



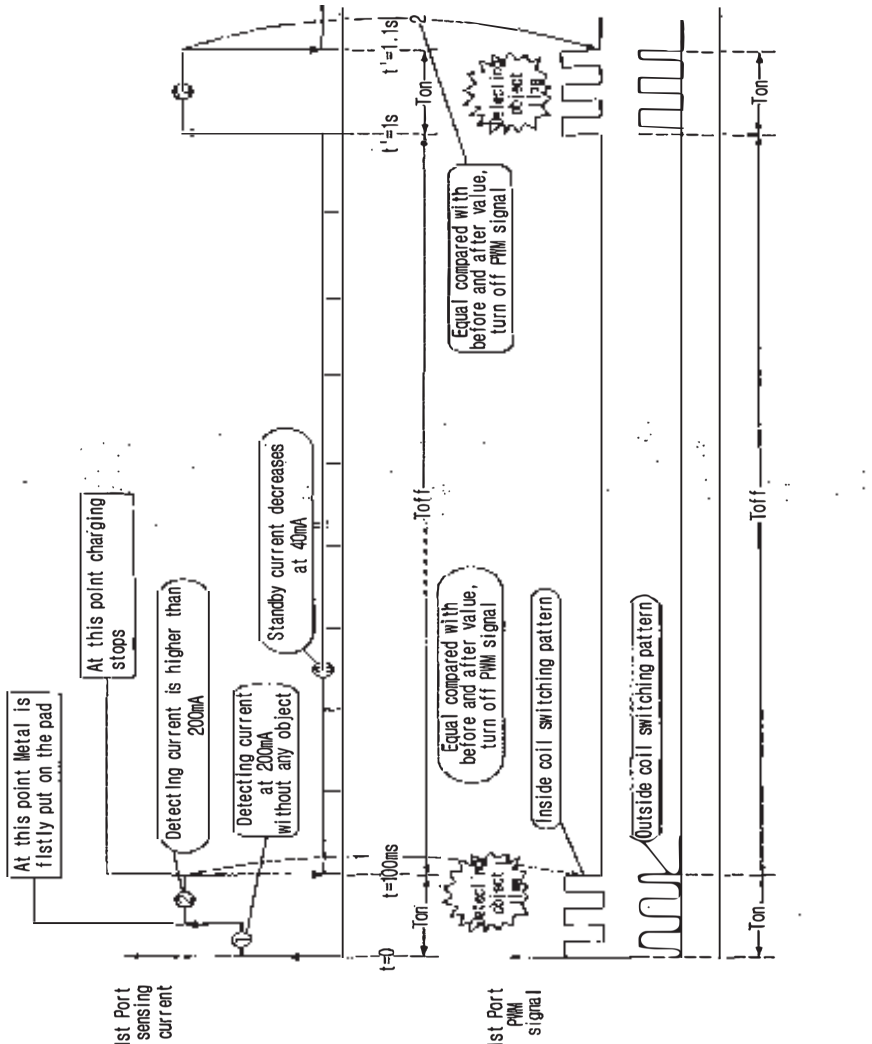
[Fig. 8]



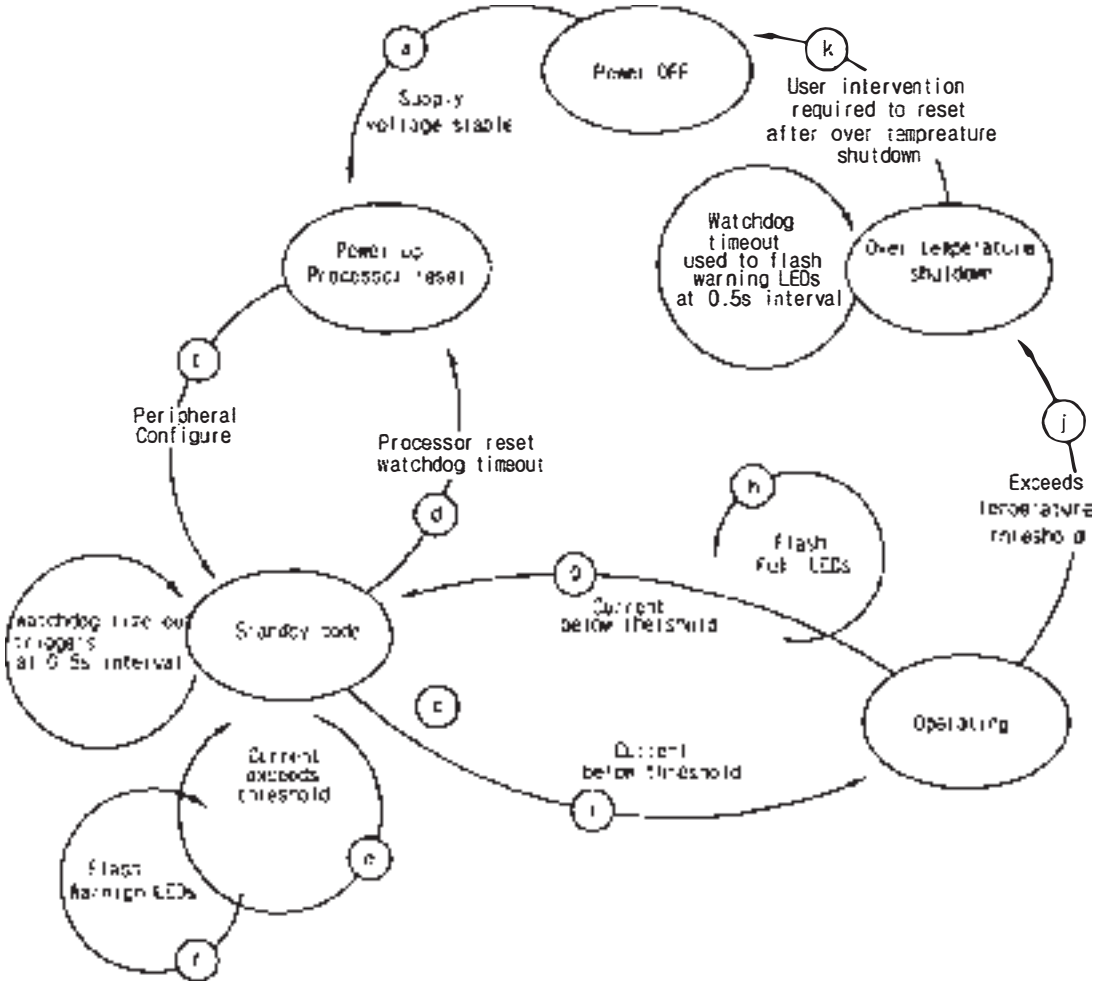
[Fig. 9]



[Fig. 10]



[Fig. 11]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2005/001037

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 H02J 7/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H02J H01M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean Patents and applications for inventions since 1975, Korean Utility models and applications for Utility models since 1975
Japanese Utility models and applications for utility models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
D/B: eKIPASS(Searching System of Korean Intellectual Property Office)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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A	US 6,118,249 A (Perdix Oy, Helsinki, Finland) 12 Sep. 2000 See the whole document	1-11
A	US 5,963,012 A (Motorola, Inc., Schaumburg, Ill.) 05 Oct. 1999 See the Abstract, Fig.3	1-11
A	US 5,568,036 A (Delco Electronics Corp., Kokomo, Ind.) 22 Oct. 1996 See the whole document	1-11

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 NOVEMBER 2005 (18.11.2005)	**18 NOVEMBER 2005 (18.11.2005)**

Name and mailing address of the ISA/KR
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Republic of Korea
Facsimile No. 82-42-472-7140

Authorized officer
LEE, Chang Yong
Telephone No. 82-42-481-5646

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/KR2005/001037

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DocCode - SCORE

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Application Number: **12451436** Document Date: **11/10/2009**

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Form Revision Date: December 8, 2006

PATENT APPLICATION SERIAL NO._____

U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE
FEE RECORD SHEET

11/13/2009 TLUU22 00000040 12451436

01 FC:1631	330.00 OP
02 FC:1633	220.00 OP
03 FC:1632	540.00 OP
04 FC:1615	52.00 OP
05 FC:1614	660.00 OP

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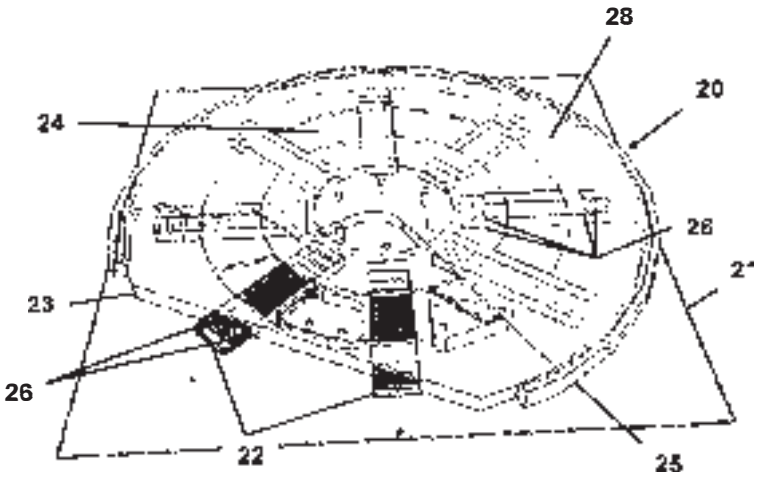

FIGURE 4

(57) Abstract: An inductive power transfer (IPT) pad and system for the charging of electric and hybid electric vehicles. The batter of such a vehicle can be selectively coupled to a high power electrical supply for fast charging or a lower power electrical supply for charging using IPT. The batteries of the vehicles are used in a system to control the load demand in an electricity network through variations of the frequency of power supplied.

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MULTI POWER SOURCED ELECTRIC VEHICLE

Field of the Invention

The present invention relates to an Inductive Power Transfer (IPT) pad, a system, method and means for charging a battery of an electric vehicle using multiple power sources and an electric vehicle powered by said battery. More particularly, the invention relates to charging the battery for an electric vehicle selectively using a high power source for charging at a high rate or a lower power source for charging at a lower rate.

Background

In the development of pure electric vehicles (i.e., those powered solely by electricity as opposed to hybrid vehicles), there are a number of problems to be solved before these vehicles can gain widespread acceptance. These include the limited range compared with more conventionally fuelled vehicles, the inconvenience of having to remember to recharge a vehicle (even if it is possible to do so at the user's premises or home) and the severe restrictions that occur should the vehicle not be charged. These problems have been subjected to greater consideration in recent times due to heightened concerns about global warming. Pure electric vehicles may have a role to play in reducing the effects of global warming as they are clearly the lowest polluters of all vehicle types and are capable of operating with a lower carbon 'footprint' than vehicles powered by more widespread and conventional means.

Many problems with electric vehicles stem directly from the battery used to store energy to power the vehicle. Virtually all battery types must be charged at a rate that is less than the allowable discharge rate, they have a limited capacity, and their cycle life is not great. Thus, it takes quite a long time to charge a vehicle, the time between charges is shorter than ideal, and the functionality of the battery declines rapidly with age.

In use, electric vehicles are however very convenient and make ideal shopping baskets and short trip commuter vehicles. Other tasks such as dropping off children at schools and running errands are also well suited. If the accumulated distance travelled in a day is within the range of the vehicle, then the battery may be recharged over-night, with service capable of being resumed the next day. This is an ideal scenario. However, if the available range is

exceeded or the battery has not been sufficiently charged, the driver and passengers may be left stranded, there will likely be a recovery fee, the battery will need to be fully charged over a longer period of time than a conventional charge cycle and, when using conventional batteries, these will almost certainly be degraded such that their available capacity is permanently reduced from what it was previously. Opportunity charging can help to eliminate this problem and involves partially charging the vehicle whenever an opportunity presents itself.

In perhaps a more serious situation where circumstances call for the vehicle to be taken on a long trip, there is little that can be done. Here hybrid vehicles may be a good solution as they can travel great distances on fossil fuels and refuel at conventional petrol stations.

For these reasons conventional pure electric vehicles have not met all of the modern requirements for a passenger transport vehicle.

Inductive Power Transfer (IPT) provides a useful alternative to more conventional charging. A charger using IPT is described in New Zealand Patent Application No. 545664, entitled "Single Phase Power Supply for Inductively Coupled Power Transfer Systems" and is incorporated herein by reference. This charger provides many advantages in that it will operate from a standard single phase supply typically available in the home, has an excellent power factor and very low harmonics. As a result of this, it would be possible to operate with several thousand of these connected to a utility network without the quality of supply being degraded. Moreover, the use of IPT obviates the need for a user to manually connect a cable to the battery.

Summary of the Invention

It is an object of the invention to provide an improved Inductive Power Transfer (IPT) pad.

It is an object of the invention to provide means for charging a vehicle which mitigates the aforementioned problems associated with conventional electric vehicles.

An alternative object of the invention is to provide a system for charging an electric vehicle.

An alternative object of the invention is to provide a method of charging an electric vehicle.

Alternatively, it is an object of the invention to at least provide a useful choice.

According to a first aspect of the invention, there is provided an inductive power transfer (IPT) pad comprising a coil having at least one turn of a conductor; one or more ferromagnetic slabs; and a shield member arranged around both said coil and said ferromagnetic slabs for channelling electromagnetic flux when in use.

Preferably, the conductor is litz wire.

Preferably, the coil comprises a plurality of turns of wire.

Preferably, the ferromagnetic slabs are monolithic slabs.

Preferably, the ferromagnetic slabs are ferrite slabs.

Preferably, each ferromagnetic slab is arranged in substantially the same plane.

Preferably, each ferromagnetic slab is arranged such that its length extends radially from a common point but spaced apart therefrom.

Preferably, each ferromagnetic slab is spaced apart from adjacent slabs by substantially the same angle.

According to a preferred embodiment, the IPT pad comprises eight ferromagnetic slabs each spaced apart from adjacent slabs by approximately 45º. Other configurations may be selected depending on system requirements.

Alternatively, in another embodiment, the IPT pad comprises a plurality of ferromagnetic slabs whereby a subset of the ferromagnetic slabs extend radially from a common point but are spaced apart therefrom, a further subset of the ferromagnetic slabs extend radially from a different common point but are spaced apart therefrom, and a still further subset of the ferromagnetic slabs are aligned perpendicularly to the direction of an imaginary straight line connecting the said common points, whereby the still further subset of ferromagnetic slabs

are positioned equidistantly from the imaginary line but spaced equally along its length and equally on each side of the imaginary line.

Preferably, the coil is arranged in a plane substantially parallel to that of the ferromagnetic slabs.

Preferably, the coil is positioned to wind around the common point such that it passes each slab at approximately the centre of the length of each slab.

Preferably, the IPT pad comprises a substantially rigid backplate.

Preferably, the backplate is substantially planar,

Preferably, the plane of the backplate is substantially parallel to the planes of the ferromagnetic slabs and the coil, with the plane of the slabs located between the planes of the backplate and the coil.

Preferably, each ferromagnetic slab is spaced apart from the backplate by a thermally conductive and mechanically insulating material so as to allow the transfer of heat there between and protect the slab from mechanical shock. According to one embodiment, each slab may be spaced apart from the backplate using foam or rubber pads. The material making up the slabs is brittle and such steps serve to prevent cracking in the slabs caused by rapid temperature changes and also due to mechanical stresses exerted on the IPT pad.

According to preferred embodiments, the backplane is formed from a material which substantially inhibits the passage of magnetic flux therethrough. In one embodiment, this material is aluminium.

Preferably, the shield member is formed from a strip of material with the ends thereof joined to form a ring.

Preferably, the shield member is formed from aluminium.

Preferably, the shield member is coupled to the backplane.

Preferably, the IPT pad comprises a member having spaces formed therein for holding the ferromagnetic slabs in position and having a channel for accommodating the coil.

Preferably, the member is formed from a material which does not significantly affect magnetic flux. In one embodiment, foam or rubber is used.

Preferably, the member is formed by a moulding process.

Preferably, the IPT pad comprises a cover plate formed from a material that is substantially transparent to magnetic flux. In one embodiment this material is a non-toxic plastic.

According to preferred embodiments, the cover plate and the backplate provide front and rear walls of a housing for the IPT pad, with side walls provided by the shield member, the shield member preferably being configured to extend from the backplate to the cover plate.

The IPT pad according to the first aspect provides for improved performance in use by channelling the flow of flux from the charging pad. More particularly, the backplate and the shield member serve to direct flux upwards from the plane of the backplate with less splay of flux in and parallel to the plane of the backplate. This not only improves the inductive coupling but also reduces the chance that any undesired objects will be subjected to the induced fields during use. It is important to note that if this leakage is not controlled, it can lead to damage of such objects. For example, in the case of an electric vehicle, such leakage may result in the wheel bearings eroding.

The IPT pad of the present invention is also beneficial in that it is relatively slimline compared to more conventional IPT pickups. This is particularly important where pickup pads are coupled to the underside of an electric vehicle since it is important that ground clearance is maintained.

According to a second aspect, there is provided an inductive power transfer system comprising two inductive power transfer pads, wherein the two inductive power transfer pads are used in combination, one of the pads being used as a pickup pad and the other pad as a charging pad.

Preferably, the charging pad is coupleable to a power supply and inductively transfers power to the pickup pad, which is coupleable to a load, such as a battery.

According to a third aspect, there is provided an apparatus for charging a battery of an electric or a hybrid electric vehicle, the apparatus comprising first means for selectively coupling the battery to a high power electrical supply; and second means for selectively coupling the battery to a lower power electrical supply wherein the second means for coupling comprises a pickup pad electrically coupled to the battery, wherein power is transferred to the pickup pad from a charging pad by inductive power transfer.

Preferably, the first means for coupling comprises a socket electrically coupled to the battery, wherein power is transferred by plugging a cable connected to the high power electrical supply into the socket. Thus, electrical energy may be rapidly transferred to the battery using the first means for coupling, resulting in rapid charging.

As would be apparent to one of skill in the art, alternatively, the first means for coupling comprises a plug electrically coupled to the battery, wherein power is transferred by plugging the plug into a socket connected to the cable connected to the high power electrical supply.

Preferably, the second means for coupling comprises a pickup pad according to the first aspect of the invention.

The use of IPT avoids the need for a user to plug in a cable for opportunity charging, including when a vehicle is parked overnight. Additionally or alternatively, a second socket may be provided or the first socket adapted, if required, so that the battery may be connected to a lower power supply using a cable. Again, in the alternative, the second socket may be substituted by a plug configured to mate with a socket connected to the lower power supply. Such embodiments provide for improved flexibility in that, where provided and where time permits, the battery may be charged using IPT. If rapid charging is required and a high power supply is available, the battery may be connected thereto. However, there remains the possibility that a battery will require charging where neither an IPT charging pad or a high power supply is available. A user could, perhaps, put the charging pad inside the vehicle when in transit so that, as required, it could be removed from the vehicle, appropriately positioned and used for charging. This is possible because embodiments of the invention involving IPT preferably work to widely available household voltages but this is inconvenient.

Thus, the second socket may be provided, preferably on an outer surface of the vehicle, to enable the battery to be connected, via a cable, to a lower power supply, such as via a conventional household socket. According to preferred embodiments, the socket used for coupling to the high power supply may also be used to couple to a lower power supply. It is therefore possible to charge a battery via most household circuits, with only a cable needing to be carried in the vehicle.

Thus, depending on requirements and which types of power supply and forms of transfer are available, a user may selectively couple the battery to a high power supply or a lower power electrical supply, preferably using IPT for transferring power from the lower power supply.

Preferably, the high power supply has a transfer rating between 10 kW and 500 kW.

Preferably, the lower power supply has a transfer rating between 0.5 kW and 2.5 kW so that it may be provided by conventional household wiring. More preferably, the lower power supply is between 1.0 kW and 2.2 kW.

Use of the word "battery" throughout the specification is not used in a limiting way and may include one or any number of cells or batteries, or super capacitors.

Preferably, the apparatus comprises an indication means for indicating alignment between the charging pad and the pickup pad.

Preferably, the apparatus comprises an indication means for indicating when the battery is being charged.

According to a fourth aspect of the invention, there is provided an electric vehicle comprising a rechargeable battery and the apparatus of the third aspect for charging said battery.

The electric vehicle may be a "pure electric vehicle" in that it may be powered only by electrical energy. However, the invention is not limited thereto and may be applied to hybrid vehicles which may be powered by electrical energy and at least one other energy source, such as a combustible fuel. Thus, references to "electric vehicles" herein include both pure electric vehicles and hybrid vehicles having electrical energy as one source of power.

According to a fifth aspect of the invention, there is provided a method of charging a battery of an electric or a hybrid electric vehicle, the method comprising selectively coupling the battery to a high power supply or a lower power supply, wherein said coupling the battery to a lower power supply comprises positioning an inductive power transfer pickup pad electrically coupled to the battery in close proximity to an inductive power transfer charging pad.

Preferably, the step of connecting the battery to the high power supply comprises mating a plug with a socket, wherein the plug is associated with one of the battery and the high power supply, and the socket is associated with the other one of the battery and the high power supply.

More preferably, the pickup pad is coupled to the underside of the vehicle and the charging pad is provided on the ground, wherein said selectively coupling the battery to the lower power supply comprises driving the vehicle into a position such that the pickup pad is positioned above, or operably adjacent to, the charging pad.

Preferably, the charging and pickup pads can be variably distanced from each other. The charging pad may be raised and lowered from the ground by a raising and lowering means. Alternatively, the pickup pad may be raised and lowered from the underside of the vehicle by a raising and lowering means.

Preferably, the method comprises indicating alignment between the charging pad and the pickup pad.

Preferably, the method comprises indicating when the battery is being charged.

Placement of an IPT pickup pad on the underside of a vehicle is preferred for aesthetic reasons, because this arrangement provides no physical obstacle to those moving around the vehicle while it is being charged, and because it is improbable that people or other foreign objects will be subjected to the induced fields during charging. However, the invention is not limited to such placement. A pickup pad may be located essentially anywhere on the vehicle with the charging pad being mounted so that IPT transfer is enabled when the vehicle is parked in position. For example, a pickup pad may be provided on the front or rear surface of the vehicle with the charging pad being mounted on a wall in a garage

so that they inductively couple when the vehicle is parked. While not preferred due to the requirement for user intervention, the invention does not preclude the mounting of the pickup pad and/or the charging pad on a moveable mounting or armature, whereby, following parking of a vehicle, a user may move one or both of the pads so that IPT transfer is enabled. While having the drawback of requiring greater user intervention, such embodiments do allow for greater tolerances in the parking position of the vehicle.

According to a sixth aspect, there is provided a system for charging a battery of an electric or a hybrid electric vehicle, the system comprising an electricity network or subnetwork having at least one generator; cabling for transferring energy generated by the at least one generator around the network; IPT coupling means for coupling the network to the battery; and control means for controlling the power transfer from the at least one generator to the battery.

Preferably, the network is coupled to a plurality of batteries of a corresponding plurality of electric or hybrid electric vehicles.

Any energy source may be used by the generator(s) to generate electrical energy. However, according to preferred embodiments, a renewable energy source is used. Through use of the control means, it is possible to overcome problems associated with the fluctuable nature of power generated from renewable sources and enhance the stability of the network by varying the power supplied to the battery so that the power demand on the network better matches the available power. These benefits are more marked according to embodiments of the system in which the network is coupled to a plurality of batteries of a corresponding plurality of electric or hybrid electric vehicles.

Preferably, the control means is configured to vary the power transfer so as to optimise the load factor. Thus, a network controller (e.g. a utility company) may vary the power transfer to batteries connected to their network to better match supply and demand.

According to one embodiment, the batteries in the vehicles are owned by a network controller which operates the network and are leased to the owners of the vehicles.

The system of the sixth aspect preferably comprises at least one IPT pad according to the first aspect and/or at least one apparatus for charging according to the third aspect and/or at least one electric vehicle according to the fourth aspect.

Preferably, the control means is controlled by way of a communications channel.

According to a seventh aspect of the invention, there is provided a method of charging a battery of an electric or a hybrid electric vehicle, the method comprising the steps of coupling the battery to an electricity network or subnetwork using inductive power transfer; transferring electrical energy to the battery via the network; and varying the power transfer according to at least one predetermined criteria.

Preferably, the at least one predetermined criteria may comprise one or more of: a time of day; the level of demand on the network; the level of available supply in the network, which is particularly relevant where the energy source for the network is fluctuable.

Preferably, the method further comprises the steps of coupling batteries of a plurality of electric vehicles to the network and selectively transferring power to all or a subset thereof.

Preferably, the method further comprises the steps of: coupling batteries of a plurality of electric vehicles to the network; and selectively transferring power to all batteries or a subset thereof.

Preferably, the method comprises the step of varying the electricity mains frequency to determine the battery load on the network.

According to an eighth aspect of the invention there is provided a system for supplying power to an electricity network, the system comprising: an electricity network or subnetwork having at least one generator; a plurality of batteries of a plurality of electric or electric hybrid vehicles; cabling for transferring energy stored in the plurality of batteries; IPT coupling means for coupling the batteries to the network; and control means for controlling the power transfer from the plurality of batteries to the network.

According to a ninth aspect of the invention there is provided a method of supplying power to an electricity network, the method comprising the steps of: coupling a plurality of batteries of

a plurality of electric or hybrid electric vehicles to the network using inductive power transfer; transferring electrical energy to the network from the battery; and varying the power transfer according to at least one predetermined criteria.

According to a tenth aspect of the invention there is provided a system for controlling load demand in an electricity network, the system comprising: an electricity network having at least one generator, the frequency of power supplied by the network being allowed to vary; at least one load connected to the network; and control means to monitor the frequency of power supplied by the network, the control means increasing or reducing power consumed by the load dependent on the frequency.

According to an eleventh aspect of the invention there is provided a method of controlling load demand on an electricity network, the method comprising: allowing the frequency of power supplied by the network to vary; monitoring the frequency of power supplied by the network; and increasing or reducing the power consumed by the load dependent on the frequency.

Further aspects of the invention, which should be considered in all its novel aspects, will become apparent to those skilled in the art upon reading the following description which provides at least one example of a practical application of the invention.

Brief Description of the Drawings

One or more embodiments of the invention will be described below by way of example only and without intending to be limiting with reference to the following drawings, in which:

Figure 1	is a perspective view showing a preferred relative positioning of an IPT charging pad and an electric vehicle during charging;
Figure 2	is a perspective view of a preferred embodiment of an IPT pad;
Figures 3 to 5	are alternative perspective views of the embodiment of the IPT pad of Figure 2, with portions removed in Figures 3 and 5, and portions shown in ghost outline in Figure 4 so as to show internal detail;
Figure 5A	is a view of an alternative embodiment of an IPT pad configuration;
Figure 5B	is a plan view of the alternative embodiment of the IPT pad of Figure 5A;
Figure 6	is a schematic representation of an electric vehicle being charged according to an embodiment of the invention; and
Figure 7	is a schematic representation of an embodiment of a system according to the invention.

Detailed Description of Preferred Embodiments

Embodiments of the invention provide for a multi-source electric vehicle that is able to operate in most situations that may occur in terms of types, length and frequency of trips. References to "multi-source electric vehicles" are used to refer to electric vehicles embodying or capable of operating with embodiments of the present invention where the batteries and/or cells used to power the vehicle may be charged using various electrical power sources. Embodiments of the invention provide all of the advantages of a plug-in electric vehicle in that it can be recharged 'at home' overnight but, according to preferred embodiments, it does so without the disadvantage of requiring a cable to be plugged in. More particularly,

according to preferred embodiments, a charging pad is preferably provided on the floor where the vehicle is usually parked, such as in the floor of a user's garage. While the vehicle is parked, the charging pad transfers energy to the vehicle's battery by Inductive Power Transfer (IPT) via a pickup provided on the underside of the vehicle. With nothing to plug in there is nothing to remember and the battery will be fully charged dependent only on the time available.

The charging pad provided on the floor is energised by a power supply and the magnetic field produced thereby couples power into the pickup attached to the vehicle and charges the on-board battery. Power transfer rates of up to around 2.2 kW are compatible with household outputs on most utility networks. The control of this power flow may be achieved using the technique described in US Patent No. 5,293,308, which is incorporated herein by reference. Other methods are also within the scope of the invention.

Figure 1 shows a preferred relative positioning of charging pad 20 and vehicle 10 during charging. The pickup pad (not shown) is preferably of the same shape and configuration of charging pad 20 and is positioned on the underside of vehicle 10 so that it is substantially directly above charging pad 20 when vehicle 10 is parked. The magnetic flux produced by charging pad 20 links the two pads. There is no functional requirement for the pickup pad to be positioned underneath the vehicle but this is preferred for aesthetic reasons and relative ease of installation for retrofitted vehicles.

Figures 2 to 5 show alternative perspective views of charging pad 20 according to preferred embodiments of the invention. More particularly, Figure 2 shows the outer housing of the pad, Figure 3 shows the pad with a portion of the outer housing cut away to show interior detail, Figure 4 corresponds to the view of Figure 3 with exterior features shown as see-through to provide additional detail of the internal arrangement of the components, and Figure 5 shows the pad with the top cover removed. Note that the pickup pad is of the same configuration as charging pad 20 and description of charging pad 20 also applies to the pickup pad, except that charging pad 20 is coupled to an electrical supply (e.g. the mains electricity supply) and the pickup pad is attached to a load (i.e., the vehicle battery to be charged).

Pads 20 are preferably placed an object formed from a material which substantially limits the passage of magnetic flux, such as a metallic backplate 21 (which is formed from aluminium in

a preferred embodiment) with 8 ferrite bars 22 displaced at 45 degrees with respect to each other. Bars 22 are held in position by rubbery moulding 23. A coil of litz wire 27 (see Figure 5) is linked by the magnetic flux passing through ferrite bars 22. Preferably, the coil of litz wire 27 is located on ferrite bars 22 in region 24 of pad 20 so that the coils wind round the generally circular body of the pad approximately half way along the lengths of bars 22. Aluminium strip 25 is coupled or formed integral to backplate 21 to assist in controlling the pattern of the flux generated. Cover 28 is coupled to the top of the main circular body of the pad. Cover 28 is formed from a material, such as PVC, or preferably a non-toxic plastic, which does not obstruct the passage of flux therethrough. The particular configuration shown enables the pads to be relatively slim-line which is particularly important for the pickup pad when retrofitted to existing vehicles so as to maintain ground clearance.

More particularly, backplate 21 and strip 25 are appropriately coupled to work together to direct flux generated by the charging pad through cover 28 in a generally perpendicular direction to backplate 21, thereby providing for improved coupling between a charging pad and a pickup pad since there is less leakage caused by the splay of flux in directions generally parallel to backplate 21. Backplate 21 and strip 25 are electrically connected in one embodiment of the invention.

Mechanical or shock insulating pads 26, preferably formed from foam or rubber, are provided to prevent bars 22 from coming into contact with other components of pad 20. Bars 22 are brittle and thermally sensitive, thus pads 26 are ideally also thermally conductive to keep the bars 22 cool. Mechanical insulating pads 26 also limit the transfer of mechanical stresses to bars 22 caused by knocks or impacts on pad 20 and also due to vibrations such as those generated when pad 20 is mounted on a vehicle.

Using pads configured as shown in the drawings, with a diameter of 400 mm and a thickness of 22 mm, power transfer at rates of up to 2 kW is readily achievable for lateral misalignments of up to +/- 50 mm and vertical separations of 25 mm to 75 mm. Power transfer with even larger tolerances is possible but this requires larger pads, increasing the cost. Where a charging pad is provided on a floor to couple with a pickup pad on the underside of a vehicle, these tolerances translate into tolerances for the parking position of the vehicle. Relatively simple methods may be used to assist a driver in parking in the correct position. For example, a ball on a string may be suspended from the ceiling and aligned with a spot on the windscreen when the vehicle is in the correct position.

Alternatively, a charging indicator may be provided in the vehicle that lights up when the battery is charging and hence the vehicle is in the correct position. Other alternatives will be readily apparent to one of skill in the art and all such alternatives are within the scope of the present invention.

According to preferred embodiments involving a transfer rate of up to around 2 kW, bars 22 preferably have a height of 10 mm, width of 30 mm and length of 120 mm, and coil 27 preferably comprises litz wire having 0.2 mm diameter individually insulated wires with 120 strands at 3.77 mm^2 or more. Strip 25 preferably has a thickness of around 4 mm and cover 28 preferably has a thickness of approximately 5 mm. It should be noted that the invention is not limited to these particular values and the skilled person will be aware that other values may be selected depending on the desired operational characteristics.

According to embodiments of the invention, the power pad on the floor under the vehicle takes the place of a 'track' in a more conventional IPT system and the power pad attached to and under the vehicle is the pickup coil. Using the technique described in the above mentioned New Zealand Patent Application No. 545664, this arrangement of coils allows power to be passed from the floor power pad to the vehicle power pad at high efficiency such that the battery on the vehicle may be charged overnight.

Embodiments of the IPT system make opportunity charging of an electric vehicle possible, not only for a single vehicle in the home, but also, for example, for a fleet of delivery vehicles and the like to allow continuous operation on a 24 x 7 basis given that the work schedule includes relatively long times where the vehicle can be parked over the floor mounted power pad. However, the typical charging rate of 2kW does not overcome the limited range problem of electric vehicles, where the total energy demand exceeds the available stored energy.

To address this problem, a high power, plug-in charger may be connected to the vehicle using a separate high power plug to provide rapid charging of the battery. Not all battery types are capable of accepting powers of the magnitude envisaged but lithium batteries are increasingly capable of doing this.

As noted above, the power pad intervention-free charger is a home-based IPT charging system providing a charging power of about 2 kW to stay within the ratings of conventional

household wiring. A typical battery in an electric vehicle may store 50 kWH of energy or 170 AH (Ampere-Hours) at 300V so that the nominal charging rate is 0.04C (where C stands for the capacity of the battery in AH). This is a conservative and safe estimate. With a single 12 hour charge, 24 kWH of energy may be transferred and if the vehicle operates with an average power demand of 10 kW, it will have a range of about 2 hours of driving or approximately 160 km per day. With a longer charging time this range can be doubled by having the vehicle fully charged. On the other hand, embodiments of the high power battery charger may provide power at a rate of 10kW - 500 kW for 6 minutes corresponding to a charging rate of 10C. Thus in 6 minutes, the battery is fully charged and the vehicle is set for another 300 km before it needs to be charged again. Note that an electric power flow of 500 kW is high but is still low compared with the energy flow rate when pumping petrol or diesel fuel into a tank.

This rapid charging will need to be carefully supervised, as needed for pumping petrol, and is not suitable for home applications for a number of reasons. Few houses have access to a 500 kW utility network and at this power level the source of supply would be at a higher voltage than the normal distribution network. There is also a degree of hazard involved so that a commercially rated facility is required. In contrast, the IPT system is safe and easy to use, making it suitable for installation in the home or other places a car may be parked, such as in public car parks.

The combination of these technologies provides a vehicle with excellent characteristics. On a daily basis it is ideal for short trips, commuting and shopping, allowing relatively low cost travelling for typically 160 km/day with minimal maintenance and no queuing for fuel. It may be used for longer trips requiring refuelling about every 300 km.

Figures 5A and 5B show an alternative embodiment of the charging pad configuration 20 according to the present invention. In Figures 5A and 5B the pad 20 is an oval shape in plan. Oval power pads can be constructed by extending the circular power pads and adding identical rectangular sections in the middle. The construction of both power pads is again preferably identical. In Figure 5B it is shown that the coil 27 is lengthened and a subset of additional ferrite or ferromagnetic bars 22A are added with similar spacing to that of the subset of bars equivalent to those of the circular power pad described above.

The advantage of this oval-shaped arrangement is that the tolerance of the pad to lateral movement (in the x direction shown in Figure 5A) is improved over the circular pad. This is advantageous as it is relatively difficult to adjust the position of a vehicle in the x direction, corresponding to a side to side movement for the vehicle. The tolerance of the pads to pick-up movement in the y direction, corresponding to the forward and reverse directions of a vehicle when positioned over the pad, is less that that for the circular pad. However, this is less critical when parking a vehicle since it is comparatively much easier to make adjustments in this direction so as to be optimally positioned over the pad in the y direction.

The ability to control the spacing between the charging pad and the pickup pad attached to the vehicle is also advantageous. This can be achieved using a variety of methods. For example, the charging pad on the floor may include means for raising and lowering it from the floor such as a jack. The jack may be hand or electrically powered. Alternatively, the pickup pad on the underside of the vehicle may include means for increasing or decreasing its distance from the underside of the vehicle. Again, this may be a jack or other known mechanisms.

One of the primary advantages of the system described herein is one of safety. An inductive charger means there is no plug connection between the charger and the vehicle, unlike in alternative electric vehicle charging systems. If a user accidentally drives the vehicle away whilst still connected in a plugged system, the apparatus may be damaged and a hazardous situation may arise through broken current-carrying equipment. In contrast, using an IPT system with no requirement to first safely disengage any plugs, the vehicle would be able to drive safely away, without fear of damage to the equipment or risk of electricity hazard. Furthermore, in the event of flood, the IPT system can function very safely without the obvious dangers of alternative plugged systems.

Figure 6 is a schematic drawing of battery 51 of electric vehicle 10 being charged by high power electrical supply 52 via cable 53. During opportunity charging, battery 51 is supplied with electricity from pickup 20 via wiring 54. High power electrical supply 52 may comprise a high power generator or alternatively merely provides an interface or conduit between a high power electricity network and cable 53. Cable 53 is provided with a plug (not shown) which mates with a socket (not shown) provided in vehicle 10. Wiring between the socket and battery 51 transfers electricity to battery 51. Preferably, the plug is provided with a safety housing to prevent access to the electrical contacts. The socket may be provided at any

point on vehicle 10 with wiring provided between the socket and battery 51. Thus, the invention is not limited to the position of the socket shown in Figure 6.

Figure 7 is a schematic representation of a system, generally marked 60, according to an embodiment of the invention. Generator 61 provides high power electricity to facility 63 which includes high power electrical supplies 52 of Figure 6. Two high power electrical supplies 52 are shown. However, as would be apparent to one skilled in the art, the invention is not limited thereto and facility 63 may include one or any number of supplies 52, limited only by the available space and the capacity of generator 61. High power cabling 62 acts as a conduit for the transfer of high power electricity to facility 63 and also to transformer 64 which reduces the supply to that of a lower power, such as that conventionally found in homes. Lower power cabling 65 then transfers lower power electricity to charging pads 20, preferably provided in the floor of a user's garage. Whilst single generator 61 is shown, system 60 may include a plurality of generators and may include separate generators for the high power supply and the lower power supply.

An important aspect of electric vehicles is their capital cost. They are typically more expensive than conventional motor cars due to the high cost of the battery. However, according to embodiments of the invention, the battery and the vehicle may be owned by different parties. More particularly, according to one embodiment of a system and method according to the invention, the battery may be owned by a utility company and leased to an owner of a vehicle. According to such embodiments, users of electric vehicles are clearly provided with the benefit of having a reduced capital outlay at the time of purchasing a vehicle. However, benefits may also be realised by utility companies and not only through charges levied for supplying the electricity. In particular, through appropriate control of power supplied to the IPT charging pads, utility companies may level their electric load, particularly overnight when a large number of batteries for electric vehicles may be charging.

With some modification to the electronics system it is also possible to transfer power in reverse from the battery to the utility. In this way at times of peak power in the utility, power may be taken from the vehicle battery and used to supply the peak. With a greater number of vehicles this reverse power may be very large and may avoid power shortages. The total energy may be small as the time that the reverse power flow occurs will likely be short.

There are significant financial advantages to a utility company being able to have a load factor of 1 and this source-side control of a demand-side load would allow this ideal to be approached, if not reached.

A communications channel may be provided between the controller of the network (typically, the utility company) and the vehicles under charge so as to enable monitoring of the charging of these vehicles. A simple cell-phone channel may be used for this purpose. As the available power varies the network controller may vary the battery charging demand to match it. This would allow the utility company to operate near their maximum power with safety as the electric vehicle load can be varied so quickly. This is similar to but more sophisticated than a ripple control system commonly used to control hot water heating. The essential differences are that partial loads are possible, and the loads can be varied more quickly and precisely.

The ability to manipulate the demand makes it more readily possible to integrate highly fluctuable 'renewable' sources of energy into power networks. The manipulation may alternatively be made by allowing the frequency of the network or grid to vary in response to variations in the fluctuable source. Thus, in strong gusts of wind over a whole wind farm the power surge may be such that the mains frequency increases by a small fraction of 1 Hz. These variations in frequency are measured by the power supply to the IPT charging pad and used to control the power pad or track current. In principle, the power transferred is made proportional to the pad current so that by varying the pad current the charging load can be matched to the available power. The variation can take place in as short a period as one cycle of the mains power.

For a large number of battery chargers, say 100,000, the pad current could be programmed so that, for example, at 49.5 Hz the pad current is zero, and at a frequency 1Hz higher the pad current is the full rated current. If all the chargers were at full demand the charging load would vary from 100,000 x 2 kW = 200 MW at a frequency of 50.5 Hz to zero at a frequency of 49.5 Hz. The 49.5 Hz set-point can of course also be varied so that full power occurs at whatever frequency is required. For example, if the set point was 49 Hz then full power would be taken at 50Hz or higher. In this manner, high surges in power caused by strong gusts of wind over large wind farms can be compensated for.

On the other hand, in the integration of wind power into a power network, there are also commonly periods where the wind completely 'dies'. In practice, these periods must be covered by having a separate spinning generator of the same power capacity, on standby. Thus, if a 200 MW wind farm is to be used then 200MW of spinning reserve must be connected to the grid, and under ideal circumstances it provides no real power at all. This protection is very expensive and in many cases makes wind power uneconomic. According to the present invention, this precaution is not required. If the wind 'dies' then all the battery charging load drops as soon as the mains frequency reaches the given set point (e.g. 49.5 or 50 Hz). As the vehicles charge they will individually disengage themselves as soon as their batteries are fully charged so that the actual load is indeterminate and is not simply the total number of vehicles connected. The load could be determined using a communication channel with each vehicle as discussed above but this would take time and a simpler option is available. If the set point was at 49.5 Hz then all of the connected vehicles that are still charging would be at 50% power if the frequency was 50 Hz. If the set point was then changed to 49.6 Hz then the charging vehicles would drop to 40% of their rated power and the change in power, over the whole country, would be 10% of the connected (total) power sink. In this particular example the actual power being taken could be increased by 6 times this change, or reduced by 4 times. In essence, the controllable battery charging load has been precisely determined.

In these circumstances a very high percentage of wind power and/or other fluctuable energy sources can now be included into the generation mix without standby generators knowing how much power is available if the wind dies, and how much spare sink capacity is available if there is a surge. This is a significant advantage over most wind farm integration schemes and will allow the percentage of wind power to be increased above the presently used 6% commonly in, for example, Ireland and Germany, with zero or minimal standby generators necessary. Other schemes for achieving this flexibility use huge batteries locally at the wind farm to store surplus power but it is more efficient if the energy is transferred directly to its destination, namely the batteries in the vehicles, since this requires only one battery charging operation. Batteries at wind farms are therefore significantly less efficient if the ultimate use of the energy is in electric vehicles.

The financial justifications of the invention are interesting. If a typical battery cost $10,000 it might be leased to the car owner for $40/week plus electricity charges of 12c/kWH charged on the basis of what has been used. A user doing 300 km per week might use 45 kWH at a

cost of $5.40 plus the battery lease fee of $40 for a total cost of $45.40 or 15 c / km. Some form of road-user charge would also likely be involved or again added to the cost of the electricity. This cost/km is perhaps high but is for very moderate usage and if the distance travelled is doubled the cost/km is significantly reduced at $50.80 for 600 km or 8.5 c/km.

Electricity generated from renewable sources other than wind power (e.g. solar, tidal etc) is also applicable to embodiments of the invention. All of these are not particularly stable and like wind may vary considerably over relatively short time scales. For example, measured rates of change for wind power in New Zealand have been as high as 200 MW in 5 minutes from a wind farm with a nominal rating of 200MW. Thus the integration of such highly fluctuable sources into an electricity network is a huge advantage. With the source-side control as outlined the charging load varies at a rate sufficient to match the fluctuable power on almost a cycle by cycle basis using small changes in the frequency of supply, allowing the use of energy that would otherwise simply be wasted. This energy would be generated at a considerably lower cost than electricity from more conventional sources.

The invention thus allows off-peak power to be used effectively and safely for electric vehicle charging. It also allows energy generated from renewable sources to be conveniently put to use to charge electric vehicles. Furthermore, the invention allows load demand to be controlled.

Unless the context clearly requires otherwise, throughout the specification, the words "comprise", "comprising", and the like, are to be construed in an inclusive sense as opposed to an exclusive or exhaustive sense, that is to say, in the sense of "including, but not limited to".

It should be noted that various changes and modifications to the presently preferred embodiments described herein will be apparent to those skilled in the art. Such changes and modifications may be made without departing from the spirit and scope of the invention and without diminishing its attendant advantages. It is therefore intended that such changes and modifications be included within the present invention.

CLAIMS

1. An inductive power transfer pad comprising:
a coil having at least one turn of a conductor;
one or more ferromagnetic slabs; and
a shield member arranged around both said coil and said ferromagnetic slabs for channelling electromagnetic flux when in use.

2. An inductive power transfer pad as claimed in claim 1, wherein the conductor is litz wire.

3. An inductive power transfer pad as claimed in claim 1 or claim 2, wherein the coil comprises a plurality of turns of wire.

4. An inductive power transfer pad as claimed in any one of the preceding claims, wherein the one or more ferromagnetic slabs are monolithic.

5. An inductive power transfer pad as claimed in any one of the preceding claims, wherein the one or more ferromagnetic slabs are ferrite.

6. An inductive power transfer pad as claimed in any one of the preceding claims, wherein each ferromagnetic slab is arranged in substantially the same plane.

7. An inductive power transfer pad as claimed in any one of the preceding claims, wherein each ferromagnetic slab is arranged such that its length extends radially from a common point but spaced apart therefrom.

8. An inductive power transfer pad as claimed in any one of the preceding claims, wherein each ferromagnetic slab is spaced apart from adjacent slabs by substantially the same angle.

9. An inductive power transfer pad as claimed in claim 6, wherein:
a subset of the ferromagnetic slabs extend radially from a common point but are spaced apart therefrom;

a further subset of the ferromagnetic slabs extend radially from a different common point but are spaced apart therefrom;

a still further subset of the ferromagnetic slabs are aligned perpendicularly to the direction of an imaginary straight line connecting the said common points, whereby the still further subset of ferromagnetic slabs are positioned equidistantly from the imaginary line but spaced equally along its length and equally on each side of the imaginary line.

10. An inductive power transfer pad as claimed in claim 6, wherein the coil is arranged in a plane substantially parallel to that of the ferromagnetic slabs.

11. An inductive power transfer pad as claimed in claims 7 and 10, wherein the coil is positioned to wind around the common point such that it passes each slab at approximately the centre of the length of each slab.

12. An inductive power transfer pad as claimed in claim 1, wherein the pad comprises a substantially rigid backplate.

13. An inductive power transfer pad as claimed in claim 12, wherein the backplate is substantially planar.

14. An inductive power transfer pad as claimed in claims 12 or 13, wherein the plane of the backplate is substantially parallel to the planes of each of the ferromagnetic slabs and the coil, the plane of each of the ferromagnetic slabs being located between the plane of the backplate and the plane of the coil.

15. An inductive power transfer pad as claimed in claim 12, wherein each ferromagnetic slab is spaced apart from the backplate by a thermally conductive and mechanically insulating material.

16. An inductive power transfer pad as claimed in claim 15, wherein the thermally conductive and mechanically insulating material is foam or rubber.

17. An inductive power transfer pad as claimed in claim 12, wherein the backplate is formed from a material which substantially inhibits the passage of magnetic flux therethrough.

18. An inductive power transfer pad as claimed in claim 17, wherein the backplate is formed from aluminium.

19. An inductive power transfer pad as claimed in claim 1, wherein the shield member is formed from a strip of material with the ends thereof joined to form a ring.

20. An inductive power transfer pad as claimed in any one of the preceding claims, wherein the shield member is formed from aluminium.

21. An inductive power transfer pad as claimed in any one of the preceding claims, wherein the shield member is coupled to the backplate.

22. An inductive power transfer pad as claimed in any one of the preceding claims, wherein the pad comprises a member having spaces formed therein for holding each of the ferromagnetic slabs in position and having a channel for accommodating the coil.

23 An inductive power transfer pad as claimed in claim 22, wherein the member is formed from a material which does not significantly affect magnetic flux.

24. An inductive power transfer pad as claimed in claim 23, wherein the member is formed from foam or rubber.

25. An inductive power transfer pad as claimed in claim 24, wherein the member is formed by a moulding process.

26. An inductive power transfer pad as claimed in any one of the preceding claims, wherein the pad comprises a cover plate formed from a material that is substantially transparent to magnetic flux.

27. An inductive power transfer pad as claimed in claim 26, wherein the cover plate is formed from a non-toxic plastic.

28. An inductive power transfer pad as claimed in claims 12 and 26, wherein the cover plate and the backplate provide front and rear walls of a housing for the pad respectively,

with side walls provided by the shield member, the shield member preferably being configured to extend from the backplate to the cover plate.

29. An inductive power transfer system comprising two inductive power transfer pads as claimed in any one of the preceding claims, wherein the two inductive power transfer pads are used in combination, one of the pads being used as a pickup pad and the other pad as a charging pad.

30. An inductive power transfer system as claimed in claim 29, wherein the charging pad is coupleable to a power supply and inductively transfers power to the pickup pad, which is coupleable to a load.

31. An inductive power transfer system as claimed in claim 30, wherein the coupling between the charging pad and the pickup pad is such that there is a low leakage of magnetic flux from the system.

32. An apparatus for charging a battery of an electric or a hybrid electric vehicle, the apparatus comprising:

first means for selectively coupling the battery to a high power electrical supply; and

second means for selectively coupling the battery to a lower power electrical supply, wherein the second means for coupling comprises a pickup pad electrically coupled to the battery, wherein power is transferred to the pickup pad from a charging pad by inductive power transfer.

33. An apparatus as claimed in claim 32, wherein the first means for coupling comprises a socket electrically coupled to the battery, wherein power is transferred by plugging a cable connected to the high power electrical supply into the socket.

34. An apparatus as claimed in claim 32, wherein the first means for coupling comprises a plug electrically coupled to the battery, wherein power is transferred by plugging the plug into a socket connected to the cable connected to the high power electrical supply..

35. An apparatus as claimed in claim 32, wherein the second means for coupling comprises a pickup pad according to claim 1.

36. An apparatus as claimed in claim 32, wherein the first means for selectively coupling the battery to a high power electrical supply may also be used to selectively couple the battery to a lower power supply.

37. An apparatus as claimed in claim 32, wherein the first means for selectively coupling the battery to a high power electrical supply may be adapted to selectively couple the battery to a lower power supply.

38. An apparatus as claimed in claim 32, wherein the apparatus comprises additional means for selectively coupling the battery to a high power electrical supply or a lower power supply.

39. An apparatus as claimed in claim 32, wherein the high power supply has a transfer rating between 10 kW and 500 kW.

40. An apparatus as claimed in claim 32, wherein the lower power supply has a transfer rating between 0.5 kW and 2.5 kW.

41. An apparatus as claimed in claim 40, wherein the lower power supply has a transfer rating between 1.0 kW and 2.2 kW.

42. An apparatus as claimed in claim 32, wherein the apparatus comprises an indication means for indicating alignment between the charging pad and the pickup pad.

43. An apparatus as claimed in claim 32, wherein the apparatus comprises an indication means for indicating when the battery is being charged.

44. An electric vehicle comprising:

a rechargeable battery; and

an apparatus for charging said battery as claimed in claim 32.

45. A method for charging a battery of an electric or a hybrid electric vehicle, the method comprising:

selectively coupling the battery to a high power supply or a lower power supply, wherein said coupling the battery to a lower power supply comprises positioning an inductive

power transfer pickup pad electrically coupled to the battery in close proximity to an inductive power transfer charging pad.

46. A method as claimed in claim 45, wherein the step of connecting the battery to the high power supply comprises mating a plug with a socket, wherein the plug is associated with one of the battery and the high power supply, and the socket is associated with the other one of the battery and the high power supply.

47. A method as claimed in claim 45, wherein the inductive power transfer pickup pad is coupled to the underside of the vehicle and the inductive power transfer charging pad is provided on the ground, and wherein selectively coupling the battery to the lower power supply comprises driving the vehicle into a position such that the pickup pad is positioned above, or operably adjacent to, the charging pad.

48. A method as claimed in claim 47, wherein the pickup pad and the charging pad can be variably distanced from each other.

49. A method as claimed in claim 48, wherein the charging pad can be raised and lowered from the ground by a raising and lowering means.

50. A method as claimed in claim 48, wherein the pickup pad can be raised and lowered from the underside of the vehicle by a raising and lowering means.

51. A method as claimed in claim 47, wherein the method comprises indicating alignment between the charging pad and the pickup pad.

52. A method as claimed in claim 48, wherein the method comprises indicating when the battery is being charged.

53. A system for charging a battery of an electric or a hybrid electric vehicle, the system comprising:

an electricity network or subnetwork having at least one generator;

cabling for transferring energy generated by the at least one generator around the network;

IPT coupling means for coupling the network to the battery; and

control means for controlling the power transfer from the at least one generator to the battery.

54. A system as claimed in claim 53, wherein the network is coupled to a plurality of batteries of a corresponding plurality of electric or hybrid electric vehicles.

55. A system as claimed in claim 53, wherein the electricity network uses a renewable energy source.

56. A system as claimed in claim 53, wherein the control means is configured to vary the power transfer so as to optimise the load factor.

57. A system as claimed in claim 56, wherein the batteries of the electric or hybrid vehicles are owned by a network controller.

58. A system as claimed in claim 53, wherein the system comprises at least one inductive power transfer pad according to claim 1 and/or at least one apparatus for charging according to claim 32 and/or at least one electric vehicle according to claim 44.

59. A system as claimed in claim 53, wherein the control means is controlled by way of a communications channel.

60. A method of charging a battery of an electric or a hybrid electric vehicle, the method comprising the steps of:

coupling the battery to an electricity network or subnetwork using inductive power transfer;

transferring electrical energy to the battery via the network; and

varying the power transfer according to at least one predetermined criteria.

61. A method as claimed in claim 60, where the at least one predetermined criteria may comprise one or more of:

the time of day;

the level of demand on the network; and

the level of available supply in the network.

62. A method as claimed in claim 60, wherein the method further comprises the steps of:
coupling batteries of a plurality of electric vehicles to the network; and
selectively transferring power to all batteries or a subset thereof.

63. A method as claimed in claim 62, wherein the method comprises the step of varying the electricity mains frequency to determine the battery load on the network.

64. A system for supplying power to an electricity network, the system comprising:
an electricity network or subnetwork having at least one generator;
a plurality of batteries of a plurality of electric or electric hybrid vehicles;
cabling for transferring energy stored in the plurality of batteries;
IPT coupling means for coupling the batteries to the network; and
control means for controlling the power transfer from the plurality of batteries to the network.

65. A method of supplying power to an electricity network, the method comprising the steps of:
coupling a plurality of batteries of a plurality of electric or hybrid electric vehicles to the network using inductive power transfer;
transferring electrical energy to the network from the battery; and
varying the power transfer according to at least one predetermined criteria.

66. A system for controlling load demand in an electricity network, the system comprising:
an electricity network having at least one generator, the frequency of power supplied by the network being allowed to vary;
at least one load connected to the network; and
control means to monitor the frequency of power supplied by the network, the control means increasing or reducing power consumed by the load dependent on the frequency.

67. A method of controlling load demand on an electricity network, the method comprising:
allowing the frequency of power supplied by the network to vary;
monitoring the frequency of power supplied by the network; and
increasing or reducing the power consumed by the load dependent on the frequency.

68. An inductive power transfer pad substantially as hereinbefore described with reference to any one of the embodiments shown in the drawings.

69. A method for charging a battery of an electric or a hybrid electric vehicle substantially as hereinbefore described with reference to any one of the embodiments shown in the drawings.

70. Apparatus for charging a battery of an electric or a hybrid electric vehicle substantially as hereinbefore described with reference to any one of the embodiments shown in the drawings.

71. A method of controlling load demand on an electricity network substantially as herein described.

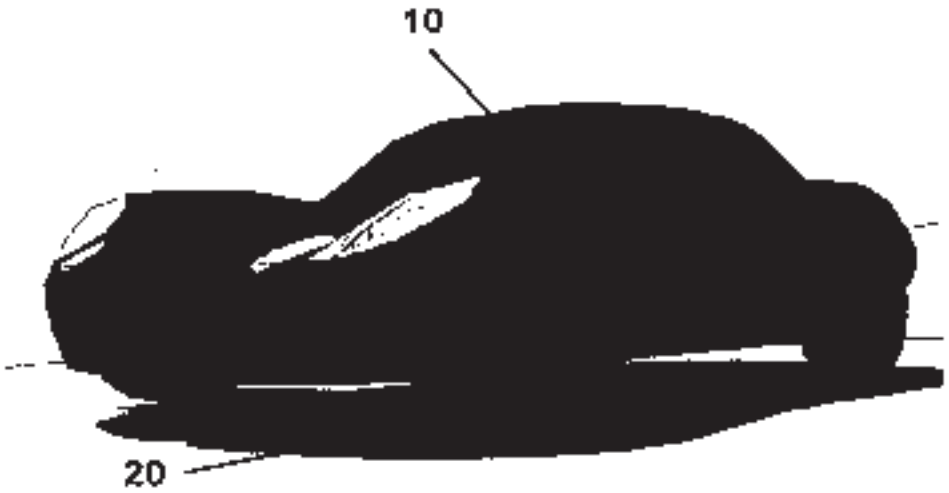

FIGURE 1

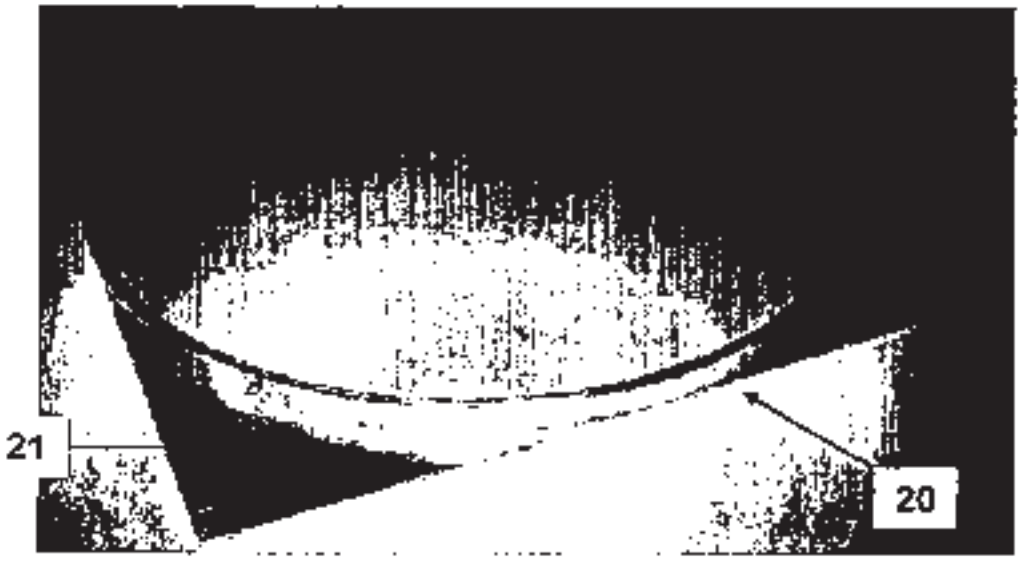

FIGURE 2

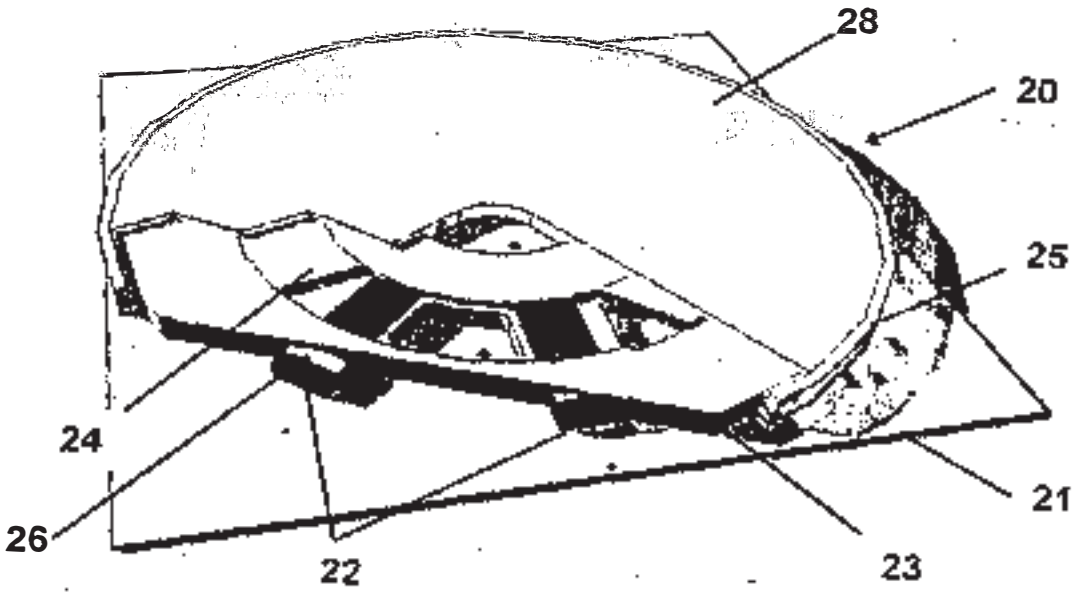

FIGURE 3

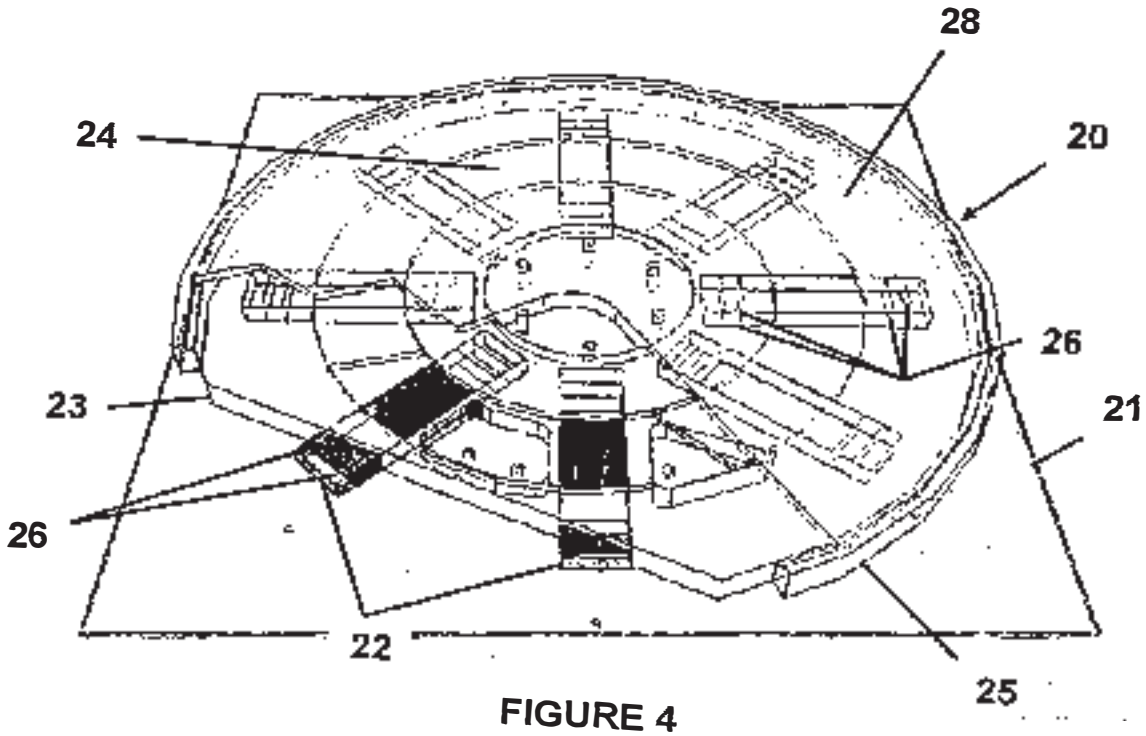

FIGURE 4

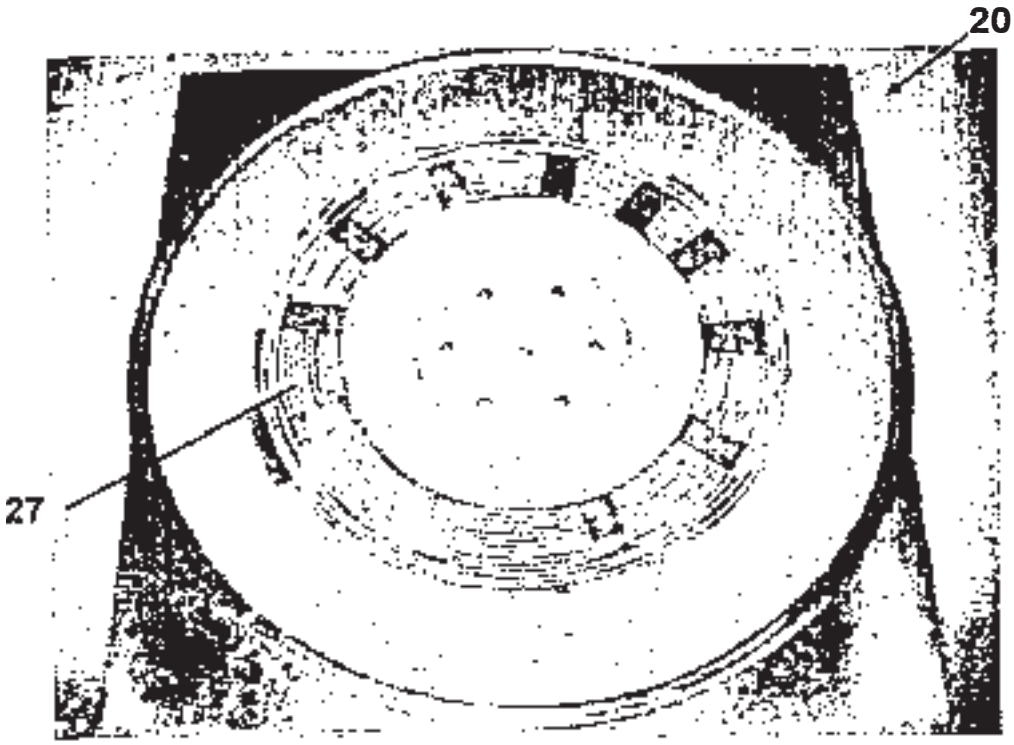

FIGURE 5

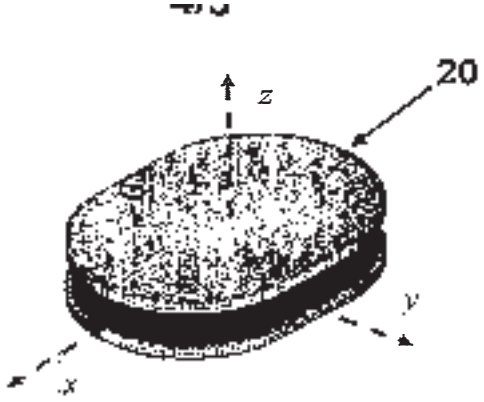

FIGURE 5A

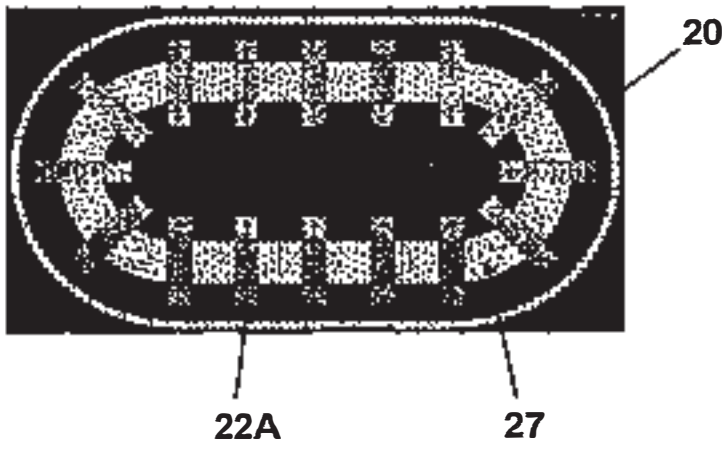

FIGURE 5B

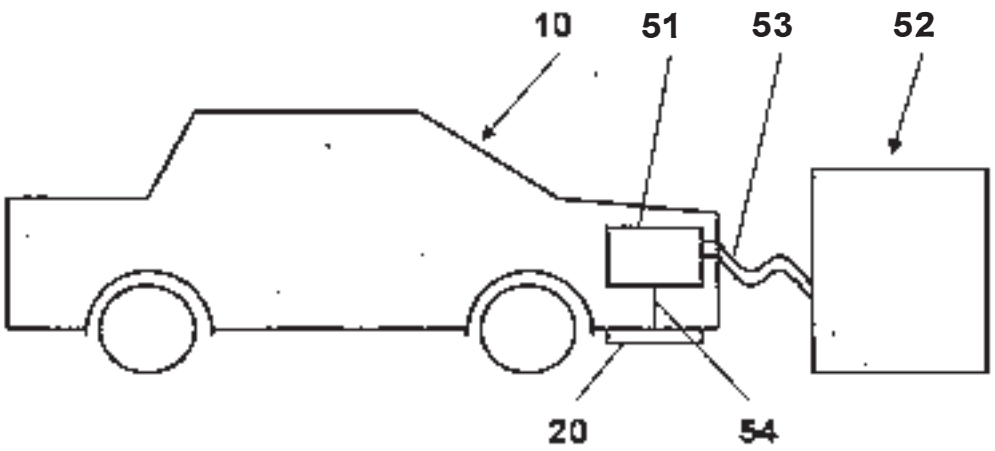

FIGURE 6

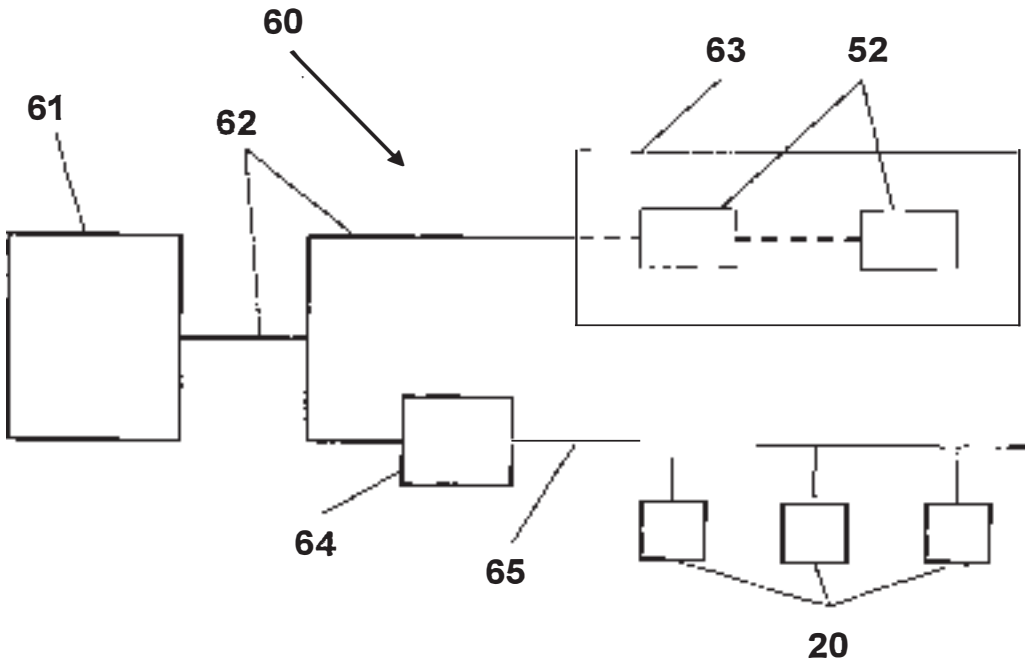

FIGURE 7

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PCT/NZ2008/000103

CERTIFICATE

This certificate is issued in support of an application for Patent registration in a country outside New Zealand pursuant to the Patents Act 1953 and the Regulations thereunder.

I hereby certify that annexed is a true copy of the Provisional Specification as filed on 10 May 2007 with an application for Letters Patent number 555128 made by GRANT ANTHONY COVIC; JOHN TALBOT BOYS and AUCKLAND UNISERVICES LIMITED.

Dated 14 May 2008.

Neville Harris
Commissioner of Patents, Trade Marks and Designs

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PATENTS FORM NO. 4 Our ref: CHW 506802NZPR

Patents Act 1953

PROVISIONAL SPECIFICATION

MULTI POWER SOURCED ELECTRIC VEHICLE

We, **GRANT ANTHONY COVIC,** a New Zealand citizen of 28 Haverstock Road, Sandringham, Auckland, **JOHN TALBOT BOYS,** a New Zealand citizen of 41A Dominion Street, Takapuna, Auckland and **AUCKLAND UNISERVICES LIMITED**, a New Zealand company of Level 10, 70 Symonds Street, Auckland, New Zealand do hereby declare this invention to be described in the following statement:

300726227_1.DOC:CHW:QAKLD

MULTI POWER SOURCED ELECTRIC VEHICLE

Field of the Invention

The present invention relates to a system, method and means for charging a battery of an electric vehicle using multiple power sources and an electric vehicle powered by said battery. More particularly, the invention relates to charging the battery for an electric vehicle selectively using a high power source for charging at a high rate or a lower power source for charging at a lower rate.

Background

In the development of pure electric vehicles (i.e., those powered solely by electricity as opposed to hybrid vehicles), there are a number of problems to be solved before these vehicles can gain widespread acceptance. These include the limited range compared with more conventionally fuelled vehicles, the inconvenience of having to remember to recharge a vehicle (even if it is possible to do so at the user's premises or home) and the severe restrictions that occur should the vehicle not be charged. These problems are now seen as being more important due to heightened concerns about global warming. Pure electric vehicles may have a role to play in reducing the effects of global warming as they are clearly the lowest polluters of all vehicle types and are capable of operating with a lower carbon 'footprint' than vehicles powered by more widespread and conventional means.

Many problems with electric vehicles stem directly from the battery used to store energy to power the vehicle. Virtually all battery types must be charged at a rate that is less than the allowable discharge rate, they have a limited capacity, and their cycle life is not great. Thus, it takes quite a long time to charge a vehicle, the time between charges is shorter than ideal, and the functionality of the battery declines rapidly with age.

In use, electric vehicles are however very convenient and make ideal shopping baskets and short trip commuter vehicles. Other tasks such as dropping off children at schools and running errands are also well suited. If the accumulated distance travelled in a day is within the range of the vehicle, then the battery may be recharged over-night, with service capable of being resumed the next day. This is an ideal scenario. However, if the available range is exceeded

or the battery has not been sufficiently charged, the driver and passengers may be left stranded, there will likely be a recovery fee, the battery will need to be fully charged over a longer period of time than a conventional charge cycle and, when using conventional batteries, these will almost certainly be degraded such that their available capacity is permanently reduced from what it was previously. Opportunity charging can help to eliminate this problem and involves partially charging the vehicle whenever an opportunity presents itself.

In perhaps a more serious situation where circumstances call for the vehicle to be taken on a long trip, there is little that can be done. Here hybrid vehicles may be a good solution as they can travel great distances on fossil fuels and refuel at conventional petrol stations.

For these reasons conventional pure electric vehicles have not met all of the modern requirements for a passenger transport vehicle.

Inductive Power Transfer (IPT) provides a useful alternative to more conventional charging. A charger using IPT is described in New Zealand Patent Application No. 545664, entitled "Single Phase Power Supply for Inductively Coupled Power Transfer Systems" and is incorporated herein by reference. This charger provides many advantages in that it will operate from a standard single phase supply typically available in the home, has an excellent power factor and very low harmonics. As a result of this, it would be possible to operate with several thousand of these connected to a utility network without the quality of supply being degraded. Moreover, the use of IPT obviates the need for a user to manually connect a cable to the battery. The basic components for IPT are a pickup (preferably mounted on the underside of the vehicle and electrically coupled to the battery) and a charging pad (preferably provided on the floor in a position directly underneath the pickup when the vehicle is parked). The charging pad is coupled to an electricity supply and when the vehicle is in the correct position, the charging pad transfers power to the pickup.

Summary of the Invention

It is an object of the invention to provide means for charging a vehicle which mitigates the aforementioned problems associated with conventional electric vehicles.

An alternative object of the invention is to provide a system for charging an electric vehicle.

An alternative object of the invention is to provide a method of charging an electric vehicle.

Alternatively, it is an object of the invention to provide at least a useful choice.

According to a first aspect of the invention, there is provided an apparatus for charging an electric vehicle, the electric vehicle comprising a rechargeable battery, the apparatus comprising first means for selectively coupling the at least one battery to a high power electrical supply; and second means for selectively coupling the at least one battery to a lower power electrical supply.

Preferably, the first means for coupling comprises a socket electrically coupled to the battery, wherein power is transferred by plugging a cable connected to the high power electrical supply into the socket. Thus, electrical energy may be rapidly transferred to the battery using the first means for coupling, resulting in rapid charging.

Preferably, the second means for coupling comprises a pickup electrically coupled to the battery, wherein power is transferred to the pickup by Inductive Power Transfer (IPT).

The use of IPT avoids the need for a user to plug in a cable for opportunity charging, including when a vehicle is parked overnight. The use of IPT is preferred but the invention is not limited thereto. Alternatively, a second socket may be provided or the first socket adapted, if required, so that the battery may be connected to a lower power supply using a cable.

As a further alternative, as well as being coupleable to the high power supply, the battery may be coupleable to a lower power supply selectively using either IPT or a cable and socket. Such embodiments provide for improved flexibility in that, where provided and where time permits, the battery may be charged using IPT. If rapid charging is required and a high power supply is available, the battery may be connected thereto. However, there remains the possibility that a battery will require charging where neither an IPT charging pad or a high power supply is available. A user could, perhaps, put the charging pad inside the vehicle when in transit so that, as required, it could be removed from the vehicle, appropriately positioned and used for charging. This is possible because embodiments of the invention involving IPT work to widely available household voltages but it is inconvenient. Thus, in addition to these means for

coupling a power supply to the battery, a socket may be provided, preferably on an outer surface of the vehicle, that enables the battery to be connected, via a cable, to the same or an alternative lower power supply. The socket may again be a dedicated socket for this purpose. However, according to preferred embodiments, the socket used for coupling to the high power supply may also be used to couple to a lower power supply. It is therefore possible to charge a battery via most household circuits, with only a cable needing to be carried in the vehicle.

Thus, depending on requirements, a user may selectively couple the battery to a high power or a lower power electrical supply.

Use of the term "battery" is not used in a limiting way and may include one or any number of cells or batteries.

According to a second aspect of the invention, there is provided an electric vehicle comprising a rechargeable battery; first means for receiving power from a high power electrical supply and second means for receiving power from a lower power electrical supply, wherein the first and second means are electrically coupled to the battery to transfer electricity thereto, when in a charging mode.

The electric vehicle may be a "pure electric vehicle" in that it may be powered only by electrical energy. However, the invention is not limited thereto and may be applied to hybrid vehicles which may be powered by electrical energy and at least one other energy source, such as a combustible fuel. Thus, references to "electric vehicles" herein include both pure electric vehicles and hybrid vehicles having electrical energy as one source of power.

According to a third aspect of the invention, there is provided a method of charging a battery of an electric vehicle, the method comprising selectively coupling the battery to a first power supply or a second power supply, wherein the power output of the first power supply is higher than that of the second power supply. Thus, charging is accomplished more rapidly using the first power supply.

Preferably, the battery is electrically coupled to a socket, the socket being adapted to be electrically coupled to the first power supply via a cable having a first end connected to the first power supply and a second end distal therefrom and provided with a plug for mating with the

socket, wherein said selectively coupling the battery to the first power supply comprises mating the plug with the socket.

Preferably, the battery is electrically coupled to an IPT pickup pad configured to derive power from magnetic flux generated by an IPT charging pad, wherein said selectively coupling the battery to the second power supply comprises positioning the pickup pad in close proximity to the charging pad.

More preferably, said pickup pad is coupled to the underside of the vehicle and the charging pad is provided on the ground, wherein said selectively coupling the battery to the second power supply comprises driving the vehicle into a position such that the pickup pad is positioned above the charging pad.

According to a fourth aspect, there is provided a system for charging at least one battery of an electric vehicle, the system comprising an electricity network or subnetwork having at least one generator and cabling for transferring energy generated by the generator around the network; means for connecting the network to said at least one battery; and control means for varying the power transfer from the generator to the battery.

Any energy source may be used by the generator to generate electrical energy. However, according to preferred embodiments, a renewable energy source is used. Through use of the control means, it is possible to overcome problems associated with the fluctuable nature of power generated from renewable sources and enhance the stability of the network by varying the power supplied to the battery so that the power demand on the network better matches the available power. This aspect is particularly prevalent according to embodiments of the system in which the network is coupled to a plurality of batteries of a corresponding plurality of electric vehicles.

Preferably, means are provided which enable, for example, the utility company which operates the network to vary the supply of electricity to the batteries so as to optimise their load factor.

According to one embodiment, the batteries in the vehicles are owned by the utility company which operates the network and leased to the owners of the vehicles.

According to a fifth aspect of the invention, there is provided a method of charging at least one battery of an electric vehicle, the method comprising coupling the battery to an electricity network or subnetwork; transferring electrical energy to the at least one battery via the network; and varying the power transfer according to at least one predetermined criteria.

Preferably, the coupling uses IPT.

The at least one predetermined criteria may comprise a time of day and/or the level of demand on the network and/or the level of available supply in the network, which is particularly relevant where the energy source for the network is fluctuable.

Preferably, the method comprises coupling batteries of a plurality of electric vehicles to the network and selectively transferring electricity to all or a subset thereof.

Further aspects of the invention, which should be considered in all its novel aspects, will become apparent to those skilled in the art upon reading the following description which provides at least one example of a practical application of the invention.

Brief Description of the Drawings

One or more embodiments of the invention will be described below by way of example only and without intending to be limiting with reference to the following drawings, in which:

Figure 1	is a perspective view showing a preferred relative positioning of an IPT charging pad and an electric vehicle during charging;
Figure 2	is a perspective view of a preferred embodiment of an IPT pad;
Figures 3 and 4	are alternative perspective views of the embodiment of the IPT pad of Figure 2, with portions removed in Figure 3 and portions shown in ghost outline in Figure 4 so as to show internal detail;
Figure 5	is a schematic representation of an electric vehicle being charged according to an embodiment of the invention; and

Figure 6 is a schematic representation of an embodiment of a system according to the invention.

Detailed Description of Preferred Embodiments

Embodiments of the invention provide for a multi-source electric vehicle that is able to operate in most situations that may occur in terms of types, length and frequency of trips. References to "multi-source electric vehicles" are used to refer to electric vehicles embodying or capable of operating with embodiments of the present invention where the batteries and/or cells used to power the vehicle may be charged using various electrical power sources. Embodiments of the invention provide all of the advantages of a plug-in electric vehicle in that it can be recharged 'at home' overnight but, according to preferred embodiments, it does so without the disadvantage of requiring a cable to be plugged in. More particularly, according to preferred embodiments, a charging pad is preferably provided on the floor where the vehicle is usually parked, such as in the floor of a user's garage. While the vehicle is parked, the charging pad transfers energy to the vehicle's battery by Inductively Coupled Power Transfer (IPT) via a pickup provided on the underside of the vehicle. With nothing to plug in there is nothing to remember and the battery will be fully charged dependent only on the time available.

The charging pad provided on the floor is energised by a power supply and the magnetic field produced thereby couples power into the pickup attached to the vehicle and charges the on-board battery. Power transfer rates of up to 2 kW are compatible with household outputs on most utility networks. The control of this power flow may be achieved using the technique described in US Patent No. 5,293,308, which is incorporated herein by reference. Other methods are also within the scope of the invention.

Figure 1 shows a preferred relative positioning of charging pad 20 and vehicle 10 during charging. The pickup pad (not shown) is preferably of the same shape and configuration of charging pad 10 and is positioned on the underside of vehicle 10 so that it is directly above charging pad 20 when vehicle 10 is parked. The magnetic flux produced by charging pad 20 links the two pads. There is no functional requirement for the pickup pad to be positioned underneath the vehicle but this is preferred for aesthetic reasons and relative ease of installation for retrofitted vehicles.

Figures 2 to 4 show alternative perspective views of charging pad 20 according to preferred embodiments of the invention. More particularly, Figure 2 shows the outer housing of the pad, Figure 3 shows the pad with a portion of the outer housing cut away to show interior detail and Figure 4 corresponds to the view of Figure 3 with exterior features shown as see-through to provide additional detail of the internal arrangement of the components. Note that the pickup pad is of the same configuration as charging pad 20 and description of charging pad 20 also applies to the pickup pad, except that charging pad 20 is coupled to an electrical supply (e.g. the mains electricity supply) and the pickup pad is attached to a drain (i.e., the vehicle battery to be charged).

Pads 20 are preferably constructed on an aluminium back-plane 21 with 8 ferrite bars 22 displaced at 45 degrees with respect to each other. Bars 22 are held in position by rubbery moulding 23. A coil of litz wire (not shown) is linked by the magnetic flux passing through ferrite bars 22. Preferably, the coil of litz wire is located on ferrite bars 22 in region 24 of pad 20 so that the coils wind round the generally circular body of the pad approximately half way between the centre and outer radius thereof. Aluminium strip 25 is coupled or formed integral to back-plane 21 to assist in controlling the pattern of the flux generated and an aluminium cover is coupled to the top of the main circular body. The particular configuration shown enables the pads to be relatively slim-line which is particularly important for the pickup pad when retrofitted to existing vehicles so as to maintain ground clearance.

Using pads configured as shown in the drawings, with a diameter of 400 mm and a thickness of 22 mm, power transfer at rates of up to 2 kW is readily achievable for lateral misalignments of up to +/- 50 mm and vertical separations of 25 mm to 75 mm. Power transfer with even larger tolerances is possible but this requires larger pads, increasing the cost. The tolerance as above is easily achievable by relatively simple methods. For example a ball on a string, suspended from the ceiling, and aligned with a spot on the windscreen when the vehicle is in the correct position. Alternatively, a charging indicator may be provided in the vehicle which lights up when the battery is charging and hence the vehicle is in the correct position. Other alternatives will be readily apparent to one of skill in the art and all such alternatives are within the scope of the present invention.

According to embodiments of the invention, the power pad on the floor under the vehicle takes the place of a 'track' in a more conventional IPT system and the power pad attached to and under the vehicle is the pickup coil. Using the technique described in the above mentioned New Zealand Patent Application No. 545664, this arrangement of coils allows power to be passed from the floor power pad to the vehicle power pad at high efficiency such that the battery on the vehicle may be charged overnight.

Embodiments of the IPT system make opportunity charging of an electric vehicle possible, not only for a single vehicle in the home, but also, for example, for a fleet of delivery vehicles and the like to allow continuous operation on a 24 x 7 basis given that the work schedule includes relatively long times where the vehicle can be parked over the floor mounted power pad. However, the typical charging rate of 2kW does not overcome the limited range problem of electric vehicles, where the total energy demand exceeds the available stored energy.

To address this problem, a high power, plug-in charger may be connected to the vehicle using a separate high power plug to provide rapid charging of the battery. Not all battery types are capable of accepting powers of the magnitude envisaged but lithium batteries are increasingly capable of doing this.

As noted above, the power pad intervention free charger is a home-based IPT charging system providing a charging power of about 2 kW to stay within the ratings of conventional household wiring. A typical battery in an electric vehicle may store 50 kWH of energy or 170 AH (Ampere-Hours) at 300V so that the nominal charging rate is 0.04C (where C stands for the capacity of the battery in AH). This is a conservative and safe estimate. With a single 12 hour charge, 24 kWH of energy may be transferred and if the vehicle operates with an average power demand of 10 kW, it will have a range of about 2 hours of driving or approximately 160 km per day. With a longer charging time this range can be doubled by having the vehicle fully charged. On the other hand, embodiments of the high power battery charger may provide power at a rate of 500 kW for 6 minutes corresponding to a charging rate of 10C. Thus in 6 minutes, the battery is fully charged and the vehicle is set for another 300 km before it needs to be charged again. Note that an electric power flow of 500 kW is high but is still low compared with the energy flow rate when pumping petrol or diesel fuel into a tank.

This rapid charging will need to be carefully supervised, as needed for pumping petrol, and is not suitable for home applications for a number of reasons. Few houses have access to a 500 kW utility network and at this power level the source of supply would be at a higher voltage than the normal distribution network. There is also a degree of hazard involved so that a commercially rated facility is required. In contrast, the IPT system is safe and easy to use, making it suitable for installation in the home or other places a car may be parked, such as in public car parks.

The combination of these technologies provides a vehicle with excellent characteristics. On a daily basis it is ideal for short trips, commuting and shopping, allowing relatively low cost travelling of typically 160 km/day with minimal maintenance and no queuing for fuel. It may be used for longer trips requiring refuelling about every 300 km.

Figure 5 is a schematic drawing of battery 51 of electric vehicle 10 being charged by high power electrical supply 52 via cable 53. During opportunity charging, battery 51 is supplied with electricity from pickup 20 via wiring 54. High power electrical supply 52 may comprise a high power generator or alternatively merely provides an interface or conduit between a high power electricity network and cable 53. Cable 53 is provided with a plug (not shown) which mates with a socket (not shown) provided in vehicle 10. Wiring between the socket and battery 51 transfers electricity to battery 51. Preferably, the plug is provided with a safety housing to prevent access to the electrical contacts. The socket may be provided at any point on vehicle 10 with wiring provided between the socket and battery 51. Thus, the invention is not limited to the position of the socket shown in Figure 5.

Figure 6 is a schematic representation of a system, generally marked 60, according to an embodiment of the invention. Generator 61 provides high power electricity to facility 63 which includes high power electrical supplies 52 of Figure 5. Two high power electrical supplies 52 are shown. However, as would be apparent to one skilled in the art, the invention is not limited thereto and facility 63 may include one or any number of supplies 52, limited only by the available space and the capacity of generator 61. High power cabling 62 acts as a conduit for the transfer of high power electricity to facility 63 and also to transformer 64 which reduces the supply to that of a lower power, such as that conventionally found in homes. Lower power cabling 65 then transfers lower power electricity to charging pads 66, preferably provided in the floor of a user's garage. Whilst single generator 61 is shown, system 60 may include a plurality

of generators and may include separate generators for the high power supply and the lower power supply.

An important aspect of electric vehicles is their capital cost. They are typically more expensive than conventional motor cars due to the high cost of the battery. However, according to embodiments of the invention, the battery and the vehicle may be owned by different parties. More particularly, according to one embodiment of a system and method according to the invention, the battery may be owned by a utility company and leased to an owner of a vehicle. According to such embodiments, users of electric vehicles are clearly provided with the benefit of having a reduced capital outlay at the time of purchasing a vehicle. However, benefits may also be realised by utility companies and not only through charges levied for supplying the electricity. In particular, through appropriate control of power supplied to the IPT charging pads, utility companies may level their electric load, particularly overnight when a large number of batteries for electric vehicles may be charging.

There are significant financial advantages to a utility company being able to have a load factor of 1 and this source-side control of a demand-side load would allow this ideal to be approached, if not reached.

A communications channel may be provided between the controller of the network (typically, the utility company) and the vehicles under charge so as to enable monitoring of the charging of these vehicles. A simple cell-phone channel may be used for this purpose. As the available power varies the network controller may vary the battery charging demand to match it. This would allow the utility company to operate near their maximum power with safety as the electric vehicle load can be varied so quickly. This is similar to but more sophisticated than a ripple control system commonly used to control hot water heating. The essential differences are that partial loads are possible, and the loads can be varied more quickly and precisely.

The ability to manipulate the demand makes it more readily possible to integrate highly fluctuable 'renewable' sources of energy into power networks. The manipulation may be made by allowing the frequency of the network or grid to vary in response to variations in the fluctuable source. Thus, in strong gusts of wind over a whole wind farm the power surge may be such that the mains frequency increases by a small fraction of 1 Hz. These variations in frequency are measured by the power supply to the IPT charging pad and used to control the

track current. In principle, the power transferred is made proportional to the track current so that by varying the track current the charging load can be matched to the available power.

For a large number of battery chargers, say 100,000, the track current could be programmed so that, for example, at 49.5 Hz the track current is zero, and at a frequency 1Hz higher the track current is the rated current. If all the chargers were at full demand the charging load would vary from 100,000 x 2 kW = 200 MW at a frequency of 50.5 Hz to zero at a frequency of 49.5 Hz. This 2% droop characteristic is known to be a stable way of operating loads on power systems. The 49.5 Hz set-point can of course also be varied so that full power occurs at whatever frequency is required. For example, if the set point was 49 Hz then full power would be taken at 50Hz or higher. In this manner, high surges in power caused by strong gusts of wind over large wind farms can be compensated for.

On the other hand, in the integration of wind power into a power network, there are also commonly periods where the wind completely 'dies'. In practice, these periods must be covered by having a separate spinning generator of the same power capacity, on standby. Thus, if a 200 MW wind farm is to be used then 200MW of spinning reserve must be connected to the grid, and under ideal circumstances it provides no real power at all. This protection is very expensive and in many cases makes wind power uneconomic. According to the present invention, this precaution is not required. If the wind 'dies' then all the battery charging load drops as soon as the mains frequency reaches the given set point (e.g. 49.5 or 50 Hz). As the vehicles charge they will individually disengage themselves as soon as their batteries are fully charged so that the actual load is indeterminate and is not simply the total number of vehicles connected. The load could be determined using a communication channel with each vehicle as discussed above but this would take time and a simpler option is available. If the set point was at 49.5 Hz then all of the connected vehicles that are still charging would be at 50% power if the frequency was 50 Hz. If the set point was then changed to 49.6 Hz then the charging vehicles would drop to 40% of their rated power and the change in power, over the whole country, would be 10% of the connected (total) power sink. In this particular example the actual power being taken could be increased by 6 times this change, or reduced by 4 times. In essence, the controllable battery charging load has been precisely determined.

In these circumstances a very high percentage of wind power and/or other fluctuable energy sources can now be included into the generation mix without standby generators knowing how

much power is available if the wind dies, and how much spare sink capacity is available if there is a surge. This is a significant advantage over most wind farm integration schemes and will allow the percentage of wind power to be increased above the present 6% with zero or minimal standby generators necessary. Other schemes for achieving this flexibility use huge batteries locally at the wind farm to store surplus power but it is more efficient if the energy is transferred directly to its destination, namely the batteries in the vehicles, since this requires only one battery charging operation. Batteries at wind farms are therefore significantly less efficient if the ultimate use of the energy is in electric vehicles.

The financial justifications of the invention are interesting. If a typical battery cost $10,000 it might be leased to the car owner for $40/week plus electricity charges of 12c/kWH charged on the basis of what has been used. A user doing 300 km per week might use 45 kWH at a cost of $5.40 plus the battery lease fee of $40 for a total cost of $45.40 or 15 c / km. Some form of road-user charge would also likely be involved or again added to the cost of the electricity. This cost/km is perhaps high but is for very moderate usage and if the distance travelled is doubled the cost/km is significantly reduced at $50.80 for 600 km or 8.5 c/km.

Electricity generated from renewable sources other than wind power (e.g. solar, tidal etc) is also applicable to embodiments of the invention. All of these are not particularly stable and like wind may vary considerably over relatively short time scales. For example, measured rates of change for wind power in New Zealand have been as high as 200 MW in 5 minutes from a wind farm with a nominal rating of 200MW. Thus the integration of such highly fluctuable sources into an electricity network is a huge advantage. With the source-side control as outlined the charging load varies at a rate sufficient to match the fluctuable power on almost a cycle by cycle basis using small changes in the frequency of supply, allowing the use of energy that would otherwise simply be wasted. This energy would be generated at a considerably lower cost than electricity from more conventional sources.

It should be noted that various changes and modifications to the presently preferred embodiments described herein will be apparent to those skilled in the art. Such changes and modifications may be made without departing from the spirit and scope of the invention and without diminishing its attendant advantages. It is therefore intended that such changes and modifications be included within the present invention.

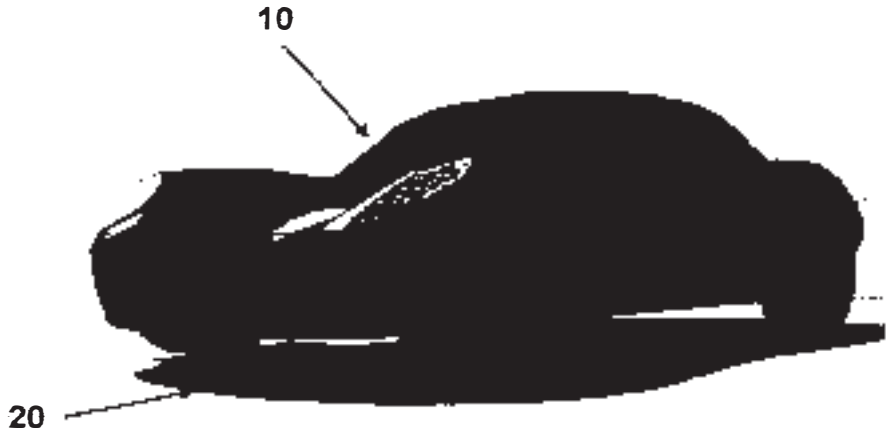

FIGURE 1

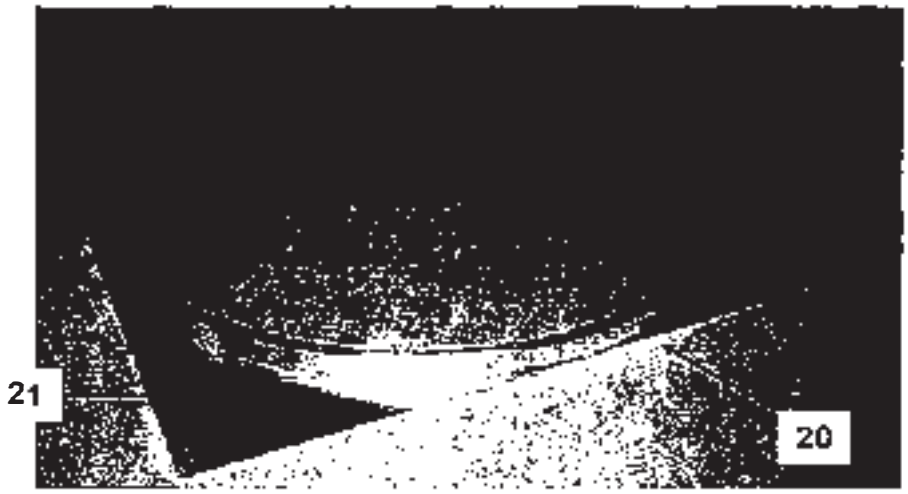

FIGURE 2

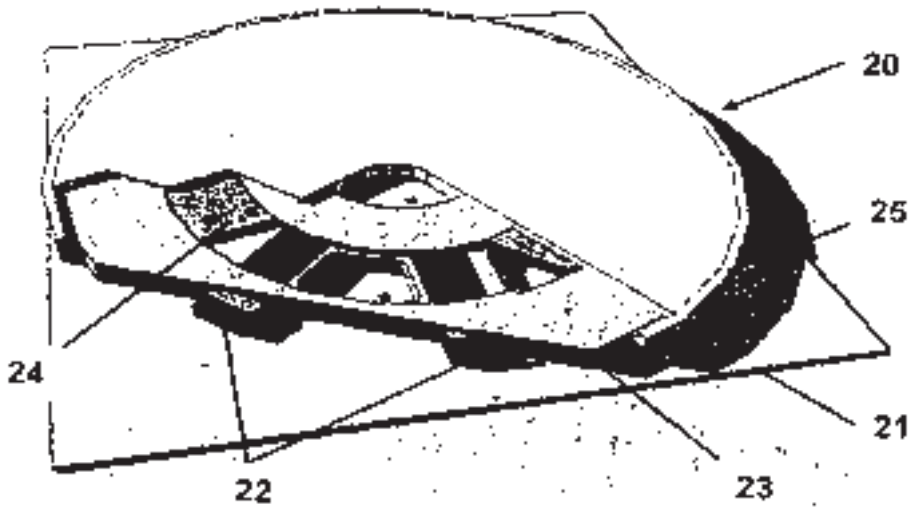

FIGURE 3

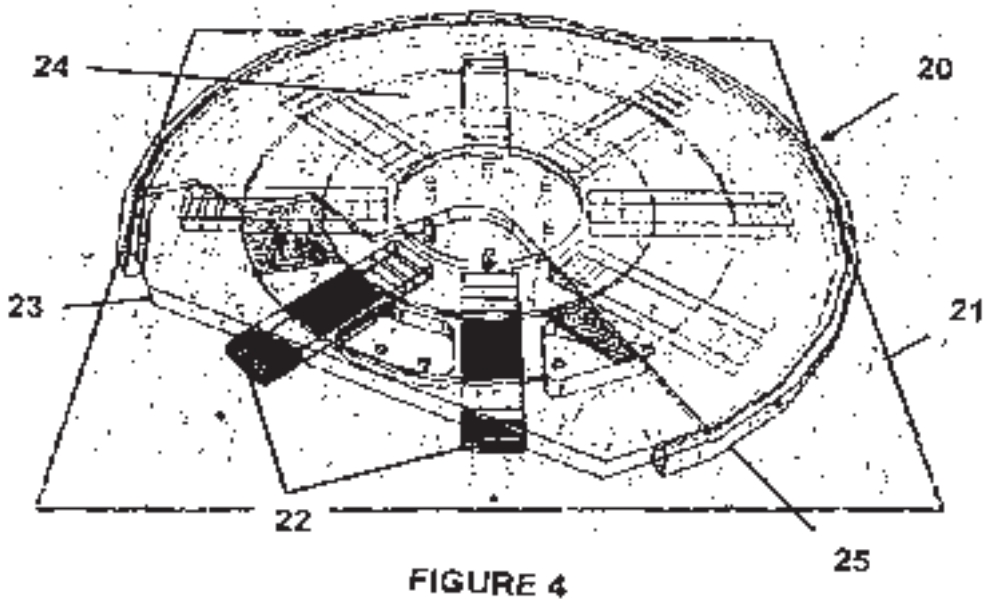

FIGURE 4

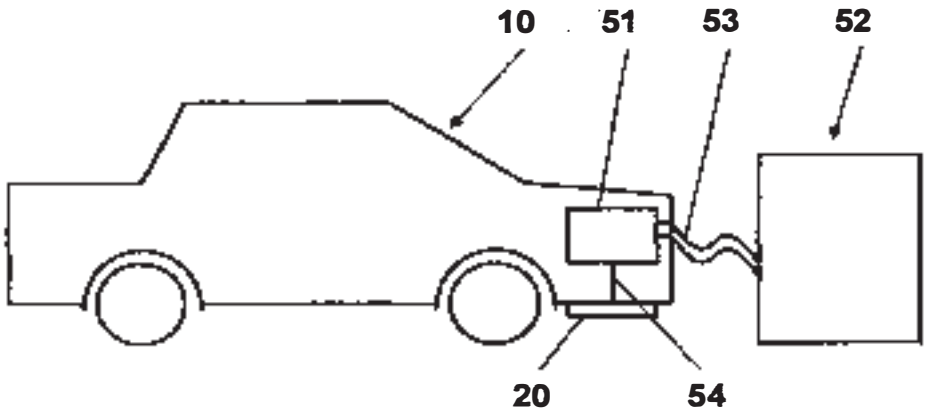

FIGURE 5

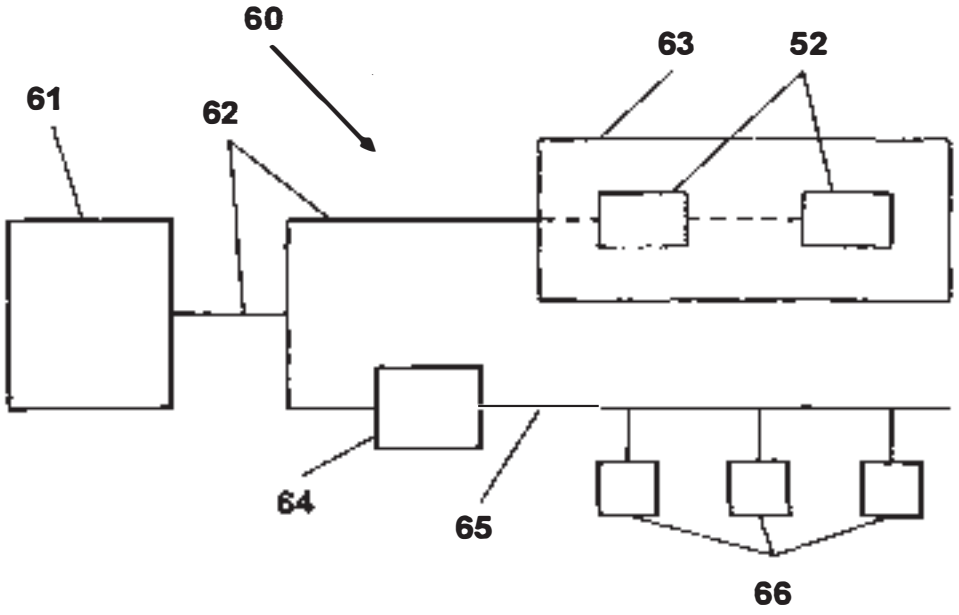

FIGURE 6

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Ministry of Economic Development
Manatū Ohanga
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PCT/NZ2008/000103

CERTIFICATE

This certificate is issued in support of an application for Patent registration in a country outside New Zealand pursuant to the Patents Act 1953 and the Regulations thereunder.

I hereby certify that annexed is a true copy of the Provisional Specification as filed on 20 July 2007 with an application for Letters Patent number 556646 made by AUCKLAND UNISERVICES LIMITED.

Dated 14 May 2008.

Neville Harris
Commissioner of Patents, Trade Marks and Designs

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PATENTS FORM NO. 4 Our ref: CHW 506950NZPR

Patents Act 1953

PROVISIONAL SPECIFICATION

MULTI POWER SOURCED ELECTRIC VEHICLE

We, **AUCKLAND UNISERVICES LIMITED**, a New Zealand company of Level 10, 70 Symonds Street, Auckland, New Zealand do hereby declare this invention to be described in the following statement:

300760297_1.DOC:CHW:QAKLD

MULTI POWER SOURCED ELECTRIC VEHICLE

Field of the Invention

The present invention relates to an Inductive Power Transfer (IPT) pad, a system, method and means for charging a battery of an electric vehicle using multiple power sources and an electric vehicle powered by said battery. More particularly, the invention relates to charging the battery for an electric vehicle selectively using a high power source for charging at a high rate or a lower power source for charging at a lower rate.

Background

In the development of pure electric vehicles (i.e., those powered solely by electricity as opposed to hybrid vehicles), there are a number of problems to be solved before these vehicles can gain widespread acceptance. These include the limited range compared with more conventionally fuelled vehicles, the inconvenience of having to remember to recharge a vehicle (even if it is possible to do so at the user's premises or home) and the severe restrictions that occur should the vehicle not be charged. These problems have been subjected to greater consideration in recent times due to heightened concerns about global warming. Pure electric vehicles may have a role to play in reducing the effects of global warming as they are clearly the lowest polluters of all vehicle types and are capable of operating with a lower carbon 'footprint' than vehicles powered by more widespread and conventional means.

Many problems with electric vehicles stem directly from the battery used to store energy to power the vehicle. Virtually all battery types must be charged at a rate that is less than the allowable discharge rate, they have a limited capacity, and their cycle life is not great. Thus, it takes quite a long time to charge a vehicle, the time between charges is shorter than ideal, and the functionality of the battery declines rapidly with age.

In use, electric vehicles are however very convenient and make ideal shopping baskets and short trip commuter vehicles. Other tasks such as dropping off children at schools and running errands are also well suited. If the accumulated distance travelled in a day is within the range of the vehicle, then the battery may be recharged over-night, with service capable of being resumed the next day. This is an ideal scenario. However, if the available range is exceeded

or the battery has not been sufficiently charged, the driver and passengers may be left stranded, there will likely be a recovery fee, the battery will need to be fully charged over a longer period of time than a conventional charge cycle and, when using conventional batteries, these will almost certainly be degraded such that their available capacity is permanently reduced from what it was previously. Opportunity charging can help to eliminate this problem and involves partially charging the vehicle whenever an opportunity presents itself.

In perhaps a more serious situation where circumstances call for the vehicle to be taken on a long trip, there is little that can be done. Here hybrid vehicles may be a good solution as they can travel great distances on fossil fuels and refuel at conventional petrol stations.

For these reasons conventional pure electric vehicles have not met all of the modern requirements for a passenger transport vehicle.

Inductive Power Transfer (IPT) provides a useful alternative to more conventional charging. A charger using IPT is described in New Zealand Patent Application No. 545664, entitled "Single Phase Power Supply for Inductively Coupled Power Transfer Systems" and is incorporated herein by reference. This charger provides many advantages in that it will operate from a standard single phase supply typically available in the home, has an excellent power factor and very low harmonics. As a result of this, it would be possible to operate with several thousand of these connected to a utility network without the quality of supply being degraded. Moreover, the use of IPT obviates the need for a user to manually connect a cable to the battery. The basic components for IPT are a pickup (preferably mounted on the underside of the vehicle and electrically coupled to the battery) and a charging pad (preferably provided on the floor in a position directly underneath the pickup when the vehicle is parked). The charging pad is coupled to an electricity supply and when the vehicle is in the correct position, the charging pad transfers power to the pickup.

Summary of the Invention

It is an object of the invention to provide an improved Inductive Power Transfer (IPT) pad.

It is an object of the invention to provide means for charging a vehicle which mitigates the aforementioned problems associated with conventional electric vehicles.

An alternative object of the invention is to provide a system for charging an electric vehicle.

An alternative object of the invention is to provide a method of charging an electric vehicle.

Alternatively, it is an object of the invention to provide at least a useful choice.

According to a first aspect of the invention, there is provided an Inductive Power Transfer (IPT) pad comprising a coil having at least a partial turn of wire; one or more ferromagnetic slabs; and a shield member arranged around said coil and said ferromagnetic slabs for channelling electromagnetic flux when in use.

The IPT pad may be used as a pickup pad or as a charging pad, wherein the charging pad is coupleable to a power supply and inductively transfers power to the pickup pad, which is coupleable to a drain, such as a battery to be charged.

Preferably, the wire is litz wire.

Preferably, the coil comprises a plurality of turns of wire.

Preferably, the ferromagnetic slab(s) are monolithic slab(s).

Preferably, the ferromagnetic slab(s) are ferrite slab(s).

Preferably, each ferromagnetic slab is arranged in substantially the same plane.

Preferably, each ferromagnetic slab is arranged such that its length extends radially from a common point but spaced apart therefrom.

Preferably, each ferromagnetic slab is spaced apart from adjacent slabs by substantially the same angle.

According to a preferred embodiment, the IPT pad comprises eight ferromagnetic slabs each spaced apart from adjacent slabs by approximately 45°. Other configurations may be selected depending on system requirements.

Preferably, the coil is arranged in a plane substantially parallel to that of the ferromagnetic slabs.

Preferably, the coil is positioned to wind around the common point such that it passes each slab at approximately the centre of their length.

Preferably, the IPT pad comprises a substantially rigid backplate.

Preferably, the backplate is substantially planar,

Preferably, the plane of the backplate is substantially parallel to the planes of the ferromagnetic slab(s) and the coil, with the plane of the slab(s) located between the planes of the backplate and the coil.

Preferably, each ferromagnetic slab is spaced apart from the backplate by a thermally insulating material so as to prevent the transfer of heat therebetween. According to one embodiment, each slab may be spaced apart from the backplate using foam or rubber pads. The material making up the slab(s) is brittle and such steps serve to prevent cracking in the slab(s) caused by rapid temperature changes and also due to mechanical stresses exerted on the IPT pad.

According to preferred embodiments, the backplane is formed from a material, such as aluminium, which substantially inhibits the passage of magnetic flux therethrough.

Preferably, the shield member is formed from a strip of material, such as aluminium, with the ends thereof joined to form a ring.

Preferably, the shield member is coupled to the backplane.

Preferably, the IPT pad comprises a member having spaces formed therein for holding the ferromagnetic slabs in position and having a channel for accommodating the coil.

Preferably, the member is formed from foam or rubber, although other materials which do not significantly affect magnetic flux may also be used.

Preferably, the member is formed by a moulding process.

Preferably, the IPT pad comprises a cover plate formed from a material that is "transparent" to magnetic flux, such as PVC.

According to preferred embodiments, the cover plate and the backplate provide front and rear walls of a housing for the IPT pad, with side walls provided by the shield member, the shield member preferably being configured to extend from the backplate to the cover plate.

The IPT pad according to the first aspect provides for improved performance in use by channelling the flow of flux from the charging pad. More particularly, the backplate and the shield member serve to direct flux upwards from the plane of the backplate with less splay of flux in and parallel to the plane of the backplate. This not only improves the inductive coupling but also reduces the chance that any undesired objects will be subjected to the induced fields during use. It is important to note that if this leakage is not controlled, it can lead to damage of such objects. For example, in the case of an electric vehicle, such leakage may result in the wheel bearings eroding.

The IPT pad of the present invention is also beneficial in that it is relatively slimline compared to more conventional IPT pads. This is particularly important where pickup pads are coupled to the underside of an electric vehicle since it is important that ground clearance is maintained.

According to a second aspect, there is provided an apparatus for charging a battery of an electric or a hybrid electric vehicle, the apparatus comprising first means for selectively coupling the battery to a high power electrical supply; and second means for selectively coupling the battery to a lower power electrical supply.

Preferably, the first means for coupling comprises a socket electrically coupled to the battery, wherein power is transferred by plugging a cable connected to the high power electrical supply

into the socket. Thus, electrical energy may be rapidly transferred to the battery using the first means for coupling, resulting in rapid charging.

As would be apparent to one of skill in the art, the battery may alternatively be associated with a plug configured to mate with a socket that is associated with the high power supply.

Preferably, the second means for coupling comprises a pickup electrically coupled to the battery, wherein power is transferred to the pickup from a charging pad by Inductive Power Transfer (IPT). More preferably, the second means for coupling comprises a pickup according to the first aspect of the invention.

The use of IPT avoids the need for a user to plug in a cable for opportunity charging, including when a vehicle is parked overnight. The use of IPT is preferred but the invention is not limited thereto. Additionally or alternatively, a second socket may be provided or the first socket adapted, if required, so that the battery may be connected to a lower power supply using a cable. Again, in the alternative, the second socket may be substituted by a plug configured to mate with a socket connected to the lower power supply. Such embodiments provide for improved flexibility in that, where provided and where time permits, the battery may be charged using IPT. If rapid charging is required and a high power supply is available, the battery may be connected thereto. However, there remains the possibility that a battery will require charging where neither an IPT charging pad or a high power supply is available. A user could, perhaps, put the charging pad inside the vehicle when in transit so that, as required, it could be removed from the vehicle, appropriately positioned and used for charging. This is possible because embodiments of the invention involving IPT preferably work to widely available household voltages but this is inconvenient. Thus, the second socket may be provided, preferably on an outer surface of the vehicle, to enable the battery to be connected, via a cable, to a lower power supply, such as via a conventional household socket. According to preferred embodiments, the socket used for coupling to the high power supply may also be used to couple to a lower power supply. It is therefore possible to charge a battery via most household circuits, with only a cable needing to be carried in the vehicle. Preferably, the same cable may be used for connecting to the high power supply and the lower power supply.

Thus, depending on requirements and which types of power supply and forms of transfer are available, a user may selectively couple the battery to a high power supply or a lower power electrical supply, preferably using IPT for transferring power from the lower power supply.

Preferably, the high power supply has a transfer rating between 50 kW and 500 kW.

Preferably, the lower power supply has a transfer rating between 0.5 kW and 2.5 kW so that it may be provided by conventional household wiring. More preferably, the lower power supply is between 1.0 kW and 2.2 kW.

Use of the word "battery" throughout the specification is not used in a limiting way and may include one or any number of cells or batteries.

According to a third aspect of the invention, there is provided an electric vehicle comprising a rechargeable battery and the apparatus of the second aspect for charging said battery.

The electric vehicle may be a "pure electric vehicle" in that it may be powered only by electrical energy. However, the invention is not limited thereto and may be applied to hybrid vehicles which may be powered by electrical energy and at least one other energy source, such as a combustible fuel. Thus, references to "electric vehicles" herein include both pure electric vehicles and hybrid vehicles having electrical energy as one source of power.

According to a fourth aspect of the invention, there is provided a method of charging a battery of an electric or a hybrid electric vehicle, the method comprising selectively coupling the battery to a high power supply or a lower power supply.

Preferably, the connecting the battery to the high power supply comprises mating a plug with a socket, wherein the plug is associated with one of the battery and the high power supply, and the socket is associated with the other one of the battery and the high power supply.

Preferably, the battery is electrically coupled to an IPT pickup pad configured to derive power from magnetic flux generated by an IPT charging pad, wherein said selectively coupling the battery to the lower power supply comprises positioning the pickup pad in close proximity to the charging pad.

More preferably, the pickup pad is coupled to the underside of the vehicle and the charging pad is provided on the ground, wherein said selectively coupling the battery to the lower power supply comprises driving the vehicle into a position such that the pickup pad is positioned above the charging pad.

Placement of an IPT pickup pad on the underside of a vehicle is preferred for aesthetic reasons, because this arrangement provides no physical obstacle to those moving around the vehicle while it is being charged, and because it is improbable that people or other foreign objects will be subjected to the induced fields during charging. However, the invention is not limited to such placement. A pickup pad may be located essentially anywhere on the vehicle with the charging pad being mounted so that IPT transfer is enabled when the vehicle is parked in position. For example, a pickup pad may be provided on the front or rear surface of the vehicle with the charging pad being mounted on a wall in a garage so that they cooperate when the vehicle is parked. While not preferred due to the requirement for user intervention, the invention does not preclude the mounting of the pickup pad and/or the charging pad on a moveable mounting or armature, whereby, following parking of a vehicle, a user may move one or both of the pads so that IPT transfer is enabled. While having the drawback of requiring greater user intervention, such embodiments do allow for greater tolerances in the parking position of the vehicle.

According to a fifth aspect, there is provided a system for charging a battery of an electric or a hybrid electric vehicle, the system comprising an electricity network or subnetwork having at least one generator and cabling for transferring energy generated by the at least one generator around the network; means for coupling the network to the battery; and control means for varying the power transfer from the at least one generator to the battery.

Any energy source may be used by the generator(s) to generate electrical energy. However, according to preferred embodiments, a renewable energy source is used. Through use of the control means, it is possible to overcome problems associated with the fluctuable nature of power generated from renewable sources and enhance the stability of the network by varying the power supplied to the battery so that the power demand on the network better matches the available power. These benefits are more marked according to embodiments of the system in

which the network is coupled to a plurality of batteries of a corresponding plurality of electric or hybrid electric vehicles.

Preferably, the control means is configured to vary the power transfer so as to optimise the load factor. Thus, a network controller (e.g. a utility company) may vary the power transfer to batteries connected to their network to better match supply and demand.

According to one embodiment, the batteries in the vehicles are owned by the utility company which operates the network and are leased to the owners of the vehicles.

The system of the fifth aspect preferably comprises at least one IPT pad according to the first aspect and/or at least one apparatus for charging according to the second aspect and/or at least one electric vehicle according to the third aspect.

According to a sixth aspect of the invention, there is provided a method of charging a battery of an electric or a hybrid electric vehicle, the method comprising coupling the battery to an electricity network or subnetwork; transferring electrical energy to the battery via the network; and varying the power transfer according to at least one predetermined criteria.

Preferably, the coupling selectively uses IPT.

The at least one predetermined criteria may comprise a time of day and/or the level of demand on the network and/or the level of available supply in the network, which is particularly relevant where the energy source for the network is fluctuable.

Preferably, the method comprises coupling batteries of a plurality of electric vehicles to the network and selectively transferring power to all or a subset thereof.

Further aspects of the invention, which should be considered in all its novel aspects, will become apparent to those skilled in the art upon reading the following description which provides at least one example of a practical application of the invention.

Brief Description of the Drawings

One or more embodiments of the invention will be described below by way of example only and without intending to be limiting with reference to the following drawings, in which:

Figure 1 is a perspective view showing a preferred relative positioning of an IPT charging pad and an electric vehicle during charging;

Figure 2 is a perspective view of a preferred embodiment of an IPT pad;

Figures 3 to 5 are alternative perspective views of the embodiment of the IPT pad of Figure 2, with portions removed in Figures 3 and 5, and portions shown in ghost outline in Figure 4 so as to show internal detail;

Figure 6 is a schematic representation of an electric vehicle being charged according to an embodiment of the invention; and

Figure 7 is a schematic representation of an embodiment of a system according to the invention.

Detailed Description of Preferred Embodiments

Embodiments of the invention provide for a multi-source electric vehicle that is able to operate in most situations that may occur in terms of types, length and frequency of trips. References to "multi-source electric vehicles" are used to refer to electric vehicles embodying or capable of operating with embodiments of the present invention where the batteries and/or cells used to power the vehicle may be charged using various electrical power sources. Embodiments of the invention provide all of the advantages of a plug-in electric vehicle in that it can be recharged 'at home' overnight but, according to preferred embodiments, it does so without the disadvantage of requiring a cable to be plugged in. More particularly, according to preferred embodiments, a charging pad is preferably provided on the floor where the vehicle is usually parked, such as in the floor of a user's garage. While the vehicle is parked, the charging pad transfers energy to the vehicle's battery by Inductive Power Transfer (IPT) via a pickup

provided on the underside of the vehicle. With nothing to plug in there is nothing to remember and the battery will be fully charged dependent only on the time available.

The charging pad provided on the floor is energised by a power supply and the magnetic field produced thereby couples power into the pickup attached to the vehicle and charges the on-board battery. Power transfer rates of up to around 2.2 kW are compatible with household outputs on most utility networks. The control of this power flow may be achieved using the technique described in US Patent No. 5,293,308, which is incorporated herein by reference. Other methods are also within the scope of the invention.

Figure 1 shows a preferred relative positioning of charging pad 20 and vehicle 10 during charging. The pickup pad (not shown) is preferably of the same shape and configuration of charging pad 20 and is positioned on the underside of vehicle 10 so that it is substantially directly above charging pad 20 when vehicle 10 is parked. The magnetic flux produced by charging pad 20 links the two pads. There is no functional requirement for the pickup pad to be positioned underneath the vehicle but this is preferred for aesthetic reasons and relative ease of installation for retrofitted vehicles.

Figures 2 to 5 show alternative perspective views of charging pad 20 according to preferred embodiments of the invention. More particularly, Figure 2 shows the outer housing of the pad, Figure 3 shows the pad with a portion of the outer housing cut away to show interior detail, Figure 4 corresponds to the view of Figure 3 with exterior features shown as see-through to provide additional detail of the internal arrangement of the components, and Figure 5 shows the pad with the top cover removed. Note that the pickup pad is of the same configuration as charging pad 20 and description of charging pad 20 also applies to the pickup pad, except that charging pad 20 is coupled to an electrical supply (e.g. the mains electricity supply) and the pickup pad is attached to a drain (i.e., the vehicle battery to be charged).

Pads 20 are preferably constructed on aluminium back-plane 21 with 8 ferrite bars 22 displaced at 45 degrees with respect to each other. Bars 22 are held in position by rubbery moulding 23. A coil of litz wire 27 (see Figure 5) is linked by the magnetic flux passing through ferrite bars 22. Preferably, the coil of litz wire 27 is located on ferrite bars 22 in region 24 of pad 20 so that the coils wind round the generally circular body of the pad approximately half way along the lengths of bars 22. Aluminium strip 25 is coupled or formed integral to back-plane 21 to assist in

controlling the pattern of the flux generated. Cover 28 is coupled to the top of the main circular body of the pad. Cover 28 is formed from a material, such as PVC, which does not obstruct the passage of flux therethrough. The particular configuration shown enables the pads to be relatively slim-line which is particularly important for the pickup pad when retrofitted to existing vehicles so as to maintain ground clearance.

More particularly, back-plane 21 and strip 25 work together to direct flux generated by the charging pad through cover 28 in a generally perpendicular direction to back-plane 21, thereby providing for improved coupling between a charging pad and a pickup pad since there is less leakage caused by the splay of flux in directions generally parallel to back-plane 21.

Thermal insulating pads 26, preferably formed from foam or rubber, are provided to prevent bars 22 from coming into contact with other components of pad 20. Bars 22 are brittle and thermal insulating pads 26 serve to prevent direct contact with other components of pad 20 which may cause a sudden change in temperature and cracking of bars 22. Thermal insulating pads 26 also limit the transfer of mechanical stresses to bars 22 caused by knocks or impacts on pad 20 and also due to vibrations such as those generated when pad 20 is mounted on a vehicle.

Using pads configured as shown in the drawings, with a diameter of 400 mm and a thickness of 22 mm, power transfer at rates of up to 2 kW is readily achievable for lateral misalignments of up to +/- 50 mm and vertical separations of 25 mm to 75 mm. Power transfer with even larger tolerances is possible but this requires larger pads, increasing the cost. Where a charging pad is provided on a floor to couple with a pickup pad on the underside of a vehicle, these tolerances translate into tolerances for the parking position of the vehicle. Relatively simple methods may be used to assist a driver in parking in the correct position. For example, a ball on a string may be suspended from the ceiling and aligned with a spot on the windscreen when the vehicle is in the correct position. Alternatively, a charging indicator may be provided in the vehicle which lights up when the battery is charging and hence the vehicle is in the correct position. Other alternatives will be readily apparent to one of skill in the art and all such alternatives are within the scope of the present invention.

According to preferred embodiments involving a transfer rate of up to around 2 kW, bars 22 preferably have a height of 10 mm, width of 30 mm and length of 120 mm, and coil 27

preferably comprises litz wire having 0.2 mm diameter individually insulated wires with 120 strands at 3.77 mm^2. Strip 25 preferably has a thickness of around 4 mm and cover 28 preferably has a thickness of approximately 5 mm. It should be noted that the invention is not limited to these particular values and the skilled man will be aware that other values may be selected depending on the desired operational characteristics.

According to embodiments of the invention, the power pad on the floor under the vehicle takes the place of a 'track' in a more conventional IPT system and the power pad attached to and under the vehicle is the pickup coil. Using the technique described in the above mentioned New Zealand Patent Application No. 545664, this arrangement of coils allows power to be passed from the floor power pad to the vehicle power pad at high efficiency such that the battery on the vehicle may be charged overnight.

Embodiments of the IPT system make opportunity charging of an electric vehicle possible, not only for a single vehicle in the home, but also, for example, for a fleet of delivery vehicles and the like to allow continuous operation on a 24 x 7 basis given that the work schedule includes relatively long times where the vehicle can be parked over the floor mounted power pad. However, the typical charging rate of 2kW does not overcome the limited range problem of electric vehicles, where the total energy demand exceeds the available stored energy.

To address this problem, a high power, plug-in charger may be connected to the vehicle using a separate high power plug to provide rapid charging of the battery. Not all battery types are capable of accepting powers of the magnitude envisaged but lithium batteries are increasingly capable of doing this.

As noted above, the power pad intervention free charger is a home-based IPT charging system providing a charging power of about 2 kW to stay within the ratings of conventional household wiring. A typical battery in an electric vehicle may store 50 kWH of energy or 170 AH (Ampere-Hours) at 300V so that the nominal charging rate is 0.04C (where C stands for the capacity of the battery in AH). This is a conservative and safe estimate. With a single 12 hour charge, 24 kWH of energy may be transferred and if the vehicle operates with an average power demand of 10 kW, it will have a range of about 2 hours of driving or approximately 160 km per day. With a longer charging time this range can be doubled by having the vehicle fully charged. On the other hand, embodiments of the high power battery charger may provide power at a rate of

500 kW for 6 minutes corresponding to a charging rate of 10C. Thus in 6 minutes, the battery is fully charged and the vehicle is set for another 300 km before it needs to be charged again. Note that an electric power flow of 500 kW is high but is still low compared with the energy flow rate when pumping petrol or diesel fuel into a tank.

This rapid charging will need to be carefully supervised, as needed for pumping petrol, and is not suitable for home applications for a number of reasons. Few houses have access to a 500 kW utility network and at this power level the source of supply would be at a higher voltage than the normal distribution network. There is also a degree of hazard involved so that a commercially rated facility is required. In contrast, the IPT system is safe and easy to use, making it suitable for installation in the home or other places a car may be parked, such as in public car parks.

The combination of these technologies provides a vehicle with excellent characteristics. On a daily basis it is ideal for short trips, commuting and shopping, allowing relatively low cost travelling of typically 160 km/day with minimal maintenance and no queuing for fuel. It may be used for longer trips requiring refuelling about every 300 km.

Figure 6 is a schematic drawing of battery 51 of electric vehicle 10 being charged by high power electrical supply 52 via cable 53. During opportunity charging, battery 51 is supplied with electricity from pickup 20 via wiring 54. High power electrical supply 52 may comprise a high power generator or alternatively merely provides an interface or conduit between a high power electricity network and cable 53. Cable 53 is provided with a plug (not shown) which mates with a socket (not shown) provided in vehicle 10. Wiring between the socket and battery 51 transfers electricity to battery 51. Preferably, the plug is provided with a safety housing to prevent access to the electrical contacts. The socket may be provided at any point on vehicle 10 with wiring provided between the socket and battery 51. Thus, the invention is not limited to the position of the socket shown in Figure 6.

Figure 7 is a schematic representation of a system, generally marked 60, according to an embodiment of the invention. Generator 61 provides high power electricity to facility 63 which includes high power electrical supplies 52 of Figure 6. Two high power electrical supplies 52 are shown. However, as would be apparent to one skilled in the art, the invention is not limited thereto and facility 63 may include one or any number of supplies 52, limited only by the

available space and the capacity of generator 61. High power cabling 62 acts as a conduit for the transfer of high power electricity to facility 63 and also to transformer 64 which reduces the supply to that of a lower power, such as that conventionally found in homes. Lower power cabling 65 then transfers lower power electricity to charging pads 20, preferably provided in the floor of a user's garage. Whilst single generator 61 is shown, system 60 may include a plurality of generators and may include separate generators for the high power supply and the lower power supply.

An important aspect of electric vehicles is their capital cost. They are typically more expensive than conventional motor cars due to the high cost of the battery. However, according to embodiments of the invention, the battery and the vehicle may be owned by different parties. More particularly, according to one embodiment of a system and method according to the invention, the battery may be owned by a utility company and leased to an owner of a vehicle. According to such embodiments, users of electric vehicles are clearly provided with the benefit of having a reduced capital outlay at the time of purchasing a vehicle. However, benefits may also be realised by utility companies and not only through charges levied for supplying the electricity. In particular, through appropriate control of power supplied to the IPT charging pads, utility companies may level their electric load, particularly overnight when a large number of batteries for electric vehicles may be charging.

There are significant financial advantages to a utility company being able to have a load factor of 1 and this source-side control of a demand-side load would allow this ideal to be approached, if not reached.

A communications channel may be provided between the controller of the network (typically, the utility company) and the vehicles under charge so as to enable monitoring of the charging of these vehicles. A simple cell-phone channel may be used for this purpose. As the available power varies the network controller may vary the battery charging demand to match it. This would allow the utility company to operate near their maximum power with safety as the electric vehicle load can be varied so quickly. This is similar to but more sophisticated than a ripple control system commonly used to control hot water heating. The essential differences are that partial loads are possible, and the loads can be varied more quickly and precisely.

The ability to manipulate the demand makes it more readily possible to integrate highly fluctuable 'renewable' sources of energy into power networks. The manipulation may be made by allowing the frequency of the network or grid to vary in response to variations in the fluctuable source. Thus, in strong gusts of wind over a whole wind farm the power surge may be such that the mains frequency increases by a small fraction of 1 Hz. These variations in frequency are measured by the power supply to the IPT charging pad and used to control the track current. In principle, the power transferred is made proportional to the track current so that by varying the track current the charging load can be matched to the available power.

For a large number of battery chargers, say 100,000, the track current could be programmed so that, for example, at 49.5 Hz the track current is zero, and at a frequency 1Hz higher the track current is the rated current. If all the chargers were at full demand the charging load would vary from 100,000 x 2 kW = 200 MW at a frequency of 50.5 Hz to zero at a frequency of 49.5 Hz. This 2% droop characteristic is known to be a stable way of operating loads on power systems. The 49.5 Hz set-point can of course also be varied so that full power occurs at whatever frequency is required. For example, if the set point was 49 Hz then full power would be taken at 50Hz or higher. In this manner, high surges in power caused by strong gusts of wind over large wind farms can be compensated for.

On the other hand, in the integration of wind power into a power network, there are also commonly periods where the wind completely 'dies'. In practice, these periods must be covered by having a separate spinning generator of the same power capacity, on standby. Thus, if a 200 MW wind farm is to be used then 200MW of spinning reserve must be connected to the grid, and under ideal circumstances it provides no real power at all. This protection is very expensive and in many cases makes wind power uneconomic. According to the present invention, this precaution is not required. If the wind 'dies' then all the battery charging load drops as soon as the mains frequency reaches the given set point (e.g. 49.5 or 50 Hz). As the vehicles charge they will individually disengage themselves as soon as their batteries are fully charged so that the actual load is indeterminate and is not simply the total number of vehicles connected. The load could be determined using a communication channel with each vehicle as discussed above but this would take time and a simpler option is available. If the set point was at 49.5 Hz then all of the connected vehicles that are still charging would be at 50% power if the frequency was 50 Hz. If the set point was then changed to 49.6 Hz then the charging vehicles would drop to 40% of their rated power and the change in power, over the whole country, would

be 10% of the connected (total) power sink. In this particular example the actual power being taken could be increased by 6 times this change, or reduced by 4 times. In essence, the controllable battery charging load has been precisely determined.

In these circumstances a very high percentage of wind power and/or other fluctuable energy sources can now be included into the generation mix without standby generators knowing how much power is available if the wind dies, and how much spare sink capacity is available if there is a surge. This is a significant advantage over most wind farm integration schemes and will allow the percentage of wind power to be increased above the present 6% with zero or minimal standby generators necessary. Other schemes for achieving this flexibility use huge batteries locally at the wind farm to store surplus power but it is more efficient if the energy is transferred directly to its destination, namely the batteries in the vehicles, since this requires only one battery charging operation. Batteries at wind farms are therefore significantly less efficient if the ultimate use of the energy is in electric vehicles.

The financial justifications of the invention are interesting. If a typical battery cost $10,000 it might be leased to the car owner for $40/week plus electricity charges of 12c/kWH charged on the basis of what has been used. A user doing 300 km per week might use 45 kWH at a cost of $5.40 plus the battery lease fee of $40 for a total cost of $45.40 or 15 c / km. Some form of road-user charge would also likely be involved or again added to the cost of the electricity. This cost/km is perhaps high but is for very moderate usage and if the distance travelled is doubled the cost/km is significantly reduced at $50.80 for 600 km or 8.5 c/km.

Electricity generated from renewable sources other than wind power (e.g. solar, tidal etc) is also applicable to embodiments of the invention. All of these are not particularly stable and like wind may vary considerably over relatively short time scales. For example, measured rates of change for wind power in New Zealand have been as high as 200 MW in 5 minutes from a wind farm with a nominal rating of 200MW. Thus the integration of such highly fluctuable sources into an electricity network is a huge advantage. With the source-side control as outlined the charging load varies at a rate sufficient to match the fluctuable power on almost a cycle by cycle basis using small changes in the frequency of supply, allowing the use of energy that would otherwise simply be wasted. This energy would be generated at a considerably lower cost than electricity from more conventional sources.

Unless the context clearly requires otherwise, throughout the specification, the words "comprise", "comprising", and the like, are to be construed in an inclusive sense as opposed to an exclusive or exhaustive sense, that is to say, in the sense of "including, but not limited to".

It should be noted that various changes and modifications to the presently preferred embodiments described herein will be apparent to those skilled in the art. Such changes and modifications may be made without departing from the spirit and scope of the invention and without diminishing its attendant advantages. It is therefore intended that such changes and modifications be included within the present invention.

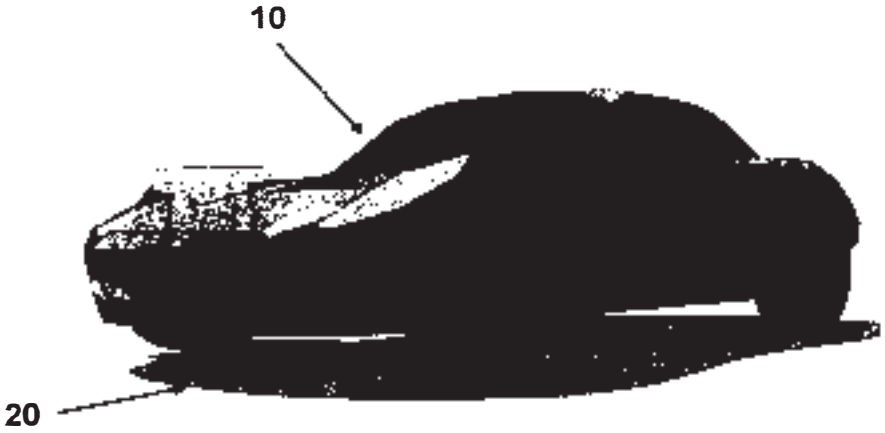

FIGURE 1

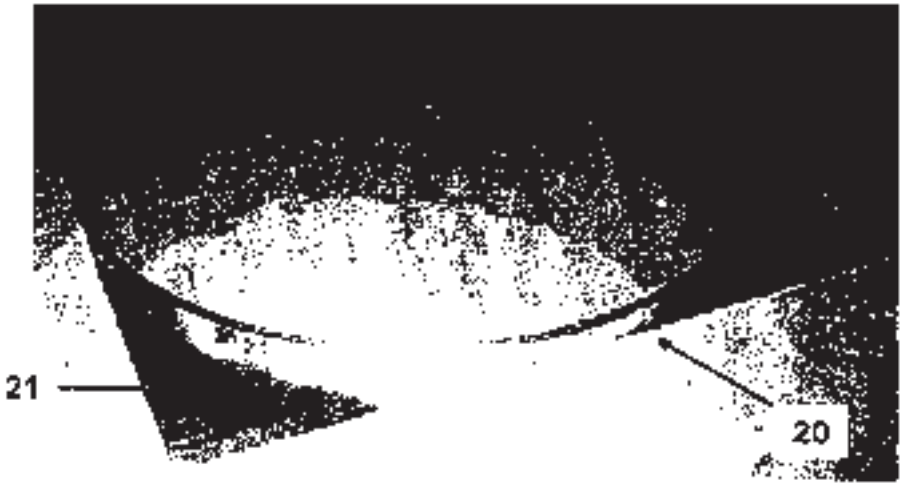

FIGURE 2

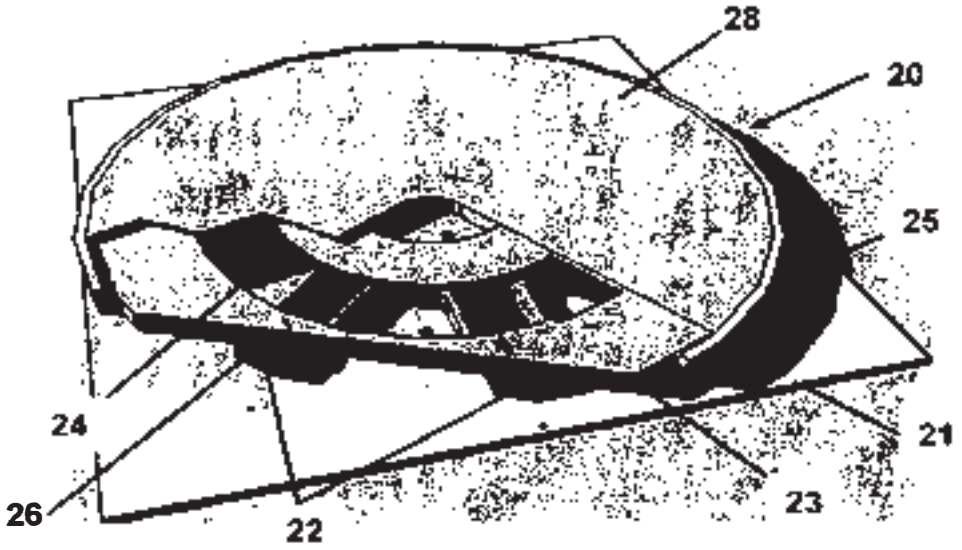

FIGURE 3

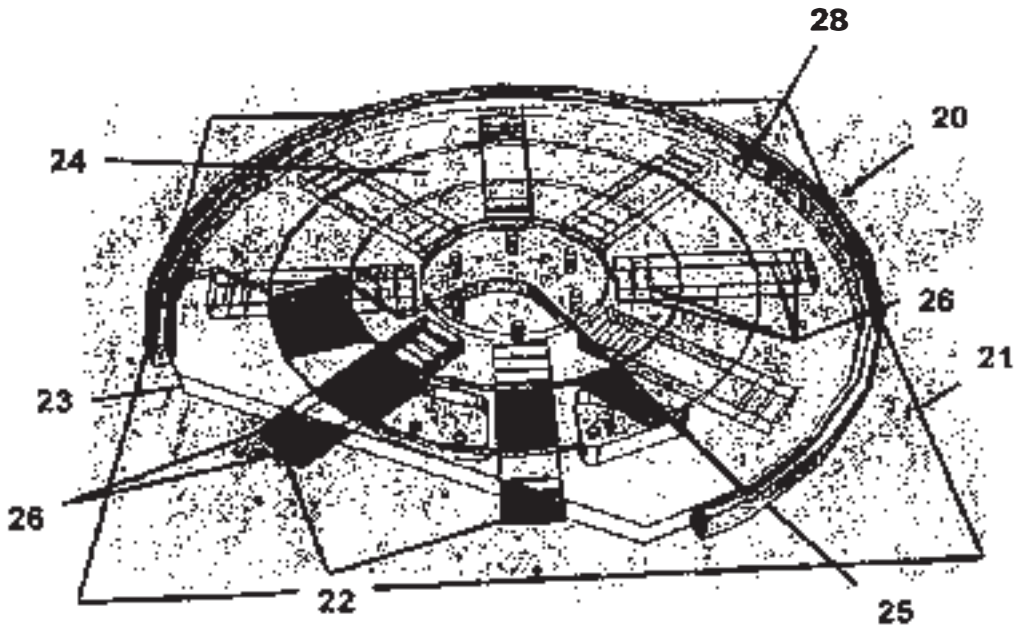

FIGURE 4

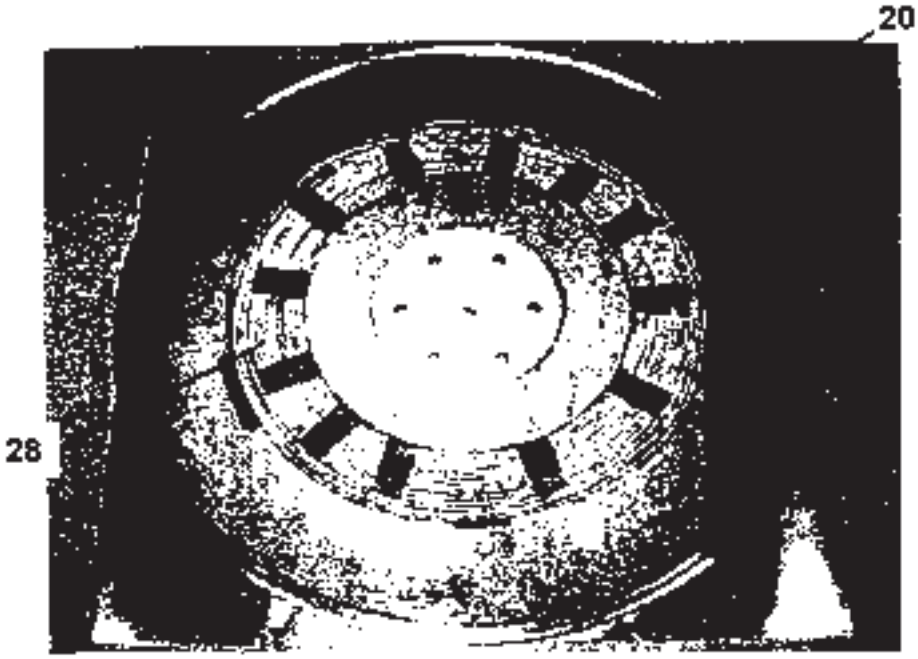

FIGURE 5

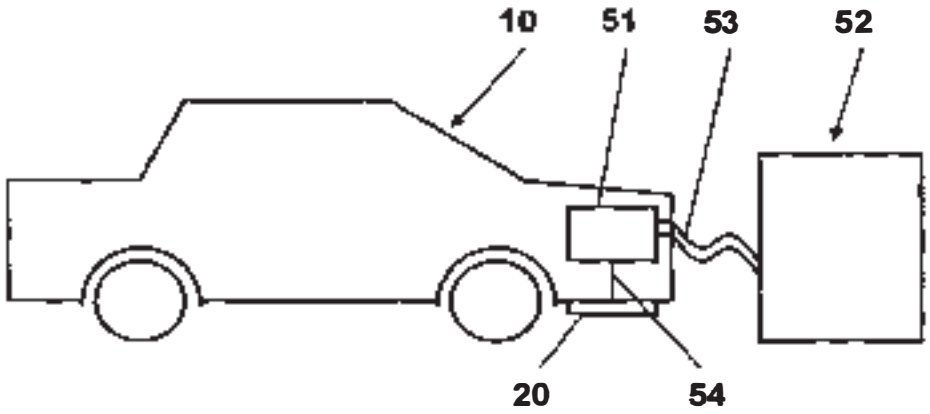

FIGURE 6

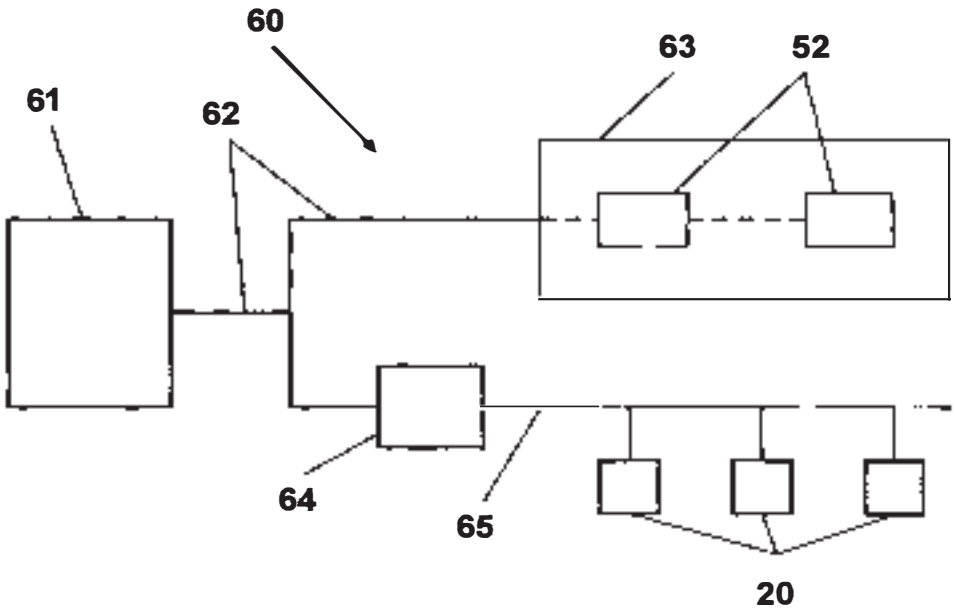

FIGURE 7

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference JL507346PCT	**FOR FURTHER ACTION**	See Form PCT/IPEA/416
International application No. **PCT**/NZ2008/000103	International filing date *(day/month/year)* 9 May 2008	Priority date *(day/month/year)* 10 May 2007

International Patent Classification (IPC) or national classification and IPC

Int. Cl.

H02J 7/00 (2006.01)

Applicant

AUCKLAND UNISERVICES LIMITED et al

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 6 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. [X] *(sent to the applicant and to the International Bureau)* a total of 9 sheets, as follows:
      - [X] sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
      - [ ] sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.

   b. [ ] *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see paragraph 3*bis* of Annex C of the Administrative Instructions).

4. This report contains indications relating to the following items:

[X]	Box No. I	Basis of the report
[ ]	Box No. II	Priority
[X]	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
[X]	Box No. IV	Lack of unity of invention
[X]	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
[ ]	Box No. VI	Certain documents cited
[ ]	Box No. VII	Certain defects in the international application
[ ]	Box No. VIII	Certain observations on the international application

Date of submission of the demand	Date of completion of this report
10 March 2009	12 August 2009
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. +61 2 6283 7999	Authorized Officer **JAMES WILLIAMS** AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No. +61 2 6283 2599

Form PCT/IPEA/409 (Cover sheet) (July 2009)

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/NZ2008/000103

Box No. I Basis of the report

1. With regard to the **language,** this report is based on:

[X] The international application in the language in which it was filed

[ ] A translation of the international application into , which is the language of a translation furnished for the purposes of:

- [ ] international search (under Rules 12.3(a) and 23.1 (b))
- [ ] publication of the international application (under Rule 12.4(a))
- [ ] international preliminary examination (Rules 55.2(a) and/or 55.3(a))

2. With regard to the **elements** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

[ ] the international application as originally filed/furnished

[X] the description:

pages **1-21** as originally filed/furnished
pages* received by this Authority on with the letter of
pages* received by this Authority on with the letter of

[X] the claims:

pages as originally filed/furnished
pages* as amended (together with any statement) under Article 19
pages* **22-30** received by this Authority on **10 March 2009** with the letter of the same
pages* received by this Authority on with the letter of

[X] the drawings:

pages **1-5** as originally filed/furnished
pages* received by this Authority on with the letter of
pages* received by this Authority on with the letter of

[ ] a sequence listing - see Supplemental Box Relating to Sequence Listing.

3. [ ] The amendments have resulted in the cancellation of:

- [ ] the description, pages
- [ ] the claims, Nos.
- [ ] the drawings, sheets/figs
- [ ] the sequence listing *(specify)*:

4. [ ] This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

- [ ] the description, pages
- [ ] the claims, Nos.
- [ ] the drawings, sheets/figs
- [ ] the sequence listing *(specify)*:

5. [ ] This report has been established taking into account **the rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 70.2(e)).

6. [ ] Supplementary international search report(s) from Authority(ies) _____ have been received and taken into account in drawing up this report (Rule 45bis.8(b) and (c)).

* *If item 4 applies, some or all of those sheets may be marked "superseded."*

Box No. III **Non-establishment of opinion with regard to novelty, inventive step and industrial applicability**

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non obvious), or to be industrially applicable have not been examined in respect of:

☐ the entire international application

☒ claims Nos: **31-70**

because:

☒ the said international application, or the said claims Nos. **67-70**
relate to the following subject matter which does not require an international preliminary examination *(specify)*:
The claims do not comply with Rule 6.2(a) because they rely on references to the description and/or drawings.

☐ the description, claims or drawings *(indicate particular elements below)* or said claims Nos.
are so unclear that no meaningful opinion could be formed *(specify)*:

☐ the claims, or said claims Nos.
are so inadequately supported by the description that no meaningful opinion could be formed *(specify)*

☒ no international search report has been established for said claim Nos. **31-66**

☐ A meaningful opinion could not be formed without the sequence listing; the applicant did not, within the prescribed time limit:

- ☐ furnish a sequence listing on paper complying with the standard provided for in Annex C of the Administrative Instructions, and such listing was not available to the International Preliminary Examining Authority in a form and manner acceptable to it.
- ☐ furnish a sequence listing in electronic form complying with the standard provided for in Annex C of the Administrative Instructions, and such listing was not available to the International Preliminary Examining Authority in a form and manner acceptable to it.
- ☐ pay the required late furnishing fee for the furnishing of a sequence listing in response to an invitation under Rules 13*ter*.1(a) or (b) and 13*ter*.2.

☐ See Supplemental Box for further details.

Box No. IV Lack of unity of invention

1. [X] In response to the invitation to restrict or pay additional fees the applicant has, within the applicable time limit:

   [ ] restricted the claims

   [ ] paid additional fees

   [ ] paid additional fees under protest and, where applicable, the protest fee

   [ ] paid additional fees under protest but the applicable protest fee was not paid

   [X] neither restricted the claims nor paid additional fees

2. [ ] This Authority found that the requirement of unity of invention is not complied with and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is:

   [ ] complied with.

   [X] not complied with for the following reasons:

   In assessing whether there is more than one invention claimed, I have given consideration to those features which can be considered to potentially distinguish the claimed combination of features from the prior art. Where different claims have different distinguishing features they define different inventions.

   This International Searching Authority has found that there are different inventions as follows:

   - Claims 1-30 directed to an inductive power transfer padIt is considered that a shield member arranged around the coil and the ferromagnetic slabs for channelling electromagnetic flux when in usecomprises a first distinguishing feature.
   - Claims 31-62 directed to an apparatus or method for charging a battery of an electric or hybrid vehicleIt is considered that the use of controlled inductive power transfercomprises a second distinguishing feature.
   - Claims 63-64 directed to a system or method for supplying power to an electricity network. It is considered that coupling the batteries to the network through controlled inductive power transfer comprises a third distinguishing feature.
   - Claims 65-66 directed to a system or method for controlling load demand in an electricity network. It is considered that increasing or reducing the power consumed by the load dependent on the frequency of power supplied by the network comprises a fourth distinguishing feature.

4. Consequently, this report has been established in respect of the following parts of the international application:

   [ ] all parts.

   [X] the parts relating to claims Nos. **1-30**

Box No. V **Reasoned statement under Article 35(2) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims **1-30**	**YES**
	Claims **NONE**	**NO**
Inventive step (IS)	Claims **1-30**	**YES**
	Claims **NONE**	**NO**
Industrial applicability (IA)	Claims **1-30**	**YES**
	Claims **NONE**	**NO**

2. Citations and explanations (Rule 70.7)

D1: WO 2005/024865

D2: US 5,528,113

D1 discloses an inductive power transfer unit having flux shields. A flux generating unit extending in two dimensions over a support surface generates flux at or in proximity to a power transfer surface of the unit so that a secondary device placed on or in proximity to the power transfer surface can receive power inductively from the unit. A flux shield made of electrically –conductive material is interposed between the flux generating unit and the support surface. The shield may have one or more portions which extend over one or more faces of the inductive power transfer unit or which extend between the side faces and the flux generating unit. The flux generating unit comprises a coil shaped into a flat solenoid wound around a former of in the form of a thin sheet of magnetic material.

D2 discloses inductive power pick-up coils in which one or more large flat horizontal ferrite cores are used to concentrate the horizontal component of magnetic flux from an extended volume into one or more secondary or pick-up coils. One or more pick-up windings are wound about each core. Each core comprises an array of individual strips of ferrite held in close contact. D2 further discloses an aluminium backplate.

None of the citations discloses the ferromagnetic slabs extending radially from a common point and spaced apart from that point.

D1 is considered the closest prior art.

Novelty

D1 discloses a coil, a ferromagnetic slab and a shield member arranged around the coil and the slab (Abstract, page 1, lines 20-24, figure 7, page 10, lines 6-19 D1 does not disclose the coil being arranged in a plane substantially parallel to that of the ferromagnetic slabs.

Therefore the subject matter of claim 1 is not obvious and meets the requirements of Article 33(2) of the PCT with regard to novelty.

Appended claims 2-30 add further features to those defined in claim 1 and are therefore also novel.

Please see Supplemental Box

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: Box V

Inventive Step

Claim 1 meets the criteria set out in PCT Article 33(3) with regard to the requirement of Inventive Step because the prior art does not obviously suggest to a person skilled in the art the coil being arranged in a plane substantially parallel to that of the ferromagnetic slabs.

Claims 2-30 embody further aspects of the inventive concept and therefore also meet the requirements of Article 33(3) of the PCT.

Industrial Applicability

Claims 1-30 meet the criteria set out in PCT Article 33(4), and thus have industrial applicability because the subject matter claimed clearly can be made or used in industry.

CLAIMS

1. An inductive power transfer pad comprising:
one or more ferromagnetic slabs;
a coil having at least one turn of a conductor, the coil being arranged in a plane substantially parallel to that of said ferromagnetic slabs; and
a shield member arranged around both said coil and said ferromagnetic slab(s) for channelling electromagnetic flux when in use.

2. An inductive power transfer pad as claimed in claim 1, wherein the conductor is litz wire.

3. An inductive power transfer pad as claimed in claim 1 or claim 2, wherein the coil comprises a plurality of turns of wire.

4. An inductive power transfer pad as claimed in any one of the preceding claims, wherein the one or more ferromagnetic slabs are monolithic.

5. An inductive power transfer pad as claimed in any one of the preceding claims, wherein the one or more ferromagnetic slabs are ferrite.

6. An inductive power transfer pad as claimed in any one of the preceding claims, wherein each ferromagnetic slab is arranged in substantially the same plane.

7. An inductive power transfer pad as claimed in any one of the preceding claims, wherein each ferromagnetic slab is arranged such that its length extends radially from a common point but spaced apart therefrom.

8. An inductive power transfer pad as claimed in any one of the preceding claims, wherein each ferromagnetic slab is spaced apart from adjacent slabs by substantially the same angle.

9. An inductive power transfer pad as claimed in claim 6, wherein:

a subset of the ferromagnetic slabs extend radially from a common point but are spaced apart therefrom;

a further subset of the ferromagnetic slabs extend radially from a different common point but are spaced apart therefrom;

a still further subset of the ferromagnetic slabs are aligned perpendicularly to the direction of an imaginary straight line connecting the said common points, whereby the still further subset of ferromagnetic slabs are positioned equidistantly from the imaginary line but spaced equally along its length and equally on each side of the imaginary line.

10. An inductive power transfer pad as claimed in claim 7, wherein the coil is positioned to wind around the common point such that it passes each slab at approximately the centre of the length of each slab.

11. An inductive power transfer pad as claimed in claim 1, wherein the pad comprises a substantially rigid backplate.

12. An inductive power transfer pad as claimed in claim 11, wherein the backplate is substantially planar.

13. An inductive power transfer pad as claimed in claims 11 or 12, wherein the plane of the backplate is substantially parallel to the planes of each of the ferromagnetic slabs and the coil, the plane of each of the ferromagnetic slabs being located between the plane of the backplate and the plane of the coil.

14. An inductive power transfer pad as claimed in claim 11, wherein each ferromagnetic slab is spaced apart from the backplate by a thermally conductive and mechanically insulating material.

15. An inductive power transfer pad as claimed in claim 14, wherein the thermally conductive and mechanically insulating material is foam or rubber.

16. An inductive power transfer pad as claimed in claim 11, wherein the backplate is formed from a material which substantially inhibits the passage of magnetic flux therethrough.

17. An inductive power transfer pad as claimed in claim 17, wherein the backplate is formed from aluminium.

18. An inductive power transfer pad as claimed in claim 1, wherein the shield member is formed from a strip of material with the ends thereof joined to form a ring.

19. An inductive power transfer pad as claimed in any one of the preceding claims, wherein the shield member is formed from aluminium.

20. An inductive power transfer pad as claimed in any one of the preceding claims, wherein the shield member is coupled to the backplate.

21. An inductive power transfer pad as claimed in any one of the preceding claims, wherein the pad comprises a member having spaces formed therein for holding each of the ferromagnetic slabs in position and having a channel for accommodating the coil.

22 An inductive power transfer pad as claimed in claim 21, wherein the member is formed from a material which does not significantly affect magnetic flux.

23. An inductive power transfer pad as claimed in claim 22, wherein the member is formed from foam or rubber.

24. An inductive power transfer pad as claimed in claim 23, wherein the member is formed by a moulding process.

25. An inductive power transfer pad as claimed in any one of the preceding claims, wherein the pad comprises a cover plate formed from a material that is substantially transparent to magnetic flux.

26. An inductive power transfer pad as claimed in claim 25, wherein the cover plate is formed from a non-toxic plastic.

27. An inductive power transfer pad as claimed in claims 11 and 25, wherein the cover plate and the backplate provide front and rear walls of a housing for the pad respectively,

with side walls provided by the shield member, the shield member preferably being configured to extend from the backplate to the cover plate.

28. An inductive power transfer system comprising two inductive power transfer pads as claimed in any one of the preceding claims, wherein the two inductive power transfer pads are used in combination, one of the pads being used as a pickup pad and the other pad as a charging pad.

29. An inductive power transfer system as claimed in claim 28, wherein the charging pad is coupleable to a power supply and inductively transfers power to the pickup pad, which is coupleable to a load.

30. An inductive power transfer system as claimed in claim 29, wherein the coupling between the charging pad and the pickup pad is such that there is a low leakage of magnetic flux from the system.

31. An apparatus for charging a battery of an electric or a hybrid electric vehicle, the apparatus comprising:

first means for selectively coupling the battery to a high power electrical supply; and

second means for selectively coupling the battery to a lower power electrical supply, wherein the second means for coupling comprises a pickup pad electrically coupled to the battery, wherein power is transferred to the pickup pad from a charging pad by inductive power transfer.

32. An apparatus as claimed in claim 31, wherein the first means for coupling comprises a socket electrically coupled to the battery, wherein power is transferred by plugging a cable connected to the high power electrical supply into the socket.

33. An apparatus as claimed in claim 31, wherein the first means for coupling comprises a plug electrically coupled to the battery, wherein power is transferred by plugging the plug into a socket connected to the cable connected to the high power electrical supply.

34. An apparatus as claimed in claim 31, wherein the second means for coupling comprises a pickup pad according to claim 1.

35. An apparatus as claimed in claim 31, wherein the first means for selectively coupling the battery to a high power electrical supply may also be used to selectively couple the battery to a lower power supply.

36. An apparatus as claimed in claim 31, wherein the first means for selectively coupling the battery to a high power electrical supply may be adapted to selectively couple the battery to a lower power supply.

37. An apparatus as claimed in claim 31, wherein the apparatus comprises additional means for selectively coupling the battery to a high power electrical supply or a lower power supply.

38. An apparatus as claimed in claim 31, wherein the high power supply has a transfer rating between 10 kW and 500 kW.

39. An apparatus as claimed in claim 31, wherein the lower power supply has a transfer rating between 0.5 kW and 2.5 kW.

40. An apparatus as claimed in claim 39, wherein the lower power supply has a transfer rating between 1.0 kW and 2.2 kW.

41. An apparatus as claimed in claim 31, wherein the apparatus comprises an indication means for indicating alignment between the charging pad and the pickup pad.

42. An apparatus as claimed in claim 31, wherein the apparatus comprises an indication means for indicating when the battery is being charged.

43. An electric vehicle comprising:
a rechargeable battery; and
an apparatus for charging said battery as claimed in claim 31.

44. A method for charging a battery of an electric or a hybrid electric vehicle, the method comprising:
selectively coupling the battery to a high power supply or a lower power supply, wherein said coupling the battery to a lower power supply comprises positioning an inductive

power transfer pickup pad electrically coupled to the battery in close proximity to an inductive power transfer charging pad.

45. A method as claimed in claim 44, wherein the step of connecting the battery to the high power supply comprises mating a plug with a socket, wherein the plug is associated with one of the battery and the high power supply, and the socket is associated with the other one of the battery and the high power supply.

46. A method as claimed in claim 44, wherein the inductive power transfer pickup pad is coupled to the underside of the vehicle and the inductive power transfer charging pad is provided on the ground, and wherein selectively coupling the battery to the lower power supply comprises driving the vehicle into a position such that the pickup pad is positioned above, or operably adjacent to, the charging pad.

47. A method as claimed in claim 46, wherein the pickup pad and the charging pad can be variably distanced from each other.

48. A method as claimed in claim 47, wherein the charging pad can be raised and lowered from the ground by a raising and lowering means.

49. A method as claimed in claim 47, wherein the pickup pad can be raised and lowered from the underside of the vehicle by a raising and lowering means.

50. A method as claimed in claim 46, wherein the method comprises indicating alignment between the charging pad and the pickup pad.

51. A method as claimed in claim 47, wherein the method comprises indicating when the battery is being charged.

52. A system for charging a battery of an electric or a hybrid electric vehicle, the system comprising:

an electricity network or subnetwork having at least one generator;

cabling for transferring energy generated by the at least one generator around the network;

IPT coupling means for coupling the network to the battery; and

control means for controlling the power transfer from the at least one generator to the battery.

53. A system as claimed in claim 52, wherein the network is coupled to a plurality of batteries of a corresponding plurality of electric or hybrid electric vehicles.

54. A system as claimed in claim 52, wherein the electricity network uses a renewable energy source.

55. A system as claimed in claim 52, wherein the control means is configured to vary the power transfer so as to optimise the load factor.

56. A system as claimed in claim 55, wherein the batteries of the electric or hybrid vehicles are owned by a network controller.

57. A system as claimed in claim 52, wherein the system comprises at least one inductive power transfer pad according to claim 1 and/or at least one apparatus for charging according to claim 32 and/or at least one electric vehicle according to claim 43.

58. A system as claimed in claim 52, wherein the control means is controlled by way of a communications channel.

59. A method of charging a battery of an electric or a hybrid electric vehicle, the method comprising the steps of:

coupling the battery to an electricity network or subnetwork using inductive power transfer;

transferring electrical energy to the battery via the network; and

varying the power transfer according to at least one predetermined criteria.

60. A method as claimed in claim 59, where the at least one predetermined criteria may comprise one or more of:

the time of day;

the level of demand on the network; and

the level of available supply in the network.

61. A method as claimed in claim 59, wherein the method further comprises the steps of:
coupling batteries of a plurality of electric vehicles to the network; and
selectively transferring power to all batteries or a subset thereof.

62. A method as claimed in claim 61, wherein the method comprises the step of varying the electricity mains frequency to determine the battery load on the network.

63. A system for supplying power to an electricity network, the system comprising:
an electricity network or subnetwork having at least one generator;
a plurality of batteries of a plurality of electric or electric hybrid vehicles;
cabling for transferring energy stored in the plurality of batteries;
IPT coupling means for coupling the batteries to the network; and
control means for controlling the power transfer from the plurality of batteries to the network.

64. A method of supplying power to an electricity network, the method comprising the steps of:
coupling a plurality of batteries of a plurality of electric or hybrid electric vehicles to the network using inductive power transfer;
transferring electrical energy to the network from the battery; and
varying the power transfer according to at least one predetermined criteria.

65. A system for controlling load demand in an electricity network, the system comprising:
an electricity network having at least one generator, the frequency of power supplied by the network being allowed to vary;
at least one load connected to the network; and
control means to monitor the frequency of power supplied by the network, the control means increasing or reducing power consumed by the load dependent on the frequency.

66. A method of controlling load demand on an electricity network, the method comprising:
allowing the frequency of power supplied by the network to vary;
monitoring the frequency of power supplied by the network; and
increasing or reducing the power consumed by the load dependent on the frequency.

67. An inductive power transfer pad substantially as hereinbefore described with reference to any one of the embodiments shown in the drawings.

68. A method for charging a battery of an electric or a hybrid electric vehicle substantially as hereinbefore described with reference to any one of the embodiments shown in the drawings.

69. Apparatus for charging a battery of an electric or a hybrid electric vehicle substantially as hereinbefore described with reference to any one of the embodiments shown in the drawings.

70. A method of controlling load demand on an electricity network substantially as herein described.

Document code: WFEE

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PTO/SB/06 (07-06)
Approved for use through 1/31/2007. OMB 0651-0032
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PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number	Filing Date	☐ To be Mailed
12/451,436	01/13/2010	

APPLICATION AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY ☐ RATE ($)	SMALL ENTITY ☐ FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	OTHER THAN SMALL ENTITY FEE ($)
☒ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	330
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =		OR	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =			X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	330

APPLICATION AS AMENDED – PART II

AMENDMENT 11/10/2009

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE ($)	SMALL ENTITY ADDITIONAL FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	* 21	Minus	** 21	= 0	X $ =		OR	X $52=	0
Independent (37 CFR 1.16(h))	* 5	Minus	***5	= 0	X $ =		OR	X $220=	0
☐ Application Size Fee (37 CFR 1.16(s))									
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	0

AMENDMENT

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)	OR	RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =		OR	X $ =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =		OR	X $ =	
☐ Application Size Fee (37 CFR 1.16(s))									
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

Legal Instrument Examiner:
/GLORIA TRAMMELL/

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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U.S. APPLICATION NUMBER NO.	FIRST NAMED APPLICANT	ATTY. DOCKET NO.
12/451,436	John Talbot Boys	6081/81072

Richard F. Jaworski
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30 Rockefeller PLaza
NewYork, NY 10112

INTERNATIONAL APPLICATION NO.	
PCT/NZ2008/000103	
I.A. FILING DATE	PRIORITY DATE
05/09/2008	05/10/2007

CONFIRMATION NO. 4685
371 FORMALITIES LETTER

OC000000039216295

Date Mailed: 12/14/2009

NOTIFICATION OF MISSING REQUIREMENTS UNDER 35 U.S.C. 371 IN THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US)

The following items have been submitted by the applicant or the IB to the United States Patent and Trademark Office as a Designated Office (37 CFR 1.494):

- Priority Document
- Copy of the International Application filed on 11/10/2009
- Copy of the International Search Report filed on 11/10/2009
- Copy of IPE Report filed on 11/10/2009
- Copy of Annexes to the IPER filed on 11/10/2009
- Preliminary Amendments filed on 11/10/2009
- Information Disclosure Statements filed on 11/10/2009
- U.S. Basic National Fees filed on 11/10/2009

The applicant needs to satisfy supplemental fees problems indicated below.

The following items **MUST** be furnished within the period set forth below in order to complete the requirements for acceptance under 35 U.S.C. 371:

- Oath or declaration of the inventors, in compliance with 37 CFR 1.497(a) and (b), identifying the application by the International application number and international filing date.
- To avoid abandonment, a surcharge (for late submission of filing fee, search fee, examination fee or oath or declaration) as set forth in 37 CFR 1.492(h) of $130 for a non-small entity, must be submitted with the missing items identified in this letter.

SUMMARY OF FEES DUE:

Total additional fees required for this application is $**130** for a Large Entity:

- $**130** Surcharge.

Additionally the following defects have been observed:

- Annexes have not been entered because the pct/ipea/409 does not cancel claim 71..

ALL OF THE ITEMS SET FORTH ABOVE MUST BE SUBMITTED WITHIN TWO (2) MONTHS FROM THE DATE OF THIS NOTICE OR BY 32 MONTHS FROM THE PRIORITY DATE FOR THE APPLICATION, WHICHEVER IS LATER. FAILURE TO PROPERLY RESPOND WILL RESULT IN ABANDONMENT.

The time period set above may be extended by filing a petition and fee for extension of time under the provisions of 37 CFR 1.136(a).

FORM PCT/DO/EO/905 (371 Formalities Notice)

Applicant is reminded that any communications to the United States Patent and Trademark Office must be mailed to the address given in the heading and include the U.S. application no. shown above (37 CFR 1.5)

Registered users of EFS-Web may alternatively submit their reply to this notice via EFS-Web.
https://sportal.uspto.gov/authenticate/AuthenticateUserLocalEPF.html

For more information about EFS-Web please call the USPTO Electronic Business Center at **1-866-217-9197** or visit our website at http://www.uspto.gov/ebc.

If you are not using EFS-Web to submit your reply, you must include a copy of this notice.

ANITA D JOHNSON

Telephone: (571) 272-0386

FORM PCT/DO/EO/905 (371 Formalities Notice)

MULTIPLE DEPENDENT CLAIM FEE CALCULATION SHEET

(FOR USE WITH FORM PTO-875)

SERIAL NO. 12-451,436

FILING DATE

APPLICANT(S)

CLAIMS

	AS FILED		AFTER 1st AMENDMENT		AFTER 2nd AMENDMENT	
	IND.	DEP.	IND.	DEP.	IND.	DEP.
TOTAL	13	60	5	16		
HIGHEST NO. PREVIOUSLY PAID FOR	23		21			

PATENT APPLICATION FEE DETERMINATION RECORD

Effective September 30,2007

Application or Docket Number: 12-451,436

CLAIMS AS FILED - PART I

	(Column 1)	(Column 2)	SMALL ENTITY TYPE ☐		OR	OTHER THAN SMALL ENTITY	
			RATE	FEE		RATE	FEE
U.S. NATIONAL STAGE FEES							
BASIC FEE	SMALL ENT. = $155	LARGE ENT = $ 310	BASIC FEE		OR	BASIC FEE	330
EXAMINATION FEE	Satisfies PCT Article 33(1)-(4) = $ 50 / $ 100	All other situations = $ 100 / $ 200	EXAM. FEE			EXAM FEE	220
SEARCH FEE	U.S. is ISA = $ 50 / $ 100 ALL other countries = $ 205 / $ 410	ALL other situations = $ 255 / $ 510	SEARCH FEE			SEARCH FEE	430
FEE FOR EXTRA SPEC. PGS.	minus 100 =	/ 50 =	X$130			X$260	
TOTAL CHARGEABLE CLAIMS	21 minus 20 =	* 1	X $ 25 =		OR	X $ ~~50~~ =	52
INDEPENDENT CLAIMS	5 minus 3 =	* 2	X $ 105 =		OR	X $ ~~210~~ =	660
MULTIPLE DEPENDENT CLAIM PRESENT ☐			$185		OR	$370	
* If the difference in column 1 is less than zero, enter "0" in column 2			TOTAL		OR	TOTAL	

CLAIMS AS AMENDED - PART II

AMENDMENT A

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM ☐				

SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X $ 25 =		OR	X $ 50 =	
X$105		OR	X$210	
$185		OR	$370	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT B

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM ☐				

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X $ 25 =		OR	X $ 50 =	
X$105		OR	X$210	
$185		OR	$370	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than "20", enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than "3", enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1

Dkt. 6081/81072

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of:	John Talbot Boys et al.
Serial No.	12/451,436
Date Filed	November 10, 2009
For	MULTI POWER SOURCED ELECTRIC VEHICLE

30 Rockefeller Plaza
New York, N.Y. 10112

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

RESPONSE TO NOTIFICATION OF MISSING REQUIREMENTS UNDER 35 U.S.C. 371 IN THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US)

Sir:

In Response to the Notification of Missing Requirements Under 35 U.S.C. §371 in the United States Designated/Elected Office (DO/EO/US), Applicants submit herewith an executed Declaration and Power of Attorney form.

Applicants also submit a check for $130 for the processing fee set forth in 37 C.F.R. 1.492(e).

I hereby certify that this paper is being deposited this date with the U.S. Postal Service as first class mail addressed to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450

January 7, 2010
Date

Richard F. Jaworski
Reg. No 33,515

01/14/2010 LLANDGRA 00000056 12451436

01 FC:1617 130.00 OP

Applicants also transmit for recordation (iv) an Assignment of this invention to Auckland Uniservices Limited, (v) Recordation Form Cover Sheet (Form PTO-1595), and (vi) check for the $40 recordation fee.

The Commissioner is authorized to charge any additional fees, or to credit any overpayment, to our Deposit Account No. 03-3125.

If a petition for an additional extension of time is required to make this response timely, this paper should be considered to be such a petition, and the Commissioner is authorized to charge the requisite fees to our Deposit Account No. 03-3125.

Respectfully submitted,

RICHARD F. JAWORSKI
Reg. No. 33,515
Attorney for Applicants
Cooper & Dunham LLP
Tel.: (212) 278-0400

6081/81072

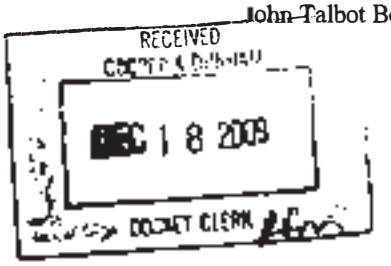
RFJ

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

U.S. APPLICATION NUMBER NO.	FIRST NAMED APPLICANT	ATTY. DOCKET NO.
12/451,436	John Talbot Boys	6081/81072

Richard F. Jaworski
c/o Cooper & Dunham LLP
30 Rockefeller PLaza
NewYork, NY 10112



INTERNATIONAL APPLICATION NO.	
PCT/NZ2008/000103	
I.A. FILING DATE	PRIORITY DATE
05/09/2008	05/10/2007

CONFIRMATION NO. 4685
371 FORMALITIES LETTER

Date Mailed: 12/14/2009

NOTIFICATION OF MISSING REQUIREMENTS UNDER 35 U.S.C. 371 IN THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US)

The following items have been submitted by the applicant or the IB to the United States Patent and Trademark Office as a Designated Office (37 CFR 1.494):

- Priority Document
- Copy of the International Application filed on 11/10/2009
- Copy of the International Search Report filed on 11/10/2009
- Copy of IPE Report filed on 11/10/2009
- Copy of Annexes to the IPER filed on 11/10/2009
- Preliminary Amendments filed on 11/10/2009
- Information Disclosure Statements filed on 11/10/2009
- U.S. Basic National Fees filed on 11/10/2009

MISSING Parts Due 2-14-10
3mo 3-14-10
4mo 4-14-10
5mo 5-14-10
6mo 6-14-10
7mo 7-14-10

The applicant needs to satisfy supplemental fees problems indicated below.

The following items **MUST** be furnished within the period set forth below in order to complete the requirements for acceptance under 35 U.S.C. 371:

- Oath or declaration of the inventors, in compliance with 37 CFR 1.497(a) and (b), identifying the application by the International application number and international filing date.
- To avoid abandonment, a surcharge (for late submission of filing fee, search fee, examination fee or oath or declaration) as set forth in 37 CFR 1.492(h) of $130 for a non-small entity, must be submitted with the missing items identified in this letter.

SUMMARY OF FEES DUE:

Total additional fees required for this application is **$130** for a Large Entity:
- **$130** Surcharge.

Additionally the following defects have been observed:

- Annexes have not been entered because the pct/ipea/409 does not cancel claim 71..

ALL OF THE ITEMS SET FORTH ABOVE MUST BE SUBMITTED WITHIN TWO (2) MONTHS FROM THE DATE OF THIS NOTICE OR BY 32 MONTHS FROM THE PRIORITY DATE FOR THE APPLICATION, WHICHEVER IS LATER. FAILURE TO PROPERLY RESPOND WILL RESULT IN ABANDONMENT.

The time period set above may be extended by filing a petition and fee for extension of time under the provisions of 37 CFR 1.136(a).

FORM PCT/DO/EO/905 (371 Formalities Notice)

Applicant is reminded that any communications to the United States Patent and Trademark Office must be mailed to the address given in the heading and include the U.S. application no. shown above (37 CFR 1.5)

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https://sportal.uspto.gov/authenticate/AuthenticateUserLocalEPF.html

For more information about EFS-Web please call the USPTO Electronic Business Center at **1-866-217-9197** or visit our website at http://www.uspto.gov/ebc.

If you are not using EFS-Web to submit your reply, you must include a copy of this notice.

ANITA D JOHNSON

Telephone: (571) 272-0386

FORM PCT/DO/EO/905 (371 Formalities Notice)

SEQUENCE LISTINGS AND TABLES RELATED THERETO IN INTERNATIONAL APPLICATIONS FILED IN THE U.S. RECEIVING OFFICE

The Administrative Instructions (AIs) under the Patent Cooperation Treaty (PCT), in force as of **July 1, 2009**, contain important changes relating to the manner of filing, and applicable fees for, sequence listings and/or tables related thereto (sequence-related tables) in international applications. The complete text may be accessed at http://www.wipo.int/pct/en/texts/index.htm.

Effective July 1, 2009, Part 8 and Annex C-*bis* will no longer form part of the AIs. Part 8 was introduced in 2001 as a temporary solution to problems arising from the filing of very large sequence listings on paper and provided for a *sequence listing forming part of the international application* to be filed in electronic form on physical medium (*e.g.*, CD), together with the remainder of the application on paper. In 2002, Part 8 was expanded to include sequence-related tables and Annex C-*bis* was added to provide technical requirements. All applicants may now file complete international applications in electronic form, eliminating the need for these temporary provisions.

I. AIS PART 8 AND ANNEX C-*BIS* DELETED AS OF JULY 1, 2009

A) **Sequence-related tables cannot be filed as a separate part of the description or in text format.** They must be provided as an integral part of the international application either:
- in PDF format as part of an international application filed in electronic form via EFS-Web; or
- on paper as part of an international application filed on paper

B) A ***sequence listing forming part of an international application*** may be provided either:
- in electronic form, as part of an international application filed in electronic form via EFS-Web, in
  - Annex C/ST.25 text format (preferred), or
  - PDF format; or
- on paper as part of an international application filed on paper.

C) A ***sequence listing not forming part of the international application*** **(for search under PCT Rule 13*ter*) in Annex C/ST.25 text format**
- is not required where the *sequence listing forming part of the international application* was filed in Annex C/ST.25 text format as part of an international application filed in electronic form via EFS-Web
- is required for search where the *sequence listing forming part of the international application* was filed in PDF
- is required for search on physical medium (*e.g.*, CD) where the *sequence listing forming part of the international application* was filed on paper as part of an international application filed on paper.

II. CALCULATION OF THE INTERNATIONAL FILING FEE AND FEE REDUCTION UNDER AI § 707

A) A **sequence-related table** must form an integral part of the international application and will incur FULL page fees with no upper limit.

B) A ***sequence listing forming part of an international application*** filed:
- via EFS-Web in Annex C/ST.25 text format will incur NO page fees;
- on paper or in PDF format will incur FULL page fees with no upper limit.

III. AVAILABILITY OF SEQUENCE LISTINGS SUBMITTED FOR SEARCH UNDER PCT RULE *13TER*

International Searching Authorities will be required to transmit to the International Bureau a copy of an Annex C/ST.25 text format sequence listing provided for search under PCT Rule 13*ter*. Any such sequence listing will be made available on PATENTSCOPE® (*sequence listings forming part of the international application* are already available).

IV. JULY 2009 REQUEST (PCT/RO/101)

The Request now has two options for the last sheet: one for paper filings; and one for EFS-Web filings. The July 2009 Request may be accessed at http://www.wipo.int/pct/en/forms/index.htm

DECLARATION AND POWER OF ATTORNEY

As a below-named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

MULTI POWER SOURCED ELECTRIC VEHICLE
(Title of Invention)

the specification of which:
(check one)

___ *is attached hereto.*

X *was filed on November 10, 2009*

Application Serial No. 12/451,436

and was amended by _____.
(if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			*Priority Claimed*	
Number	*Country*	*Filing Date*	*Yes*	*No*
PCT/NZ2008/000103	*PCT*	*May 9, 2008*	*X*	
555128	*NZ*	*May10, 2007*	*X*	
556646	*NZ*	*July 20, 2007*	*X*	

Declaration and Power of Attorney

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States Application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose to the Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

Application Serial No.	*Filing Date*	*Status*

And I hereby appoint ***Ivan S. Kavrukov (Reg. No. 25161); Christopher C. Dunham (Reg. No. 22031); Norman H. Zivin (Reg. No. 25385); John P. White (Reg. No. 28678); Robert D. Katz (Reg. No. 30141); Peter J. Phillips (Reg. No. 29691); Richard S. Milner (Reg. No. 33970); Richard F. Jaworski (Reg. No. 33515); Paul Teng (Reg. No. 40837),*** *and each of them, all c/o Cooper & Dunham LLP of 1185 Avenue of the Americas, New York, New York 10036 (Tel. 212-278-0400),*

my attorneys, each with full power of substitution and revocation, to prosecute this application, to make alterations and amendments therein, to receive the patent, to transact all business in the Patent and Trademark Office connected herewith and to file any International Applications which are based thereon under the provisions of the Patent Cooperation Treaty.

Please address all communications, and direct all telephone calls, regarding this application to:

Richard F. Jaworski *Reg. No.* ***33,515***
Cooper & Dunham LLP
1185 Avenue of the Americas
New York, New York 10036
Tel. (212) 278-0400

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Declaration and Power of Attorney

Full name of sole or first joint inventor John Talbot BOYS

Inventor's signature _____

Citizenship New Zealand Date of signature 22/12/09

Residence 41A Dominion Street, Takapuna, Auckland 1309 (NZ)

Post Office Address Same as Residence

Full name of sole or second joint inventor Grant Anthony COVIC

Inventor's signature _____

Citizenship New Zealand Date of signature 22/12/09

Residence 28 Haverstock Road, Sandringham, Auckland 1004 (NZ)

Post Office Address Same as Residence

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

U.S. APPLICATION NUMBER NO.	FIRST NAMED APPLICANT	ATTY. DOCKET NO.
12/451,436	John Talbot Boys	6081/81072

Richard F Jaworski
c/o Cooper & Dunham
30 Rockefeller PLaza
NewYork, NY 10112

INTERNATIONAL APPLICATION NO.	
PCT/NZ2008/000103	
I.A. FILING DATE	PRIORITY DATE
05/09/2008	05/10/2007

CONFIRMATION NO. 4685
371 ACCEPTANCE LETTER

OC000000039867586

Date Mailed: 01/28/2010

NOTICE OF ACCEPTANCE OF APPLICATION UNDER 35 U.S.C 371 AND 37 CFR 1.495

The applicant is hereby advised that the United States Patent and Trademark Office in its capacity as a Designated / Elected Office (37 CFR 1.495), has determined that the above identified international application has met the requirements of 35 U.S.C. 371, and is ACCEPTED for national patentability examination in the United States Patent and Trademark Office.

The United States Application Number assigned to the application is shown above and the relevant dates are:

01/13/2010	01/13/2010
DATE OF RECEIPT OF 35 U.S.C. 371(c)(1), (c)(2) and (c)(4) REQUIREMENTS	DATE OF COMPLETION OF ALL 35 U.S.C. 371 REQUIREMENTS

A Filing Receipt (PTO-103X) will be issued for the present application in due course. **THE DATE APPEARING ON THE FILING RECEIPT AS THE " FILING DATE" IS THE DATE ON WHICH THE LAST OF THE 35 U.S.C. 371 (c)(1), (c)(2) and (c)(4) REQUIREMENTS HAS BEEN RECEIVED IN THE OFFICE. THIS DATE IS SHOWN ABOVE.** *The filing date of the above identified application is the international filing date of the international application (Article 11(3) and 35 U.S.C. 363).* Once the Filing Receipt has been received, send all correspondence to the Group Art Unit designated thereon.

The following items have been received:

- Copy of the International Application filed on 11/10/2009
- Copy of the International Search Report filed on 11/10/2009
- Copy of IPE Report filed on 11/10/2009
- Copy of Annexes to the IPER filed on 11/10/2009
- English Translation of Annexes to the IPE filed on 01/13/2010
- Preliminary Amendments filed on 11/10/2009
- Information Disclosure Statements filed on 11/10/2009
- Oath or Declaration filed on 01/13/2010
- U.S. Basic National Fees filed on 11/10/2009

Applicant is reminded that any communications to the United States Patent and Trademark Office must be mailed to the address given in the heading and include the U.S. application no. shown above (37 CFR 1.5)

ZETA T ADAMS

Telephone: (703) 756-1417

FORM PCT/DO/EO/903 (371 Acceptance Notice)

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
PO Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
12/451,436	01/13/2010		1602	6081/81072	21	5

CONFIRMATION NO. 4685

Richard F Jaworski
c/o Cooper & Dunham
30 Rockefeller PLaza
NewYork, NY 10112

FILING RECEIPT

OC000000039867585

Date Mailed: 01/28/2010

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Applicant(s)

John Talbot Boys, Auckland, NEW ZEALAND;
Grant Anthony Covic, Auckland, NEW ZEALAND;

Power of Attorney:
Richard Jaworski--33515

Domestic Priority data as claimed by applicant

This application is a 371 of PCT/NZ2008/000103 05/09/2008

Foreign Applications
NEW ZEALAND 555128 05/10/2007
NEW ZEALAND 556646 07/20/2007

If Required, Foreign Filing License Granted: 01/26/2010

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 12/451,436**

Projected Publication Date: 05/06/2010

Non-Publication Request: No

Early Publication Request: No

Title

MULTI POWER SOURCED ELECTRIC VEHICLE

Preliminary Class

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4158).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier

license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
PO Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
12/451,436	01/13/2010	John Talbot Boys	6081/81072

CONFIRMATION NO. 4685

Richard F Jaworski
c/o Cooper & Dunham
30 Rockefeller PLaza
NewYork, NY 10112

PUBLICATION NOTICE

Title:MULTI POWER SOURCED ELECTRIC VEHICLE

Publication No.US-2010-0109604-A1
Publication Date:05/06/2010

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

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APPLICATION NUMBER	PATENT NUMBER	GROUP ART UNIT	FILE WRAPPER LOCATION
12/451,436		2858	0540

OC000000042448168

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30 Rockefeller Plaza
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Application Number	12/451,436
Filing Date	January 12, 2010
First Named Inventor	John Talbot BOYS
Art Unit	
Examiner Name	
Attorney Docket Number	6081/81072

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☐ Assignee of record of the entire interest.
Statement under 37 CFR 3.73(b) is enclosed. (Form PTO/SB/96).

☑ Attorney or agent of record. Registration Number 33,515

☐ Registered practitioner named in the application transmittal letter in an application without an executed oath or declaration. See 37 CFR 1.33(a)(1). Registration Number

Signature

Typed or Printed Name Richard F. Jaworski

Date April 21, 2011 Telephone [illegible]

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below.

☐ *Total of forms are submitted.

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☐ Registered practitioner named in the application transmittal letter in an application without an executed oath or declaration. See 37 CFR 1.33(a)(1). Registration Number

Signature

Typed or Printed Name Richard I. Aronoff

Date April 21, 2011 | Telephone 631 692-9839

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Atty. Docket No.	Serial No.
1172/69068	12/451,436
Applicant	
John Talbot BOYS et al.	
Filing Date	**Group**
January 13, 2010	NYA

U.S. PATENT DOCUMENTS

Examiner Initial		Document Number	Date	Name	Class	Subclass	Filing Date if Appropriate
	AA						
	AB						
	AC						
	AD						
	AE						
	AF						
	AG						
	AH						
	AI						
	AJ						
	AK						
	AL						
	AM						
	AN						
	AO						
	AP						

FOREIGN PATENT DOCUMENTS

		Document Number	Date	Country	Class	Subclass	Translation Yes	Translation No
	AQ	06-6439 3	Sept. 9, 1994	Japan				
	AR	03-23913 6	Oct. 24, 1991	Japan			Abst.	
	AS							
	AT							

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

	AU	
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EXAMINER	DATE CONSIDERED

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609: Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 03-239136
(43)Date of publication of application : 24.10.1991

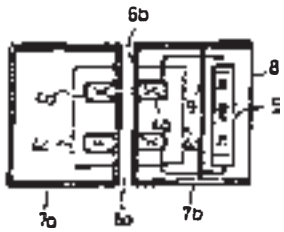
(51)Int.Cl. H02J 17/00
H02M 7/48

(21)Application number : 02-032953
(22)Date of filing : 14.02.1990

(71)Applicant : MITSUBISHI ELECTRIC CORP
(72)Inventor : YAMAZAKI HIROYOSHI
FUJII MANABU

(54) FEEDER SYSTEM

(57)Abstract:
PURPOSE: To improve safety, to lower leakage flux and to reduce noises by forming insulating sections to the opposed surfaces of a primary coil and secondary coil and covering the peripheries of the primary coil and the secondary coil with a package having low reluctance.



CONSTITUTION: Insulating sections 6a, 6b are formed on each opposed surface in the primary coils 4a and secondary coils 4b of an output transformer. The peripheries of the primary coils 4a and the secondary coils 4b except the opposed surfaces are covered with packages 7a, 7b having low reluctance or electric resistance. A parting plate 9 installed on the rear side of a discharge lamp 5 functions as a metallic reflecting plate, and reflects the light of the discharge lamp 5 to the outside. A surface cover 8 is mounted outside the discharge lamp 5, and formed of a material having the excellent transmitting properties of light.

⑲日本国特許庁(JP)　⑩特許出願公開

⑫公開特許公報(A)　平3−239136

⑤Int. Cl.⁵	識別記号	庁内整理番号
H 02 J 17/00	Z	2116−5G
H 02 M 7/48	Z	8730−5H

⑬公開　平成3年(1991)10月24日

審査請求　未請求　請求項の数 1　(全4頁)

④発明の名称　給電装置

⑳特　願　平2−32953
㉒出　願　平2(1990)2月14日

㉑発明者　山崎　広義　神奈川県鎌倉市大船2丁目14番40号　三菱電機株式会社生活システム研究所内
㉑発明者　藤井　学　東京都千代田区丸の内2丁目2番3号　三菱電機株式会社内
⑦出願人　三菱電機株式会社　東京都千代田区丸の内2丁目2番3号
⑭代理人　弁理士　大岩　増雄　外2名

明　細　書

1．発明の名称

給電装置

2．特許請求の範囲

高周波電力を発生するインバータの出力トランスの一次コイルと二次コイルの対向面にそれぞれ電気抵抗の高い絶縁部を設けると共に、この出力トランスの一次コイルと二次コイルを前記対向面を除いて磁気抵抗あるいは電気抵抗の低い材料からなる外囲器で覆い、前記出力トランスの二次コイルに誘起した電力を該二次コイルに接続した放電灯負荷に供給するようにしたことを特徴とする給電装置。

3．発明の詳細な説明

(産業上の利用分野)

この発明は、電磁誘導により出力トランスの二次側の放電灯負荷に高周波電力を供給する給電装置に関するものである。

(従来の技術)

第6図は例えば特開昭56−147380号公報に示された従来の放電灯の給電装置の構成図で、一部を破断して示している。図において、4a，4bは出力トランスを構成している一次コイル及び二次コイルで、一次コイル4aはソケット側に設けられ、二次コイル4bは放電灯5側に設けられている。13aはソケット側のランプ受部、13bは放電灯5側のソケット装着部である。

上記ソケット側の一次コイル4aは、図示していないが交流電源に接続されており、装着部13bをランプ受部13aに嵌合させて放電灯5をソケットに取り付けると、一次コイル4aと出力トランスを構成している二次コイル4bに高周波電力が誘起される。そして、この誘起電力が放電灯5に供給され、放電灯5が点灯する。また、放電灯5をソケットから取り外せば、放電灯5は消灯する。

このように構成された装置においては、電磁誘導により電力の供給を行っているため、感電などの事故が防止され、安全性が高いものとなる。

（発明が解決しようとする課題）

従来の給電装置は以上のように構成されているので、安全性は高いが漏れ磁束が多く、ノイズが多く発生するという問題点があった。

この発明は、上記のような問題点を解消するためになされたもので、安全性が高く、しかも漏れ磁束が少なく、ノイズ減少を図ることができる給電装置を得ることを目的としている。

（課題を解決するための手段）

この発明に係る給電装置は、高周波電力を発生するインバータの出力トランスの一次コイルと二次コイルの対向面にそれぞれ電気抵抗の高い絶縁部を設けると共に、この出力トランスの一次コイルと二次コイルを前記対向面を除いて磁気抵抗あるいは電気抵抗の低い材料からなる外囲器で覆い、前記出力トランスの二次コイルに誘起した電力を該二次コイルに接続した放電灯負荷に供給するように構成したものである。

（作用）

この発明の給電装置においては、各々の対向面に絶縁部を設けた一次コイルから二次コイルに電磁誘導で電力が伝達され、この電力が二次コイルに接続された放電灯負荷に供給される。その際、一次コイル及び二次コイルは磁気抵抗あるいは電気抵抗の低い外囲器で覆われているので、磁束の漏れが抑制される。

（実施例）

第１図はこの発明の第１実施例を示す構成図であり、第６図と同一符号は同一構成要素を示している。図において、４ａ，４ｂは出力トランスを構成している一次コイル及び二次コイル、５はその二次コイル４ｂに接続された負荷である放電灯、６ａ，６ｂは上記一次コイル４ａと二次コイル４ｂの対向面にそれぞれ設けられた絶縁部で、電気抵抗の高い材料で形成されている。７ａ，７ｂは一次コイル４ａと二次コイル４ｂを上記対向面を除いて覆っている外囲器で、磁気抵抗あるいは電気抵抗の低い材料で形成されている。８は放電灯５の外側の表面カバーで、光の透過性の良い材料で形成されている。９は二次側の外囲器７ｂの中で二次コイル４ｂと放電灯５を仕切っている仕切板で、放電灯５の光を外側に反射させる金属反射板を兼ねている。

第２図は上記装置の回路構成図である。図中、１は交流電源、２はその交流を直流に変換する整流回路、３は整流回路２の出力を再び交流に変換するインバータ、４はインバータ３の出力トランスで、一次コイル４ａがインバータ３と接続されている。

上記インバータ３にはスイッチング素子及びその駆動制御回路等が備えられており、出力トランス４に高周波電力を発生させる。この高周波電力、すなわち出力トランス４の二次コイル４ｂに誘起した高周波電力は、該二次コイル４ｂに接続された放電灯５に供給され、これにより放電灯５が点灯する。

ここで、上記出力トランス４の一次コイル４ａと二次コイル４ｂは、各々の対向面に絶縁部６ａ，６ｂが設けられており、電磁誘導によって電力の供給が行われるので、感電などの事故が防止され、安全性が高い。また、この対向面を除く一次コイル４ａと二次コイル４ｂの周囲は磁気抵抗あるいは電気抵抗の低い外囲器７ａ，７ｂで覆われているので、漏れ磁束が少なく、ノイズ減少を図ることができる。更に、放電灯５の後側に設けた仕切板９は金属反射板となっているので、明るい照明器具を構成することができる。

第３図はこの発明の第２実施例を示す構成図であり、第３図（ａ）は出力トランス４の二次側の構成、第３図（ｂ）は表面カバー側の構成を示している。

この実施例は、第１図の表面カバー８を金属メッシュ１０で構成したもので、このような構成としても上記実施例と同様の作用効果を得ることができる。

また、第４図はこの発明の第３実施例を示す構成図である。この実施例は、トランス１１を設けて放電灯５を無電極放電させるようにしたものである。また、第３図の実施例と同様、表面カバーに金属メッシュ１０を用いている。第５図にその

電気回路の構成を示す。

上記のように、放電灯５を無電極放電させることでメンテナンスフリーとなり、ランプ交換が不要となる。従って、金属メッシュ１０等で構成した放電灯５の表面カバーを防水構造とすることができる。

〔発明の効果〕

以上のように、この発明によれば、出力トランスを構成する一次コイルと二次コイルの対向面に絶縁部を設け、且つこの対向面を除いた一次コイルと二次コイルの周囲を磁気抵抗あるいは電気抵抗の低い外囲器で覆い、一次コイルから二次コイルに電磁誘導で電力を伝達して放電灯負荷に供給するようにしたため、感電などの事故が防止され、安全性が高いことは勿論、漏れ磁束が少なく、ノイズ減少を図ることができるという効果がある。

４．図面の簡単な説明

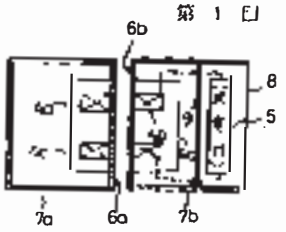
第１図はこの発明の第１実施例を示す構成図、第２図は同上の回路構成図、第３図（ａ）、（ｂ）はこの発明の第２実施例を示す構成図、第４図はこの発明の第３実施例を示す構成図、第５図は同上の電気回路図、第６図は従来装置を一部を破断して示す構成図である。

１……交流電源
２……整流回路
３……インバータ
４……出力トランス
４ａ……一次コイル
４ｂ……二次コイル
５……放電灯
６ａ，６ｂ……絶縁部
７ａ，７ｂ……外囲器
８……表面カバー
９……仕切板
１０……金属メッシュ
１１……トランス

なお、図中同一符号は同一または相当部分を示す。

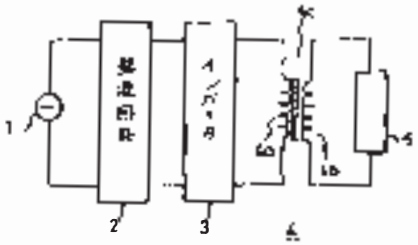
代理人　大岩増雄

第１図



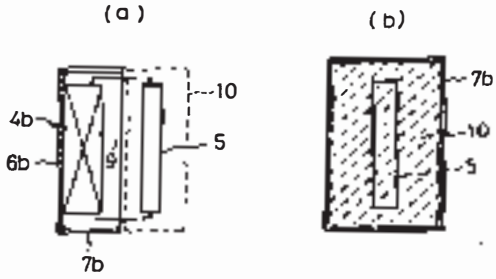
4a　一次コイル
4b　二次コイル
5　放電灯
6a6b　外囲器
7a,7b　絶縁部
8　表面カバー
9　仕切板

第２図

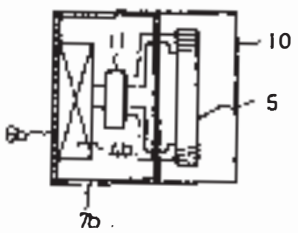


1　交流電源
4　出力トランス

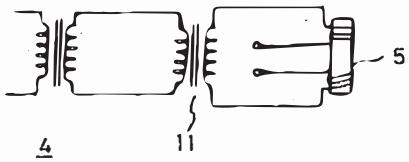
第３図



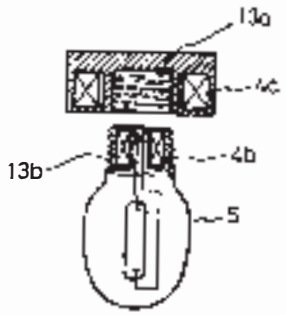
第４図



第 5 図



第 6 図



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19 July 2011

Attention: Richard Jaworski

Your Ref: 69068
Our Ref: WEJ 507346USPR
Partner Ref: Wes Jones

Email: rich@richardjaworski.com
CONFIRMATION VIA MAIL

Dear Colleagues

Auckland UniServices Limited
United States Patent Application No. 12/451,436
MULTI POWER SOURCED ELECTRIC VEHICLE

We **enclose** two Japanese patent publications that were submitted by an unknown third party to the Japanese Patent Office in connection with the corresponding Japanese patent application.

Please disclose the publications to the USPTO.

Yours sincerely
Baldwins Intellectual Property

Wes Jones
Partner

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Email: wes.jones@baldwins.com

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301911465_1.DOC:WEJ:jaw

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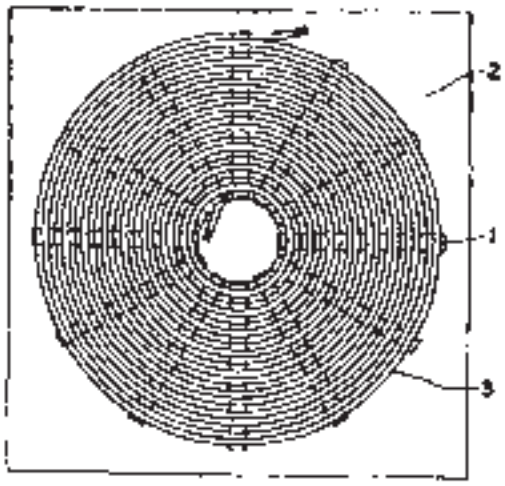
(54)【考案の名称】　電磁誘導加熱式調理器のワークコイル

(57)【要約】
【構成】　フエライト棒など高周波用磁性体棒１を放射状に配置して、該磁性体棒の一面側にアルミ板など非磁性体金属板２を固定し、該磁性体棒の他面側にリッツ線を用いた渦巻状コイル３を固定してなる。
【効果】　渦巻状コイルとこれにつながる制御回路との間の磁気遮蔽と静電遮蔽を良好に達成して調理器の性能に変動を来すことがなく、また調理器内部の冷却作用も良好に維持することができる。



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【実用新案登録請求の範囲】

【請求項1】　少なくとも四本以上のフエライト棒など高周波用磁性体棒を放射状に配置して、該磁性体棒の一面側にアルミ板など非磁性体金属板を固定し、該磁性体棒の他面側にリッツ線を用いた渦巻状コイルを固定してなる電磁誘導加熱式調理器のワークコイル。

【請求項2】　前記高周波用磁性体棒を収縮ビニルチューブなど電気絶縁体で被覆し、該電気絶縁体を介して、前記高周波用磁性体棒の一面側に前記非磁性体金属板を固定し、該磁性体棒の他面側に前記渦巻状コイルを固定してなる電磁誘導加熱式調理器のワークコイル。

【請求項3】　前記高周波用磁性体棒の一面側に前記非磁性体金属板を固定し、該磁性体棒の他面側にポリエステル系合成繊維（商品名テトロンフィルム）など耐熱性のプラスチックシートを貼着し、該該耐熱性プラスチックシートを介して前記高周波用磁性体棒に前記渦巻状コイルを固定してなる電磁誘導加熱式調理器のワークコイル。

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【図面の簡単な説明】

【図1】本考案の一実施例を示す平面図である。

【図2】同要部縦断拡大側面図である。

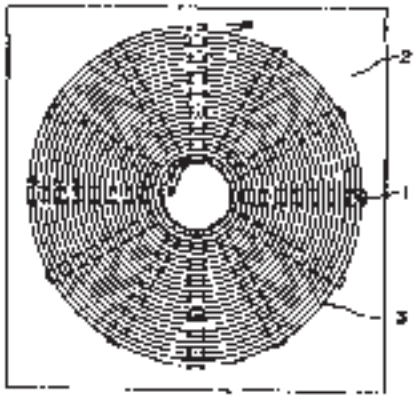
【図3】同他の実施例を示す要部縦断拡大側面図である。

【図4】同更に他の実施例を示す要部縦断拡大側面図である。

【符号の説明】

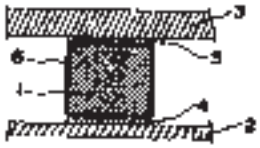
1　高周波用磁性体棒
2　非磁性体金属板
3　渦巻状コイル
4　接着剤
5　接着剤
6　電気絶縁体
7　耐熱性プラスチックシート
8　接着剤

【図1】



【図2】

【図3】



【図4】

【考案の詳細な説明】

【０００１】

【産業上の利用分野】

本考案は、電磁誘導加熱式調理器のワークコイルに関するものである。

【０００２】

【従来の技術】

従来、この種の電磁誘導加熱式調理器のワークコイルとしては、円盤状の耐熱樹脂成形体の片面に、四本の高周波用フェライト棒を放射状に配置して貼り付け、他の片面に、リッツ線を用いた渦巻状コイルを貼り付けたものを利用することが知られている。

【０００３】

この種のワークコイルでは、電磁誘導加熱式調理器の匡体内で発生させた電源で渦巻状コイルを駆動させ、また該コイルは高周波電力増幅器の共振コイルとして動作しているため、渦巻状コイルと電源を含む制御回路との間に、磁気遮蔽と静電遮蔽とが充分に達成されれば、渦巻状コイルから制御回路への帰還により調理器動作が誤動作し、初期の目的を達成することが困難である。即ち、４本の高周波用磁性体棒を介在させるだけでは磁気遮蔽と磁気抵抗の軽減が若干可能であっても、正常な動作をさせるために必要で充分な磁気遮蔽が困難であり、まして静電遮蔽は殆ど実施されていないため、電磁誘導加熱式調理器が指定通りの作動をしないことが多々あった。

【０００４】

そのうえ渦巻状コイルで発生するジュール熱の放熱が耐熱樹脂成形物により熱絶縁されているため不十分であるため、強力な冷却を実施する必要があった。即ち、渦巻状コイルには数１０Ａと言った大電流が流れるので、渦巻状コイルで多量のジュール熱が発生しても、耐熱樹脂成形体により熱絶縁されるため、電磁誘導加熱式調理器の匡体内の調理領域外で低温に保持されるべき部分の温度が異常に上昇するため、これを防止するために冷却用ファンモータの風量を増加させる必要があり、電磁誘導加熱式調理器の小型化とコスト低減を計ることを困難にしている。

【０００５】

【考案が解決しようとする課題】

本考案は、従来の上記問題的に鑑み、小型で軽量で、しかも磁気遮蔽と静電遮蔽とを充分に行い、制御回路への帰還を無くして安定した電磁誘導加熱を行うことができ、また渦巻状コイルで発生した熱量は効率よく放熱出来るようにして、調理器の調理領域外の温度を低くし、機器が局所的に高温になり破損や、動作不良になることを極力防止することを目的とする。

【０００６】

【課題を解決するための手段】

上記目的を達成するために、請求項１に示す考案にあっては、少なくとも四本以上のフエライト棒など高周波用磁性体棒を放射状に配置して、該磁性体棒の一面側にアルミ板など非磁性体金属板を固定し、該磁性体棒の他面側にリッツ線を用いた渦巻状コイルを固定してなる構成を採用するものである。

【０００７】

また請求項２に示す考案にあっては、前記高周波用磁性体棒を収縮ビニルチューブなど電気絶縁体で被覆し、該電気絶縁体を介して、前記高周波用磁性体棒の一面側に前記非磁性体金属板を固定し、該磁性体棒の他面側に前記渦巻状コイルを固定してなる構成を採用するものである。

【０００８】

また請求項３にあっては、前記高周波用磁性体棒の一面側に前記非磁性体金属板を固定し、該磁性体棒の他面側にポリエステル系合成繊維（商品名テトロンフィルム）など耐熱性のプラスチックシートを貼着し、該該耐熱性プラスチックシートを介して前記高周波用磁性体棒に前記渦巻状コイルを固定してなる構成を採用するものである。

【０００９】

【作用】

本考案によれば、渦巻状コイルで発生する電磁界は、静電遮蔽用の非磁性体金属板と磁気遮蔽用の高周波用磁性体棒により遮蔽されるため、該電磁界が渦巻状コイルから制御回路へ伝播されないことになり、渦巻状コイルから制御回路基板

への帰還がなくなる。高周波用磁性体棒は磁気漏洩を極力防止するために径の細いものを多数個、少なくとも４本以上使用されることが好ましい。このように構成することによって、制御回路での異常発振を防止しするだけでなく、制御信号に乗る誤信号、即ち雑音をも軽減でき、電磁誘導加熱式調理器を指定通りに正常に作動させることができる。また、渦巻状コイルで発生する熱量は熱伝導の良い上記非磁性体金属板に容易に伝達され、表面積の大きい該金属板から熱放射が行われるため渦巻状コイルとその周辺の温度上昇を抑えることが出来る。そのため、渦巻状コイルとその周辺の温度上昇を抑えるための強制空冷の風量を少なくでき、省エネルギにも貢献する。

【００１０】

さらに本考案によれば、静電遮蔽用の非磁性体金属板は電磁誘導加熱式調理器匡体の天井や側板、または底板として利用することができ、小型化と価格軽減化にも貢献するものである。

【００１１】

【実施例】

図１及び図２において、高周波用磁性体棒１としては、例えばラジオ受信機などで使われるバーアンテナ用のフェライト棒が用いられ、これらの磁性体棒１をその一端側を収束させて放射状に配置し、これらの放射状に配置された高周波磁性体棒１の一面側に、例えば板厚２㎜のアルミ板からなる非磁性体金属板２をシリコン接着剤４により固定する。また高周波用磁性体棒１の他面側にリッツ線を用いた渦巻状コイル３をシリコン接着剤５にて固定して、ワークコイルを形成し、電磁誘導加熱式調理器の匡体上部に配置して使用する。

【００１２】

上記の非磁性体金属板としては静電遮蔽を良好に達成する材料、例えばアルミ材の他、ステンレス、銅、真鍮材などで、容易に撓まない厚みのものが望ましい。

【００１３】

また、高周波用磁性体棒は径の細いものを多数個使用されることにより、非磁性体金属板への漏洩磁束による電力損失を減少させ、電磁誘導加熱式調理器の効

率向上に役立つ。

【００１４】

また、渦巻状コイルに高周波大電流が流れるので、一般にはリッツ線が用いられ、さらに効率を上げるために、撚り線外径の大なるものを用いることが望ましい。

【００１５】

図３は、本考案の他の実施例を示す。即ち、電磁誘導加熱式調理器動作時、渦巻状コイル３は１００Ｖ－１５００Ｖの高電位になるので、特に高周波用磁性体棒１として導電性のあるものを用いるときは、リック線のエナメル被覆だけでは、絶縁耐力がないので、この場合高周波用磁性体棒１に、熱収縮性ビニルチューブなどの電気絶縁体６を被覆して、該電気絶縁体６を介して磁性体棒１に非磁性体金属板２と渦巻状コイル３とをシリコン接着剤４，５によって一体的に固定することによって、上記のような高電圧のもとでも、電気絶縁が保たれる。

【００１６】

図４は、更に本考案の他の実施例を示す。上記の電気絶縁体６を高周波用磁性体棒１に被覆する代わりに、高周波用磁性体棒１と渦巻状コイル３との間に、例えば商品名テトロンフィルムなどのポリエステル系合成繊維で、１００℃以上の耐熱性能をもったプラスチックシート７を配置し、シリコン接着剤５，８にて両者を互いに一体的に固定することにより、上記と同様にワークコイルの放熱、冷却など熱的条件を殆ど損なうことなく電気絶縁が保持される。

【００１７】

【考案の効果】

請求項１に示す考案によれば、アルミ板など非磁性体金属板を必要寸法に裁断したものに、四本以上のフェライトなど高周波用磁性体棒を放射状に配置して接着固定し、その上にリッツ線を用いた渦巻状コイルを接着固定する簡単な作業によって、渦巻状コイルとこれにつながる制御回路との間の磁気遮蔽と静電遮蔽を良好に達成して調理器の性能に変動を来すことがなく、また調理器内部の冷却作用も良好に維持することができる。

【００１８】

同時に、アルミ板など非磁性体金属板を電磁誘導加熱式調理器の匡体の一部、たとえば天板として利用することにより、機器構成の簡素化が計れる。

【００１９】

請求項２の考案によれば、高周波用磁性体棒と渦巻状コイルとの間にに電気絶縁物を介在させるため、導電性の有無に関係なく使用できる。

【００２０】

請求項３の考案によれば、放射状に配置した高周波用磁性体棒と渦巻状コイルとの間に耐熱性プラスチックシートを介在して固定するという、より簡単な作業で高周波用磁性体棒の導電性の有無に関係なく使用できる。

IFW

Dkt. 1172/69068

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of : John Talbot BOYS et al.

Serial No. : 12/451,436 Examiner:

Date Filed : January 13, 2010 GAU:

For : MULTI POWER SOURCED ELECTRIC VEHICLE

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The information listed in the attached form PTO-1449 is brought to the attention of the Examiner. In accordance with 37 C.F.R. §1.92(a)(2)(ii), copies of U.S. Patents listed herein need not be provided.

It is respectfully requested that the information cited in annexed Form PTO-1449 be considered by the Examiner in connection with the above-identified patent application, and that such art be made of record in said application.

These items were submitted by an unknown third party to the Japanese Patent Office in connection with a corresponding Japanese patent application.

I hereby certify that this paper is being deposited this date with the U.S. Postal Service as first class mail addressed to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450

Richard F. Jaworski
Reg. No. 33,515

July 20, 2011
Date

The citation of the listed items is not a representation that they constitute a complete or exhaustive listing of the relevant art or that these items are prior art. The items listed are submitted in good faith, but are not intended to substitute for the Examiner's search. It is hoped, however, that in addition to apprising the Examiner of the particular items, they will assist in identifying fields of search and in making as full and complete a search as possible.

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This Information Disclosure Statement is being submitted in the present application prior to receipt by applicants of any action on the merits. Accordingly, it is believed that no fee is required for consideration of this Information Disclosure Statement.

However, if a fee is deemed to be required, the Office is authorized to charge any fees or credit any overpayment of fees to Deposit Account 50-5504.

Early and favorable consideration of the case is respectfully requested.

Respectfully submitted,

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Applicant	
John Talbot BOYS et al.	
Filing Date	**Group**
January 13, 2010	NYA

U.S. PATENT DOCUMENTS

Examiner Initial		Document Number	Date	Name	Class	Subclass	Filing Date if Appropriate
	AA						
	AB						
	AC						
	AD						
	AE						
	AF						
	AG						
	AH						
	AI						
	AJ						
	AK						
	AL						
	AM						
	AN						
	AO						
	AP						

FOREIGN PATENT DOCUMENTS

		Document Number	Date	Country	Class	Subclass	Translation Yes	Translation No
	AQ	06-643937	Sept. 9, 1994	Japan			Yes	
	AR							
	AS							
	AT							

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

	AU	
	AV	
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	AX	

EXAMINER	DATE CONSIDERED

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CLAIMS

[Claims]
[Claim 1]A work coil of an electromagnetic-induction-heating type cooking device which arranges radiately magnetic body sticks for high frequency, such as at least four or more ferrite rods, fixes nonmagnetic material metal plates, such as an aluminum board, to the whole surface side of this magnetic body stick, and fixes a spiral coil of this magnetic body stick which used a litz wire for a side on the other hand.
[Claim 2]Said magnetic body stick for high frequency is covered with electric insulators, such as the contraction polyvinyl chloride tube, said nonmagnetic material metal plate is fixed to the whole surface side of said magnetic body stick for high frequency via this electric insulator, and it is a work coil of an electromagnetic-induction-heating type cooking device of this magnetic body stick which fixes said spiral coil to a side on the other hand.
[Claim 3]Fix said nonmagnetic material metal plate to the whole surface side of said magnetic body stick for high frequency, and, on the other hand, plastic sheets of this magnetic body stick which are heat resistance, such as a polyester system synthetic fiber (trade name Tetron film), are stuck on a side, A work coil of an electromagnetic-induction-heating type cooking device which fixes said spiral coil to said magnetic body stick for high frequency via this this heat-resistant plastic sheet.

[Translation done.]

DETAILED DESCRIPTION

[A detailed explanation of the device]
[0001]
[Industrial Application]
This design is related with the work coil of an electromagnetic-induction-heating type cooking device.
[0002]
[Description of the Prior Art]
Using conventionally what has arranged four ferrite rods for high frequency on one side of a disc-like heat-resistant resin-molding object radiately, stuck them on it as a work coil of this kind of electromagnetic-induction-heating type cooking device, and stuck the spiral coil which used the litz wire for other one side is known.
[0003]
Since a spiral coil is made to drive in this kind of work coil with the power supply generated within the box of an electromagnetic-induction-heating type cooking device and this coil is operating as a resonance coil of a high-frequency power amplifier, It is difficult for cooking device operation to fully malfunction between a spiral coil and a control circuit including a power supply by the return to a control circuit from achievement salmon **** and a spiral coil, and for magnetic shielding and electrostatic shielding to attain the early purpose to it. Namely, since magnetic shielding required in order to carry out normal operation, and sufficient is difficult, furthermore most electrostatic shielding is not carried out only by making four magnetic body sticks for high frequency intervene, even if some are possible for magnetic shielding and mitigation of magnetic resistance, An electromagnetic-induction-heating type cooking device did not sometimes carry out the operation as specification plentifully.
[0004]
Since the heat insulation of the heat dissipation of the Joule heat moreover generated with a spiral coil was carried out with the heat-resistant resin-molding thing and it was insufficiency, powerful cooling needed to be carried out. Namely, since heat insulation is carried out with a heat-resistant resin-molding object even if a lot of Joule heat occurs with a spiral coil in that of ** through which the high current called number 10A flows into a spiral coil, Since the temperature of the portion which should be held at low temperature out of the cooking field in the box of an electromagnetic-induction-heating type cooking device rises unusually, in order to prevent this, it is necessary to make the air capacity of the fan motor for cooling increase, and makes it difficult to measure a miniaturization and cost reduction of an electromagnetic-induction-heating type cooking device.
[0005]
[Problem(s) to be Solved by the Device]
This design takes an example like the conventional above-mentioned problem, it is small, is lightweight and, moreover, fully performs magnetic shielding and electrostatic shielding, As the quantity of heat which could perform electromagnetic induction heating which lost the return to a control circuit and was stabilized, and was generated with the spiral coil can radiate heat efficiently, temperature outside the cooking field of a cooking device is made low, and it aims at apparatus preventing becoming an elevated temperature locally and becoming breakage and a malfunction as much as possible.
[0006]
[Means for solving problem]To achieve the above objects, if it is in the device shown in Claim 1, The composition which arranges radiately magnetic body sticks for high frequency, such as at least four or more ferrite rods, fixes nonmagnetic material metal plates, such as an aluminum board, to the whole surface side of this magnetic body stick, and fixes the spiral coil of this magnetic body stick which used the litz wire for the side on the other hand is adopted.
[0007]
If it is in a device shown in Claim 2, cover said magnetic body stick for high frequency with electric insulators, such as the contraction polyvinyl chloride tube, and via this electric insulator, Said nonmagnetic material metal plate is fixed to the whole surface side of said magnetic body stick for high frequency, and composition of this magnetic body stick which fixes said spiral coil to a side on the other hand is adopted.
[0008]
If it is in Claim 3, said nonmagnetic material metal plate is fixed to the whole surface side of said magnetic body stick for high frequency, Composition of this magnetic body stick which, on the other hand, sticks heat-resistant plastic sheets, such as a polyester system synthetic fiber (trade name Tetron film), on a side, and fixes said spiral coil to said magnetic body stick for high frequency via this this heat-resistant plastic sheet is adopted.

[0009]
[Function]
According to this design, since it is covered with the nonmagnetic material metal plate for electrostatic shielding, and the magnetic body stick for high frequency for magnetic shielding, the electromagnetic field generated with a spiral coil will not be spread by this electromagnetic field from a spiral coil to a control circuit, and the return to a control circuit board of it is lost from a spiral coil. As for the magnetic body stick for high frequency, in order to prevent magnetic leakage as much as possible, it is preferred to use many at least four or more things which have a thin path. Not only preventing and carrying out the abnormal oscillation in a control circuit by constituting in this way but a control signal
It can be alike, the misbelief item which rides, i.e., noise, can be reduced, and an electromagnetic-induction-heating type cooking device can be normally operated as specification. The quantity of heat generated with a spiral coil is easily transmitted to the good above-mentioned nonmagnetic material metal plate of heat conduction, and since thermal radiation is performed from this metal plate with large surface area, it can suppress a spiral coil and the rise in heat of the circumference of it. Therefore, air capacity of the air cooling with blower for suppressing a spiral coil and the rise in heat of the circumference of it can be lessened, and it contributes also to energy saving.
[0010]
Furthermore, according to this design, the nonmagnetic material metal plate for electrostatic shielding can be used as the ceiling of an electromagnetic-induction-heating type cooking device box, a side board, or a bottom plate, and contributes also to a miniaturization and price reduction.
[0011]
[Working example]
In drawing 1 and drawing 2, as the magnetic body stick 1 for high frequency, For example, the ferrite rod for bar antennas used for a radio set etc. is used, The nonmagnetic material metal plate 2 which is, for example from the aluminum board of 2 mm of board thickness on the whole surface side of the high frequency magnetic body stick 1 which completed the end side, has arranged these magnetic body sticks 1 radiately, and has been arranged at these radials is fixed with the silicon adhesives 4. The spiral coil 3 of the magnetic body stick 1 for high frequency which used the litz wire for the side on the other hand is fixed with the silicon adhesives 5, a work coil is formed, and it is arranged and used for the box upper part of an electromagnetic-induction-heating type cooking device.
[0012]
It is stainless steel, copper, brass material, etc. besides material which attains electrostatic shielding good as the above-mentioned nonmagnetic material metal plate, for example, an aluminum material, and a thing of thickness which does not bend easily is desirable.
[0013]
By using many things which have a thin path, a magnetic body stick for high frequency decreases power loss by magnetic leakage flux to a nonmagnetic material metal plate, and is useful for improve efficiency of an electromagnetic-induction-heating type cooking device.
[0014]
Since a high frequency high current flows into a spiral coil, in order to use a litz wire generally and to raise efficiency further, it is desirable to use a so-called size of a stranded wire outer diameter.
[0015]
Drawing 3 shows other working examples of this design. Namely, since the spiral coil 3 becomes the high potential of 100V-1500V at the time of electromagnetic-induction-heating type cooking device operation, when using an existing conductive thing as the magnetic body stick 1 for high frequency especially, Since there is no dielectric strength, the electric insulators 6, such as the heat contraction nature polyvinyl chloride tube, are covered only with enamel covering of the Rick line on the magnetic body stick 1 for high frequency in this case, Electric insulation is maintained also a basis of the above high tensions by fixing the nonmagnetic material metal plate 2 and the spiral coil 3 to the magnetic body stick 1 in one with the silicon adhesives 4 and 5 via this electric insulator 6.
[0016]
Drawing 4 shows other working examples of this design further. Instead of covering the above-mentioned electric insulator 6 on the magnetic body stick 1 for high frequency, between the magnetic body stick 1 for high frequency, and the spiral coil 3, for example with polyester system synthetic fibers, such as a trade name Tetron film. Electric insulation is held by arranging the plastic sheet 7 with the heat-resistant performance of not less than 100 **, and fixing both of each other in one with the silicon adhesives 5 and 8, without spoiling most thermal conditions, such as heat dissipation of a work coil, and cooling, like the above.
[0017]
[Effect of the Device]
According to the device shown in Claim 1, nonmagnetic material metal plates, such as an aluminum board, to what was judged to the required dimension. The spiral coil which has arranged radiately magnetic body sticks for high frequency, such as four or more ferrites, carried out adhesion fixing, and used the litz wire on it according to the easy work which carries out adhesion fixing. Magnetic shielding and electrostatic shielding between a spiral coil and the control circuit connected with this can be attained good, and change cannot be caused to the performance of a cooking device, and the cooling effect inside a cooking device can also be maintained good.
[0018]
Simultaneously, the simplification of a configuration can be measured by using nonmagnetic material metal plates,

such as an aluminum board, as a part of box of an electromagnetic-induction-heating type cooking device, for example, a top plate.

[0019]

since according to the device of Claim 2 it is alike between the magnetic body stick for high frequency, and a spiral coil and an electrical insulator is made to intervene, it can be used regardless of conductive existence.

[0020]

According to the device of Claim 3, a heat-resistant plastic sheet can be used regardless of the conductive existence of the magnetic body stick for high frequency by easier work [say / intervening and fixing] between the magnetic body stick for high frequency and spiral coil which have been arranged radiately.

[Translation done.]

TECHNICAL FIELD

[Industrial Application]
This design is related with the work coil of an electromagnetic-induction-heating type cooking device.
[0002]

[Translation done.]

PRIOR ART

[Description of the Prior Art]
Using conventionally what has arranged four ferrite rods for high frequency on one side of a disc-like heat-resistant resin-molding object radiately, stuck them on it as a work coil of this kind of electromagnetic-induction-heating type cooking device, and stuck the spiral coil which used the litz wire for other one side is known.
[0003]
Since a spiral coil is made to drive in this kind of work coil with the power supply generated within the box of an electromagnetic-induction-heating type cooking device and this coil is operating as a resonance coil of a high-frequency power amplifier, It is difficult for cooking device operation to fully malfunction between a spiral coil and a control circuit including a power supply by the return to a control circuit from achievement salmon **** and a spiral coil, and for magnetic shielding and electrostatic shielding to attain the early purpose to it. Namely, since magnetic shielding required in order to carry out normal operation, and sufficient is difficult, furthermore most electrostatic shielding is not carried out only by making four magnetic body sticks for high frequency intervene, even if some are possible for magnetic shielding and mitigation of magnetic resistance, An electromagnetic-induction-heating type cooking device did not sometimes carry out the operation as specification plentifully.
[0004]
Since the heat insulation of the heat dissipation of the Joule heat moreover generated with a spiral coil was carried out with the heat-resistant resin-molding thing and it was insufficiency, powerful cooling needed to be carried out. Namely, since heat insulation is carried out with a heat-resistant resin-molding object even if a lot of Joule heat occurs with a spiral coil in that of ** through which the high current called number 10A flows into a spiral coil, Since the temperature of the portion which should be held at low temperature out of the cooking field in the box of an electromagnetic-induction-heating type cooking device rises unusually, in order to prevent this, it is necessary to make the air capacity of the fan motor for cooling increase, and makes it difficult to measure a miniaturization and cost reduction of an electromagnetic-induction-heating type cooking device.
[0005]

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Device]
According to the device shown in Claim 1, nonmagnetic material metal plates, such as an aluminum board, to what was judged to the required dimension. The spiral coil which has arranged radiately magnetic body sticks for high frequency, such as four or more ferrites, carried out adhesion fixing, and used the litz wire on it according to the easy work which carries out adhesion fixing. Magnetic shielding and electrostatic shielding between a spiral coil and the control circuit connected with this can be attained good, and change cannot be caused to the performance of a cooking device, and the cooling effect inside a cooking device can also be maintained good.
[0018]
Simultaneously, the simplification of a configuration can be measured by using nonmagnetic material metal plates, such as an aluminum board, as a part of box of an electromagnetic-induction-heating type cooking device, for example, a top plate.
[0019]
since according to the device of Claim 2 it is alike between the magnetic body stick for high frequency, and a spiral coil and an electrical insulator is made to intervene, it can be used regardless of conductive existence.
[0020]
According to the device of Claim 3, a heat-resistant plastic sheet can be used regardless of the conductive existence of the magnetic body stick for high frequency by easier work [say / intervening and fixing] between the magnetic body stick for high frequency and spiral coil which have been arranged radiately.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Device]
This design takes an example like the conventional above-mentioned problem, it is small, is lightweight and, moreover, fully performs magnetic shielding and electrostatic shielding, As the quantity of heat which could perform electromagnetic induction heating which lost the return to a control circuit and was stabilized, and was generated with the spiral coil can radiate heat efficiently, temperature outside the cooking field of a cooking device is made low, and it aims at apparatus preventing becoming an elevated temperature locally and becoming breakage and a malfunction as much as possible.
[0006]

[Translation done.]

MEANS

[Means for solving problem]To achieve the above objects, if it is in the device shown in Claim 1, The composition which arranges radiately magnetic body sticks for high frequency, such as at least four or more ferrite rods, fixes nonmagnetic material metal plates, such as an aluminum board, to the whole surface side of this magnetic body stick, and fixes the spiral coil of this magnetic body stick which used the litz wire for the side on the other hand is adopted.
[0007]
If it is in the device shown in Claim 2, cover said magnetic body stick for high frequency with electric insulators, such as the contraction polyvinyl chloride tube, and via this electric insulator, Said nonmagnetic material metal plate is fixed to the whole surface side of said magnetic body stick for high frequency, and the composition of this magnetic body stick which fixes said spiral coil to a side on the other hand is adopted.
[0008]
If it is in Claim 3, said nonmagnetic material metal plate is fixed to the whole surface side of said magnetic body stick for high frequency, The composition of this magnetic body stick which, on the other hand, sticks heat-resistant plastic sheets, such as a polyester system synthetic fiber (trade name Tetron film), on a side, and fixes said spiral coil to said magnetic body stick for high frequency via this this heat-resistant plastic sheet is adopted.
[0009]

[Translation done.]

OPERATION

[Function]
According to this design, since it is covered with the nonmagnetic material metal plate for electrostatic shielding, and the magnetic body stick for high frequency for magnetic shielding, the electromagnetic field generated with a spiral coil will not be spread by this electromagnetic field from a spiral coil to a control circuit, and the return to a control circuit board of it is lost from a spiral coil. As for the magnetic body stick for high frequency, in order to prevent magnetic leakage as much as possible, it is preferred to use many at least four or more things which have a thin path. Not only preventing and carrying out the abnormal oscillation in a control circuit by constituting in this way but a control signal
It can be alike, the misbelief item which rides, i.e., noise, can be reduced, and an electromagnetic-induction-heating type cooking device can be normally operated as specification. The quantity of heat generated with a spiral coil is easily transmitted to the good above-mentioned nonmagnetic material metal plate of heat conduction, and since thermal radiation is performed from this metal plate with large surface area, it can suppress a spiral coil and the rise in heat of the circumference of it. Therefore, air capacity of the air cooling with blower for suppressing a spiral coil and the rise in heat of the circumference of it can be lessened, and it contributes also to energy saving.
[0010]
Furthermore, according to this design, the nonmagnetic material metal plate for electrostatic shielding can be used as the ceiling of an electromagnetic-induction-heating type cooking device box, a side board, or a bottom plate, and contributes also to a miniaturization and price reduction.
[0011]

[Translation done.]

EXAMPLE

[Working example]
In drawing 1 and drawing 2, as the magnetic body stick 1 for high frequency, For example, the ferrite rod for bar antennas used for a radio set etc. is used, The nonmagnetic material metal plate 2 which is, for example from the aluminum board of 2 mm of board thickness on the whole surface side of the high frequency magnetic body stick 1 which completed the end side, has arranged these magnetic body sticks 1 radiately, and has been arranged at these radials is fixed with the silicon adhesives 4. The spiral coil 3 of the magnetic body stick 1 for high frequency which used the litz wire for the side on the other hand is fixed with the silicon adhesives 5, a work coil is formed, and it is arranged and used for the box upper part of an electromagnetic-induction-heating type cooking device.
[0012]
It is stainless steel, copper, brass material, etc. besides the material which attains electrostatic shielding good as the above-mentioned nonmagnetic material metal plate, for example, an aluminum material, and the thing of thickness which does not bend easily is desirable.
[0013]
By using many things which have a thin path, the magnetic body stick for high frequency decreases the power loss by the magnetic leakage flux to a nonmagnetic material metal plate, and is useful for the improve efficiency of an electromagnetic-induction-heating type cooking device.
[0014]
Since a high frequency high current flows into a spiral coil, in order to use a litz wire generally and to raise efficiency further, it is desirable to use a so-called size of a stranded wire outer diameter.
[0015]
Drawing 3 shows other working examples of this design. Namely, since the spiral coil 3 becomes the high potential of 100V-1500V at the time of electromagnetic-induction-heating type cooking device operation, when using the existing conductive thing as the magnetic body stick 1 for high frequency especially, Since there is no dielectric strength, the electric insulators 6, such as the heat contraction nature polyvinyl chloride tube, are covered only with enamel covering of the Rick line on the magnetic body stick 1 for high frequency in this case, Electric insulation is maintained also the basis of the above high tensions by fixing the nonmagnetic material metal plate 2 and the spiral coil 3 to the magnetic body stick 1 in one with the silicon adhesives 4 and 5 via this electric insulator 6.
[0016]
Drawing 4 shows other working examples of this design further. Instead of covering the above-mentioned electric insulator 6 on the magnetic body stick 1 for high frequency, between the magnetic body stick 1 for high frequency, and the spiral coil 3, for example with polyester system synthetic fibers, such as a trade name Tetron film. Electric insulation is held by arranging the plastic sheet 7 with the heat-resistant performance of not less than 100 **, and fixing both of each other in one with the silicon adhesives 5 and 8, without spoiling most thermal conditions, such as heat dissipation of a work coil, and cooling, like the above.
[0017]

[Translation done.]

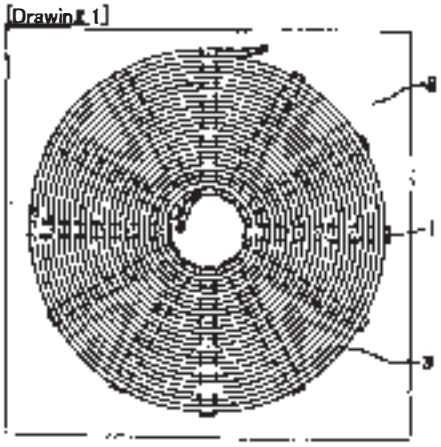
DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is a top view showing one working example of this design.
[Drawing 2]It is the important section vertical section expansion side view.
[Drawing 3]It is an important section vertical section expansion side view showing the working example of the others.
[Drawing 4]It is an important section vertical section expansion side view showing an working example besides ******.
[Explanations of letters or numerals]
1 The magnetic body stick for high frequency
2 Nonmagnetic material metal plate
3 Spiral coil
4 Adhesives
5 Adhesives
6 Electric insulator
7 Heat-resistant plastic sheet
8 Adhesives

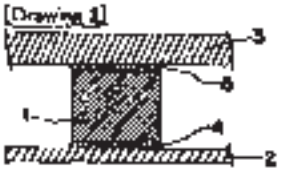
[Translation done.]

DRAWINGS

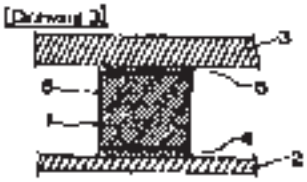
[Drawing 1]



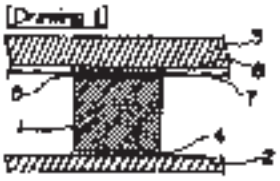
[Drawing 2]



[Drawing 3]



[Drawing 4]



[Translation done.]

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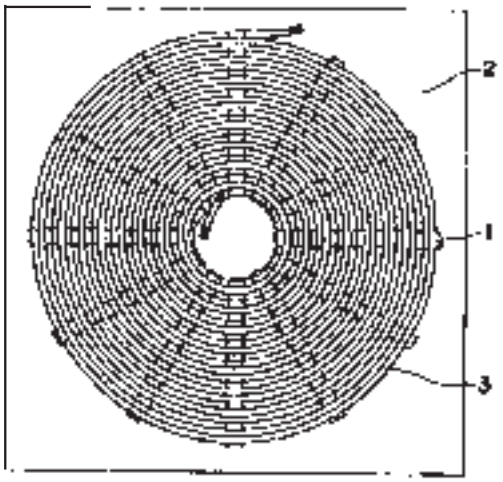
(54)【考案の名称】　誘導加熱式調理器のワークコイル

(57)【要約】
【構成】　フエライト棒など高周波用磁性体棒１を放射状に配置して、該磁性体棒の一面側にアルミ板など非磁性体金属板２を固定し、該磁性体棒の他面側にリッツ線を用いた渦巻状コイル３を固定してなる。
【効果】　渦巻状コイルとこれにつながる制御回路との間の磁気遮蔽と静電遮蔽を良好に達成して調理器の性能に変動を来すことがなく、また調理器内部の冷却作用も良好に維持することができる。



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【実用新案登録請求の範囲】

【請求項１】　少なくとも四本以上のフエライト棒など高周波用磁性体棒を放射状に配置して、該磁性体棒の一面側にアルミ板など非磁性体金属板を固定し、該磁性体棒の他面側にリッツ線を用いた渦巻状コイルを固定してなる電磁誘導加熱式調理器のワークコイル。

【請求項２】　前記高周波用磁性体棒を収縮ビニルチューブなど電気絶縁体で被覆し、該電気絶縁体を介して、前記高周波用磁性体棒の一面側に前記非磁性体金属板を固定し、該磁性体棒の他面側に前記渦巻状コイルを固定してなる電磁誘導加熱式調理器のワークコイル。

【請求項３】　前記高周波用磁性体棒の一面側に前記非磁性体金属板を固定し、該磁性体棒の他面側にポリエステル系合成繊維（商品名テトロンフィルム）など耐熱性のプラスチックシートを貼着し、該該耐熱性プラスチックシートを介して前記高周波用磁性体棒に前記渦巻状コイルを固定してなる電磁誘導加熱式調理器のワークコイ＊

2

＊ル。

【図面の簡単な説明】

【図１】本考案の一実施例を示す平面図である。

【図２】同要部縦断拡大側面図である。

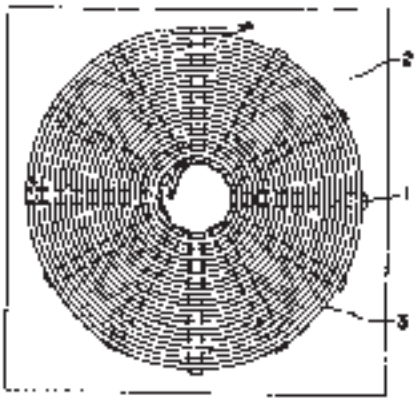
【図３】同他の実施例を示す要部縦断拡大側面図である。

【図４】同更に他の実施例を示す要部縦断拡大側面図である。

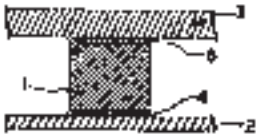
【符号の説明】

1　高周波用磁性体棒
2　非磁性体金属板
3　渦巻状コイル
4　接着剤
5　接着剤
6　電気絶縁体
7　耐熱性プラスチックシート
8　接着剤

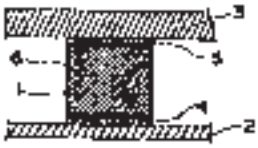
【図１】



【図２】



【図３】



【図４】

【考案の詳細な説明】

【０００１】

【産業上の利用分野】

本考案は、電磁誘導加熱式調理器のワークコイルに関するものである。

【０００２】

【従来の技術】

従来、この種の電磁誘導加熱式調理器のワークコイルとしては、円盤状の耐熱樹脂成形体の片面に、四本の高周波用フェライト棒を放射状に配置して貼り付け、他の片面に、リッツ線を用いた渦巻状コイルを貼り付けたものを利用することが知られている。

【０００３】

この種のワークコイルでは、電磁誘導加熱式調理器の匡体内で発生させた電源で渦巻状コイルを駆動させ、また該コイルは高周波電力増幅器の共振コイルとして動作しているため、渦巻状コイルと電源を含む制御回路との間に、磁気遮蔽と静電遮蔽とが充分に達成されれば、渦巻状コイルから制御回路への帰還により調理器動作が誤動作し、初期の目的を達成することが困難である。即ち、４本の高周波用磁性体棒を介在させるだけでは磁気遮蔽と磁気抵抗の軽減が若干可能であっても、正常な動作をさせるために必要で充分な磁気遮蔽が困難であり、まして静電遮蔽は殆ど実施されていないため、電磁誘導加熱式調理器が指定通りの作動をしないことが多々あった。

【０００４】

そのうえ渦巻状コイルで発生するジュール熱の放熱が耐熱樹脂成形物により熱絶縁されているため不十分であるため、強力な冷却を実施する必要があった。即ち、渦巻状コイルには数１０Ａと言った大電流が流れるので、渦巻状コイルで多量のジュール熱が発生しても、耐熱樹脂成形体により熱絶縁されるため、電磁誘導加熱式調理器の匡体内の調理領域外で低温に保持されるべき部分の温度が異常に上昇するため、これを防止するために冷却用ファンモータの風量を増加させる必要があり、電磁誘導加熱式調理器の小型化とコスト低減を計ることを困難にしている。

【０００５】

【考案が解決しようとする課題】

本考案は、従来の上記問題的に鑑み、小型で軽量で、しかも磁気遮蔽と静電遮蔽とを充分に行い、制御回路への帰還を無くして安定した電磁誘導加熱を行うことができ、また渦巻状コイルで発生した熱量は効率よく放熱出来るようにして、調理器の調理領域外の温度を低くし、機器が局所的に高温になり破損や、動作不良になることを極力防止することを目的とする。

【０００６】

【課題を解決するための手段】

上記目的を達成するために、請求項１に示す考案にあっては、少なくとも四本以上のフエライト棒など高周波用磁性体棒を放射状に配置して、該磁性体棒の一面側にアルミ板など非磁性体金属板を固定し、該磁性体棒の他面側にリッツ線を用いた渦巻状コイルを固定してなる構成を採用するものである。

【０００７】

また請求項２に示す考案にあっては、前記高周波用磁性体棒を収縮ビニルチューブなど電気絶縁体で被覆し、該電気絶縁体を介して、前記高周波用磁性体棒の一面側に前記非磁性体金属板を固定し、該磁性体棒の他面側に前記渦巻状コイルを固定してなる構成を採用するものである。

【０００８】

また請求項３にあっては、前記高周波用磁性体棒の一面側に前記非磁性体金属板を固定し、該磁性体棒の他面側にポリエステル系合成繊維（商品名テトロンフィルム）など耐熱性のプラスチックシートを貼着し、該該耐熱性プラスチックシートを介して前記高周波用磁性体棒に前記渦巻状コイルを固定してなる構成を採用するものである。

【０００９】

【作用】

本考案によれば、渦巻状コイルで発生する電磁界は、静電遮蔽用の非磁性体金属板と磁気遮蔽用の高周波用磁性体棒により遮蔽されるため、該電磁界が渦巻状コイルから制御回路へ伝播されないことになり、渦巻状コイルから制御回路基板

への帰還がなくなる。高周波用磁性体棒は磁気漏洩を極力防止するために径の細いものを多数個、少なくとも４本以上使用されることが好ましい。このように構成することによって、制御回路での異常発振を防止しするだけでなく、制御信号に乗る誤信号、即ち雑音をも軽減でき、電磁誘導加熱式調理器を指定通りに正常に作動させることができる。また、渦巻状コイルで発生する熱量は熱伝導の良い上記非磁性体金属板に容易に伝達され、表面積の大きい該金属板から熱放射が行われるため渦巻状コイルとその周辺の温度上昇を抑えることが出来る。そのため、渦巻状コイルとその周辺の温度上昇を抑えるための強制空冷の風量を少なくでき、省エネルギにも貢献する。

【００１０】

さらに本考案によれば、静電遮蔽用の非磁性体金属板は電磁誘導加熱式調理器匡体の天井や側板、または底板として利用することができ、小型化と価格軽減化にも貢献するものである。

【００１１】

【実施例】

図１及び図２において、高周波用磁性体棒１としては、例えばラジオ受信機などで使われるバーアンテナ用のフェライト棒が用いられ、これらの磁性体棒１をその一端側を収束させて放射状に配置し、これらの放射状に配置された高周波磁性体棒１の一面側に、例えば板厚２㎜のアルミ板からなる非磁性体金属板２をシリコン接着剤４により固定する。また高周波用磁性体棒１の他面側にリッツ線を用いた渦巻状コイル３をシリコン接着剤５にて固定して、ワークコイルを形成し、電磁誘導加熱式調理器の匡体上部に配置して使用する。

【００１２】

上記の非磁性体金属板としては静電遮蔽を良好に達成する材料、例えばアルミ材の他、ステンレス、銅、真鍮材などで、容易に撓まない厚みのものが望ましい。

【００１３】

また、高周波用磁性体棒は径の細いものを多数個使用されることにより、非磁性体金属板への漏洩磁束による電力損失を減少させ、電磁誘導加熱式調理器の効

率向上に役立つ。

【００１４】

また、渦巻状コイルに高周波大電流が流れるので、一般にはリッツ線が用いられ、さらに効率を上げるために、撚り線外径の大なるものを用いることが望ましい。

【００１５】

図３は、本考案の他の実施例を示す。即ち、電磁誘導加熱式調理器動作時、渦巻状コイル３は１００Ｖ－１５００Ｖの高電位になるので、特に高周波用磁性体棒１として導電性のあるものを用いるときは、リック線のエナメル被覆だけでは、絶縁耐力がないので、この場合高周波用磁性体棒１に、熱収縮性ビニルチューブなどの電気絶縁体６を被覆して、該電気絶縁体６を介して磁性体棒１に非磁性体金属板２と渦巻状コイル３とをシリコン接着剤４，５によって一体的に固定することによって、上記のような高電圧のもとでも、電気絶縁が保たれる。

【００１６】

図４は、更に本考案の他の実施例を示す。上記の電気絶縁体６を高周波用磁性体棒１に被覆する代わりに、高周波用磁性体棒１と渦巻状コイル３との間に、例えば商品名テトロンフィルムなどのポリエステル系合成繊維で、１００℃以上の耐熱性能をもったプラスチックシート７を配置し、シリコン接着剤５，８にて両者を互いに一体的に固定することにより、上記と同様にワークコイルの放熱、冷却など熱的条件を殆ど損なうことなく電気絶縁が保持される。

【００１７】

【考案の効果】

請求項１に示す考案によれば、アルミ板など非磁性体金属板を必要寸法に裁断したものに、四本以上のフェライトなど高周波用磁性体棒を放射状に配置して接着固定し、その上にリッツ線を用いた渦巻状コイルを接着固定する簡単な作業によって、渦巻状コイルとこれにつながる制御回路との間の磁気遮蔽と静電遮蔽を良好に達成して調理器の性能に変動を来すことがなく、また調理器内部の冷却作用も良好に維持することができる。

【００１８】

同時に、アルミ板など非磁性体金属板を電磁誘導加熱式調理器の匡体の一部、たとえば天板として利用することにより、機器構成の簡素化が計れる。

【００１９】

請求項２の考案によれば、高周波用磁性体棒と渦巻状コイルとの間にに電気絶縁物を介在させるため、導電性の有無に関係なく使用できる。

【００２０】

請求項３の考案によれば、放射状に配置した高周波用磁性体棒と渦巻状コイルとの間に耐熱性プラスチックシートを介在して固定するという、より簡単な作業で高周波用磁性体棒の導電性の有無に関係なく使用できる。

Dkt. 1172/69068 TJW

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of : John Talbot BOYS et al.

Serial No. : 12/451,436 Examiner:

Date Filed : January 13, 2010 GAU:

For : MULTI POWER SOURCED ELECTRIC VEHICLE

273 Walt Whitman Rd.
Suite 327
Huntington Station, NY 11746

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT

The information listed in the attached form PTO-1449 is brought to the attention of the Examiner. In accordance with 37 C.F.R. §1.92(a)(2)(ii), copies of U.S. Patents listed herein need not be provided.

It is respectfully requested that the information cited in annexed Form PTO-1449 be considered by the Examiner in connection with the above-identified patent application, and that such art be made of record in said application.

Attached is a computer translation of Japanese document 6-64393 which was cited in the Information Disclosure Statement dated July 20, 2011.

I hereby certify that this paper is being deposited this date with the U.S. Postal Service as first class mail addressed to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450

July 22, 2011
Date

Richard F. Jaworski
Reg. No. 33,515

The citation of the listed items is not a representation that they constitute a complete or exhaustive listing of the relevant art or that these items are prior art. The items listed are submitted in good faith, but are not intended to substitute for the Examiner's search. It is hoped, however, that in addition to apprising the Examiner of the particular items, they will assist in identifying fields of search and in making as full and complete a search as possible.

The filing of this Information Disclosure Statement is not an admission that the information cited herein is, or is considered to be, material to patentability as defined in 37 C.F.R. §1.56(b).

This Information Disclosure Statement is being submitted in the present application prior to receipt by applicants of any action on the merits. Accordingly, it is believed that no fee is required for consideration of this Information Disclosure Statement.

However, if a fee is deemed to be required, the Office is authorized to charge any fees or credit any overpayment of fees to Deposit Account 50-5504.

Early and favorable consideration of the case is respectfully requested.

Respectfully submitted,

RICHARD F. JAWORSKI
Registration No. 33,515
Attorney for Applicant
Customer No. 14443
The Law Office of Richard F. Jaworski, PC
Tel. (631) 659-3608

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/451,436	01/13/2010	John Talbot Boys	6081/81072	4685

14443 7590 04/12/2012
The Law Office of Richard F. Jaworski, PC
273 Walt Whitman Road
Suite 327
Huntington Station, NY 11746-4149

EXAMINER	
TSO, EDWARD H	
ART UNIT	PAPER NUMBER
2859	
MAIL DATE	DELIVERY MODE
04/12/2012	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	12/451,436	BOYS ET AL.	
	Examiner	Art Unit	
	EDWARD TSO	2859	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *1* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on ____.

2a)☐ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on ____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

5)☒ Claim(s) *72-92* is/are pending in the application.

5a) Of the above claim(s) ____ is/are withdrawn from consideration.

6)☐ Claim(s) ____ is/are allowed.

7)☐ Claim(s) ____ is/are rejected.

8)☐ Claim(s) ____ is/are objected to.

9)☒ Claim(s) *72-92* are subject to restriction and/or election requirement.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on ____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

12)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. ____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *11/09;7/11 (3 IDSes)*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. ____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: ____.

DETAILED ACTION

Election/Restrictions

Restriction to one of the following inventions is required under 35 U.S.C. 121:

I. Claims 72-83, drawn to an inductive charging pad, classified in class 336, subclass 229.

II. Claim 84, drawn to a charger for a battery, classified in class 320, subclass 108.

III. Claims 85-92, drawn to distributor of energy between vehicles, classified in class 700, subclass 295.

The inventions are distinct, each from the other because of the following reasons:

Inventions I, II and III are related as combination and subcombination. Inventions in this relationship are distinct if it can be shown that (1) the combination as claimed does not require the particulars of the subcombination as claimed for patentability, and (2) that the subcombination has utility by itself or in other combinations (MPEP § 806.05(c)). In the instant case, the combination as claimed does not require the particulars of the subcombination as claimed because load demand can be applied to regular electric power off the line instead of inductive power. The subcombination has separate utility such as the inductive power maybe used to recharge cellular phones instead of hybrid vehicles.

The examiner has required restriction between combination and subcombination inventions. Where applicant elects a subcombination, and claims thereto are subsequently found allowable, any claim(s) depending from or otherwise requiring all the limitations of the allowable subcombination will be examined for patentability in accordance with 37 CFR 1.104. See MPEP § 821.04(a). Applicant is advised that if any claim presented in a continuation or divisional application is anticipated by, or includes all the limitations of, a claim that is allowable in the present application, such claim may be subject to provisional statutory and/or nonstatutory double patenting rejections over the claims of the instant application.

Restriction for examination purposes as indicated is proper because all these inventions listed in this action are independent or distinct for the reasons given above and there would be a serious search and/or examination burden if restriction were not required because at least the following reason(s) apply:

They are classified in distinct classes.

Applicant is advised that the reply to this requirement to be complete must include (i) an election of a invention to be examined even though the requirement may be traversed (37 CFR 1.143) **and (ii) identification of the claims encompassing the elected invention**.

The election of an invention may be made with or without traverse. To reserve a right to petition, the election must be made with traverse. If the reply does not distinctly

and specifically point out supposed errors in the restriction requirement, the election shall be treated as an election without traverse. Traversal must be presented at the time of election in order to be considered timely. Failure to timely traverse the requirement will result in the loss of right to petition under 37 CFR 1.144. If claims are added after the election, applicant must indicate which of these claims are readable upon the elected invention.

Should applicant traverse on the ground that the inventions are not patentably distinct, applicant should submit evidence or identify such evidence now of record showing the inventions to be obvious variants or clearly admit on the record that this is the case. In either instance, if the examiner finds one of the inventions unpatentable over the prior art, the evidence or admission may be used in a rejection under 35 U.S.C. 103(a) of the other invention.

A telephone call was made to Mr. Richard Jaworski on 4/6/2012 to request an oral election to the above restriction requirement, but did not result in an election being made.

Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

Any inquiry concerning this communication should be directed to the Examiner at the below-listed number. The Examiner can normally be reached on Mon-Thu and Sat from 9:00am-5:00pm.

The Examiner's SPE is Drew Dunn and he can be reached at 571.272.2312. The fax number for the organization where this application is assigned is 571.273.8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866.217.9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800.786.9199 (IN USA OR CANADA) or 571.272.1000.

/Edward H Tso/

EDWARD H TSO
Primary Examiner, AU 2859
571.272.2087

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12451436	BOYS ET AL.
	Examiner	Art Unit
	EDWARD TSO	2859

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	04/08/2012								
	72	-								
	73									
	74	-								
	75	-								
	76	-								
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	92	-								

12451436 - GAU: 2859

Form PTO-1449 — U.S. Department of Commerce, Patent and Trademark Office

INFORMATION DISCLOSURE CITATION BY APPLICANT
(Use several sheets if necessary)

Atty. Docket No.	Serial No.
6081/81072	Not Yet Assigned
Applicant: Grant Anthony Covic et al.	
Filing Date: Concurrently Herewith	Group:

U.S. PATENT DOCUMENTS

Examiner Initial		Document Number	Date	Name	Class	Subclass	Filing Date if Appropriate
	AA	5 5 2 8 1 1 3	June 18, 1996	Boys et al.			
	AB	5 7 1 0 5 0 2	January 20, 1998	Poumey			
	AC	5 8 2 1 6 3 8	October 13, 1998	Boys et al.			
	AD	6 9 3 4 1 6 7	August 23, 2005	Jang et al.			
	AE						
	AP						
	AG						
	AH						
	AI						
	AJ						
	AK						
	AL						
	AM						
	AN						
	AO						
	AP						

FOREIGN PATENT DOCUMENTS

		Document Number	Date	Country	Class	Subclass	Translation Yes	Translation No
		WO 2005 02 48 6 5	March 17, 2005	PCT				
		WO 2006 10 12 8 5	September 28, 2006	PCT				

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

	B
	B
	B
	A,D

EXAMINER: /Edward Tso/ DATE CONSIDERED: 4/2012

***EXAMINER:** Initial if reference considered, whether or not citation is in conformance with MPEP 609: Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /ET/

Form PTO-1449 U.S. Department of Commerce Patent and Trademark Office

INFORMATION DISCLOSURE CITATION BY APPLICANT (Use several sheets if necessary)

Atty. Docket No.	Serial No.
1172/69068	12/451,436
Applicant	
John Talbot BOYS et al.	
Filing Date	**Group**
January 13, 2010	NYA

U.S. PATENT DOCUMENTS

Examiner Initial		Document Number	Date	Name	Class	Subclass	Filing Date if Appropriate
	AA						
	AB						
	AC						
	AD						
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	AG						
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	AI						
	AJ						
	AK						
	AL						
	AM						
	AN						
	AO						
	AP						

FOREIGN PATENT DOCUMENTS

		Document Number	Date	Country	Class	Subclass	Translation Yes	Translation No
	AQ	06 - 6 4 3 9 3	Sept. 9, 1994	Japan				
	AR	03 - 23 9 1 3 6	Oct. 24, 1991	Japan			Abst.	
	AS							
	AT							

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

	AU	
	AV	
	AW	
	AX	

EXAMINER /Edward Tso/ DATE CONSIDERED 4/2012

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ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /ET/

Form PTO-1449 U.S. Department of Commerce
Patent and Trademark Office

JUL 26 2011 IAP23 PATENT & TRADEMARK OFFICE

INFORMATION DISCLOSURE CITATION
BY APPLICANT
(Use several sheets if necessary)

Atty. Docket No.	Serial No.
1172/69068	12/451,436
Applicant: John Talbot BOYS et al.	
Filing Date: January 13, 2010	Group: NYA

U.S. PATENT DOCUMENTS

Examiner Initial		Document Number	Date	Name	Class	Subclass	Filing Date if Appropriate
	AA						
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	AN						
	AO						
	AP						

FOREIGN PATENT DOCUMENTS

		Document Number	Date	Country	Class	Subclass	Translation Yes	Translation No
	AQ	06 - 6 4 3 9 3	Sept. 9, 1994	Japan			Yes	
	AR							
	AS							
	AT							

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

	AU	
	AV	
	AW	
	AX	

EXAMINER /Edward Tso/ DATE CONSIDERED 4/2012

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609: Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /ET/

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12451436	BOYS ET AL.
	Examiner	Art Unit
	EDWARD TSO	2859

SEARCHED			
Class	Subclass	Date	Examiner

SEARCH NOTES		
Search Notes	Date	Examiner
restriction sent	4/2012	et

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner

Dkt. 1172/69068

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of : John Talbot BOYS et al.

Serial No. : 12/451,436 Examiner: Edward H. Tso

Date Filed : January 13, 2010 GAU: 2859

For : MULTI POWER SOURCED ELECTRIC VEHICLE

273 Walt Whitman Road, Suite 327
Huntington Station, New York 11746

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

SUPPLEMENTAL PRELIMINARY AMENDMENT AND RESPONSE TO RESTRICTION REQUIREMENT

Sir:

Prior to examination on the merits and in response to the Restriction Requirement dated April 12, 2012, please amend the above-identified application as follows:

Amendments to the claims are reflected in the listing of claims which begin on page 2 of this paper.

Remarks begin on page 9 of this paper.

I hereby certify that this paper is being deposited this date with the U.S. Postal Service as first class mail addressed to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450

June 12, 2012
Date

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Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claims 1-71 (presently canceled)

72. (currently amended) An inductive power transfer pad comprising:

one or more ferromagnetic slabs;

a coil having at least one turn of a conductor, the coil being arranged in a plane substantially parallel to that of said ferromagnetic slabs; and

a shield member comprising a backplate defining a second plane substantially parallel to that of said ferromagnetic slabs, said backplate arranged to control said magnetic field generated by said coil ~~arranged around both said coil and said ferromagnetic slab(s) for channeling electromagnetic flux when in use~~.

73. (previously presented) The inductive power transfer pad as claimed in claim 72, wherein each ferromagnetic slab is arranged such that its length extends radially from a common point but spaced apart therefrom.

74. (currently amended) The inductive power transfer pad as claimed in claim 73, wherein the coil is positioned to wind around the common point such that it passes each slab at approximately ~~the~~ a center of the length of each slab.

75. (previously presented) The inductive power transfer pad as claimed in claim 72, wherein:

a subset of the ferromagnetic slabs extend radially from a common point but are spaced apart therefrom;

a further subset of the ferromagnetic slabs extend radially from a different common point but are spaced apart therefrom;

a still further subset of the ferromagnetic slabs are aligned perpendicularly to the direction of an imaginary straight line connecting the said common points, whereby the still further subset of ferromagnetic slabs are positioned equidistantly from the imaginary line but spaced equally along its length and equally on each side of the imaginary line.

76. (currently amended) The inductive power transfer pad as claimed in claim 72, wherein the ~~pad comprises a~~ backplate is substantially rigid ~~backplate~~.

77. (currently amended) The inductive power transfer pad as claimed in claim 72 ~~76~~, wherein ~~the plane of the backplate is substantially parallel to the planes of each of the ferromagnetic slabs and the coil,~~ the plane of the or each of the ferromagnetic slabs ~~being~~ is located between the second plane ~~of the backplate~~ and the plane of the coil.

78. (currently amended) The inductive power transfer pad as claimed in claim 72 ~~76~~, wherein each ferromagnetic slab is spaced apart from the backplate by a thermally conductive and mechanically insulating material.

79. (currently amended) The inductive power transfer pad as claimed in claim 72 ~~76~~, wherein the backplate is formed from a material which substantially inhibits the passage of magnetic flux therethrough.

80. (currently amended) The inductive power transfer pad as claimed in claim 72, wherein the shield member forms a side wall ~~side walls~~ around the pad.

81. (currently amended) The inductive power transfer pad as claimed in claim 80, wherein the side wall ~~shield member~~ extends from the backplate and is integrally formed therewith.

82. (currently amended) The inductive power transfer pad as claimed in claim 72, wherein the one or more ferromagnetic slabs comprise ~~are~~ ferrite.

83. (previously presented) An inductive power transfer system comprising two inductive power transfer pads as claimed in claim 72, wherein the two inductive power transfer pads are used in combination, one of the pads being used as a pickup pad and the other pad as a charging pad.

Claims 84 – 92 (currently canceled).

93. (new) The inductive power transfer pad of claim 72, wherein a magnetic dipole produced by said coil is generally perpendicular to said plane defined by said ferromagnetic slabs.

94. (new) The inductive power transfer pad of claim 72, wherein said backplate is formed of metal.

95. (new) The inductive power transfer pad of claim 94, wherein said backplate is formed of aluminum.

96. (new) The inductive power transfer pad of claim 72, wherein said shield member further comprises a metal strip defining a barrier, wherein said backplate and said metal strip are arranged to control said magnetic field generated by said coil.

97. (new) An inductive power transfer pad comprising:

means for generating a magnetic flux;

means for channeling said magnetic flux, said means for generating said magnetic flux arranged in a plane substantially parallel to that of said means for channeling said magnetic flux; and

means for shielding against said magnetic flux, said means for shielding further defining a second plane substantially parallel to that of said means for channeling said magnetic flux.

98. (new) The inductive power transfer pad as claimed in claim 97, wherein said means for channeling said magnetic flux comprises a plurality of magnetically permeable members.

99. (new) The inductive power transfer pad as claimed in claim 98 wherein each magnetically permeable member is arranged such that it extends radially from a common point.

100. (new) The inductive power transfer pad as claimed in claim 97, wherein the means for generating a magnetic flux is positioned adjacent to one side of the means for channeling said magnetic flux.

101. (new) The inductive power transfer pad as claimed in claim 100 wherein said second plane

is located on the other side of the means for channeling said magnetic flux.

102. (new) The inductive power transfer pad as claimed in claim 97, wherein the means for shielding against said magnetic flux is substantially rigid.

103. (new) The inductive power transfer pad as claimed in claim 97, wherein the plane of the means for channeling said magnetic flux is located between the second plane and the plane of the means for generating said magnetic flux.

104. (new) The inductive power transfer pad as claimed in claim 97, wherein a thermally conductive means is provided between the means for channeling said magnetic flux and the means for shielding against said magnetic flux.

105. (new) The inductive power transfer pad as claimed in claim 97 wherein a mechanically insulating means is provided between the means for channeling said magnetic flux and the means for shielding against said magnetic flux.

106. (new) The inductive power transfer pad as claimed in claim 105 wherein the mechanically insulating means comprises a thermally conductive means.

107. (new) The inductive power transfer pad as claimed in claim 97, wherein the means for shielding against said magnetic flux comprises a material which substantially inhibits the passage of magnetic flux therethrough.