PTO/AIA/15 (07-12)
Approved for use through 01/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office. U.S. DEPARTMENT OF COMMERCE

UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	1172/69068-Div 2
First Inventor	John Talbot BOYS
Title	Multi Power Sourced Electric Vehicle
Express Mail Label No.	EG 902909371 US

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. ☑ **Fee Transmittal Form.** (PTO/SB/17 or equivalent)
2. ☐ **Applicant claims small entity status.** See 37 CFR 1.27.
3. ☑ **Specification.** [*Total Pages* 22] Both the claims and abstract must start on a new page *(For information on the preferred arrangement, see MPEP § 608.01(a))*
4. ☑ **Drawing(s).** *(35 U.S.C. 113)* [*Total Sheets* 5]
5. **Inventor's Oath or Declaration.** [*Total Sheets* 3] *(including substitute statements under 37 CFR 1.64 and assignments serving as an oath or declaration under 37 CFR 1.63(e))*
   a. ☐ Newly executed (original or copy)
   b. ☑ A copy from a prior application (37 CFR 1.63(d))
6. ☑ **Application Data Sheet.** **See Note below.* See 37 CFR 1.76 (PTO/AIA/14 or equivalent)
7. ☐ **CD-ROM or CD-R.** in duplicate, large table or Computer Program *(Appendix)*
   ☐ Landscape Table on CD
8. **Nucleotide and/or Amino Acid Sequence Submission.** *(if applicable, items a. – c. are required)*
   a. ☐ Computer Readable Form (CRF)
   b. ☐ Specification Sequence Listing on:
      i. ☐ CD-ROM or CD-R (2 copies); or
      ii. ☐ Paper
   c. ☐ Statements verifying identity of above copies

ADDRESS TO: **Commissioner for Patents, P.O. Box 1450, Alexandria VA 22313-1450**

ACCOMPANYING APPLICATION PARTS

9. ☐ **Assignment Papers.** (cover sheet & document(s)) Name of Assignee
10. ☐ **37 CFR 3.73(c) Statement.** ☐ **Power of Attorney.** *(when there is an assignee)*
11. ☐ **English Translation Document.** *(if applicable)*
12. ☑ **Information Disclosure Statement.** (PTO/SB/08 or PTO-1449) ☐ Copies of citations attached
13. ☑ **Preliminary Amendment.**
14. ☑ **Return Receipt Postcard.** *(MPEP § 503) (Should be specifically itemized)*
15. ☐ **Certified Copy of Priority Document(s).** *(if foreign priority is claimed)*
16. ☐ **Nonpublication Request.** Under 35 U.S.C. 122(b)(2)(B)(i). Applicant must attach form PTO/SB/35 or equivalent.
17. ☑ **Other:** 1 copy of International Publication Number WO 2008/140333

***Note:** (1) Benefit claims under 37 CFR 1.78 and foreign priority claims under 1.55 **must** be included in an Application Data Sheet (ADS).
(2) For applications filed under 35 U.S.C. 111, the application must contain an ADS specifying the applicant if the applicant is an assignee, person to whom the inventor is under an obligation to assign, or person who otherwise shows sufficient proprietary interest in the matter. See 37 CFR 1.46(b).

18. CORRESPONDENCE ADDRESS

☑ The address associated with Customer Number: 14443 *OR* ☐ Correspondence address below

Name					
Address					
City		State		Zip Code	
Country		Telephone		Email	
Signature			Date	May 5, 2014	
Name (Print/Type)	Richard F. Jaworski			Registration No. (Attorney/Agent)	33,515

PTO/SB/17 (03-13)
Approved for use through 01/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

FEE TRANSMITTAL

Complete if known	
Application Number	Div. of 12/451,436
Filing Date	Concurrently Herewith
First Named Inventor	John Talbot BOYS
Examiner Name	
Art Unit	2832
Practitioner Docket No.	1172/69068-Div 2

☐ Applicant asserts small entity status. See 37 CFR 1.27.

☐ Applicant certifies micro entity status. See 37 CFR 1.29. Form PTO/SB/15A or B or equivalent must either be enclosed or have been submitted previously.

TOTAL AMOUNT OF PAYMENT ($) 2,000

METHOD OF PAYMENT (check all that apply)

☑ Check ☐ Credit Card ☐ Money Order ☐ None ☐ Other (please identify): _____

☑ Deposit Account Deposit Account Number: 50-5504 Deposit Account Name: Law Office of Richard F. Jaworski, PC

For the above-identified deposit account, the Director is hereby authorized to (check all that apply):

☐ Charge fee(s) indicated below ☐ Charge fee(s) indicated below, **except for the filing fee**

☑ Charge any additional fee(s) or underpayment of fee(s) under 37 CFR 1.16 and 1.17 ☑ Credit any overpayment of fee(s)

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.

FEE CALCULATION

1. BASIC FILING, SEARCH, AND EXAMINATION FEES (U = undiscounted fee; S = small entity fee; M = micro entity fee)

	FILING FEES			SEARCH FEES			EXAMINATION FEES			
Application Type	U ($)	S ($)	M ($)	U ($)	S ($)	M ($)	U ($)	S ($)	M ($)	Fees Paid ($)
Utility	280	140*	70	600	300	150	720	360	180	$1,600
Design	180	90	45	120	60	30	460	230	115	
Plant	180	90	45	380	190	95	580	290	145	
Reissue	280	140	70	600	300	150	2,160	1,080	540	
Provisional	260	130	65	0	0	0	0	0	0	

* The $140 small entity status filing fee for a utility application is further reduced to $70 for a small entity status applicant who files the application via EFS-Web.

2. EXCESS CLAIM FEES

Fee Description	Undiscounted Fee ($)	Small Entity Fee ($)	Micro Entity Fee ($)
Each claim over 20 (including Reissues)	80	40	20
Each independent claim over 3 (including Reissues)	420	210	105
Multiple dependent claims	780	390	195

Total Claims		Extra Claims	Fee ($)		Fee Paid ($)
11	-20 or HP =	0	x	=	0

HP = highest number of total claims paid for, if greater than 20.

Indep. Claims		Extra Claims	Fee ($)		Fee Paid ($)
3	-3 or HP =	0	x	=	0

HP = highest number of independent claims paid for, if greater than 3.

Multiple Dependent Claims	Fee ($)	Fee Paid ($)

3. APPLICATION SIZE FEE

If the specification and drawings exceed 100 sheets of paper (excluding electronically filed sequence or computer listings under 37 CFR 1.52(e)), the application size fee due is $400 ($200 for small entity) ($100 for micro entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).

Total Sheets		Extra Sheets		Number of each additional 50 or fraction thereof		Fee ($)		Fee Paid ($)
35	- 100 =		/ 50 =		(round up to a whole number) x	0	=	

4. OTHER FEE(S)

	Fees Paid ($)
Non-English specification, $130 fee (no small or micro entity discount)	
Non-electronic filing fee under 37 CFR 1.16(t) for a utility application, $400 fee ($200 small or micro entity)	$400
Other (e.g., late filing surcharge):	

SUBMITTED BY

Signature	[signature]	Registration No. (Attorney/Agent) 33,515	Telephone 631 659-3608
Name (Print/Type)	Richard F. Jaworski		Date May 5, 2014

PTO/AIA/14 (03-13)
Approved for use through 01/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1172/69068-Div 2
	Application Number	
Title of Invention	Multi Power Sourced Electric Vehicle	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	John	Talbot	BOYS	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Auckland	Country of Residence [i]	NZ

Mailing Address of Inventor:

Address 1	41A Dominion Street		
Address 2			
City	Takapuna	**State/Province**	
Postal Code	1309	**Country** [i]	NZ

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Grant	Anthony	COVIC	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Auckland	Country of Residence [i]	NZ

Mailing Address of Inventor:

Address 1	28 Haverstock Road		
Address 2			
City	Sandringham	**State/Province**	
Postal Code	1004	**Country** [i]	NZ

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

PTO/AIA/14 (03-13)
Approved for use through 01/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1172/69068-Div 2
	Application Number	
Title of Invention	Multi Power Sourced Electric Vehicle	

Enter either Customer Number or complete the Correspondence Information section below. For further information see 37 CFR 1.33(a).			
☐ An Address is being provided for the correspondence Information of this application.			
Customer Number	14443		
Email Address	rich@richardjaworski.com	Add Email	Remove Email

Application Information:

Title of the Invention	Multi Power Sourced Electric Vehicle		
Attorney Docket Number	1172/69068-Div 2	Small Entity Status Claimed	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	5	Suggested Figure for Publication (if any)	

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	◉ Customer Number	○ US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	14443		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c) or indicate National Stage entry from a PCT application. Providing this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
	Division of	12/451436	2010-01-13

PTO/AIA/14 (03-13)
Approved for use through 01/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1172/69068-Div 2
	Application Number	
Title of Invention	Multi Power Sourced Electric Vehicle	

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button.

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55(d). When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(h)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Remove

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)
PCT/NZ2008/000103	WO	2008-05-09	

Remove

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)
555128	NZ	2007-05-10	

Remove

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)
556646	NZ	2007-07-20	

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button.

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.

NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

Authorization to Permit Access:

☒ Authorization to Permit Access to the Instant Application by the Participating Offices

PTO/AIA/14 (03-13)
Approved for use through 01/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1172/69068-Div 2
	Application Number	

Title of Invention: Multi Power Sourced Electric Vehicle

If checked, the undersigned hereby grants the USPTO authority to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the World Intellectual Property Office (WIPO), and any other intellectual property offices in which a foreign application claiming priority to the instant patent application is filed access to the instant patent application. See 37 CFR 1.14(c) and (h). This box should not be checked if the applicant does not wish the EPO, JPO, KIPO, WIPO, or other intellectual property office in which a foreign application claiming priority to the instant patent application is filed to have access to the instant patent application.

In accordance with 37 CFR 1.14(h)(3), access will be provided to a copy of the instant patent application with respect to: 1) the instant patent application-as-filed; 2) any foreign application to which the instant patent application claims priority under 35 U.S.C. 119(a)-(d) if a copy of the foreign application that satisfies the certified copy requirement of 37 CFR 1.55 has been filed in the instant patent application; and 3) any U.S. application-as-filed from which benefit is sought in the instant patent application.

In accordance with 37 CFR 1.14(c), access may be provided to information concerning the date o f filing this Authorization.

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

◯ Assignee ◯ Legal Representative under 35 U.S.C. 117 ◯ Joint Inventor

◯ Person to whom the inventor is obligated to assign. ◯ Person who shows sufficient proprietary interest

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor :

If the Applicant is an Organization check here. ☐

Prefix	Given Name	Middle Name	Family Name	Suffix

PTO/AIA/14 (03-13)
Approved for use through 01/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1172/69068-Div 2
	Application Number	
Title of Invention	Multi Power Sourced Electric Vehicle	

Mailing Address Information For Applicant:			
Address 1			
Address 2			
City		**State/Province**	
Country		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button.

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not subsitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication . An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

If the Assignee is an Organization check here. ☒

Organization Name	Auckland Uniservices Limited

Mailing Address Information For Non-Applicant Assignee:			
Address 1	Level 10, Symonds Street		
Address 2			
City	Auckland	**State/Province**	
Country	NZ	Postal Code	1010
Phone Number		Fax Number	
Email Address			

Additional Assignee Data may be generated within this form by selecting the Add button.

Signature:

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Signature	[signature] 33,515	Date (YYYY-MM-DD)	2014-05-05

EFS Web 2.2.8

PTO/AIA/14 (03-13)
Approved for use through 01/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1172/69068-Div 2
	Application Number	
Title of Invention	Multi Power Sourced Electric Vehicle	

First Name	Richard	Last Name	Jaworski	Registration Number	33515

Additional Signature may be generated within this form by selecting the Add button.

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

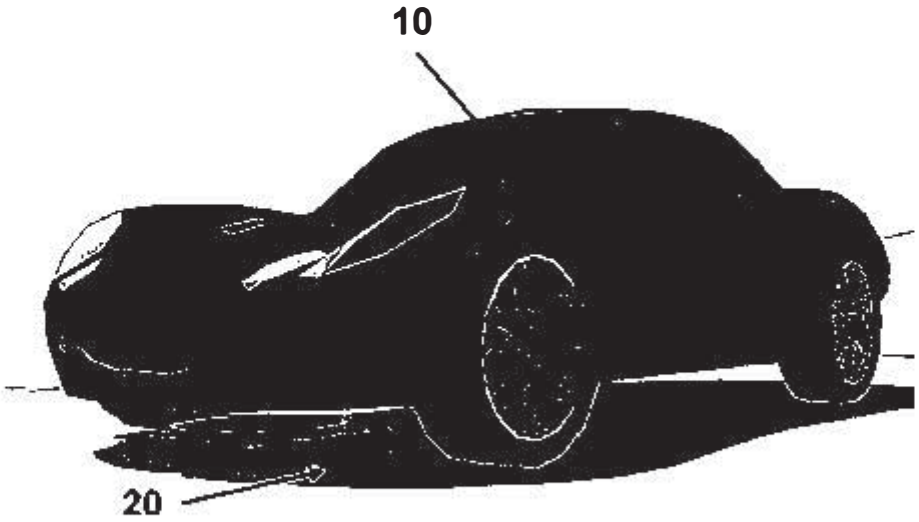


FIGURE 1

5

FIGURE 2

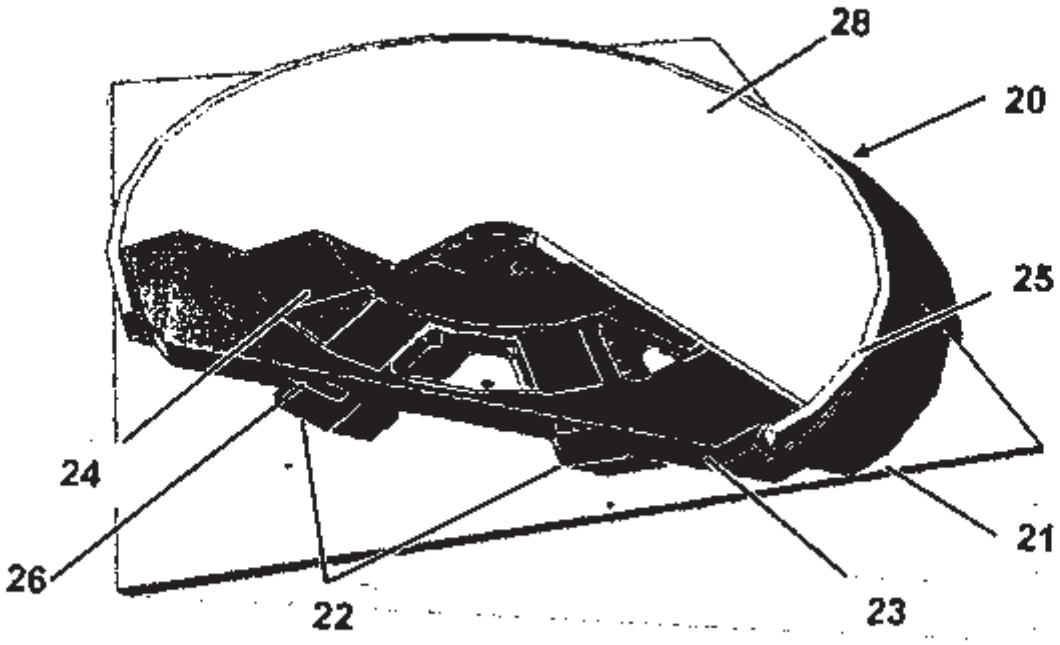


FIGURE 3

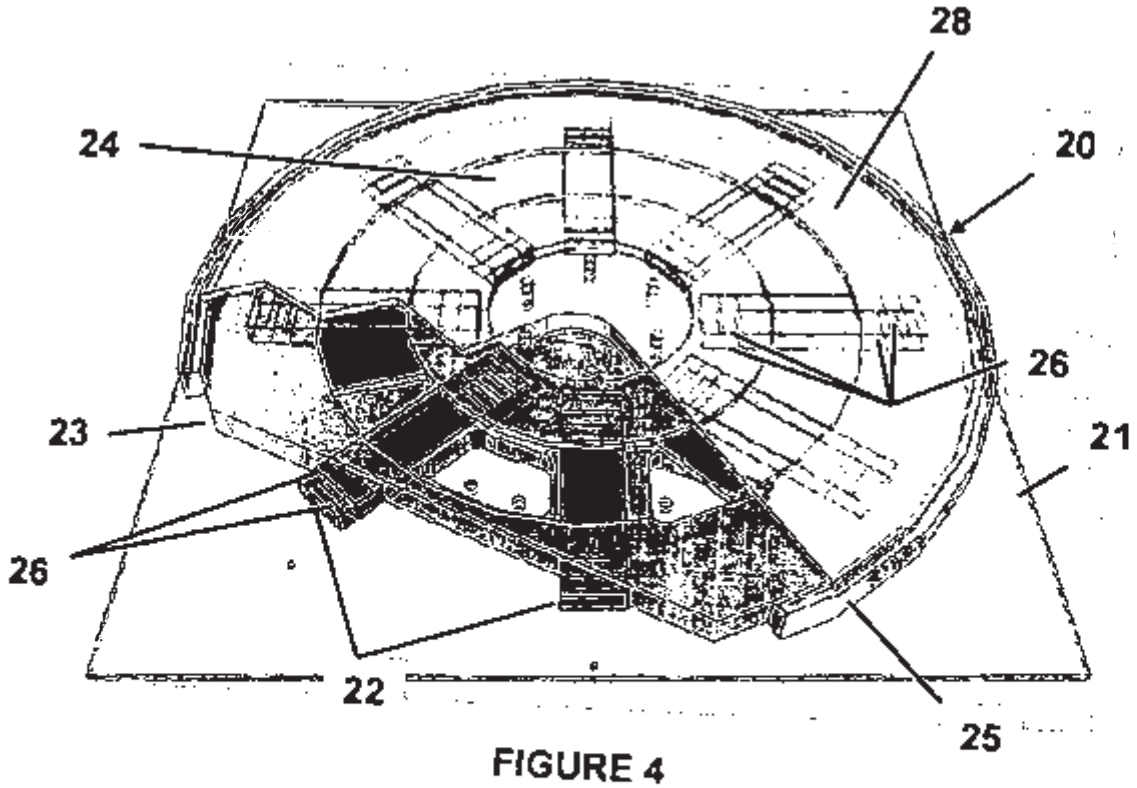
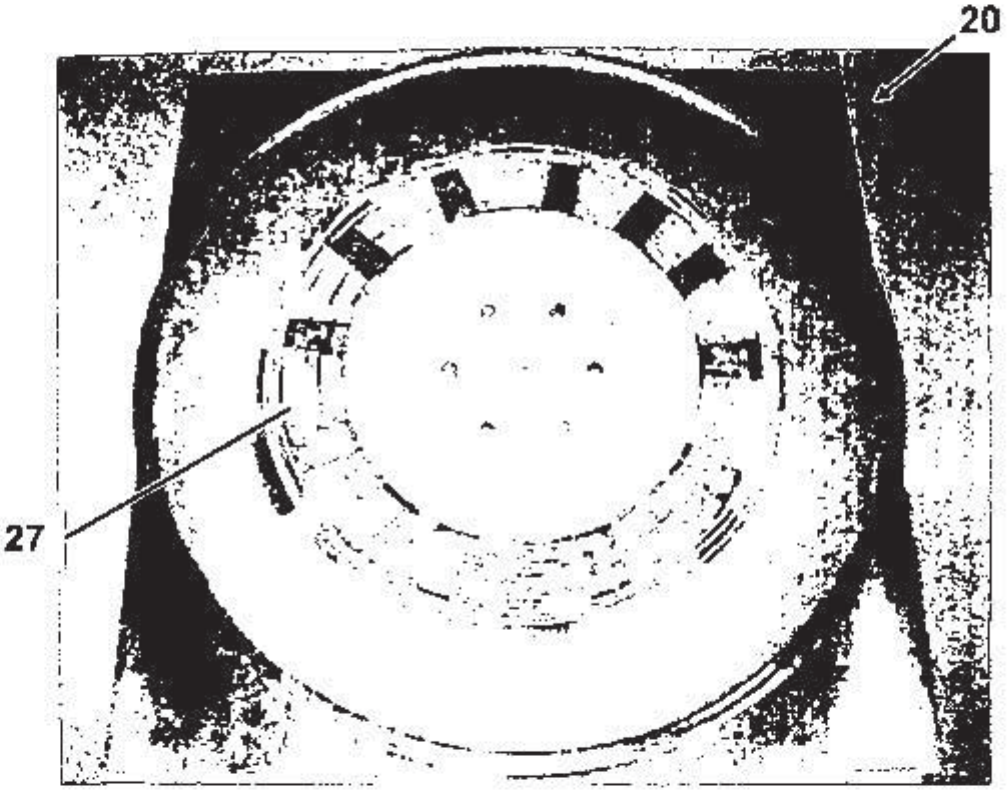


FIGURE 4



5

FIGURE 5

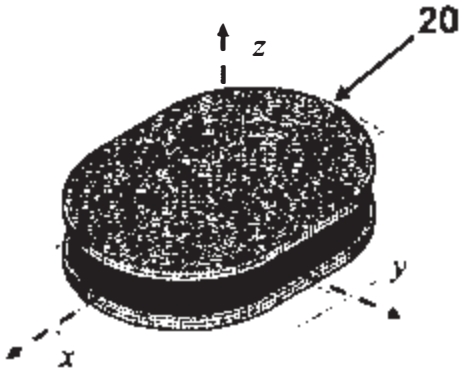


FIGURE 5A

5

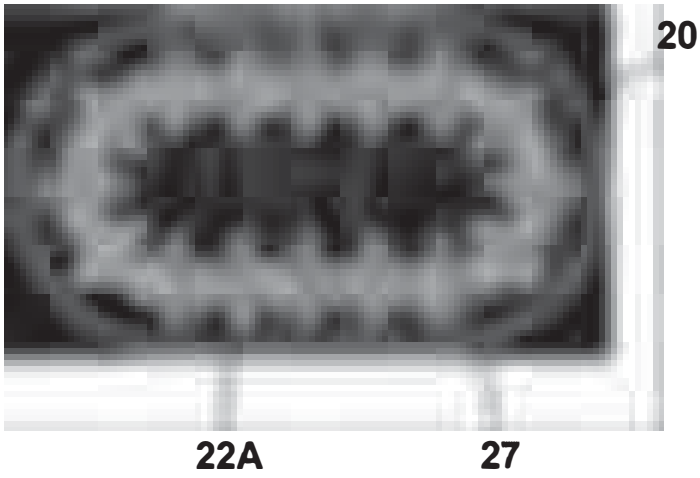


FIGURE 5B

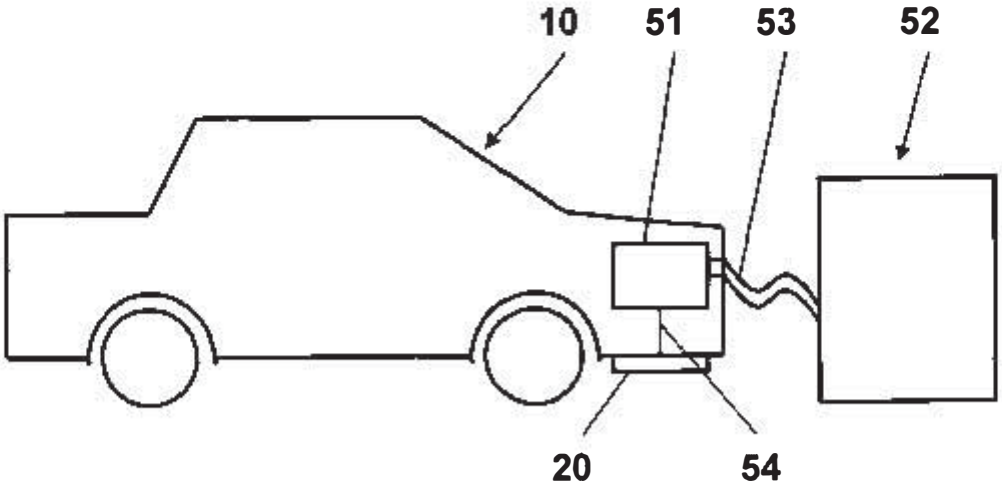


FIGURE 6

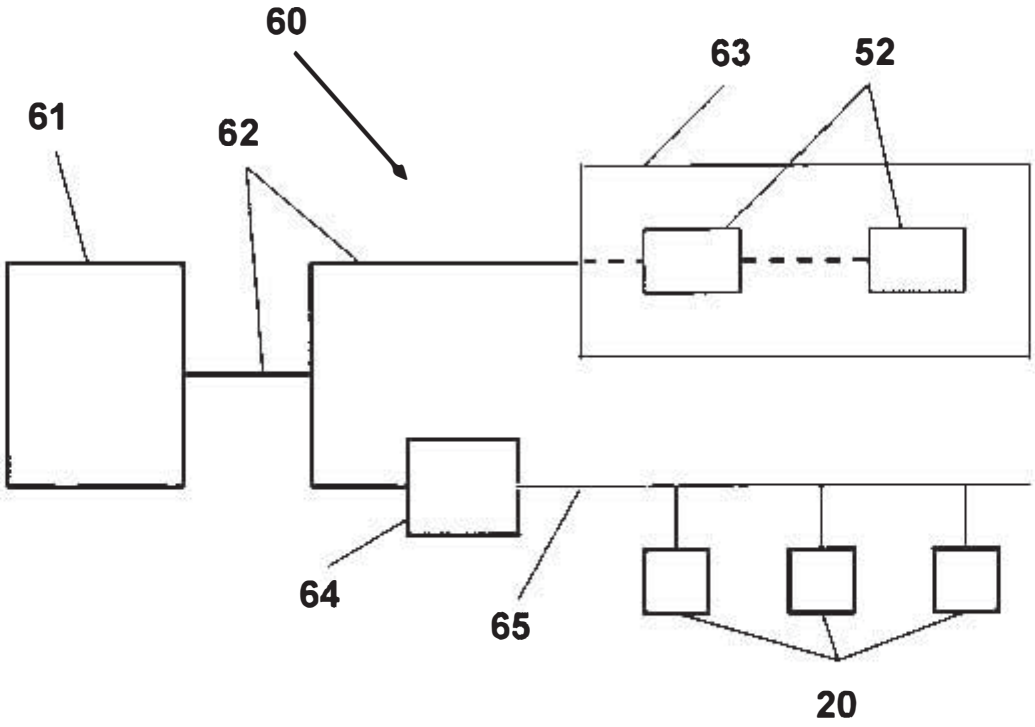


FIGURE 7

SCORE Placeholder Sheet for IFW Content

Application Number: **14120197** Document Date: **05/05/2014**

The presence of this form in the IFW record indicates that the following document type was received in paper and is scanned and stored in the SCORE database.

- Drawings

Images of the original documents are scanned in gray scale or color and stored in SCORE. Bi-tonal images are also stored in IFW. Defects visible in both IFW and SCORE are indicative of defects in the original paper documents.

To access the documents in the SCORE database, refer to instructions developed by SIRA.

At the time of document entry (noted above):

- Examiners may access SCORE content via the eDAN interface.
- Other USPTO employees can bookmark the current SCORE URL (http://Score.uspto.gov/ScoreAccessWeb/).
- External customers may access SCORE content via the Public and Private PAIR interfaces.

Form Revision Date: September 17, 2013

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.

05/96

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

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of : John Talbot BOYS et al.

Serial No. : Div. of 12/451,436 Examiner:

Date Filed : Concurrently Herewith GAU: 2832

For : MULTI POWER SOURCED ELECTRIC VEHICLE

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 Specification begin on page 2 of this paper.

Amendments to the Claims are reflected in the listing of claims which begins on page 3 of this paper.

Remarks begin on page 5 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:

Please amend the claims as shown below:

Claims 1-71 (presently canceled)

72. (New) An inductive power transfer pad for transmitting wireless power to a wireless power receiver separable from the inductive power transfer pad, the inductive power transfer pad comprising:

a coil having at least one turn of a conductor in a first layer; and

a plurality of ferromagnetic slabs arranged in a second layer substantially parallel to that of the coil, the ferromagnetic slabs being arranged so as to be spaced apart from one another about the coil with their lengths extending across a longitudinal length of the coil.

73. (New) An inductive power transfer pad as claimed in claim 72, wherein at least some of the ferromagnetic slabs are arranged such that their lengths extend radially from a common point but spaced apart therefrom.

74. (New) An inductive power transfer pad as claimed in claim 73, wherein the coil is substantially circular and all of the ferromagnetic slabs are arranged such that their lengths extend radially from a center of the circular coil but spaced apart therefrom.

75. (New) An inductive power transfer pad as claimed in claim 73, wherein:

the at least some of the ferromagnetic slabs are a first subset of the ferromagnetic slabs;

a second subset of the ferromagnetic slabs are arranged such that their length extends radially from a different common point but are spaced apart therefrom; and

a third subset of the ferromagnetic slabs are arranged such that their length are aligned perpendicularly to the direction of, and spaced apart from, an imaginary straight line connecting the said common points.

76. (New) An inductive power transfer pad as claimed in claim 74, wherein the third 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.

77. (New) An inductive power transfer pad as claimed in claim 72, wherein the coil is positioned to wind around the common point such that it passes each slab at approximately a center of the length of each slab.

78. (New) An inductive power transfer pad as claimed in claim 72, wherein the ferromagnetic slabs are ferrite.

79. (New) 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.

ABSTRACT

An inductive power transfer pad for transmitting wireless power to a wireless power receiver separable from the inductive power transfer pad. The inductive power transfer pad includes a coil having at least one turn of a conductor in a first layer and a plurality of ferromagnetic slabs arranged in a second layer substantially parallel to that of the coil, the ferromagnetic slabs being arranged so as to be spaced apart from one another about the coil with their lengths extending across a longitudinal length of the coil.

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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
20 November 2008 (20.11.2008)

PCT

(10) International Publication Number
WO 2008/140333 A2

(51) International Patent Classification: Not classified

(21) International Application Number:
PCT/NZ2008/000103

(22) International Filing Date: 9 May 2008 (09.05.2008)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
555128 10 May 2007 (10.05.2007) NZ
556646 20 July 2007 (20.07.2007) NZ

(71) Applicant *(for all designated States except US)*: **AUCKLAND UNISERVICES LIMITED** [NZ/NZ]; Level 10, 70 Symonds Street, Auckland, 1010 (NZ).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **BOYS, John, Talbot** [NZ/NZ]; 41A Dominion Street, Takapuna, Auckland, 1309 (NZ). **COVIC, Grant, Anthony** [NZ/NZ]; 28 Haverstock Road, Sandringham, Auckland, 1004 (NZ).

(74) Agent: **BALDWINS**; P O Box 5999, Wellesley Street, Auckland, 1141 (NZ).

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

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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

(54) Title: MULTI POWER SOURCED ELECTRIC VEHICLE

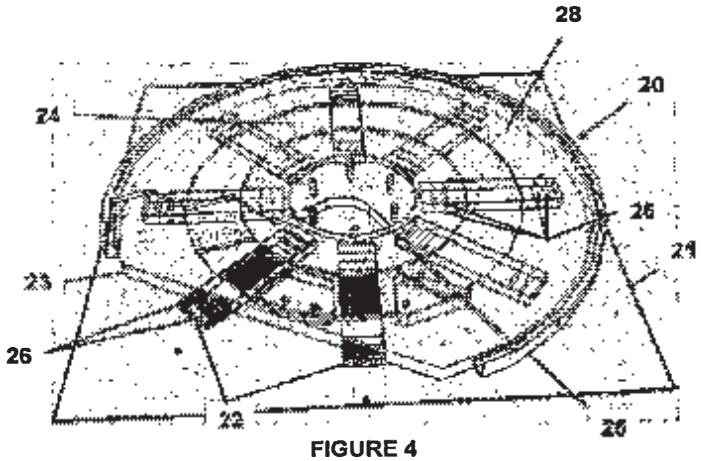


FIGURE 4

(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.

WO 2008/140333 A2

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 45°. 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.

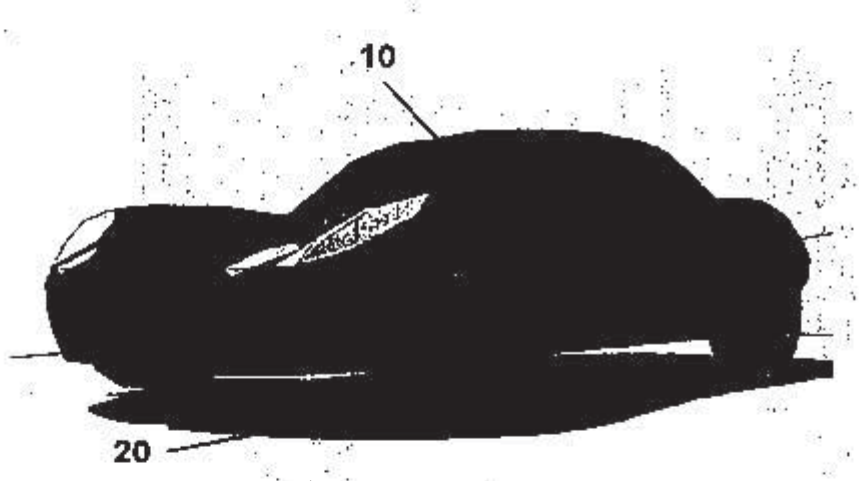


FIGURE 1

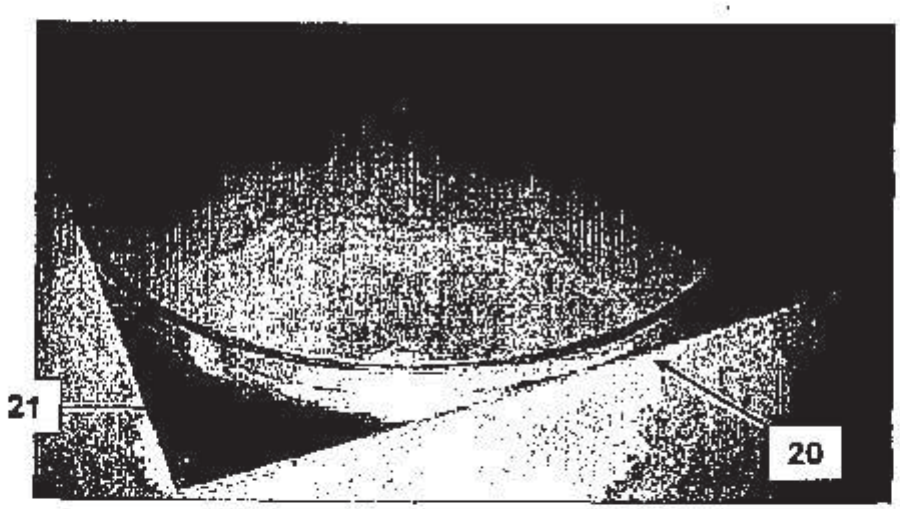


FIGURE 2

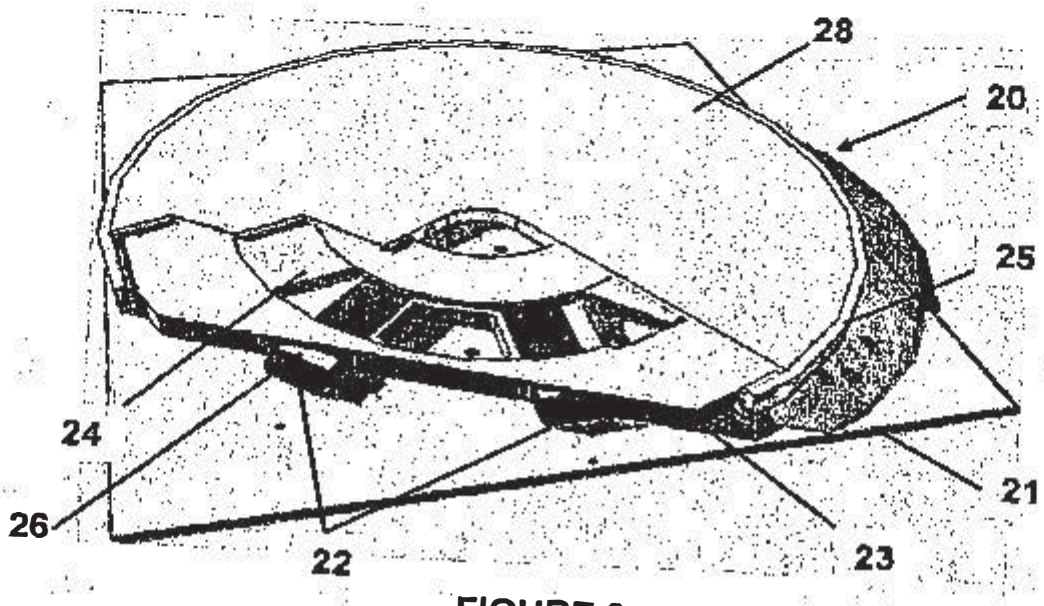


FIGURE 3

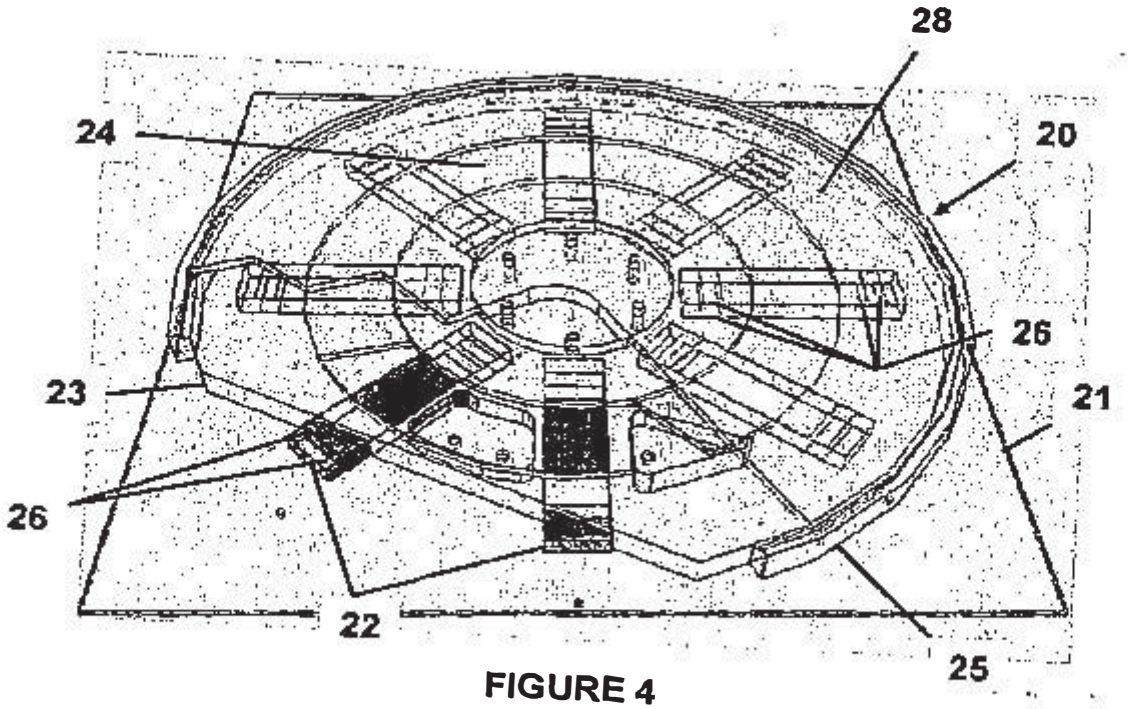


FIGURE 4

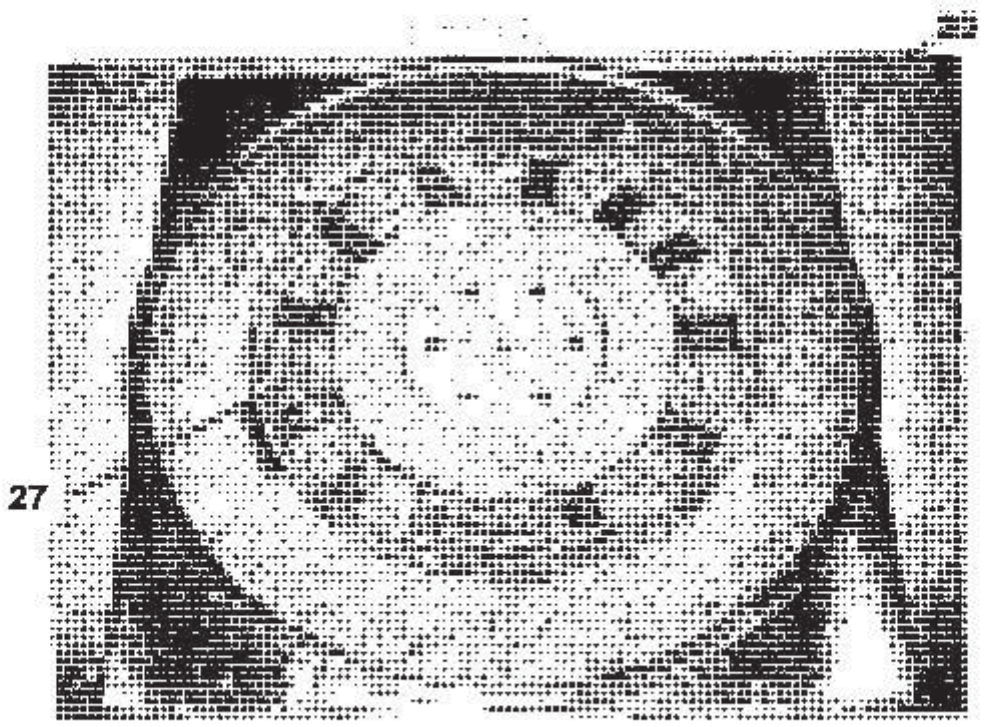


FIGURE 5

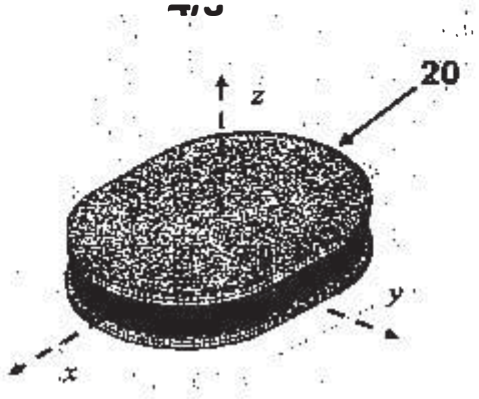


FIGURE 5A

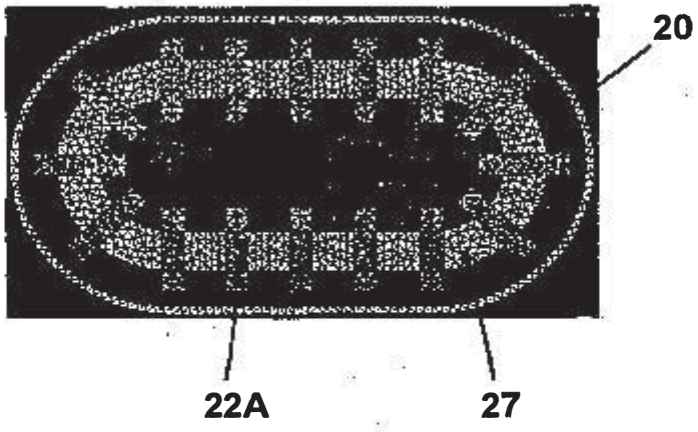


FIGURE 5B

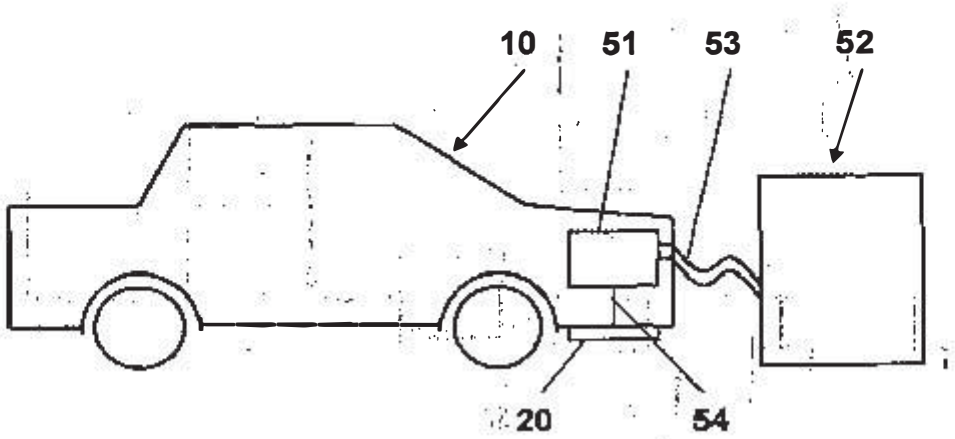


FIGURE 6

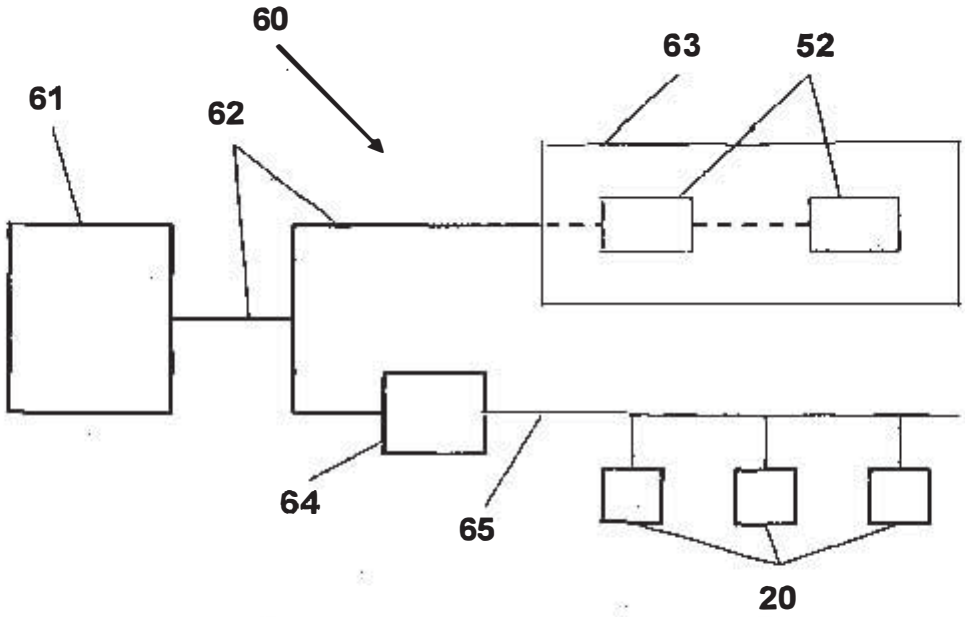


FIGURE 7

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of : John Talbot BOYS et al.

Serial No. : Div. of 12/451,436 Examiner:

Date Filed : Concurrently Herewith GAU: 2832

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

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.

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 along with filing of the present Divisional Application of Application Serial No. 12/451,436 filed January 13, 2010. Since each of the documents cited herein is of record in that parent application, it is believed that copies of the documents are not required.

It is believed that no fee is required for consideration of the present Information Disclosure Statement. However, if a fee is deemed to be required, the Office is authorized to charge any 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

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-Div 2	NYA
Applicant	
John Talbot BOYS et al.	
Filing Date	**Group**
Herewith	2832

U.S. PATENT DOCUMENTS

Examiner Initial		Document Number	Date	Name	Class	Subclass	Filing Date if Appropriate
	AA	5 4 6 9 0 3 6	Nov. 21, 1995	Eto			
	AB	4 8 7 3 6 7 7	Oct. 10, 1989	Sakamoto et al.			
	AC	6 5 0 1 3 6 4	Dec. 31, 2002	Hui et al.			
	AD	6 9 0 6 4 9 5	June 14, 2005	Cheng et al.			
	AE	5 5 2 8 1 1 3	June 18, 1996	Boys et al.			
	AF	5 7 1 0 5 0 2	Jan. 20, 1998	Poumey			
	AG	5 8 2 1 6 3 8	Oct. 13, 1998	Boys et al.			
	AH	6 9 3 4 1 6 7	Aug. 23, 2005	Jang et al.			
	AI						
	AJ						
	AK						
	AL						
	AM						
	AN						
	AO						
	AP						

FOREIGN PATENT DOCUMENTS

		Document Number	Date	Country	Class	Subclass	Translation Yes	Translation No
	AQ	JP 06 - 27 73 5 8	Oct. 4, 1994	Japan			Abst.	
	AR	JP 20 02 - 23 15 45	Aug. 16, 2002	Japan			Abst.	
	AS	JP 8 - 23 83 2 6	Sept. 17, 1996	Japan			Abst.	
	AT	JP T2 00 7- 50 54 80		Japan				

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

	AU	Notice of Reasons for Rejection in corresponding Japanese application p2010-507347 (Original and English Translation)
	AV	
	AW	
	AX	

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.

Form PTO-1449	U.S. Department of Commerce Patent and Trademark Office	Atty. Docket No.	Serial No.
		1172/69068-Div 2	NYA
		Applicant	
		John Talbot BOYS et al.	
	INFORMATION DISCLOSURE CITATION BY APPLICANT (Use several sheets if necessary)	Filing Date	Group
		Herewith	2832

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	No
	AQ							
	AR	03 - 23 9 1 3 6	Oct. 24, 1991	Japan			Abst.	
	AS	WO 20 05 02 48 6 5	March 17, 2005	PCT				
	AT	WO 20 06 10 12 8 5	Sept. 28, 2006	PCT				

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

	AU	
	AV	
	AW	
	AX	

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.

Form PTO-1449	U.S. Department of Commerce Patent and Trademark Office	Atty. Docket No. 1172/69068-Div 2	Serial No. NYA
		Applicant John Talbot BOYS et al.	
	INFORMATION DISCLOSURE CITATION BY APPLICANT (Use several sheets if necessary)	Filing Date Herewith	Group 2832

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 - 6 4 3 9 3	Sept. 9, 1994	Japan			X	
	AR	6 - 6 6 2 0 6	Sept. 16, 1994	Japan			X	
	AS	11 - 09 7 2 6 3	Apr. 9, 1999	Japan			X	
	AT	20 04 - 47 7 0 1	Feb. 12, 2004	Japan			X	

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

	AU	
	AV	
	AW	
	AX	

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.

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-Div 2	NYA
Applicant	
John Talbot BOYS et al.	
Filing Date	**Group**
Herewith	2832

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	WO 2008/051611	May 2, 2008	WIPO				
	AR	2002-345575	Nov. 29, 2002	Japan			X	
	AS	2000-207025	July 18, 2000	Japan			X	
	AT	6-86321	Dec. 13, 1994	Japan			X	

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

	AU	
	AV	
	AW	
	AX	

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.

The PTO did not receive the following listed item(s)

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.

5

Amendments to the Specification:

Please add the following new paragraph after the title on page 1:

REFERENCE TO RELATED APPLICATIONS

The present disclosure is a Divisional Application of co-pending U.S. Patent Application Serial No. 12/451,436 filed January 13, 2010 which is based on and claims benefit from International Application Number PCT/NZ2008/000103 filed on May 9, 2008 which claims benefit from New Zealand applications 555128 filed May 10, 2007 and 556646 filed July 20, 2007, the entire contents of each of which are herein incorporated by reference.

Please add the attached sheet entitled "ABSTRACT" to the end of the specification of the present application.

REMARKS

Claims 72-79 are pending in this application, with claims 72 and 79 being in independent form. Claims 1-71 have been canceled without prejudice and claims 72-79 have been added. It is submitted that no new matter has been added and no new issues have been raised by the present Amendment.

Any additional fees required for consideration of this Preliminary Amendment may be charged to Deposit Account No. 50-5504.

If a 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. 50-5504.

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
The Law Office of
Richard F. Jaworski, P.C.
Tel.: (631) 659-3608
Customer No. 14443

PATENT APPLICATION SERIAL NO. _____

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

05/07/2014 MBLANCO 00000016 14120197

01 FC:1011 200.00 OP
02 FC:1090 400.00 OP
03 FC:1111 500.00 OP
04 FC:1311 720.00 OP

PTO – 1556
(5/87)

*U.S. Government Printing Office 2002-489-267/69033

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number	Filing Date	To be Mailed
14/120,197	05/05/2014	☐

ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	x $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	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 $310 ($155 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	

APPLICATION AS AMENDED – PART II

AMENDMENT 05/05/2014

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	* 8	Minus	** 20	= 0	x $80 =	0
Independent (37 CFR 1.16(h))	* 1	Minus	***3	= 0	x $420 =	0
☐ Application Size Fee (37 CFR 1.16(s))						
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					TOTAL ADD'L FEE	0

AMENDMENT

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	*	Minus	**	=	x $ =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	x $ =	
☐ Application Size Fee (37 CFR 1.16(s))						
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					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.

LDRC
/ANDREW JAMES JR/

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 14/120,197	Filing Date 05/05/2014	☐ To be Mailed

ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	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 $310 ($155 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	

APPLICATION AS AMENDED – PART II

AMENDMENT 05/05/2014

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	* 8	Minus	** 20	=	X $ =	
Independent (37 CFR 1.16(h))	* 1	Minus	***3	=	X $ =	
☐ Application Size Fee (37 CFR 1.16(s))						
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					TOTAL ADD'L FEE	

AMENDMENT

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =	
☐ Application Size Fee (37 CFR 1.16(s))						
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					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.

LDRC
/ANDREW JAMES JR/

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number	Filing Date	To be Mailed
14/120,197	05/05/2014	☐

ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	x $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	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 $310 ($155 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	

APPLICATION AS AMENDED – PART II

AMENDMENT 05/05/2014

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	* 8	Minus	** 20	= 0	x $80 =	0
Independent (37 CFR 1.16(h))	* 1	Minus	***3	= 0	x $420 =	0
☐ Application Size Fee (37 CFR 1.16(s))						
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					TOTAL ADD'L FEE	0

AMENDMENT

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	*	Minus	**	=	x $ =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	x $ =	
☐ Application Size Fee (37 CFR 1.16(s))						
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					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.

LDRC
/ANDREW JAMES JR/

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 NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
14/120,197	05/05/2014	John Talbot Boys	1172/69068-Div 2

CONFIRMATION NO. 4659

14443
The Law Office of Richard F. Jaworski, PC
273 Walt Whitman Road
Suite 327
Huntington Station, NY 11746-4149

FORMALITIES LETTER

OC000000068501169

Date Mailed: 05/16/2014

NOTICE TO FILE CORRECTED APPLICATION PAPERS

Filing Date Granted

An application number and filing date have been accorded to this application. The application is informal since it does not comply with the regulations for the reason(s) indicated below. Applicant is given TWO MONTHS from the date of this Notice within which to correct the informalities indicated below. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

The required item(s) identified below must be timely submitted to avoid abandonment:

- Replacement drawings in compliance with 37 CFR 1.84 and 37 CFR 1.121(d) are required. The drawings submitted are not acceptable because:
  - The drawings submitted to the Office are not electronically reproducible because portions of figures 1-5B are missing and/or blurry.

Applicant is cautioned that correction of the above items may cause the specification and drawings page count to exceed 100 pages. If the specification and drawings exceed 100 pages, applicant will need to submit the required application size fee.

Items Required To Avoid Processing Delays:

Applicant is notified that the above-identified application contains the deficiencies noted below. No period for reply is set forth in this notice for correction of these deficiencies. However, if a deficiency relates to the inventor's oath or declaration, the applicant must file an oath or declaration in compliance with 37 CFR 1.63, or a substitute statement in compliance with 37 CFR 1.64, executed by or with respect to each actual inventor no later than the expiration of the time period set in the "Notice of Allowability" to avoid abandonment. See 37 CFR 1.53(f).

A new inventor's oath or declaration that identifies this application (e.g., by Application Number and filing date) is required. The inventor's oath or declaration does not comply with 37 CFR 1.63 in that it:

- does not state that the above-identified application was made or authorized to be made by the person executing the oath or declaration.
  John Talbot Boys
  Grant Anthony Covic

Replies must be received in the USPTO within the set time period or must include a proper Certificate of Mailing or Transmission under 37 CFR 1.8 with a mailing or transmission date within the set time period. For more information and a suggested format, see Form PTO/SB/92 and MPEP 512.

Replies should be mailed to:

Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

Registered users of EFS-Web may alternatively submit their reply to this notice via EFS-Web, including a copy of this Notice and selecting the document description "Applicant response to Pre-Exam Formalities Notice". 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.

/tnguyen/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 14/120,197

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	280
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	600
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	720
TOTAL CLAIMS (37 CFR 1.16(i))	8 minus 20 =	*			OR	x 80 =	0.00
INDEPENDENT CLAIMS (37 CFR 1.16(h))	1 minus 3 =	*				x 420 =	0.00
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 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).						0.00
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	1600

APPLICATION AS AMENDED - PART II

AMENDMENT A

	(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))	*	Minus	**	=	x =		OR	x =	
Independent (37CFR 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	

AMENDMENT B

	(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 (37CFR 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 found in the appropriate box in column 1.

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 NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
14/120,197	05/05/2014	3742	2000	1172/69068-Div 2	8	1

CONFIRMATION NO. 4659

14443
The Law Office of Richard F. Jaworski, PC
273 Walt Whitman Road
Suite 327
Huntington Station, NY 11746-4149

FILING RECEIPT

OC0000000068501168

Date Mailed: 05/16/2014

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**

Inventor(s)

John Talbot Boys, Auckland, NEW ZEALAND;
Grant Anthony Covic, Auckland, NEW ZEALAND;

Applicant(s)

John Talbot Boys, Auckland, NEW ZEALAND;
Grant Anthony Covic, Auckland, NEW ZEALAND;

Assignment For Published Patent Application

Auckland Uniservices Limited, Auckland, NEW ZEALAND

Power of Attorney:

Christopher Dunham--22031
Ivan Kavrukov--25161
Norman Zivin--25385
John White--28678
Peter Phillips--29691
Robert Katz--30141
Richard Jaworski--33515
Richard Milner--33970
Paul Teng--40837

Domestic Priority data as claimed by applicant

This application is a DIV of 12/451,436 01/13/2010

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access - A proper **Authorization to Permit Access to Application by Participating Offices** (PTO/SB/39 or its equivalent) has been received by the USPTO.

If Required, Foreign Filing License Granted: 05/16/2014

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 14/120,197**

Projected Publication Date: To Be Determined - pending completion of Corrected Papers

Non-Publication Request: No

Early Publication Request: No

Title

Multi power sourced electric vehicle

Preliminary Class

219

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

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 (1-866-999-4258).

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).

Dkt. 1172/69068-Div. 2

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of : John Talbot BOYS et al.

Serial No. : 14/120,197

Filing Date : May 5, 2014

For : MULTI POWER SOURCED ELECTRIC VEHICLE

273 Walt Whitman Rd, Suite 327
Huntington Sta. NY 11746-4149

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

RESPONSE TO NOTICE TO FILE CORRECTED APPLICATION PAPERS

Sir:

In Response to the Notice to File Corrected Application Papers dated May 16, 2014, Applicants submit herewith Replacement Sheets of drawings to replace sheets 1-4 (Figs. 1-5b). A copy of the Notice is also enclosed.

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

Sept. 16, 2014

Richard F. Jaworski — Date
Reg. No. 33,515

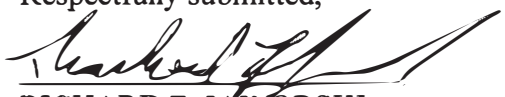
Applicants also submit herewith a new inventor's declaration to even more closely comply with 37 CFR 1.63.

Submitted herewith is a modified page of the Application Data Sheet that has been modified to move reference to the corresponding PCT application to its proper place. The changes are shown by underline and strikethrough as required by the Rules.

The Commissioner is authorized to charge any additional fees as required for entry of this Response, or to credit any overpayment, to our Deposit Account No. 50-5504.

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. 50-5504.

Respectfully submitted,



RICHARD F. JAWORSKI
Reg. No. 33,515
Attorney for Applicants
The Law Office of Richard F. Jaworski, PC
Tel.: (631) 659-3608

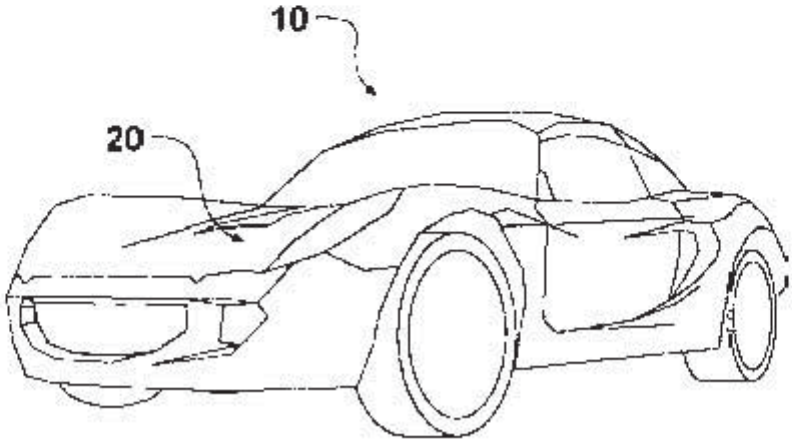


Figure 1

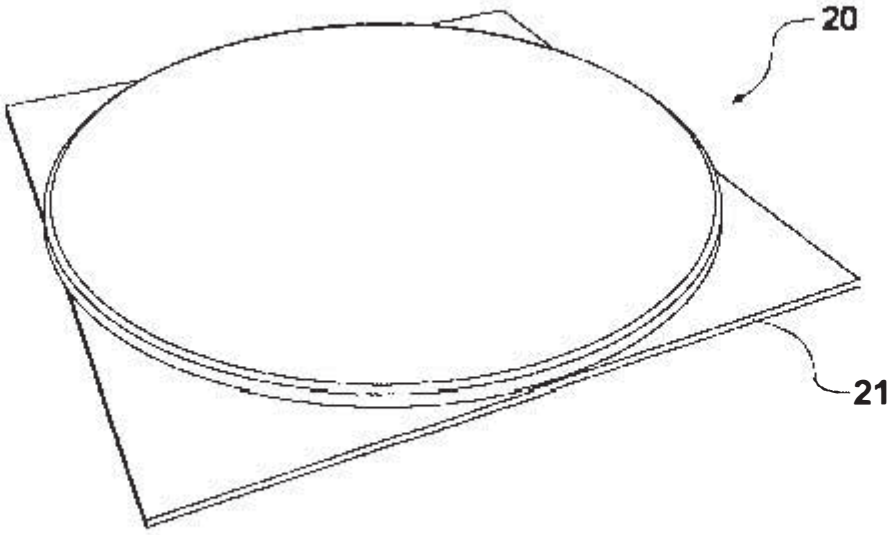


Figure 2

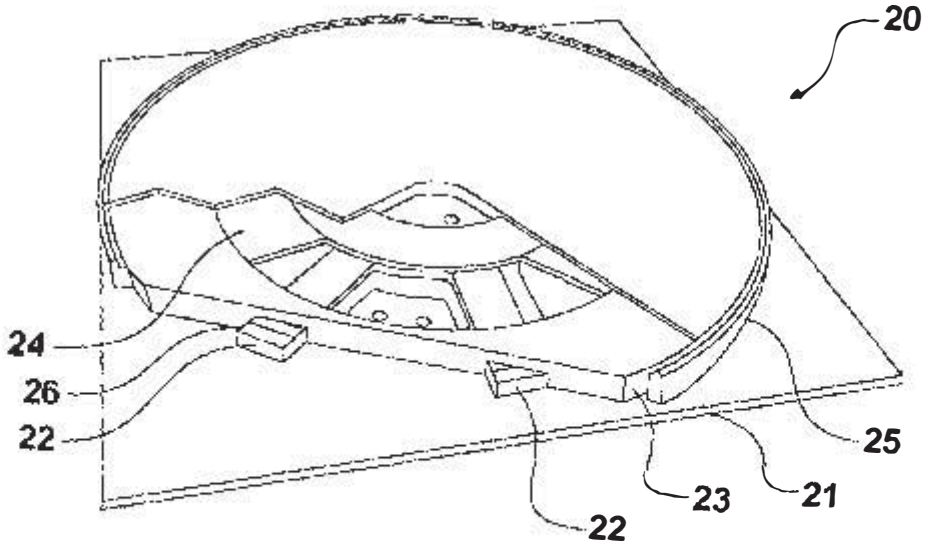


Figure 3

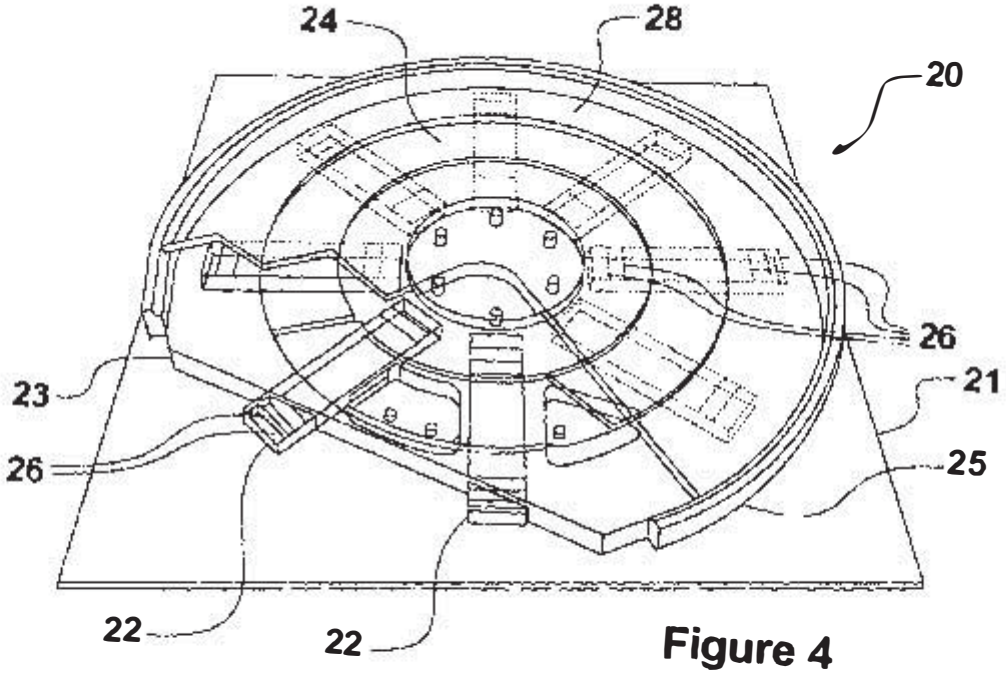


Figure 4

REPLACEMENT SHEET

3/5

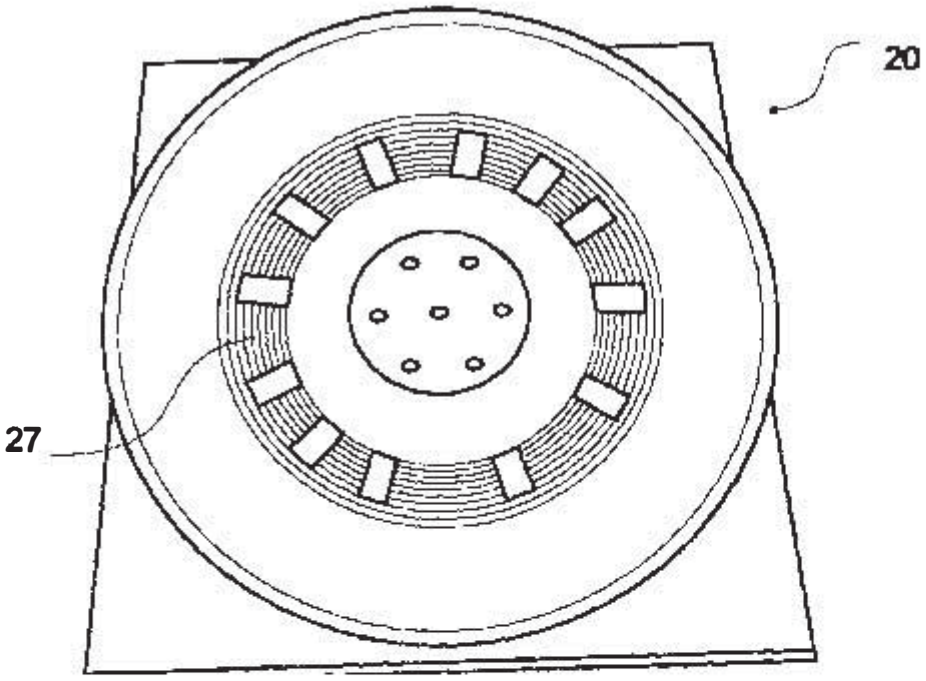


Figure 5

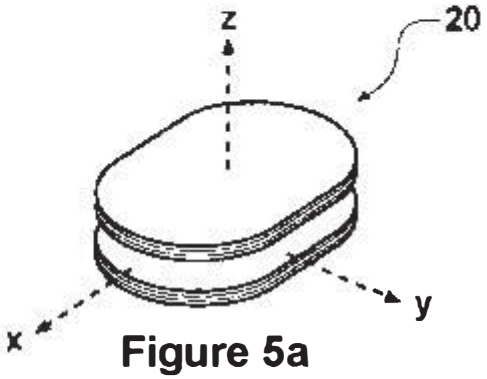


Figure 5a

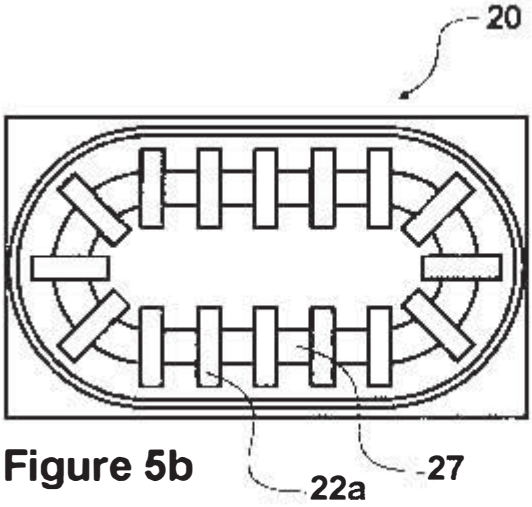


Figure 5b

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 NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
14/120,197	05/05/2014	John Talbot Boys	1172/69068-Div 2

CONFIRMATION NO. 4659

14443
The Law Office of Richard F. Jaworski, PC
273 Walt Whitman Road
Suite 327
Huntington Station, NY 11746-4149

FORMALITIES LETTER

Date Mailed: 05/16/2014

7/16/14 Resp
8/16/14 x1
9/16/14 x2
10/16/14 x3

NOTICE TO FILE CORRECTED APPLICATION PAPERS

Filing Date Granted

An application number and filing date have been accorded to this application. The application is informal since it does not comply with the regulations for the reason(s) indicated below. Applicant is given TWO MONTHS from the date of this Notice within which to correct the informalities indicated below. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

The required item(s) identified below must be timely submitted to avoid abandonment:

- Replacement drawings in compliance with 37 CFR 1.84 and 37 CFR 1.121(d) are required. The drawings submitted are not acceptable because:
  - The drawings submitted to the Office are not electronically reproducible because portions of figures 1-5B are missing and/or blurry.

Applicant is cautioned that correction of the above items may cause the specification and drawings page count to exceed 100 pages. If the specification and drawings exceed 100 pages, applicant will need to submit the required application size fee.

Items Required To Avoid Processing Delays:

Applicant is notified that the above-identified application contains the deficiencies noted below. No period for reply is set forth in this notice for correction of these deficiencies. However, if a deficiency relates to the inventor's oath or declaration, the applicant must file an oath or declaration in compliance with 37 CFR 1.63, or a substitute statement in compliance with 37 CFR 1.64, executed by or with respect to each actual inventor no later than the expiration of the time period set in the "Notice of Allowability" to avoid abandonment. See 37 CFR 1.53(f).

A new inventor's oath or declaration that identifies this application (e.g., by Application Number and filing date) is required. The inventor's oath or declaration does not comply with 37 CFR 1.63 in that it:

- does not state that the above-identified application was made or authorized to be made by the person executing the oath or declaration.
  John Talbot Boys
  Grant Anthony Covic

Replies must be received in the USPTO within the set time period or must include a proper Certificate of Mailing or Transmission under 37 CFR 1.8 with a mailing or transmission date within the set time period. For more information and a suggested format, see Form PTO/SB/92 and MPEP 512.

Replies should be mailed to:

Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

Registered users of EFS-Web may alternatively submit their reply to this notice via EFS-Web, including a copy of this Notice and selecting the document description "Applicant response to Pre-Exam Formalities Notice". 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.

/tnguyen/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

Doc Code: Oath
Document Description: Oath or declaration filed

PTO/AIA/08 (06-12)
Approved for use through 01/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)

☐ Declaration Submitted With Initial Filing OR ■ Declaration Submitted After Initial Filing (surcharge (37 CFR 1.16(f)) required)

Attorney Docket Number	1172/69068-Div 2
First Named Inventor	John Talbot BOYS
COMPLETE IF KNOWN	
Application Number	14/120,197
Filing Date	May 5, 2014
Art Unit	3742
Examiner Name	

MULTI POWER SOURCED ELECTRIC VEHICLE

(Title of the Invention)

As a below named inventor, I hereby declare that:

This declaration is directed to:

☐ The attached application,

OR

■ United States Application Number or PCT International application number 14/120,197 filed on May 5, 2014

The above-identified application was made or authorized to be made by me.

I believe I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

Authorization To Permit Access To Application by Participating Office

If checked, the undersigned hereby grants the USPTO authority to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the World Intellectual Property Office (WIPO), and any other intellectual property offices in which a foreign application claiming priority to the above-identified patent application is filed access to the above-identified patent application. See 37 CFR 1.14(c) and (h). This box should not be checked if the applicant does not wish the EPO, JPO, KIPO, WIPO, or other intellectual property office in which a foreign application claiming priority to the above-identified patent application is filed to have access to the above-identified patent application.

In accordance with 37 CFR 1.14(h)(3), access will be provided to a copy of the above-identified patent application with respect to: 1) the above-identified patent application-as-filed; 2) any foreign application to which the above-identified patent application claims priority under 35 U.S.C. 119(a)-(d) if a copy of the foreign application that satisfies the certified copy requirement of 37 CFR 1.55 has been filed in the above-identified patent application; and 3) any U.S. application-as-filed from which benefit is sought in the above-identified patent application.

In accordance with 37 CFR 1.14(c), access may be provided to information concerning the date of filing the Authorization to Permit Access to Application by Participating Offices.

PTO/AIA/08 (06-12)
Approved for use through 01/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

DECLARATION — Utility or Design Patent Application

Direct all correspondence to: ☒ The address associated with Customer Number: 14443 OR ☐ Correspondence address below

Name

Address

City | State | Zip

Country | Telephone | Email

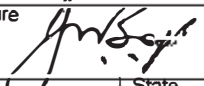
WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available. Petitioner/applicant is advised that documents which form the record of a patent application (such as the PTO/SB/01) are placed into the Privacy Act system of records DEPARTMENT OF COMMERCE, COMMERCE-PAT-7, System name: *Patent Application Files* . Documents not retained in an application file (such as the PTO-2038) are placed into the Privacy Act system of COMMERCE/PAT-TM-10, System name: *Deposit Accounts and Electronic Funds Transfer Profiles* .

LEGAL NAME OF SOLE OR FIRST INVENTOR:

(*E.g.*, Given Name (first and middle (if any)) and Family Name or Surname)

John Talbot BOYS

Inventor's Signature  Date (Optional) 17-7-2014

Residence: City Auckland | State | Country New Zealand

Mailing Address 16 Campbell Road, Takapuna

City Auckland | State | Zip 0622 | Country New Zealand

☒ Additional inventors are being named on the 1 supplemental sheet(s) PTO/AIA/10 attached hereto

PTO/AIA/10 (08-12)
Approved for use through 01/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

SUPPLEMENTAL SHEET FOR DECLARATION | **ADDITIONAL INVENTOR(S)**
Supplemental Sheet (for PTO/AIA/08,09) Page 3 of 3

Legal Name of Additional Joint Inventor, if any:

(*E.g.*, Given Name (first and middle (if any)) and Family Name or Surname)

Grant Anthony COVIC

Inventor's Signature [signature] Date (Optional) 29/7/2014

Residence: City Auckland | State | Country New Zealand

Mailing Address 42 Lloyd Ave., Mr. Albert

City Auckland | State | Zip 1025 | Country New Zealand

Legal Name of Additional Joint Inventor, if any:

(*E.g.*, Given Name (first and middle (if any)) and Family Name or Surname)

Inventor's Signature | Date (Optional)

Residence: City | State | Country

Mailing Address

City | State | Zip | Country

Legal Name of Additional Joint Inventor, if any:

(*E.g.*, Given Name (first and middle (if any)) and Family Name or Surname)

Inventor's Signature | Date (Optional)

Residence: City | State | Country

Mailing Address

City | State | Zip | Country

updated Application Data Sheet
Appln S/N 14/120,197

PTO/AIA/14 (03-13)
Approved for use through 01/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1172/69068-Div 2
	Application Number	
Title of Invention	Multi Power Sourced Electric Vehicle	

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
	a 371 of international	PCT/NZ2008/000103	2008-05-09

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button.

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55(d). When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(h)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Remove

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)
~~PCT/NZ2008/000103~~	~~WO~~	~~2008-05-09~~	

Remove

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)
555128	NZ	2007-05-10	

Remove

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)
556646	NZ	2007-07-20	

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button.

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

Dkt. 1172/69068-Div. 2

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of: John Talbot BOYS et al.

Serial No. : 14/120,197

Date Filed : May 5, 2014

For : MULTI POWER SOURCED ELECTRIC VEHICLE

273 Walt Whitman Rd., Suite 327
Huntington Sta. NY 11746-4149

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

PETITION FOR EXTENSION OF TIME

Sir:

It is respectfully requested that the period for filing a response to the Notice to File Corrected Application Papers dated May 16, 2014, be extended by two month(s), i.e. from July 16, 2014 to September 16, 2014.

The $600.00 statutory extension fee for filing a response within the second month pursuant to 1.136(a) by (other than) a small entity may be charged to the below indicated deposit account.

The Commissioner is authorized to charge any additional fees, or credit any overpayment, to our Deposit Account No. 50-5504.

Respectfully submitted,

RICHARD F. JAWORSKI
Registration No. 33,515
Attorney for Applicant
The Law Office of
Richard F. Jaworski, P.C.
Tel.: (631) 659-3608

09/19/2014 HVUONG2 00000004 505504 14120197
01 FC:1252 600.00 DA

I hereby certify that this paper is being deposited this date with the U.S. Postal Service as first class mail addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450

Richard F. Jaworski — Sept. 16, 2014 — Date
Reg. No. 33,515

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 14/120,197

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	280
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	600
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	720
TOTAL CLAIMS (37 CFR 1.16(i))	8 minus 20 =	*			OR	x 80 =	0.00
INDEPENDENT CLAIMS (37 CFR 1.16(h))	1 minus 3 =	*				x 420 =	0.00
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 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).						0.00
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	1600

APPLICATION AS AMENDED - PART II

AMENDMENT A

	(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))	*	Minus	**	=	x =		OR	x =	
Independent (37CFR 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	

AMENDMENT B

	(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))	*	Minus	**	=	x =		OR	x =	
Independent (37CFR 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 found in the appropriate box in column 1.

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 NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
14/120,197	05/05/2014	3742	2000	1172/69068-Div. 2	8	1

CONFIRMATION NO. 4659

UPDATED FILING RECEIPT

14443
The Law Office of Richard F. Jaworski, PC
273 Walt Whitman Road
Suite 327
Huntington Station, NY 11746-4149

OC000000071031887

Date Mailed: 09/29/2014

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**

Inventor(s)

John Talbot Boys, Auckland, NEW ZEALAND;
Grant Anthony Covic, Auckland, NEW ZEALAND;

Applicant(s)

John Talbot Boys, Auckland, NEW ZEALAND;
Grant Anthony Covic, Auckland, NEW ZEALAND;

Assignment For Published Patent Application

Auckland Uniservices Limited, Auckland, NEW ZEALAND

Power of Attorney:

Christopher Dunham--22031
Ivan Kavrukov--25161
Norman Zivin--25385
John White--28678
Peter Phillips--29691
Robert Katz--30141
Richard Jaworski--33515
Richard Milner--33970
Paul Teng--40837

Domestic Priority data as claimed by applicant

This application is a DIV of 12/451,436 01/13/2010 PAT 8749334

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access - A proper **Authorization to Permit Access to Application by Participating Offices** (PTO/SB/39 or its equivalent) has been received by the USPTO.

If Required, Foreign Filing License Granted: 05/16/2014

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 14/120,197**

Projected Publication Date: 01/08/2015

Non-Publication Request: No

Early Publication Request: No
Title

Multi power sourced electric vehicle

Preliminary Class

219

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

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 (1-866-999-4258).

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
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
14/120,197	05/05/2014	John Talbot Boys	1172/69068-Div. 2

CONFIRMATION NO. 4659

IMPROPER CFR REQUEST

14443
The Law Office of Richard F. Jaworski, PC
273 Walt Whitman Road
Suite 327
Huntington Station, NY 11746-4149

OC000000071032016

Date Mailed: 09/29/2014

RESPONSE TO REQUEST FOR CORRECTED FILING RECEIPT

Power of Attorney, Claims, Fees, System Limitations, and Miscellaneous

In response to your request for a corrected Filing Receipt, the Office is unable to comply with your request because:

- The ADS submitted on 09-19-2014 was not properly signed. An application data sheet must be signed in compliance with 37 CFR 1.33(b). An unsigned application data sheet will be treated only as a transmittal letter. See 37 CFR 1.76(e).

/lqchau/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

Dkt. 1172/69068-Div. 2

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of : John Talbot BOYS et al.

Serial No. : 14/120,197 Examiner:

Date Filed : May 5, 2014 GAU: 3742

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

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.

The cited documents were both third party submissions in a corresponding Japanese patent application. In addition, document WO 03/105308 was recently cited by the EPO in an extended European Search Report.

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.

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 — Nov. 14, 2014 (Date)
Reg. No. 33,515

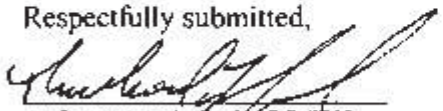
The citation of the listed items is not a representation that they constitute a complete or exhaustive listing of the relevant art or that these items are prior art. The items listed are submitted in good faith, but are not intended to substitute for the Examiner's search. It is hoped, however, that 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 prior to receipt of an action on the merits. Accordingly, it is believed that no fee is required for consideration of the present Information Disclosure Statement. However, if a fee is deemed to be required, the Office is authorized to charge any 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

Form PTO-1449	U.S. Department of Commerce Patent and Trademark Office	Atty. Docket No. 1172/69068-Div. 2	Serial No. 14/120,197
		Applicant John Talbot BOYS et al.	
	INFORMATION DISCLOSURE CITATION BY APPLICANT (Use several sheets if necessary)	Filing Date March 14, 2014	Group 3742

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	JP 2006-425197	Feb. 9, 2006	Japan			X	
	AR	WO 03/105318	Dec. 18, 2003	WIPO				
	AS							
	AT							

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

	AU	
	AV	
	AW	
	AX	

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.

【書類名】 刊行物等提出書
【あて先】 特許庁長官殿
【事件の表示】
【出願番号】 特願2010-507347
【提出者】
【住所又は居所】 省略
【氏名又は名称】 省略
【提出する刊行物等】 文献１：特開２００６－４２５１９号公報、文献２：国際公開２００３／１０５３０８号公報
【提出物件の目録】
【物件名】 特開２００６－４２５１９号公報 1
【物件名】 国際公開２００３／１０５３０８号公報 1

JP 2006-42519 A 2006.2.9

(19)日本国特許庁(JP) (12)公開特許公報(A) (11)特許出願公開番号
特開2006-42519
(P2006-42519A)
(43)公開日 平成18年2月9日(2006.2.9)

(51)Int.Cl.'		F I			テーマコード(参考)
H02J	17/00	H02J	17/00	B	5G003
H02J	7/00	H02J	7/00	301 D	

【添付書類】
12 199

審査請求 未請求 請求項の数 10 OL (全12頁)

(21)出願番号 特願2004-219904(P2004-219904)
(22)出願日 平成16年7月28日(2004.7.28)

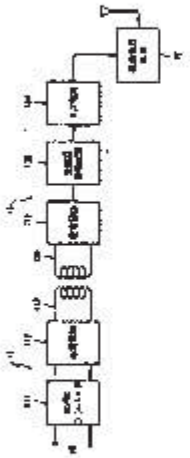
(71)出願人 000002369
セイコーエプソン株式会社
東京都新宿区西新宿2丁目4番1号
(74)代理人 100066980
弁理士 森 哲也
(74)代理人 100075579
弁理士 内藤 嘉昭
(74)代理人 100103850
弁理士 崔 秀▲てつ▼
(72)発明者 石澤 幸二
長野県諏訪市大和3丁目3番5号 セイコーエプソン株式会社内
(72)発明者 高木 勉
長野県諏訪市大和3丁目3番5号 セイコーエプソン株式会社内

Fターム(参考) 5G003 AA01 BA01 FA03 GB08

【裏面有】

(54)【発明の名称】非接触電力伝送装置

(57)【要約】
【課題】非接触電力伝送に使用される送電コイルと受電コイルの薄型化を図る際に、そのコイルからの不要輻射を抑制し、かつ、電力伝送の効率化を図ること。
【解決手段】この発明は、送電装置１１と受電装置１３からなり、動作時に、送電コイル１１３と受電コイル１３１とが電磁的に結合することにより、非接触で電力伝送を行うようになっている。両コイル１１３、１３１は、渦巻き状であってその平面が対向するようになっている平面コイルからなる。さらに、その両平面コイルは、両者が対向する面の反対側の面に、両コイルの発生する磁界による不要輻射を抑える磁性シートが、その面全体を覆うようにそれぞれ設けられている。
【選択図】 図１



【特許請求の範囲】
【請求項１】
第１コイルを含む送電装置と、第２コイルおよび２次電池を含む受電装置とを備え、
前記送電装置は、前記第１コイルが前記第２コイルと電磁結合するときに、前記第１コイルに供給する交流を生成する送電手段を有し、
前記受電装置は、前記第２コイルが前記第１コイルと電磁結合するときに、前記第２コイルに誘起される交流を直流に変換し、この変換された直流により前記２次電池の充電を行う受電手段を有し、
さらに、前記第１コイルおよび前記第２コイルは、渦巻き状であってその平面が対向するようになっている第１平面コイルおよび第２平面コイルからなり、
かつ、前記第１平面コイルおよび前記第２平面コイルは、その両者が対向する面の反対側の面に、磁性シートをそれぞれ設けたことを特徴とする非接触電力伝送装置。
【請求項２】
前記第１平面コイルおよび前記第２平面コイルに設けた各磁性シートの外側面に、さらに、金属シートをそれぞれ重ねて設けたことを特徴とする請求項１に記載の非接触電力伝送装置。
【請求項３】
前記受電装置を構成する前記第２コイル、前記受電手段、および前記２次電池のうち、少なくとも前記第２コイルと前記２次電池を一体化したことを特徴とする請求項１または請求項２に記載の非接触電力伝送装置。
【請求項４】
前記受電装置を構成する前記第２コイル、前記受電手段、および前記２次電池のうち、少なくとも前記第２コイルと前記２次電池は、所定のケース内に収容し又は固形化するようにしたことを特徴とする請求項１または請求項２に記載の非接触電力伝送装置。
【請求項５】
前記受電装置は、携帯電話に搭載させたことを特徴とする請求項１乃至請求項４のうちのいずれか１の請求項に記載の非接触電力伝送装置。
【請求項６】
第１コイルを含む送電装置と、第２コイルおよび第１の２次電池を含む送電・受電兼用装置と、第３コイルおよび第２の２次電池を含む受電装置とを備え、
前記送電装置は、
前記第１コイルが前記第２コイルまたは前記第３コイルと電磁結合するときに、前記第１コイルに供給する交流を生成する送電手段を有し、
前記送電・受電兼用装置は、
前記第２コイルが前記第３コイルと電磁結合するときに、前記第１の２次電池を電源として用いて前記第２コイルに供給する交流を生成する送電手段と、
前記第２コイルが前記第１コイルと電磁結合するときに、その第２コイルに誘起される交流を直流に変換し、この変換された直流により前記第１の２次電池の充電を行う受電手段とを有し、
前記受電装置は、
前記第３コイルが前記第１コイルまたは前記第２コイルと電磁結合するときに、その第３コイルに誘起される交流を直流に変換し、この変換された直流により前記第２の２次電池の充電を行う受電手段を有し、
さらに、前記第１コイル、前記第２コイル、および前記第３コイルは、渦巻き状であってその平面が相互に対向するようになっている第１平面コイル、第２平面コイル、および第３平面コイルからなり、
かつ、前記第１平面コイル、第２平面コイル、および前記第３平面コイルは、それぞれ対向する面の反対側の面に、磁性シートを設けたことを特徴とする非接触電力伝送装置。
【請求項７】
前記第１平面コイル、前記第２平面コイル、および前記第３平面コイルに設けた各磁性

シートの外側面に、さらに、金属シートをそれぞれ重ねて設けたことを特徴とする請求項６に記載の非接触電力伝送装置。

【請求項８】

前記送電・受電兼用装置を構成する前記第２コイル、前記送電手段、前記受電手段、および前記第１の２次電池のうち、少なくとも前記第２コイルと前記第１の２次電池を一体化し、

かつ、前記受電装置を構成する前記第３コイル、前記受電手段、および前記第２の２次電池のうち、少なくとも前記第３コイルと前記第２の２次電池を一体化したことを特徴とする請求項６または請求項７に記載の非接触電力伝送装置。

【請求項９】

前記送電・受電兼用装置を構成する前記第２コイル、前記送電手段、前記受電手段、および前記第１の２次電池のうち、少なくとも前記第２コイルと前記第１の２次電池は、所定のケース内に収容し又は固形化するようにし、

かつ、前記受電装置を構成する前記第３コイル、前記受電手段、および前記第２の２次電池のうち、少なくとも前記第３コイルと前記第２の２次電池は、所定のケース内に収容し又は固形化するようにしたことを特徴とする請求項６または請求項７に記載の非接触電力伝送装置。

【請求項１０】

前記送電・受電兼用装置および前記受電装置は、それぞれ携帯電話に搭載させたことを特徴とする請求項６乃至請求項９のうちのいずれか１の請求項に記載の非接触電力伝送装置。

【発明の詳細な説明】

【技術分野】

【０００１】

本発明は、例えば携帯電話のような携帯端末と充電器との間などで、非接触電力伝送を行うことができる非接触電力伝送装置に関するものである。

【背景技術】

【０００２】

従来、この種の非接触電力伝送装置としては、携帯用通信機の本体底部の形状に関係なく、充電部の送電コイルと被充電部の受電コイルとの間の電磁誘導による非接触電力伝送の効率向上を図るようにしたものが知られている（例えば、特許文献１、特許文献２を参照）。

そして、送電コイルは送電コイル用コアに巻かれ、受電コイルは受電コイル用コアに巻かれている。また、送電コイル用コアと受電コイル用コアとはいずれも棒状体で構成され、使用時には、その両コアの端面同士が対向するようになっている。

【特許文献１】特開平１０－４６３９号公報

【特許文献２】特開平１０－１４１２４号公報

【発明の開示】

【発明が解決しようとする課題】

【０００３】

ところで、従来の非接触電力伝送装置に使用される送電コイルと受電コイルは、いずれもコアに巻かれている。この場合には、コイルから発生する磁界はその殆どがコアに集中するため、磁界による不要な輻射はごくわずかであり、不要輻射を抑える対策が特に必要ではない。しかし、コイルから発生する磁界をコアに集中させるためには、上記のように、使用時にその両コアの端面同時を対向するような構造にする必要がある。

【０００４】

このため、従来のように、送電コイルと受電コイルとを異なるコアに巻いて使用する場合には、両コイルの形態や構造に制約があるので、薄型化や平面化を図るのが困難であるという不具合がある。

そこで、送電コイルと受電コイルの薄型化を実現するには、その両コイルの平面化を図

ることが考えられるが、それを平面化した場合にはコアの使用ができないので、コイルから発生する磁界による不要輻射の抑制、および電力伝送の効率化を図る必要がある。

【０００５】

本発明の目的は、上記の点に鑑み、非接触電力伝送に使用される送電コイルと受電コイルの平面化を図る際に、そのコイルからの不要輻射の抑制、および電力伝送の効率化を図ることができる非接触電力伝送装置を提供することにある。

【課題を解決するための手段】

【０００６】

上記の課題を解決し本発明の目的を達成するために、各発明は、以下のような構成からなる。

すなわち、第１の発明は、第１コイルを含む送電装置と、第２コイルおよび２次電池を含む受電装置とを備え、前記送電装置は、前記第１コイルが前記第２コイルと電磁結合するときに、前記第１コイルに供給する交流を生成する送電手段を有し、前記受電装置は、前記第２コイルが前記第１コイルと電磁結合するときに、前記第２コイルに誘起される交流を直流に変換し、この変換された直流により前記２次電池の充電を行う受電手段を有し、さらに、前記第１コイルおよび前記第２コイルは、渦巻き状であってその平面が対向するようになっている第１平面コイルおよび第２平面コイルからなり、かつ、前記第１平面コイルおよび前記第２平面コイルは、その両者が対向する面の反対側の面に、磁性シートをそれぞれ設けるようにした。

【０００７】

第２の発明は、第１の発明において、前記第１平面コイルおよび前記第２平面コイルに設けた各磁性シートの外側面に、さらに、金属シートをそれぞれ重ねて設けるようにした。

第３の発明は、第１または第２の発明において、前記受電装置を構成する前記第２コイル、前記受電手段、および前記２次電池のうち、少なくとも前記第２コイルと前記２次電池を一体化した。

【０００８】

第４の発明は、第１または第２の発明において、前記受電装置を構成する前記第２コイル、前記受電手段、および前記２次電池のうち、少なくとも前記第２コイルと前記２次電池は、所定のケース内に収容し又は固形化するようにした。

第５の発明は、第１乃至第４のうちのいずれかの発明において、前記受電装置は、携帯電話に搭載させるようにした。

【０００９】

第６の発明は、第１コイルを含む送電装置と、第２コイルおよび第１の２次電池を含む送電・受電兼用装置と、第３コイルおよび第２の２次電池を含む受電装置とを備え、前記送電装置は、前記第１コイルが前記第２コイルまたは前記第３コイルと電磁結合するときに、前記第１コイルに供給する交流を生成する送電手段を有し、前記送電・受電兼用装置は、前記第２コイルが前記第３コイルと電磁結合するときに、前記第１の２次電池を電源として用いて前記第２コイルに供給する交流を生成する送電手段と、前記第２コイルが前記第１コイルと電磁結合するときに、その第２コイルに誘起される交流を直流に変換し、この変換された直流により前記第１の２次電池の充電を行う受電手段とを有し、前記受電装置は、前記第３コイルが前記第１コイルまたは前記第２コイルと電磁結合するときに、その第３コイルに誘起される交流を直流に変換し、この変換された直流により前記第２の２次電池の充電を行う受電手段を有し、さらに、前記第１コイル、前記第２コイル、および前記第３コイルは、渦巻き状であってその平面が相互に対向するようになっている第１平面コイル、第２平面コイル、および第３平面コイルからなり、かつ、前記第１平面コイル、第２平面コイル、および前記第３平面コイルは、それぞれ対向する面の反対側の面に、磁性シートを設けるようにした。

【００１０】

第７の発明は、第６の発明において、前記第１平面コイル、前記第２平面コイル、およ

び前記第３平面コイルに設けた各磁性シートの外側面に、さらに、金属シートをそれぞれ重ねて設けるようにした。

第８の発明は、第６または第７の発明において、前記送電・受電兼用装置を構成する前記第２コイル、前記送電手段、前記受電手段、および前記第１の２次電池のうち、少なくとも前記第２コイルと前記第１の２次電池を一体化し、かつ、前記受電装置を構成する前記第３コイル、前記受電手段、および前記第２の２次電池のうち、少なくとも前記第３コイルと前記第２の２次電池を一体化した。

【００１１】

第９の発明は、第６または第７の発明において、前記送電・受電兼用装置を構成する前記第２コイル、前記送電手段、前記受電手段、および前記第１の２次電池のうち、少なくとも前記第２コイルと前記第１の２次電池は、所定のケース内に収容し又は固形化するようにし、かつ、前記受電装置を構成する前記第３コイル、前記受電手段、および前記第２の２次電池のうち、少なくとも前記第３コイルと前記第２の２次電池は、所定のケース内に収容し又は固形化するようにした。

【００１２】

第１０の発明は、第６乃至第９のうちのいずれかの発明において、前記送電・受電兼用装置および前記受電装置は、それぞれ携帯電話に搭載させるようにした。

以上のような構成からなる本発明によれば、非接触電力伝送に使用される送電用コイルや受電用コイルなどが平面コイルからなり、使用の際には、それらは変圧器を形成するが、両コイルが発生する磁界等による不要輻射を抑制でき、かつ、電力伝送の効率化が図れる。

【発明を実施するための最良の形態】

【００１３】

以下、本発明の実施形態について、図面を参照して説明する。

【００１４】

（第１実施形態）

本発明の非接触電力伝送装置の第１実施形態の構成について、図１を参照しながら説明する。

この第１実施形態に係る非接触電力伝送装置は、例えば携帯電話に適用したものであり、図１に示すように、充電器として機能する送電装置１１と、携帯電話本体１２の電源となる２次電池を含む受電装置１３とを備えている。

【００１５】

送電装置１１と受電装置１３とは、電磁的に結合することにより、後述のように非接触で電力伝送を行う非接触電力伝送装置を形成するようになっている。

送電装置１１は、図１に示すように、ＡＣ／ＤＣコンバータ１１１と、送電回路１１２と、送電コイル１１３とを備えている。

ＡＣ／ＤＣコンバータ１１１は、例えば家庭に供給される１００〔Ｖ〕の交流電圧を所定の直流電圧に変換するものであり、その変換された直流電圧を送電回路１１２に供給するようになっている。送電回路１１２は、ＡＣ／ＤＣコンバータ１１１からの直流電圧を使用して所定の周波数の交流電圧を生成する回路であり、この生成した交流電圧を送電コイル１１３に供給するようになっている。

【００１６】

受電装置１３は、図１に示すように、受電コイル１３１と、受電回路１３２と、充放電制御回路１３３と、２次電池１３４とを備えている。

この受電装置１３は、構成要素である受電コイル１３１、受電回路１３２、充放電制御回路１３３、および２次電池１３４を、一体に１つの容器に収容させたり、または熱硬化性の合成樹脂などを用いて一体にモジュール化（固形化）させ、受電装置モジュール（電池パック）として形成するようにした。

【００１７】

受電コイル１３１は、送電装置１１の送電コイル１１３と接近させて使用する場合には

、その両コイル１３１、１１３が、電磁結合して両者の間で変圧器を形成するようになっている。電磁結合により受電コイル１３１に誘起される交流電圧は、受電回路１３２に供給されるようになっている。

受電回路１３２は、受電コイル１３１に誘起される交流電圧を整流して直流電圧を出力する回路である。受電回路１３２から出力される直流電圧は、充放電制御回路１３３を介して２次電池１３４に供給され、２次電池１３４を充電するようになっている。

【００１８】

充放電制御回路１３３は、受電回路１３２からの出力により２次電池１３４を充電する場合にはその充電の制御を行い、２次電池１３４で負荷である携帯電話本体１２を動作させる場合には放電の制御を行う回路である。

２次電池１３４は、例えばリチウムイオン電池のように、放電後に充電により繰り返して使用できる電池である。

【００１９】

次に、送電装置１１の送電コイル１１３、および受電装置１３の受電コイル１３１の具体的な構造について、図２および図３を参照して説明する。

送電コイル１１３は、図２示すように、平面渦巻き型コイル１１３ａと、磁性シート１１３ｂと、金属シート１１３ｃとからなる。そして、図３に示すように、平面渦巻き型コイル１１３ａの外面側に、その外面側全体を覆うように、磁性シート１１３ｂと金属シート１１３ｃとが重ねた状態で設けられている。

【００２０】

従って、送電コイル１１３の構成要素は、図３に示すように、平面渦巻き型コイル１１３ａ、磁性シート１１３ｂ、および金属シート１１３ｃの順序で大きくなるように構成され、これらは接着剤などの適宜手段で一体に密着、または固定されている。

また、受電コイル１３１は、図２に示すように、平面渦巻き型コイル１３１ａと、磁性シート１３１ｂと、金属シート１３１ｃとからなる。そして、図３に示すように、平面渦巻き型コイル１３１ａの外面側に、その外面側全体を覆うように、磁性シート１３１ｂと金属シート１３１ｃとが重ねた状態で設けられている。

【００２１】

従って、受電コイル１３１の構成要素は、図３に示すように、平面渦巻き型コイル１３１ａ、磁性シート１３１ｂ、および金属シート１３１ｃの順序で大きくなるように構成され、これらは接着剤などの適宜手段で一体に密着または固定されている。

さらに、送電コイル１１３側の平面渦巻き型コイル１１３ａと、受電コイル１３１側の平面渦巻き型コイル１３１ａとは、使用時には、図３に示すようにその内面側同士が対向して変圧器を形成するようになっている。このため、使用時には、磁性シート１１３ｂ、１３１ｂは、平面渦巻き型コイル１１３ａ、１３１ａが発生する磁界による不要輻射を抑制でき、金属シート１１３ｃ、１３１ｃは、平面渦巻き型コイル１１３ａ、１３１ａが発生する電界による不要輻射を抑制できるようになっている。

【００２２】

ここで、平面渦巻き型コイル１１３ａ，１３１ａは、単線または撚り線のような絶縁された電線からなり、その電線を図２および図３に示すように同一平面内で渦巻き状に巻いたものである。

また、磁性シート１１３ｂ，１３１ｂは、板状またはシート状の磁性材料からなり、けい素鋼板、アモルファス金属の磁性シートなどが使用される。

【００２３】

さらに、金属シート１１３ｃ，１３１ｃは、板状またはシート状の金属材料からなり、アルミニウムなどが使用される。

次に、図１～図３に示すような構成からなる送電装置１１と受電装置１３とを、充電器のケースと携帯電話のケースにそれぞれ組み込んだ場合の具体例について、図４を参照して説明する。

【００２４】

図１に示す送電装置１１を構成する各要素は、図４に示す充電器のケース２１内に組み込まれ、図１に示す受電装置１３を構成する各要素は、図４に示す携帯電話のケース３１内に組み込まれている。

充電器のケース２１は、図４に示すように、その上部側に、携帯電話の充電時に携帯電話のケース３１が収容される携帯電話収容部２１１を備えている。また、充電器のケース２１は、その携帯電話収容部２１１の下部側に送電コイル収納部２１２を備え、その送電コイル収納部２１２内に、図３に示す送電コイル１１３が例えば密封された状態で収納されている。さらに、充電器のケース２１内には、送電装置１１のＡＣ／ＤＣコンバータ１１１や送電回路１１２などの構成部品を搭載した回路基板２２が収容されている。

【００２５】

携帯電話のケース３１は、図４に示すように、その下部側に、図１に示す受電装置１３をモジュール化した受電装置モジュール３２を収容する収容部３１１と、その受電装置モジュール３２の交換の際にその収容部３１１の開閉を行う蓋３１２と、を備えている。

ここで、受電装置モジュール３２は、上記のように、受電装置１３を構成する、受電コイル１３１、受電回路１３２、充放電制御回路１３３、および２次電池１３４を、一体に１つの容器に収容し、または熱硬化性の合成樹脂などを用いて一体にモジュール化したものである。

【００２６】

図４に示す受電装置モジュール３２は、同図に示すように、例えば薄型の直方形のケース３２１内に受電回路１３２、充放電制御回路１３３、および２次電池１３４が収納され、かつそのケース３２１の下面に受電コイル１３１がケース３２１に一体に取り付けられている。

また、携帯電話のケース３１内には、携帯電話本体１２を構成する各種の電子回路の構成部品を搭載した回路基板３３が収容されている。

【００２７】

次に、このような構成からなる第１実施形態の動作例について、図１および図３を参照して説明する。

受電装置１３の２次電池１３４を、送電装置１１を用いて充電する場合について説明する。この場合には、受電装置１３の受電コイル１３１を送電装置１１の送電コイル１１３に接近させて、両コイル１３１、１１３を電磁結合する状態にさせる。このときには、送電コイル１１３と受電コイル１３１とは、例えば図３または図４に示す状態になる。

【００２８】

このように、送電コイル１１３と受電コイル１３１が電磁結合されると、受電装置１３の２次電池１３４は、送電装置１１による充電が開始される。この充電時には、受電回路１３２により２次電池１３４の充電が行われる。

この充電時には、送電コイル１１３と受電コイル１３１には磁界や電界が発生し、その不要輻射がある。しかし、図３に示すように、磁性シート１１３ｂ、１３１ｂは、平面渦巻き型コイル１１３ａ、１３１ａが発生する磁界による不要輻射を抑制し、金属シート１１３ｃ、１３１ｃは、平面渦巻き型コイル１１３ａ、１３１ａが発生する電界による不要輻射を抑制する。

【００２９】

充放電制御回路１３３は、２次電池１３４の充電状態を監視し、その充電が終了すると、受電回路１３２による２次電池１３４の充電を停止させる。

このようにして、２次電池１３４に充電が終了した場合には、受電装置１３の受電コイル１３１を送電装置１１の送電コイル１１３から離し、これにより、携帯電話本体１２は、その充電された２次電池１３４を電源として使用できる。

【００３０】

以上説明したように、この第１実施形態では、非接触電力伝送に使用される送電コイル１１３および受電コイル１３１が平面コイルからなり、使用の際には、それらは変圧器を形成するが、両コイルからの磁界や電界による不要輻射を抑制でき、かつ効率的な電力伝

送ができる。

【００３１】

(第２実施形態)

本発明の非接触電力伝送装置の第２実施形態の構成について、図５を参照しながら説明する。

【００３２】

この第２実施形態に係る非接触電力伝送装置は、例えば携帯電話に適用したものであり、図５に示すように、充電器として機能する送電装置１１と、携帯電話本体１２の電源となる２次電池を含む受電装置１３と、充電器として機能するとともに携帯電話本体１５の電源となる２次電池を含む送電・受電兼用装置１４とを備えている。

そして、送電装置１１は、送電・受電兼用装置１４または受電装置１３と電磁的に結合することにより非接触電力伝送装置をそれぞれ形成し、送電・受電兼用装置１４と結合した場合にはそれに含まれる２電池を充電でき、受電装置１３と結合した場合にはそれに含まれる２次電池を充電できるようになっている。また、送電・受電兼用装置１４は、受電装置１３と電磁的に結合することにより非接触電力伝送装置を形成し、このときには受電装置１３に含まれる２電池を充電できるようになっている。

【００３３】

次に、この第２実施形態の各部の具体的な構成について、図５を参照して説明する。

送電装置１１および受電装置１３は、図１に示す送電装置１１および受電装置１３と同様に構成されるので、同一の構成要素には同一符号を付して、ここではその構成の説明は省略する。

送電・受電兼用装置１４は、図５に示すように、送電回路１４１と、受電回路１４２と、２次電池１４３と、充放電制御回路１４４と、送電・受電コイル１４５と、切り換えスイッチＳＷ１～ＳＷ３と、設定器１４６と、制御回路１４７と、表示器１４８とを備えている。

【００３４】

この送電・受電兼用装置１４は、構成要素である送電回路１４１、受電回路１４２、２次電池１４３、充放電制御回路１４４、送電・受電コイル１４５、切り換えスイッチＳＷ１～ＳＷ３、設定器１４６、制御回路１４７、および表示器１４８のうち、設定器１４６および表示器１４８を除く他の各構成要素を、一体に１つの容器に収容させたり、または熱硬化性の合成樹脂などを用いて一体にモジュール化（固形化）させ、送電・受電兼用装置モジュールとして形成するようにした。

【００３５】

ここで、その送電・受電兼用装置モジュールは、図１に示す受電装置１３をモジュール化した受電装置モジュールと基本的に同様のものであり、例えば図４に示す受電装置モジュール３２と同様に形成される。

送電回路１４１は、動作時に、２次電池1.４３から供給される直流電圧を使用して所定の周波数の交流電圧を生成し、この生成した交流電圧を送電・受電コイル１４５に供給する回路である。受電回路１４２は、送電・受電コイル１４５が送電装置１１の送電コイル１１３と電磁結合して送電装置１１から電力が送電される場合に、送電・受電コイル１４５に誘起される交流電圧を整流して直流電圧を生成する回路、すなわち交流ー直流変換回路である。受電回路１４２で生成される直流電圧は、充放電制御回路１４４を介して２次電池１４３に供給され、２次電池１４３を充電するようになっている。

【００３６】

２次電池１４３は、例えばリチウムイオン電池のように、放電後に充電により繰り返して使用できる電池である。充放電制御回路１４４は、受電回路１４２により２次電池１４３を充電する場合にはその充電の制御（監視）を行い、２次電池１４３で送電回路１４１や負荷である携帯電話本体１５を動作させる場合には放電の制御（監視）を行う回路である。

【００３７】

送電・受電コイル１４５は、送電装置１１の送電コイル１１３と接近させて使用する場合には、その両コイル１４５、１１３は、電磁結合して両者の間で変圧器を形成するようになっている。また、送電・受電コイル１４５は、受電装置１３の受電コイル１３１と接近させて使用する場合には、その両コイル１４５、１３１は、電磁結合して両者の間で変圧器を形成するようになっている。すなわち、送電コイル１１３、送電・受電コイル１４５、および受電コイル１３１は、相互に電磁結合でき、かつ相互に分離できるようになっている。

【００３８】

切り換えスイッチＳＷ１，ＳＷ２は、送電・受電コイル１４５と、送電回路１４１または受電回路１４２との選択的な接続を行うものである。また、切り換えスイッチＳＷ３は、２次電池１４３と、送電回路１４１または受電回路１４２との選択的な接続を行うものである。これらの切り換えスイッチＳＷ１～ＳＷ３の各接点は、通常は、例えば図示のように受電回路１４２側に接続されている。

【００３９】

設定器１４６は、使用者が、送電回路１４１または受電回路１４２の使用を選択的に設定するものであり、その設定データが制御回路１４７に入力されるようになっている。制御回路１４７は、その設定器１４６からの設定データに従って、その動作状態を表示器１４８を表示させるとともに、切り換えスイッチＳＷ１～ＳＷ３の接点の切り換えを制御する回路である。表示器１４８は、液晶表示器などからなり、上記のように所定の情報が表示されるようになっている。

【００４０】

次に、図５に示す送電コイル１１３、受電コイル１３１、および送電・受電コイル１４５の具体的な構成について、図３を参照して説明する。

図５に示す送電コイル１１３および受電コイル１３１は、図３に示す第１実施形態の送電コイル１１３および受電コイル１３１と同様に構成される。また、図５に示す送電・受電コイル１４５は、例えば図３に示す送電コイル１１３または受電コイル１３１と同様に構成される。

【００４１】

このような構成により、図５に示す送電コイル１１３、送電・受電コイル１４５、および受電コイル１３１は、使用時に、そのうちの２つのコイルが相互に電磁結合して変圧器を形成し、その際に各コイルで生成される電界や磁界による不要輻射を抑制して効率的な電力伝送ができる。

次に、このような構成からなる第２実施形態の動作例について、図５を参照して説明する。

【００４２】

ここで、第２実施形態では、第１実施形態の場合と同様に、受電装置１３の２次電池１３４を送電装置１１で充電する場合があるが、この場合はすでに説明済みであるので、以下では他の場合の動作について説明する。

まず、携帯電話本体１５に搭載される送電・受電兼用装置１４の２次電池１４３を、送電装置１１を用いて充電する場合について説明する。この場合には、送電・受電兼用装置１４の送電・受電コイル１４５を送電装置１１の送電コイル１１３に接近させて、両コイル１４５、１１３が電磁結合する状態にさせる。

【００４３】

この状態で、設定器１４６により、送電装置１１を用いて２次電池１４３の充電を行う旨の設定を行うと、その設定データが制御回路１４７に入力される。制御回路１４７は、その設定データに従い、その旨の表示を表示器１４８に表示させるとともに、切り換えスイッチＳＷ１～ＳＷ３の接点を、図５に示す位置、すなわち、受電回路１４２側に接続させる。

【００４４】

この結果、送電・受電兼用装置１４の２次電池１４３は、送電装置１１による充電が開

始される。この充電時には、受電回路１４２により２次電池１４３の充電が行われる。
また、この充電時には、送電コイル１１３と送電・受電コイル１４５により磁界や電界が生成され、その不要輻射がある。しかし、このときには、送電コイル１１３と送電・受電コイル１４５とは、上記のように図３に示す送電コイル１１３および受電コイル１３１と同様に構成される。このため、送電コイル１１３と送電・受電コイル１４５は、図３に示す送電コイル１１３および受電コイル１３１と同様に、コイルが発生する磁界や電界による不要輻射を抑制できる。

【００４５】

充放電制御回路１４４は、２次電池１４３の充電状態を監視し、その充電が終了すると、受電回路１４２による２次電池１４３の充電を停止させる。
次に、携帯電話本体１２に搭載される受電装置１３の２次電池１３４が使用不能となり、その２次電池１３４の充電を、携帯電話本体１５に搭載される送電・受電兼用装置１４を用いて充電する場合について説明する。

【００４６】

この場合には、受電装置１３の受電コイル１３１を送電・受電兼用装置１４の送電・受電コイル１４５に接近させて、両コイル１３１、１４５が電磁結合する状態にさせる。この状態で、送電・受電兼用装置１４により２次電池１３４を充電させる旨の設定を設定器１４６で行うと、その設定データが制御回路１４７に入力される。制御回路１４７は、その設定データに従い、その旨の表示を表示器１４８に表示させるとともに、切り換えスイッチＳＷ１～ＳＷ３の接点を、図に示す位置とは反対の位置、すなわち、送電回路１４１側に切り換える。

【００４７】

この結果、受電装置１３の２次電池１３４は、送電・受電兼用装置１４による充電が開始される。この充電時には、受電回路１３２により２次電池１３４の充電が行われる。
また、この充電時には、受電コイル１３１と送電・受電コイル１４５により磁界や電界が生成され、その不要輻射がある。しかし、このときには、受電コイル１３１と送電・受電コイル１４５とは、上記のように図３に示す送電コイル１１３および受電コイル１３１と同様に構成される。このため、、受電コイル１３１と送電・受電コイル１４５は、図３に示す送電コイル１１３および受電コイル１３１と同様に、コイルが発生する磁界や電界による不要輻射を抑制できる。

【００４８】

充放電制御回路１３３は、２次電池１３４の充電状態を監視し、その充電が終了すると、受電回路１３２による２次電池１３４の充電を停止させる。
以上説明したように、この第２実施形態では、非接触電力伝送に使用される送電コイル１１３、送電・受電コイル１４５、および受電コイル１３１が平面コイルからり、使用の際には、そのうちの２つのコイルにより変圧器が形成されるが、その変圧器を形成するコイルからの磁界や電界による不要輻射を抑制でき、かつ、電力伝送の効率化を図ることができる。

【００４９】

また、この第２実施形態では、充電器として機能するとともに２次電池１４３を含む送電・受電兼用装置１４を携帯電話本体１５に搭載し、２次電池１３４を含む受電装置１３を携帯電話本体１２に搭載するようした。
このため、第２実施形態によれば、受電装置１３を搭載する携帯電話が使用不能になっても、送電・受電兼用装置１４を搭載する携帯電話を使用して受電装置１３の２次電池１３４を充電できるので、非常に便宜である。

【００５０】

さらに、第２実施形態の送電・受電兼用装置１４では、２次電池として使用する場合または充電器として使用する場合に、その使用を任意に設定できる上に、その設定状態を使用者が表示器により容易に認識できるので、その設定ミスによる誤動作を防止できる。

（その他の実施形態）

第１実施形態では、図２および図３に示すように、送電コイル１１３は、平面渦巻き型コイル１１３ａ、磁性シート１１３ｂ、および金属シート１１３ｃから構成し、受電コイル１３１は、平面渦巻き型コイル１３１ａ、磁性シート１３１ｂ、および金属シート１３１ｃから構成するようにした。しかし、送電コイル１１３および受電コイル１３１は、金属シート１１３ｃ、１３１ｃをそれぞれ省略するようにしても良い。

【００５１】

この点の構成については、第２実施形態における送電コイル１１３、送電・受電コイル１４５、および受電コイル１３１の各構成についても同様である。

また、第１実施形態では、受電装置１３は、構成要素である受電コイル１３１、受電回路１３２、充放電制御回路１３３、および２次電池１３４を一体化し、受電装置モジュールとして形成するようにしたが、この一体化は少なくとも受電コイル１３１と２次電池１３４であれば良い。

【００５２】

さらに、第２実施形態では、送電・受電兼用装置１４は、構成要素である送電回路１４１、受電回路１４２、２次電池１４３、充放電制御回路１４４、送電・受電コイル１４５、切り換えスイッチＳＷ１～ＳＷ３、設定器１４６、制御回路１４７、および表示器１４８のうち、設定器１４６および表示器１４８を除く他の各構成要素を一体化し、送電・受電兼用装置モジュールとして形成するようにした。しかし、この一体化は少なくとも送電・受電コイル１３１と２次電池１４３であれば良い。

【００５３】

また、第１実施形態および第２実施形態では、携帯電話に適用した場合について説明したが、これに代えて携帯用のコンピュータなどの携帯端末、またはビデオカメラのような携帯機器に適用できる。

【図面の簡単な説明】

【００５４】

【図１】本発明の第１実施形態の構成を示すブロック図である。

【図２】送電コイルと受電コイルの各構成要素を分解した斜視図である。

【図３】送電コイルと受電コイルの構成を示す断面図である。

【図４】送電装置と受電装置とを、充電器のケースと携帯電話のケースに組み込んだ状態を表す断面図である。

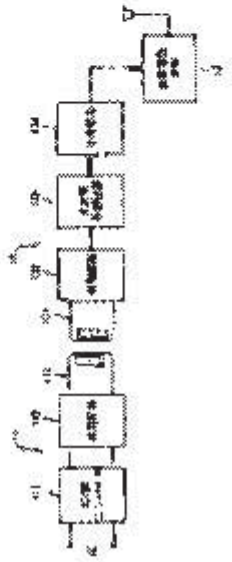
【図５】本発明の第２実施形態の構成を示すブロック図である。

【符号の説明】

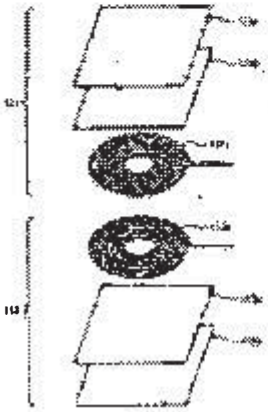
【００５５】

１１・・・送電装置、１２、１５・・・携帯電話本体、１３・・・受電装置、１４・・・送電・受電兼用装置、３２・・・受電装置モジュール、１１３・・・送電コイル、１１３ａ、１３１ａ・・・平面渦巻き型コイル、１１３ｂ、１３１ｂ・・・磁性シート、１１３ｃ、１３１ｃ・・・金属シート、１１２、１４１・・・送電回路、１３１・・・受電コイル、１３２、１４２・・・受電回路、１３４、１４３・・・２次電池、１４５・・・送電・受電コイル。

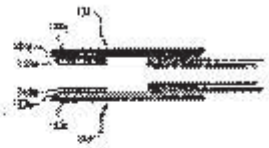
【図１】



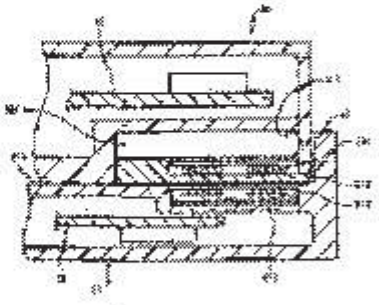
【図２】



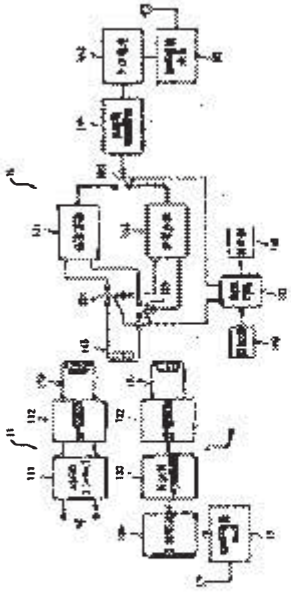
【図３】



【図４】



【図５】



DESCRIPTION JP2006042519

[0001]

The present invention relates to non-contact power transmission apparatus capable of, such as between a charger and a portable terminal such as a mobile phone to carry out a non-contact power transmission.

[0002]

Conventionally, as a non-contact power transmission device of this type, regardless of the shape of the bottom of the unit of the portable communication device, and the non-contact power transmission using electromagnetic induction between the power receiving coil of the charging unit and the power transmission coil of the charging unit (for example, see Patent Document 1, Patent Document 2) which was set to improve efficiency is known.

The transmitting coil is wound to the transmitting coil core, the receiving coil is wound in a receiving coil core.

Also, both are composed of rod-like body and the receiving coil and the transmitting coil core core, in use, the end faces of the two cores is in opposition.

10-14124 No. 10-4639 JP Hei

[0003]

Meanwhile, the receiving coil power transmission coil that is used for non-contact power transmission device of the prior art is wound on the core either.

In this case, since the most concentrated on the core, unnecessary radiation due to the magnetic field is negligible, the magnetic field generated from the coil is not particularly necessary to take measures to suppress unnecessary radiation.

However, in order to focus on their core a magnetic field generated from the coil, as described above, it is necessary to structure such as to face the end surfaces simultaneously for the both cores in use.

[0004]

Therefore, as in the prior art, when it is used by winding the core to a different power receiving coil and the transmitting coil, because there are restrictions on the structure and form of the coils, it is difficult to achieve planar thinner and there is a problem that.

Therefore, it is conceivable to realize the thickness of the receiving coil and the transmitting coil, thereby planarization of the two coils, the use of the core is not possible in plan of the same, magnetic field generated from the coil some suppression of unnecessary radiation by, and is necessary to improve the efficiency of power transmission.

[0005]

When In view of the above, to achieve planarization of the receiving coil and the transmitting coil is used for contactless power transmission, suppression of unwanted radiation from the coil, and an object of the present invention, improve the efficiency of power transmission The present invention is to provide a non-contact power transmission apparatus capable.

[0006]

In order to achieve the object of the present invention to solve the above problem, the invention comprises the following configuration.

That is, the first aspect of the present invention, and a power transmission device including a first coil and a power receiving device including a secondary battery and a second coil, wherein the power transmission device is electromagnetically coupled to the second coil, wherein the first coil When it has a transmission means for generating a supply alternating current to the first coil, when the second coil is electromagnetically coupled to the first coil, the power receiving device, alternating current is induced in the second coil and a receiving means for charging the secondary battery by direct current is converted to direct current and converted this further, the second coil and the first coil, so that its plane faces and a spiral the surface opposite the surface on which both of them are opposed to each other and consisting of the second planar coil and the first planar coil is in, said second planar coil and said first planar coil is provided each magnetic sheet was on.

[0007]

The second invention, in the first invention, the outer surface of the magnetic sheet provided on the second planar coil and said first planar coil was further be provided so as to overlap each metal sheet.

In the first or second invention, the second coil constituting the power receiving device, the receiving means, and one of the secondary battery, according to the third invention, integral to the secondary battery and the second coil of at least ized.

[0008]

In the first or second invention, the second coil constituting the power receiving device, the receiving means, and one of the secondary battery, the fourth invention, the secondary battery and the second coil at least, I was to be solidified or accommodated in the case within a given.

In the invention of any one of the fourth and the power receiving device, a fifth aspect of the present invention, and so as to mobile phones through the first.

[0009]

A power transmission device comprising a first coil, and transmission and receiving compatible apparatus including a secondary battery of the first and second coils, a sixth invention, a power receiving device including a secondary battery of the second and third coil and a, when the first coil is electromagnetically coupled to the third coil or the second coil, and a transmission means for generating a supply alternating current to the first coil, wherein the power transmission device, the transmission and receiving combined when the second coil is electromagnetically coupled with said third coil, and a transmission means for generating the supplied AC to the second coil by using a battery as a power supply secondary of said first device, said second coil When you try to electromagnetically coupled with said first coil, and a power receiving means for charging the secondary battery according to claim 1 by a DC that converts alternating current into direct current induced in the second coil, and the transformed , when the third coil electromagnetically coupled to the second coil or the first coil, the power receiving device, the second by a DC that converts alternating current into direct current which is induced in the third coil, and the transformed and a receiving means for charging the secondary battery 2, further wherein the first coil, the second coil, and the third coil, the plane so as to face each other and a spiral and, and a third planar coil first planar coil yl, and the second planar coil, wherein the first planar coil,On the opposite side of the surface facing each of the second planar coil, and the third planar coil was provided to the magnetic sheet.

[0010]

In the sixth invention, the first planar coil, said second planar coil, and the outer surface of the magnetic sheet provided on the third planar coil, further, a seventh aspect of the present invention, provided so as to overlap each metal sheet was so.

Aspect 7 or 6, wherein the second coil constituting the transmission and receiving compatible apparatus, the power transmission means, said receiving means, and of the secondary battery of the first, the eighth invention, the at least In and integrated rechargeable battery of the first and second coil, the third coil which constitutes the power receiving device, the receiving means, and of the secondary battery of said second and said third coil at least I have integrated a secondary battery of the second.

[0011]

Aspect 7 or 6, wherein the second coil constituting the transmission and receiving compatible apparatus, the power transmission means, said receiving means, and of the secondary battery of the first, the ninth invention, the at least In and, so as to solidify or housing, the third coil which constitutes the power receiving device, the receiving means, and the secondary battery of the first and second coil 2 and the second in the case of the given Which of the following cell, secondary battery and the second and the third coil is set to be solidified or housed in the case at least a predetermined.

[0012]

In the invention of any one of the ninth to the power receiving device and the transmission and receiving compatible apparatus, a tenth aspect of the present invention, and so as to mobile phones through 6 respectively.

According to the present invention with the structure as described above, and the power receiving coil and power transmission coil that is used for contactless power transfer is made from the planar coil, at the time of use, although they form a transformer, It can be suppress unnecessary radiation due to the magnetic field such that both coils occurs, it is possible to achieve the efficiency of power transmission.

[0013]

Hereinafter, embodiments of the present invention will be described with reference to the drawings.

[0014]

(First embodiment)

The configuration of the first embodiment of the non-contact power transmission apparatus of the present invention will be described with reference to Figure 1.

Non-contact power transmission apparatus according to the first embodiment is, for example, it is applied to a mobile phone, as shown in Figure 1, the power transmitting device 11 which functions as a charger, 2 as the power of the cellular phone unit 12 I and a power receiving device 13 including: a battery.

[0015]

The power receiving device 13 and the power transmission device 11, by binding electromagnetically, and is adapted to form a non-contact power transmission apparatus that performs transmission power without contact as described below.

As shown in Figure 1, the AC / DC converter 111, a transmission circuit 112, the power transmission device 11, and a transmitting coil 113.

It is intended for converting a predetermined DC voltage to AC voltage of 100 [V] for example is supplied to the home, AC / DC converter 111 is adapted to supply to the transmission circuit 112 and the DC voltage converted .

This is a circuit that generates an AC voltage of a predetermined frequency using the DC voltage from the AC / DC converter 111, transmission circuit 112 is adapted to supply to the transmitting coil 113 to the AC voltage generated.

[0016]

As shown in Figure 1, the power receiving device 13 includes a receiving coil 131, a receiving circuit 132, the charge and discharge control circuit 133, and a secondary battery 134.

Can be housed in a single container together, the secondary battery 134 receiving coil is a component 131, receiving circuit 132, and discharge control circuit 133, or the power receiving device 13, and synthetic thermosetting resin By using integrally modularized was (solidified), it is arranged to form a module powered device (battery pack).

[0017]

The receiving coil 131, when it is used to be close to the power transmission coil 113 of the power transmission device 11, the two coils 131,113 is adapted to form a transformer between them by electromagnetic coupling.

AC voltage induced in the receiving coil 131 by electromagnetic coupling, are supplied to the receiving circuit 132.

Receiving circuit 132 is a circuit that outputs a DC voltage by rectifying the AC voltage induced in the receiving coil 131.

Is supplied to the secondary battery 134 via the discharge control circuit 133, the DC voltage output from the power receiving circuit 132 is adapted to charge the secondary battery 134.

[0018]

And performs control of the charge in the case of charging the secondary battery 134 by the output from the receiving circuit 132, discharge control circuit 133, discharge when operating the mobile phone unit 12 is the load at the secondary battery 134 is a circuit for controlling the.

Secondary battery 134 is a battery such as a lithium ion battery, it can be used repeatedly by charging after discharge.

[0019]

Next, the specific structure of the power receiving coil 131 of the power receiving device 13 and the power transmission coil 113, the power transmitting device 11, will be described with reference to FIGS.

As shown in Figure 2, the planar spiral coil 113a, the magnetic sheet 113b, the power transmission coil 113 is made of a metal sheet 113c.

Then, as shown in Figure 3, the outer surface of the flat spiral coils 113a, so as to cover the outer surface entirety, and is provided in a state in which the metal sheet 113c and the magnetic sheet 113b is stacked.

[0020]

Therefore, as shown in Figure 3, is configured to be larger in the order of metal sheet 113c planar spiral coil 113a, and magnetic sheet 113b,, the components of the power transmission coil 113, a suitable means such as adhesives are and fixed contact or, together.

In addition, as shown in Figure 2, the planar spiral coil 131a, the magnetic sheet 131b, receiving coil 131 is made of a metal sheet 131c.

Then, as shown in Figure 3, the outer surface of the flat spiral coils 131a, so as to cover the outer surface entirety, and is provided in a state in which the metal sheet 131c and the magnetic sheet 131b is stacked.

[0021]

Therefore, as shown in Figure 3, is configured to be larger in the order of metal sheet 131c planar spiral coil 131a, and magnetic sheet 131b,, the components of the receiving coil 131, a suitable means such as adhesives are and fixed contact or together.

In addition, a planar spiral coil 113a of the power transmission coil 113 side and the planar spiral coil 131a of the receiving coil 131 side, in use, to form a transformer its inner side each other to face, as shown in Figure 3 has become.

For this reason, when in use, can suppress unnecessary radiation by the magnetic field planar spiral coil 113a, 131a occurs, metal sheet 113c, the 131c, magnetic sheet 113b, 131b is due to the electric field planar spiral coil 113a, 131a occurs I have been able to suppress unnecessary radiation.

[0022]

Here, in which the planar spiral coils 113a, 131a is made of insulated wires, such as twisted or single wire, wound spirally in the same plane as shown in Figures 2 and 3 the wire .

Moreover, it becomes a magnetic material plate-like or sheet-like, magnetic sheet 113b, 131b is used, magnetic silicon steel sheet, amorphous metal.

[0023]

The metal sheet 113c, the 131c, is made of a metallic material or sheet-like plate, and aluminum is used.

Next, a specific example of incorporating each cell phone case and the case of the charger, and a power receiving unit 13 and the power transmission device 11 having a structure as shown in Figures 1 to 3, with reference to Figure 4 described.

[0024]

Each element is built into the case 21 of the charger shown in Figure 4, which constitute the power receiving device 13 shown in Figure 1, each element constituting the power transmission device 11 shown in Figure 1, a cell phone case shown in Figure 4 It is built into the 31.

Case 21 of the charger, as shown in Figure 4, on the upper side, I have provided a mobile phone accommodating portion 211 of the case 31 of the mobile phone is accommodated when charging the mobile phone.

Also, with the power transmission coil receiving portion 212 on the lower side of the mobile phone housing portion 211, to the power transmission coil receiving portion 212, case 21 of the charger in a state where the power transmission coil 113 shown in Figure 3, for example sealed are housed.

Furthermore, the case 21 of the charger, the circuit board 22 mounted with components such as power transmission circuit 112 and the AC / DC converter 111 of the power transmission device 11 is accommodated.

[0025]

Case 31 of the cellular phone, as shown in Figure 4, in its lower part, a housing portion 311 which houses a power receiving device module 32 modularized the power receiving device 13 shown in Figure 1, the exchange of the power receiving device module 32 and a, a lid 312 for opening and closing of the housing portion 311 when.

Here, as described above, the power receiving device module 32 is housed in one container together, the secondary battery 134 constituting the power receiving device 13, the receiving coil 131, receiving circuit 132, and discharge control circuit 133, , or is obtained by modularized together with the synthetic resin and thermosetting.

[0026]

As shown in the figure, the power receiving device module 32 shown in Figure 4, the case 321 such secondary battery 134 receiving circuit 132, and discharge control circuit 133, is, and is housed in a case 321 of a rectangular-shaped thin The receiving coil 131 is integrally attached to the casing 321 of the lower surface.

Also, the case 31 of the portable phone, the circuit board 33 mounted with electronic components of the various circuits making up the main body of the cellular phone 12 is housed.

[0027]

Next, an operation example of the first embodiment having such a configuration will be described with reference to FIGS.

Will be described as being charged using the power transmission device 11, the secondary battery 134 of the power receiving device 13.

In this case, to a state brought close to the power transmission coil 113 of the power transmission device 11 and the receiving coil 131 of the power receiving device 13, for electromagnetic coupling of two coils 131,113.

In this case, the receiving coil 131 and the power transmission coil 113, for example, I will state shown in Figure 4 or Figure 3.

[0028]

Thus, the receiving coil 131 and the power transmission coil 113 is electromagnetically coupled to the secondary battery 134 of the power receiving device 13, charging by the power transmitting device 11 is started.

This charging time, charging of the secondary battery 134 is performed by receiving circuit 132.

This charging time, electric field and magnetic field is generated in the receiving coil 131 and the transmitting coil 113, there is the unnecessary radiation.

However, as shown in Figure 3, the magnetic sheet 113b, the 131b, it is possible to suppress unnecessary radiation due to magnetic fields flat spiral coils 113a, 131a is generated, the metal sheet 113c, 131c is generated planar spiral coil 113a, the 131a to suppress unnecessary radiation due to the electric field to be.

[0029]

Monitors the state of charge of the secondary battery 134, the charging is terminated, the charge and discharge control circuit 133 stops the charging of the secondary battery 134 by the receiving circuit 132.

In this way, when the charging is completed to the secondary battery 134, and away from the power transmission coil 113 of the power transmission device 11 and the receiving coil 131 of the power receiving device 13, whereby the main body of the cellular phone 12, 2, which is charged the I can be used as a power source to the next battery 134.

[0030]

As described above, in this first embodiment, the receiving coil 131 and the power transmission coil 113 is used for contactless power transfer is made from the planar coil, In use, they form a transformer, but both power transmission and efficient, can suppress unnecessary radiation due to the electric field and magnetic field from the coil can be.

[0031]

(Second Embodiment)

The configuration of the second embodiment of the non-contact power transmission apparatus of the present invention will be described with reference to FIG.

[0032]

Non-contact power transmission apparatus according to the second embodiment is, for example, it is applied to a mobile phone, as shown in Figure 5, the power transmitting device 11 which functions as a charger, 2 as the power of the cellular phone unit 12 and a transmission and receiving device 14 combined, including the secondary battery as a power source of the mobile phone unit 15 and the power receiving device 13, including: a battery, functions as a charger.

Then, the power transmission device 11 is included in it when it was formed, respectively, non-contact power transmission equipment by the electromagnetically coupled to the powered device 13 or transmission and receiving compatible apparatus 14, was combined with the transmission and receiving compatible apparatus 14 It can be charged by a secondary battery that is included in it if it is possible to charge the battery 2, bound to the powered device 13.

Also form a non-contact power transmission system by binding electromagnetically power receiving apparatus 13, transmission and receiving compatible apparatus 14 is enabled to charge the storage batteries included in the power receiving device 13 at this time.

[0033]

Next, the specific configuration of each part of the second embodiment will be described with reference to FIG.

Power receiving device 13 and the power transmission device 11, so that the same structure as the power receiving device 13 and the power transmission device 11 shown in Figure 1, and the same reference numerals are added to the same components, description of the configuration is omitted here .

As shown in Figure 5, a transmission circuit 141, a receiving circuit 142, a secondary battery 143, the charge and discharge control circuit 144, the transmission and receiving coil 145, transmission and receiving device 14 combined, the selector switch SW1~SW3 and, I'm provided with a setting device 146, a control circuit 147, and a display 148.

[0034]

141, 143 incoming circuit 142,2 battery, 144 charge and discharge control circuit, transmission and receiving coil 145, the changeover switch SW1~SW3, setting device 146, the transmission and receiving compatible apparatus 14, control circuit power transmission circuit, which is a component of the display 148, or is contained in a single container together, each component other than the display unit 148 and the setting device 146, modularized together or by using a synthetic thermosetting resin and 147, and then (solidified), it is arranged to form a transmission and receiving module compatible apparatus.

[0035]

Here, it is basically the same as the power receiving device module has a module of the power receiving device 13 shown in Figure 1, the transmission and receiving compatible apparatus module is formed similarly to the power receiving device module 32, for example, shown in Figure 4 that.

In operation, generates an AC voltage of a predetermined frequency using the DC voltage supplied from the secondary battery 143, transmission circuit 141 is a circuit for supplying to the transmission and receiving coil 145 of the AC voltage generated.

If the power is transmitted thereto from the power transmitting device 11 transmission and receiving coil 145 is electromagnetically coupled with the power transmission coil 113 of the power transmission device 11, the receiving circuit 142 rectifies the AC voltage induced in the transmission and receiving coil 145 circuit for generating a DC voltage, that the AC - DC converter is a circuit.

Is supplied to the secondary battery 143 via the discharge control circuit 144, the DC voltage generated by the power receiving circuit 142 is adapted to charge the secondary battery 143.

[0036]

Secondary battery 143 is a battery such as a lithium ion battery, it can be used repeatedly by charging after discharge.

Performs control of the charging (monitoring) in the case of charging the secondary battery 143 through 142 receiving circuit, the charge and discharge control circuit 144 operates the mobile phone unit 15 is a load and power transmission circuit 141 in the secondary battery 143 is a circuit for controlling the discharge (monitor) when.

[0037]

The transmission and receiving coil 145, when it is used to be close to the power transmission coil 113 of the power transmission device 11, the two coils 145,113 is adapted to form a transformer between them by electromagnetic coupling .

Also, the transmission and receiving coil 145, in the case of using is brought close to the receiving coil 131 of the power receiving device 13, the two coils 145,131 are adapted to form a transformer between them by electromagnetic coupling have.

In other words, the receiving coil 131 transmitting coil 113, and the transmission and receiving coil 145, is adapted to be separated from each other and can be electromagnetically coupled to each other.

[0038]

SW1, SW2 select switch is configured to perform a selective connection with the transmission and receiving coil 145, and the receiving circuit 142 or the power transmission circuit 141.

Also, changeover switch SW3 is configured to perform a selective connection between the secondary battery 143, and the receiving circuit 142 or the power transmission circuit 141.

Normally, the contacts of the changeover switch SW1~SW3 These are connected to the power receiving side circuit 142, for example as shown.

[0039]

The setting unit 146, and is intended user to selectively set the use of the receiving circuit 142 or the power transmission circuit 141, the configuration data are inputted to the control circuit 147.

According to the setting data from the setting device 146, the control circuit 147 is a circuit that causes the display unit 148 displays the operation state to control the switching of the contacts of the changeover switch SW1~SW3.

The display 148 is made of a liquid crystal display device, predetermined information is intended to be displayed as described above.

[0040]

Next, a specific configuration of the transmission and receiving coil 145 113, and receiving coil 131, the power transmission coil shown in FIG 5, will be described with reference to FIG.

Receiving coil 131 and the transmitting coil 113 shown in Figure 5, configured in the same manner as the receiving coil 131 and the transmitting coil 113 of the first embodiment shown in FIG.

Also, transmission and receiving coil 145 shown in Figure 5 is configured in the same manner as the receiving coil 131 or the transmitting coil 113 for example shown in Figure 3.

[0041]

With this configuration, in use, to form a transformer coils two of which are electromagnetically coupled to each other, receiving coil 131 113, and the transmission and receiving coil 145, the power transmission coil shown in Figure 5, when the thus power transmission efficiency by suppressing unnecessary radiation caused by an electric field or a magnetic field generated by each coil.

Next, an operation example of the second embodiment having such a configuration will be described with reference to FIG.

[0042]

Here, in the second embodiment, similarly to the first embodiment, it may be charged by the power transmitting device 11 and 134 secondary battery of the power receiving device 13, but in this case because it is already explained, the following I The operation of other cases.

First, a description will be given when charging with the power transmitting device 11, the secondary battery 143 of the transmission and receiving compatible apparatus 14 mounted on a main body of the cellular phone 15.

In this case, it is in a state where it is brought close to the power transmission coil 113 of the power transmission device 11 and transmission and receiving coil 145 of the transmission and receiving device 14 combined, both coils 145,113 are electromagnetically coupled.

[0043]

In this state, the setting unit 146, the setting is made to the effect that charging the secondary battery 143 using the power transmission device 11, the setting data is input to the control circuit 147.

Accordance with the configuration data, causes the display unit 148 to display to that effect, the position shown in Figure 5, the contact of the changeover switch SW1~SW3, that is, the control circuit 147, is connected to the receiving circuit 142 side.

[0044]

As a result, the secondary battery 143 of the transmission and receiving compatible apparatus 14, charging by the power transmitting device 11 is started.

This charging time, charging of the secondary battery 143 is performed by receiving circuit 142.

In addition, the charging time, electric field and magnetic field is generated by the 145 transmission and receiving coil and the transmitting coil 113, there is the unnecessary radiation.

However, at this time, the transmission and receiving coil 145 and the power transmission coil 113 is configured in the same manner as the receiving coil 131 and the power transmission coil 113 shown in Figure 3 as described above.

For this reason, in the same manner as the receiving coil 131 and the transmitting coil 113 shown in Figure 3, transmission and receiving coil 145 and the transmitting coil 113 can suppress unnecessary radiation due to the electric field and magnetic field coil generates.

[0045]

Monitors the state of charge of the secondary battery 143, the charging is terminated, the charge and discharge control circuit 144 stops the charging of the secondary battery 143 by the receiving circuit 142.

Then, 134 secondary battery of the power receiving device 13 to be mounted on the mobile phone unit 12 is unusable, by using the transmission and receiving compatible apparatus 14 mounted on a main body of the cellular phone 15, the charging of the secondary battery 134 will be described to be charged.

[0046]

In this case, it is in a state where it is brought close to the transmission and receiving coil 145 of the transmission and receiving unit 14 serves a receiving coil 131 of the power receiving device 13, both coils 131,145 are electromagnetically coupled.

In this state, it is performed in the setting unit 146 to set the effect that charging the secondary battery 134 by the transmission and receiving device 14 combined, the setting data is input to the control circuit 147.

In accordance with the setting data, and causes the display 148 to display to that effect, the position opposite to the position shown in the figure, the contact of the changeover switch SW1~SW3, that is, the control circuit 147 switches the power transmission circuit 141 side .

[0047]

As a result, 134 secondary battery powered device 13, charging by the transmission and receiving compatible apparatus 14 is started.

This charging time, charging of the secondary battery 134 is performed by receiving circuit 132.

In addition, the time of charging, electric field and magnetic field is generated by the transmission and 145 receiving coil and the receiving coil 131, there is the unwanted radiation.

However, at this time, the transmission and receiving coil 145 and receiver coil 131 is configured in the same manner as the receiving coil 131 and the power transmission coil 113 shown in Figure 3 as described above.

Similar to the receiving coil 131 and the transmitting coil 113 shown in Figure 3, transmission and receiving coil and 145 „ receiving coil 131 can suppress unnecessary radiation due to the electric field and magnetic field coil generates for this.

[0048]

Monitors the state of charge of the secondary battery 134, the charging is terminated, the charge and discharge control circuit 133 stops the charging of the secondary battery 134 by the receiving circuit 132.

As described above, in this second embodiment, the receiving coil 131 113, and the transmission and receiving coil 145, power transmission coils to be used for non-contact power transmission is changing suddenly planar coil, In use, the two of which transformer is formed by the coil of Tsu, it can be, and can suppress unnecessary radiation due to magnetic or electric fields from the coils forming the transformer, to improve the efficiency of power transmission.

[0049]

Also, in this second embodiment, it is mounted on a portable phone unit 15 and transmission and receiving compatible apparatus 14 including a secondary battery 143 functions as a charger, the mobile phone body 12 to the power receiving device 13 including a secondary battery 134 was like to be mounted on.

Therefore, according to the second embodiment, a mobile phone equipped with the power receiving device 13 becomes unavailable, 134 secondary battery of the power receiving device 13 using a mobile phone equipped with a transmission and receiving compatible apparatus 14 it is possible to charge, it is very convenience.

[0050]

Furthermore, in the transmission and receiving compatible apparatus 14 of the second embodiment, when used as a battery charger or when used as a secondary battery, on which can be set freely its use, display unit user the setting state it can be easily recognized by, it is possible to prevent malfunction due to the misconfiguration.

Other Embodiments

In the first embodiment, as shown in Figures 2 and 3, composed of a metal sheet 113c planar spiral coil 113a, and magnetic sheet 113b,, the receiving coil 131, the power transmission coil 113, the planar spiral coil 131a, I was to be made of a metal sheet and 131c magnetic sheet 131b,.

However, the receiving coil 131 and the transmitting coil 113 may be omitted each metal sheet 113c, and 131c.

[0051]

The configuration of this point, it is the same for each component of the receiving coil 131 power transmission coils in the second embodiment 113, and transmission and receiving coil 145,.

In the first embodiment, the power receiving device 13, and integrating the secondary battery 134 receiving coil is a component 131, receiving circuit 132, and discharge control circuit 133, it is arranged to form a power receiving device module This integration may be any secondary battery 134 and the receiving coil 131 at least.

[0052]

Furthermore, in the second embodiment, transmission and receiving device 14 combined, 141, 143 receiving circuit battery 142,2, 144 charge and discharge control circuit, transmission and receiving coil 145, the selector switch SW1~SW3 transmission circuit which is a component , of the display device 148 set 146, and a control circuit 147, and integrating the components other than the display unit 148 and the setting device 146, it is arranged to form a transmission and receiving compatible apparatus module.

However, this integration may be any secondary battery 143 and the transmission and receiving coil 131 at least.

[0053]

In the second embodiment and the first embodiment has been described as being applied to a mobile phone, but can be applied to a portable device such as a video camera or mobile terminals, such as portable computers and in place of this.

[0054]

Is a block diagram showing a configuration of a first embodiment of the present invention.

Is an exploded perspective view of each component of the receiving coil and the transmitting coil.

Is a cross-sectional view showing the structure of a receiving coil and transmitting coil.

Is a cross-sectional view showing a state incorporated in the cell phone case and the case of the charger, and a power transmitting apparatus and the power receiving apparatus.

Is a block diagram showing the configuration of a second embodiment of the present invention.

[0055]

11 ... the power transmission device, 12 and 15 ... mobile phone body, 13 ... powered device, 14 ... transmission and receiving compatible apparatus, 32 ... powered device module, 113 ... power transmission coil, 113a , 131a ··· planar spiral coil, 113b, 131b ··· magnetic sheet, 113c, 131c ··· metal sheet, 112,141 ... power transmission circuit, 131 ... receiving coil, 132, 142 ... incoming circuit, 134,143 ... secondary battery, 145 ... transmission and receiving coil.

CLAIMS JP2006042519

[0001]

And a power transmission device including a first coil and a power receiving device including a secondary battery and a second coil,

When the first coil is electromagnetically coupled to the second coil, wherein the power transmission device has a transmission means for generating an alternating current supplied to the first coil,

When the second coil is electromagnetically coupled to the first coil, the power receiving device, for charging of the secondary battery by a DC that converts alternating current into direct current induced in the second coil, and the transformed and a receiving means,

Further, the second coil and the first coil consists second planar coil and the first planar coil that plane is adapted to face a spiral,

And said second planar coil and the first planar coil, the non-contact power transmission device to the surface opposite to the surface in which the two faces, and characterized by providing each of the magnetic sheet.

[0002]

The outer surface of the magnetic sheet provided on the second planar coil and the first planar coil, further, the non-contact power transmission device according to claim 1, characterized in that is provided to overlap each metal sheet.

[0003]

The second coil constituting the power receiving device, the receiving means, and one of the secondary battery, to claim 1, characterized in that it is integrated to the secondary battery and the second coil of at least non-contact power transmission device according.

[0004]

The second coil constituting the power receiving device, the receiving means, and one of the secondary batteries, the secondary battery and the second coil, it has to be solidified or accommodated in a case at least a predetermined The contactless power transmission apparatus according to claim 1, wherein the.

[0005]

The power receiving device, the non-contact power transmission apparatus according to claim 1 of any one of claims 1 to 4, characterized in that it was mounted on a cellular phone.

[0006]

And a power transmission device including a first coil, and the transmission and receiving combined device including a secondary battery of the first and second coil and a power receiving device including a secondary battery of the second and third coil,

The power transmission device,

When electromagnetically coupled to the third coil of the first coil or the second coil, and a transmission means for generating an alternating current supplied to the first coil,

The transmission and receiving compatible apparatus is,

when the second coil is electromagnetically coupled with said third coil, and a transmission means for generating an alternating current supplied to the second coil by using a battery as a power supply of the secondary first,

when the second coil is electromagnetically coupled to the first coil, and receiving means for charging the secondary battery according to claim 1 by a DC that converts alternating current into direct current induced in the second coil, and the transformed and a door,

The powered device,

When electromagnetically coupled to the second coil and the third coil or the first coil, the secondary battery and the second by a DC that converts alternating current into direct current which is induced in the third coil, and the transformed and a receiving means for charging,

Further, the first coil, the second coil, and the third coil, the third planar first planar coil the plane is in opposition to each other a spiral, and the second planar coil, and a coil,

And wherein the first planar coil, the second planar coil, and the third planar coil, the non-contact power transmission apparatus is characterized in that a surface opposite to a surface facing, respectively, and provided with a magnetic sheet.

[0007]

The first planar coil, said second planar coil, and the outer surface of the magnetic sheet provided on the third planar coil, further, according to claim 6, characterized in that is provided to overlap each metal sheet non-contact power transmission equipment.

[0008]

The second coil constituting the transmission and receiving compatible apparatus, said power transmission means, said receiving means, and of the secondary battery according to claim 1, the integrated rechargeable battery of the first and the second coil, at least,

And the third coil which constitutes the power receiving device, the receiving means, and of the secondary battery and the second, characterized in that it has integrated rechargeable battery and the second and the third coil at least The contactless power transmission apparatus according to claim 6 or 7.

[0009]

The second coil constituting the transmission and receiving compatible apparatus, said power transmission means, said receiving means, and of the secondary battery according to claim 1, the secondary battery of the first and the second coil is at least a predetermined and so as to solidify or housed in the case,

And the third coil which constitutes the power receiving device, the receiving means, and of the secondary battery of the second secondary battery and the second and the third coil is housed within a case at least a predetermined or the non-contact power transmission apparatus according to claim 6, characterized in that it is arranged to solidify.

[0010]

The power receiving device and the transmission and receiving combined device, non-contact power transmission apparatus according to claim 1 any one of claims 9 to claim 6, characterized in that it was mounted on a cellular phone, respectively.

【添付書面】

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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
18 December 2003 (18.12.2003)

PCT

(10) International Publication Number
WO 03/105308 A1

(51) International Patent Classification[7]: H02J 7/00, H01F 38/14

(21) International Application Number: PCT/AU03/00721

(22) International Filing Date: 10 June 2003 (10.06.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:

0213374.2	10 June 2002 (10.06.2002)	GB
0226893.6	18 November 2002 (18.11.2002)	GB
0305428.5	10 March 2003 (10.03.2003)	GB

(71) Applicant (*for all designated States except US*): CITY UNIVERSITY OF HONG KONG [—/—]; Tat Chee Avenue, Kowloon Tong, Kowloon, Hong Kong (CN).

(72) Inventor; and

(75) Inventor/Applicant (*for US only*): HUI, Ron, Shu-yuen [AU/—]; 2B, Block 29, Greenwood Terrace, 26-28 Sui Wo Road, Shatin, New Territories, Hong Kong (CN).

(74) Agent: HODGKINSON OLD MCINNES; Level 3, 20 Alfred Street, Milsons Point, NSW 2061 (AU).

(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, 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, NI, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

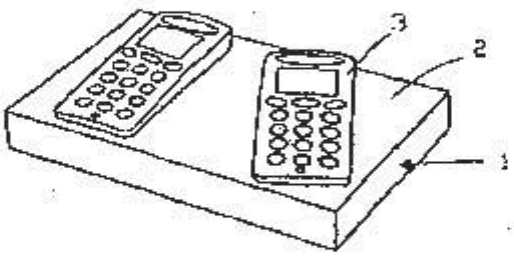
(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search 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.

【裏面有】

(54) Title: PLANAR INDUCTIVE BATTERY CHARGER



(57) Abstract: There is provided a planar inductive battery charging system designed to enable electronic devices to be recharged. The system includes a planar charging module having a charging surface on which a device is placed. Within the charging module and parallel to the charging surface is at least one and preferably an array of primary windings that couple energy inductively to a secondary winding formed in the device. The invention also provides secondary modules that allow the system to be used with conventional electronic devices not formed with secondary windings.

WO 03/105308 A1

PLANAR INDUCTIVE BATTERY CHARGER

FIELD OF THE INVENTION

This invention relates to a battery charger, and in particular to a battery charger having a planar surface on which one or more battery powered devices may be placed for battery recharging through induction. The invention also extends to a battery charging system for use with conventional electronic devices and that allows conventional electronic devices to be charged using the battery charging system of the present invention.

BACKGROUND OF THE INVENTION

Portable electronic equipment such as mobile phones, handheld computers, personal data assistants, and devices such as a wireless computer mouse, are normally powered by batteries. In many cases, rechargeable batteries are preferred because of environmental and economical concerns. The most common way to charge rechargeable batteries is to use a conventional charger, which normally consists of an AC-DC power supply (in case of using the ac mains) or a DC-DC power supply (in case of using a car battery). Conventional chargers normally use a cord (an electric cable for a physical electrical connection) to connect the charger circuit (a power supply) to the battery located in the portable electronic equipment. The basic schematic of the conventional battery charger is shown in Fig.1.

PRIOR ART

Inductive electronic chargers without direct physical electrical connection have been developed in some portable electronic equipment such as electric toothbrushes

where because they are designed to be used in the bathroom in the vicinity of sinks and water, it is not safe to provide a conventional electrical connection. US6,356,049, US6301,128, US6,118,249, also all describe various forms of inductive chargers. These inductive type chargers, however, use traditional transformer designs with windings wound around ferrite magnetic cores as shown in Fig.2. The main magnetic flux between the primary winding and secondary winding has to go through the magnetic core materials. Other contactless chargers proposed also use magnetic cores as the main structure for the coupled transformer windings.

A contactless charger using a single primary printed winding without any EMI shielding has been proposed by Choi et al in "A new contactless battery charger for portable telecommunications/computing electronics" ICCE International Conference on Consumer Electronics 2001 Pages 58-59. However, the magnetic flux distribution of a single spiral winding has a major problem of non-uniform magnetic flux distribution. As illustrated further below, the magnitude of the magnetic field in the centre of the core of a spiral winding is highest and decreases from the centre. This means that if the portable electronic device is not placed properly in the central region, the charging effect is not effective in this non-uniform field distribution. Furthermore, without proper EMI shielding, undesirable induced currents may flow in other metallic parts of the portable electronic equipment.

SUMMARY OF THE INVENTION

According to the present invention there is provided a battery charger system comprising a charging module comprising a primary charging circuit and being formed with a planar charging surface adapted to receive an electronic device to be charged, wherein said primary charging circuit includes the primary winding of a transformer,

said primary winding being substantially parallel to said planar charging surface, wherein said primary winding is provided with electromagnetic shielding on the side of said winding opposite from said planar charging surface, and wherein said electronic device is formed with a secondary winding.

In a preferred embodiment the primary winding is formed on a planar printed circuit board.

Preferably the magnetic flux generated by the primary winding is substantially uniform over at least a major part of the planar charging surface. In this way the precise position and orientation of the electronic device on the charging surface is not critical. To achieve this the charging module may comprise a plurality of primary windings, which may preferably be disposed in a regular array.

In a preferred embodiment the primary winding is provided with electromagnetic shielding on the side of said winding opposite from said planar charging surface. This shielding may include a sheet of ferrite material, and more preferably also may further include a sheet of conductive material such as copper or aluminium

It is an advantage of the present invention that in preferred embodiments the planar charging surface may be large enough to receive two or more electronic devices, and the primary charging circuit is adapted to charge two or more devices simultaneously. In this way it is possible to charge more than one device simultaneously. For example the planar charging surface may be divided into a plurality of charging regions, which regions may be defined by providing a plurality of primary transformer windings arranged in a regular array and connecting the windings in groups to define said charging regions. A further advantage of the present invention is that it enables the possibility of allowing a device to move over the charging surface while being charged

at the same time. This possibility is particularly useful to a device which is designed to be moved such as a wireless computer mouse

Viewed from another aspect the present invention provides a battery charging system comprising a charging module comprising a primary charging circuit and being formed with a charging surface for receiving an electronic device to be charged, wherein said charging module comprises a plurality of transformer primary windings arranged in a regular array.

In addition to the battery charging system, the invention also extends to a battery powered portable electronic device comprising a rechargeable battery, and wherein the device includes a planar secondary winding for receiving electrical energy from a battery charger, and electromagnetic shielding between the winding and the major electronic components of said device.

Preferably, the shielding comprises a sheet of ferrite material and a sheet of conductive material such as copper.

Preferably the winding is formed integrally with a back cover of said device.

An important aspect of the present invention is that it provides a battery charging system that employs a localised charging concept. In particular, when there is an array of primary coils, it will be understood that energy is only transferred from those primary coils that are adjacent the secondary coil located in the device being charged. In other words, when a device is placed on a planar charging surface that is greater in size than the device, energy is only transferred from that part of the planar charging surface that is directly beneath the device, and possibly also immediately adjacent areas that are still able to couple to the secondary coil.

Viewed from another aspect the present invention provides a battery charging system comprising a primary module and at least one secondary module, said primary

module comprising means for connecting to a mains supply, and at least one primary winding adjacent to a charging surface of said primary module, and wherein said secondary module comprises a secondary winding adjacent to a surface of said secondary module, circuit means for converting alternating current generated in said secondary winding to a regulated DC output, and a charging connector for connection to the charging socket of an electronic device.

According to another aspect the invention also extends to a secondary module for a battery charging system, comprising: a housing having at least one charging surface, a winding provided in said housing adjacent to said surface and adapted to receive magnetic flux when said surface is brought adjacent to a primary winding, circuit means for converting alternating current in said secondary winding to a regulated DC output, and a connector means for connecting said DC output to the charging socket of an electronic device.

BRIEF DESCRIPTION OF THE DRAWINGS

Some embodiments of the invention will now be described by way of example and with reference to the accompanying drawings, in which:-

Fig.1 is a schematic view of a conventional prior art battery charger with direct electrical connection,

Fig.2 is a schematic view of a conventional magnetic core-based transformer as used in prior art inductive battery charger systems,

Fig.3 is a schematic view of a planar transformer with shielding,

Figs.4(a)-(c) are (a) a perspective view of a battery charger system according to an embodiment of the present invention, (b) a view similar to (a) but showing

the structure of the primary charging system, and (c) a view similar to (a) and (b) but showing the top cover removed for clarity,

Figs.5(a) & (b) show the structure of the primary charger with the top cover removed for clarity, and in Fig.5(a) with the structure shown in exploded view,

Figs.6(a) & (b) show (a) a single spiral PCB winding, and (b) the measured magnetic field distribution of a single spiral winding,

Figs.7(a) & (b) illustrate the use of a magnetic core to control magnetic field distribution,

Fig.8 shows an embodiment of the invention in which a plurality of primary windings are arranged in an array structure,

Figs.9(a) & (b) shows (a) a 4 x 4 primary winding array, and (b) the resulting magnetic field distribution,

Figs.10(a)-(c) illustrate an embodiment of the invention in which primary windings are arranged in groups with Fig.10(c) showing the equivalent circuit,

Fig.11 shows an example of the back cover of an electronic device designed to be recharged using an embodiment of the present invention,

Figs.12(a)-(d) show exploded views of the back cover of Fig.11,

Figs.13(a) & (b) show views of a watch that may be recharged in accordance with an embodiment of the invention,

Fig.14 shows a charging module in accordance with an alternative embodiment of the invention,

Fig.15 shows a first layer of a 4x5 winding array for use in a multi-layer embodiment,

Fig.16 shows a second layer of a 3x4 winding array for use in conjunction with the layer of Fig.15 in a multi-layer embodiment,

Fig.17 shows the layers of Fig.15 and Fig.16 in the two-layer structure,

Fig.18 is simplified version of Fig.15,

Fig.19 is a simplified version of Fig.16,

Fig.20 is a simplified version of Fig.17,

Fig.21 is a plot showing the smoothing effect of the two-layer structure,

Fig.22 shows a hexagonal spiral winding,

Fig.23 is a simplified form of Fig.22,

Fig.24 shows a single-layer of hexagonal spiral windings,

Fig.25 shows two adjacent hexagonal spiral windings,

Fig.26 shows the mmf distribution of the adjacent windings of Fig.25,

Fig.27 shows three adjacent hexagonal spiral windings and the peaks and minima of the flux distribution,

Fig.28 shows two overlapped layers of hexagonal spiral windings,

Fig.29 shows the location of the peak flux in the structure of Fig.28,

Fig.30 corresponds to Fig.29 but also shows the location of the flux minima,

Fig.31 shows an embodiment of the invention formed with three overlapped layers,

Fig.32 corresponds to Fig.31 but shows the location of the flux peaks,

Fig.33 is a plot showing the uniformity of the flux distribution along a line,

Fig.34 shows a square spiral winding,

Fig.35 is a simplified version of Fig.34,

Fig.36 shows a first layer of square spiral windings,

Fig.37 corresponds to Fig.36 but shows the location of the flux maxima and minima,

Fig.38 shows two overlapped layers of square spiral windings including the location of the flux maxima and minima,

Fig.39 shows three overlapped layers of square spiral windings including the location of the flux maxima and minima,

Fig.40 shows four overlapped layers of square spiral windings including the location of the flux maxima and minima,

Fig.41 illustrates a battery charging system according to a further embodiment of the invention,

Fig.42 is a view similar to Fig.41 but part broken away to show the primary winding,

Fig.43 is a view similar to Fig.42 but of an alternate embodiment,

Figs.44(a) and (b) illustrate possible magnetic cores for use in the embodiment of Fig.42,

Fig.45 shows an equivalent circuit for the charging system of an embodiment of the invention,

Fig.46 illustrates an example of a secondary module for use in an embodiment of the invention,

Fig.47 shows a part broken away view of secondary module of an embodiment of the invention,

Fig.48 is a view similar to Fig.47 but of a further embodiment,

Fig.49 is a view showing the complete charging system according to an embodiment of the invention,

Fig.50 is a view similar to Fig.49 but showing how the charging system according to an embodiment of the invention can be used to charge multiple devices having different forms of charging connections, and

Fig.51 is a view illustrating how an embodiment of the present invention can be used to enable a conventional electronic device to be charged using an inductive charging platform as shown in Fig.4.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The present invention will now be described in respect of a preferred embodiment in the form of an inductive battery charger for portable electronic equipment such as mobile phones, handheld computers and personal digital assistants (PDA), and devices such as a wireless computer mouse.

Referring firstly to Fig.4, the inductive charger system comprises two modules, a power delivering charger module that contains the primary circuit of a planar isolation transformer and a secondary circuit that is located in the portable electronic equipment to be charged. In this embodiment of the invention, the charger circuit is located within a housing 1 that is formed with a flat charging surface 2. The secondary circuit is formed in the portable equipment to be charged (in this example a mobile phone 3) and the equipment is formed with at least one planar surface. As will be seen from the following description the equipment is charged simply by placing the equipment on the surface so that the planar surface on the equipment is brought into contact with the flat charging surface 2. It is a particularly preferred aspect of the present invention that the equipment to be charged does not have to be positioned on the charging surface in any special orientation. Furthermore, in preferred embodiments of the invention two or more mobile devices may be charged simultaneously on the same charging surface, and/or a device that is designed to be moved (such as a wireless computer mouse) can be charged while being moved over the charging surface (which could be integrated into a computer mouse pad). It will also be seen from the following description that the energy

transfer is "localised" in the sense that energy is only transferred from the charging surface to the device from that part of the charging surface that is directly beneath the device (and possibly to a lesser extent regions adjacent thereto).

Referring in particular to Fig.4(b) the primary charging module comprises a printed circuit board 4 formed with at least one spiral conductive track formed thereon as a primary winding. It will be understood, however, that the primary winding need not necessarily be formed on a PCB and could be formed separately. Alternatively, multiple PCBs each formed with at least one winding could be "stacked" on top of each other to increase the total flux. Preferably, as will be described further below, there are in fact a plurality of such spiral tracks disposed in an array as shown in Fig.4(c) in which a top insulating sheet has been removed for clarity. Beneath the PCB 4 (ie the side of the PCB away from the charging surface) is provided EMI shielding comprising firstly a ferrite sheet 5 adjacent the PCB 4, and then a conductive sheet 6 which in this example may be a copper sheet. Beneath the copper sheet 6 may be provided any suitable form of substrate material 7, eg a plastics material. Above the PCB 4 may be provided a sheet of insulating material 8 which forms the charging surface. Preferably the PCB 4, the EMI shielding sheets 5,6, the substrate 7 and the insulating cover sheet 8 may also be generally the same size and shape, for example rectangular, so as to form the primary charging module with the charging surface being large enough to accommodate at least one, and more preferably two or more, devices to be charged. Figs.5(a) and (b) also show the structure of the charging module without the cover sheet and without any devices to be charged thereon for the sake of clarity.

As shown in Fig.4, the primary transformer circuit module transmits electrical energy at high frequency through a flat charging surface that contains the primary transformer windings. The secondary winding is also planar and is located in the

portable electronic equipment and couples this energy, and a rectifier within the portable equipment rectifies the high-frequency secondary AC voltage into a DC voltage for charging the battery inside the portable equipment either directly or via a charging circuit. The rectified DC voltage is applied to the battery via mechanical contacts provided in an integrated back cover as will be described further below. No physical electrical connection between the primary charger circuit and the portable electronic equipment is needed.

The primary charger circuit has (1) a switched mode power electronic circuit, (2) the primary side of a planar transformer that consists of a group of primary windings connected in series or in parallel or a combination of both, (3) an EMI shield and (4) a flat interface surface on which one or more portable electronic devices can be placed and charged simultaneously. The schematic of the primary charger system is shown in Fig.5(a) and (b) without the insulating cover.

The battery charging system can be powered by AC or DC power sources. If the power supply is the AC mains, the switched mode power electronic circuit should perform a low-frequency (50 or 60Hz) AC to DC power conversion and then DC to high-frequency (typically in the range from 20kHz to 10MHz) AC power conversion. This high-frequency AC voltage will feed the primary planar windings of the primary charger circuit. If the power supply is a battery (e.g. a car battery), the switched mode power supply should perform a DC to high-frequency AC power conversion. The high-frequency voltage is fed to the primary windings of the planar transformer.

Preferably, the charger should be able to charge one or more than one items of portable electronic equipment at the same time. In order to achieve such a function, the AC magnetic flux experienced by each item of portable equipment placed on the charging surface should be as even as possible. A standard planar spiral winding as

shown in Fig.6(a) is not suitable to meet this requirement because its flux distribution is not uniform as shown in Fig.6(b) when the winding is excited by an AC power source. The reason for such non-uniform magnetic flux distribution is that the number of turns in the central region of the single spiral winding is largest. As the magnitude of the magnetic flux and the magnetomotive force (mmf) is proportional to the product of the number of turn and the current in the winding, the magnetic flux is highest in the centre of the winding.

One method to ensure uniform magnetic flux or mmf distribution is to use a concentric primary winding with a planar magnetic core as shown in Fig.7(a). This magnetic core-based approach allows the magnetic flux to concentrate inside the core and typical magnetic flux distribution is shown in Fig.7(b). In general, the flat charging interface surface of the primary charger should be larger than the total area of the portable electronic equipment.

In order to ensure that more than one item of portable electronic equipment can be placed on the flat charging surface and charged simultaneously, a second and more preferred method proposed is to ensure that the magnetic flux distribution experienced by each items of portable electronic equipment is as uniform as possible. This method can be realized by using a "distributed" primary planar transformer winding array structure as shown in Fig.8. This planar winding array consists of many printed spiral windings formed on the PCB. These printed spiral windings can be hexagonal, circular, square or rectangular spirals, and can be connected in series, in parallel or a combination of both to the high-frequency AC voltage generated in the power supply in the primary charger circuit. The array should comprises relatively closely spaced coils so as to be able to generate the required near-uniform magnetic flux distribution, as an array of widely spaced apart coils may not generate such a near-uniform field.

Fig.9(a) shows a practical example with the transformer winding array connected in series so that all the fluxes created in the windings point to the same direction. Fig.9(b) show the measured flux distribution of one planar transformer when the windings in the transformer array are connected in series. This measurement confirms the near uniform magnetic flux distribution of the array structure. Comparison of Fig.6(b) and Fig.9(b) confirms the improvement of the uniform magnetic field distribution using the transformer array structure. In addition, this transformer array structure provides for the possibility of multiple primary transformer windings being provided for localized charging as will now be explained.

The primary transformer windings can also take the form of a combination of series and parallel connections if desired. Such an arrangement allows the charging surface to be divided into various charging regions to cater for different sizes of the secondary windings inside the portable electronic equipment. Fig.10(a) illustrates this localized charging zone principle. Assume that the transformer array is divided into 4 zones (A, B, C, and D). The transformer windings within each zone are connected in series to form one primary winding group with the distributed magnetic flux feature. There will be four primary windings in the equivalent circuit as shown in Fig.10(c). If the portable electronic equipment is placed on Zones A and B as shown in Fig.10(b), the equivalent electrical circuit is shown in Fig.10(c). Only the parallel primary transformer winding groups for Zones A and B are loaded because they can sense a nearby secondary winding circuit in the portable electronic equipment. Therefore, they will generate magnetic flux in Zones A and B. Primary transformer windings C and D are not loaded because they have no secondary transformer circuit close to them and their equivalent secondary circuits are simply an open-circuit (Fig.10(c)). As a result, power transfer between the primary charger circuit and the secondary windings inside the

portable electronic equipment takes place basically through the coupled regions (areas) of the charging interface surface covered by the portable electronic equipment. The non-covered area of the charging surface will transfer virtually no energy. This special design avoids unnecessary electromagnetic interference. A further advantage of this localised energy transfer concept, is that it enables a movable device (such as a wireless computer mouse) to be continually charged as it moves over the charging surface. In the case of a wireless computer mouse, for example, the primary charging circuit could be integrated into a mousepad and the mouse may be charged as it rests on and/or moves over the mousepad.

The back cover of the portable electronic equipment is a detachable back cover shown in Fig.12(a) that covers the battery and which may be removed when the battery is replaced. In preferred embodiments of the present invention, this back cover has a built-in secondary planar transformer winding 10, a diode rectifier circuit 13 and preferably a thin EMI shield 11,12 as shown in Fig.12(b) & (c). When the back cover side of the portable equipment is placed near the flat charging surface of the primary charger circuit, this secondary winding couples the energy from the nearby primary transformer winding or windings. The rectifier circuit rectifies the coupled AC voltage into a DC voltage for charging the battery through mechanical contacts 14. This rectifier circuit also prevents the battery from discharging into the secondary winding. In order to avoid induced circuit from circulating in other metal parts inside portable electronic circuit, it is preferable to include a thin EMI shield as part of the integrated back cover structure as shown in Fig.12. This EMI shield can be a thin piece of ferrite material (such as a flexible ferrite sheet developed by Siemens) or ferrite sheets, or more preferably a combination of a ferrite sheet 11 and then a thin sheet 12 of copper of another conductive material such as aluminium.

It will thus be seen that, at least in its preferred forms, the present invention provides a new planar inductive battery charger for portable electronic equipment such as mobile phones, handheld computers, personal data assistant (PDA) and electronic watches, and wireless computer mice. The inductive charger system consists of two modules, including (1) a power delivering charger circuit that contains the primary circuit of a planar isolation transformer and a flat charging surface and (2) a separate secondary transformer circuit that consists of a printed winding, a rectifier and preferably a thin EMI shield and which is located in the portable electronic equipment to be charged.

An advantage of the present invention, at least in preferred forms, is that the primary charger circuit system has the primary side of a planar transformer and a flat interface surface on which one or more portable electronic devices can be placed and charged simultaneously. The secondary circuit can be integrated into the back cover of the portable electronic device or separately placed inside the electronic device. The invention also extends to a back cover design with an in-built secondary circuit for the portable equipment. The secondary winding of the planar transformer can be EMI shielded and integrated into the back cover adjacent to the battery in the portable electronic device. As long as the back cover sides of the portable electronic device are placed on the charger surface, one or more portable electronic devices can be charged simultaneously, regardless of their orientations.

Figs.13(a) and (b) show how an embodiment of the invention may be used to recharge a watch battery. A watch is formed with a basic watch mechanism 20, which is powered by a rechargeable battery 21. The watch mechanism is shielded from electrical interference in the charging process by an EMI shield consisting of, for example, a copper sheet 22 and a ferrite sheet 23 (with the copper sheet closer to the watch

mechanism than the ferrite sheet). The other side of the EMI shield is provided a planar coreless transformer secondary winding 24 formed with electrical contacts 26 for connection to the battery 21 and with a rectifier circuit to prevent discharge of the battery. Finally, the watch structure is completed by the provision of a planar back cover 25 formed of non-metallic material. It will be understood that the watch battery may be recharged by placing the watch on the charging surface of a battery charging system as described in the above embodiments such that the back cover 25 lies flat on the planar charging surface. Electrical energy is then coupled from the primary winding(s) in the battery charging module to the secondary winding in the watch and then to the rechargeable battery.

In the embodiments described above the charging module is formed as a single integral unit (as shown for example in Figs.4 and 5). However, in some situations it may be desirable to separate the electronic charging circuit from the planar charging surface. This possibility is shown in Fig.14 in which the electronic charging circuit 30 is connected by a cable 31 to the charging surface 32. The charging surface 32 includes an insulating top cover, the planar primary windings printed on a PCB, and a bottom EMI shield formed of ferrite and a conductive sheet such as copper. This embodiment has the advantage that the charging surface is relatively thin, and therefore may be useful for example when the device to be charged is a wireless computer mouse because the charging surface can double as a mousepad as well as a charging surface.

In the embodiments described above a single layer of transformer arrays is provided. However, in order to generate a more uniform magnetic field distribution, multi-layer transformer arrays can be used. The following embodiments describe how multiple layers of transformer arrays may be used that can provide a very uniform magnetic field distribution on the charging surface.

Fig.15 shows a 4x5 primary planar transformer winding array which consists of square-sprial winding patterns. This can be fabricated on one layer of the printed circuit board structure. It should be noted that, for an individual winding pattern in the array, the magnitude of the magnetic flux is highest in the center of the spiral winding. The magnitude of the magnetic flux is smallest in the small gap between adjacent winding patterns.

A second layer with a 3x4 transformer winding array is shown in Fig.16. The individual winding patterns in both layers are identical. As shown in Fig.17, by having the two layers of arrays arranged in such a manner that the center (region of maximum magnetic flux magnitude) of a winding pattern on one layer is placed on the gap (region of minimum magnetic flux magnitude) between adjacent winding patterns on the other layer, the variation of the magnetic field magnitude can be minimized and the magnetic flux magnitude can therefore be made as even as possible over the overlapped surface. The essence of the multi-layer transformer arrays is to have a displacement between the individual winding patterns of the two layers so that the regions of the maximum magnetic field magnitude of one layer is "evened out" by the regions of the minimum magnetic field magnitude.

In order to examine the 'uniform magnetic field magnitude' feature of the proposed overlapped multi-layer transformer arrays, this 'magnitude smoothing' concept is illustrated in simplified diagrams in Fig.18 to 20. Fig.18 is a simplified version of Fig.15. Each solid square in Fig.18 represents a square-spiral winding pattern in the first layer (Fig.15). Fig.19 is a simplified version of the Fig.16. Each dotted square represents a square-spiral winding pattern in the second layer (Fig.16). The simplified version of the multi-layer array structure is shown in Fig.20. From Fig.20, it can be seen that the overlapped array structure (with correct displacement between the

two layers) divides each square-spiral winding pattern into four smaller sub-regions. The important feature is that the four sub-regions are identical in terms of winding structure. Despite that fact that the distribution of the magnetic field magnitude on the surface of each individual square-spiral winding is not uniform, the distribution of the resultant magnitude field magnitude on the surface of each sub-region is more or less identical because of the overlapped multi-layer winding structure. The concept of the generating uniform magnetic field magnitude over the charging surface is illustrated in Fig.21.

In this example, a multi-layer transformer winding array structure that can provide a uniform magnetic field magnitude distribution is described. This example is based on square-spiral winding patterns. In principle, winding patterns of other shapes can also be applied as long as the resultant magnetic field magnitude distribution is as uniform as possible.

The use of two layers of transformer arrays can reduce the variation in the magnetic flux over the charging surface. However, there may still be some variations and the use of a three or four layer structure may provide a still more uniform flux distribution as described in the following embodiments.

The following embodiment is a structure comprising three layers of planar winding arrays. This PCB winding structure can generate magnetomotive force (*mmf*) of substantially even magnitude over the charging surface. Each winding array consists of a plurality spiral windings each of which are of an hexagonal shape. A spiral winding arranged in a hexagonal shape is shown in Fig.22. For simplicity, it will be represented as a hexagon as shown in Fig.23. A plurality of hexagonal spiral windings can be arranged as an array as shown in Fig.24. These windings can be connected in parallel, in series or a combination of both to the electronic driving circuit. If a current passes

through each spiral winding pattern, a magnetomotive force (*mmf*), which is equal to the product of the number of turns (*N*) and current (*I*) (i.e. *NI*), is generated. Fig.25 shows two spiral winding patterns adjacent to each other and the per-unit *mmf* plot over the distance (dotted line) can be linearized as shown in Fig.26. It can be seen that the *mmf* distribution over the distance is not uniform. The maximum *mmf* occurs in the center of the hexagonal pattern and the minimum *mmf* occurs in the edge of the pattern.

Fig.27 shows three adjacent windings. The maximum *mmf* region is labelled by a symbol 'P' (which stands for Peak *mmf*). The minimum *mmf* region at the junction of two patterns is labeled as 'V' (which stands for Valley of the *mmf* distribution). In order to generate a uniform *mmf* distribution over the planar charging surface, two more layers of PCB winding arrays should be added. This principle is explained firstly by adding a second layer of PCB winding array to the first one as shown in Fig.28. The second layer is placed on the first one in such a way that the peak *mmf* positions (P) of the patterns of one layer are placed directly over the valley positions (V) of the patterns in the other layer. Fig.29 highlights the peak positions of the patterns that are directly over the valley positions of the other layer for the two overlapped PCB layers in Fig.28.

It can be observed from Fig.29, however, that the use of two layers of PCB winding arrays, while presenting an improvement over a single layer, does not offer the optimal solution for generating uniform *mmf* over the inductive charging surface. For each hexagonal pattern in the 2-layer structure, the peak positions occupy the central position and three (out of six) vertices of each hexagon. The remaining three vertices are valley positions (V) that need to be filled by a third layer of PCB winding arrays. These valley positions are shown in Fig.30 as empty squares.

Careful examination of Fig.30 shows that there are six peak positions (P) surrounding each valley position. Therefore, a third layer of a hexagonal PCB winding

array can be used to fill up all these remaining valley positions. By placing the central positions (peak *mmf* positions) of the hexagonal winding patterns of the third layer of the PCB winding array over the remaining valley positions of the two-layer structure, an optimal three-layer structure is formed as shown in Fig.31. Fig.32 highlights the peak *mmf* positions of the three-layer structure. It can be observed that all central positions and vertices of all hexagonal patterns have peak *mmf*.

In order to confirm that the *mmf* over the surface has uniform *mmf* distribution, any distance between any two adjacent peak *mmf* positions can be considered as illustrated in Fig.33. If the winding patterns are excited in the same manner and polarity so that the *mmf* generated by each layer of the winding array are always in the same direction at any moment, the resultant *mmf* is simply the sum of the *mmf* generated by each layer. The dotted line in Fig.33 shows that the resultant *mmf* over the distance between any two adjacent peak positions in Fig.33 is equal to 1.0 per unit. This confirms that the proposed three-layer PCB winding array structure can be used to generate highly uniform *mmf* over the inductive charging surface. When used as a contactless, inductive charging surface, this uniform *mmf* distribution feature ensures that, for a given airgap, a secondary PCB coupling winding can always couple the same amount of magnetic flux regardless of the position of the secondary (coupling) PCB on the inductive charging surface. In addition, the voltage induced in the secondary winding would be the same over the inductive charging surface.

In another embodiment, the three-layer PCB winding array structure can be constructed as a four-layer PCB, with one of the four layers accommodating the return paths of the spiral windings to the electronic driving circuit.

A further embodiment is based again on square spiral winding patterns. In this embodiment four layers of square-spiral winding arrays are used to generate highly

uniform *mmf* over the PCB surface. As in the hexagonal embodiment described above, for convenience of illustration each square-spiral winding pattern (Fig.34) is simplified as a square symbol (Fig.35) in the following description.

Fig.36 shows the first layer of the square-spiral PCB winding array. The *mmf* in the central region of each square pattern is highest. These regions are highlighted as 'Peak' or (P) in Fig.37. The regions of the minimum *mmf* (i.e. the valleys) occurs along the edges of the square patterns. These regions are highlighted with dots (•) in Fig.37.

In order to reduce the *mmf* ripples on the surface, the peak (P) positions of a second layer of square-spiral PCB winding array can placed over some of the valley positions (•) as shown in Fig.38. When a third layer of square-spiral PCB winding array is added to the structure in Fig.38, the resultant layout is shown in Fig.39. It can now be observed that one more layer of the square-spiral PCB windings is needed to fill up all the valleys with peaks as shown in Fig.40.

The inductive battery charging platform described above, which can be regarded as the primary circuit of a transformer system (or the primary inductive charging system), can be used as a standard battery charging platform for portable electronic equipment with compatible inbuilt secondary circuitry in the electronic equipment to be charged. However, existing electronic equipment that is not designed for compatibility with the abovedescribed battery charging platform cannot take advantage of the convenience offered by the battery charging platform. Another embodiment of the present invention therefore provides both a battery charging system that can stand independently and can be used to charge existing conventional devices, and a means by which a conventional electronic device can be charged using the charging platform described above.

Referring firstly to Fig.41 there is shown therein a perspective view of a part of a battery charging system according to an embodiment of the present invention. The part of the charging system shown in Fig.41 may be termed the primary inductive charging system since as will be explained below it comprises at least one primary winding. The part of the battery charging system shown in Fig.41 may also be considered to be an extension system since in preferred forms it may be adapted to charge multiple devices and is therefore analogous to a conventional extension lead that allows multiple items of electronic equipment to share the same power socket.

The charging system is provided with multiple charging slots 100,101,102 for receiving secondary charging modules to be described further below. As will be explained further below each charging slot is provided with a primary winding. Fig.41 shows a schematic of the primary inductive charging extension system with three charging slots. However, it should be noted that the number of slots is not restricted to three and can be as few as a single charging slot, or can be more than three. It will be understood that the number of charging slots dictate the number of devices that can be charged simultaneously. The primary charging extension system is connected to the mains through a plug 103 and includes a power electronic circuit 104 that provides a high-frequency (typically in the range of 1kHz to 2MHz) AC voltage to the primary windings that are located under the charging slot surfaces. It should be noted that the surfaces of the slots are flat and the slots are separated from each other by dividing walls. Each slot is therefore the same size as the surface of a housing of a secondary module to be described below, and the separating walls and mechanical switches to be described below together act to engage a secondary module and hold it in a correct orientation for efficient charging.

Each primary winding can be a coil 105 as shown in Fig.42 or a printed-circuit-board (PCB) winding 106 as shown in Fig.43. If the primary winding is a coil 105, the coil 105 is preferably accommodated in a space 107 defined by a magnetic structure 108 such as the two examples shown in Fig.44(a) and (b) in which the coil is wound around a magnetic core 108. If a PCB winding is used, appropriate electromagnetic (EM) shielding, such as the combined use of ferrite and copper sheets described in US 6501364, can be placed under the PCB winding in order to ensure that the magnetic flux generated in the PCB winding will not penetrate through the base of the primary inductive charging extension system. Preferably, mechanical switches 109 can be provided in each charging slot that when closed activate the primary winding to the high-frequency AC voltage source when the secondary charging module (to be described below) is inserted in that particular slot. As discussed above, the mechanical switches may also serve to engage and hold the secondary module in place. This mechanism ensures that only windings in the slots used by the secondary modules are excited by the high-frequency AC voltage source. The equivalent circuit is shown in Fig.45.

It will also be understood that the primary winding could be constructed as a multiple layer structure as discussed above in order to provide a particularly preferred even flux distribution over the charging surface.

Fig.46 shows a typical secondary charging module 200 for use with the primary charging extension system shown in Fig.41. Each secondary module has a conventional cable 201 and charger connecter 202 that is adapted to be received within the charging socket of a conventional electronic device. It will be understood that different secondary charging modules 200 may be provided differing only by the type of the connector 202. Each secondary charging module 200 is provided with a housing 203 that contains a

25

secondary circuit to be described below. The housing is preferably rectangular (but of course could be any suitable shape) and of such a size that it may be received in one of the slots 100-102 of the primary charging extension system. The housing 203 should have at least one preferably flat surface for placing on the charging slot of the primary charging extension system. This flat surface is preferably parallel to the plane of the secondary winding within the housing such that when the secondary module is placed in a slot of the primary extension system the secondary winding is substantially parallel to the primary winding beneath the surface of the slot. The housing 203 of the secondary module should preferably be made of non-conductive and non-ferromagnetic material so that no current will be induced in the housing material.

As can be seen from Figs.47 and 48 inside each secondary charging module 200 are at least one secondary winding 204 and charger circuitry 205 that receives the induced AC voltage in the secondary winding and provides a regulated DC output voltage for the charging purpose. The secondary winding should be kept inside the housing. The secondary winding can be a coil (Fig.47) or it can be printed on a PCB (Fig.48). The function of the secondary winding is to act as the secondary winding of a transformer system to pick up the changing magnetic flux generated by the primary winding of the primary charging extension system.

The secondary coil or PCB winding should be placed close to the (preferably flat) surface of the housing of the secondary charging module so as to pick up maximum changing AC magnetic flux from the primary inductive charging extension system or platform. According to Faraday's Law, an AC voltage will be induced across the secondary winding if the secondary winding senses a changing magnetic flux (that can be generated by the primary winding in the primary inductive charging system).

The terminals of the secondary winding are connected to the input terminals of an electronic circuit 205 that (1) performs the AC-DC power conversion function (i.e. rectifying the AC voltage into DC) and (2) preferably also regulate the DC voltage to a desired value (typically in the range from 3V to 24V) within a certain tolerance. Through a cable and a charger connector for connecting to charging socket in the portable equipment, this DC voltage can be used to charge the portable equipment a shown in Fig.49.

The secondary winding design (such as number of turns and dimensions of windings), the DC regulated voltage level and the type of connector can be designed according to the charging requirements of specific electronic products. Therefore, different secondary charging modules can be designed for different ranges of products, but all secondary modules are compatible with the same primary charging extension system as shown in Fig.50 in which two different types of secondary modules adapted for charging different devices and having different connectors 202,202' are shown in adjacent slots of the primary charging extension system. As the primary inductive charging extension system preferably has several charging slots for accommodating the secondary charging modules, it can be used to charge several items of conventional portable electronic equipment simultaneously.

A further advantage of the secondary charging module is that it allows a conventional electronic device to be charged using the inductive battery charging platform described above. Although a conventional electronic device cannot be charged by placing it directly on the charging platform surface because it does not have the in-built secondary winding, instead a secondary charging module can be placed in the inductive charging system and charge the conventional device therefrom as shown in Fig.51

In principle, the housing of the secondary charging module can have more than one preferably flat interface surface. If the housing is a cuboid it will have two large opposed interface surfaces (eg upper and lower surfaces of a relatively thin flat cuboid structure a shown in the Figures) and with this cuboid design, either interface surface of the secondary module housing can be placed on the charging slots of the primary inductive charging extension system or other charging platform. This cuboid design makes the secondary charging modules very user-friendly because it does not matter which way up the housing of the secondary module is placed on the primary charging surface.

In summary, a preferred embodiment of the secondary charging module consists of

(i) a non-conductive housing that has at least one surface (and prefetably two surfaces) for placing on the charging slot of the primary charging extension system or the charging platform and that accommodates the secondary winding and circuitry for charging the electronic equipment,

(ii) A secondary winding, that can either be printed in a printed-circuit-board (PCB) or a conductor coil,

(iii) an AC-DC power conversion circuit that converts the ac induced voltage picked by the secondary winding from the primary AC voltage excitation into a regulated or unregulated DC voltage, typically in the range from 3V to 24V,

(iv) a conventional cable that connects the DC voltage output of the secondary circuitry to a connector that is compatible with the charging socket in the conventional electronic equipment.

It will thus be seen that, at least in preferred forms, the charging system of the present invention including the proposed secondary charging modules offers users a

convenient and user-friendly battery charging system for a wide range of portable electronic equipment. Using the appropriate charger connectors that are compatible with different portable equipment, the proposed charging system enables one single charging system (that occupies only one power point or socket in the ac mains) to charge a wide range of electronic equipment.

The present invention, at least in preferred forms, provides a new charging system allows more than one piece of equipment to be charged simultaneously, and regardless of their orientations on the charging surface, and allows a movable device to be charged while it moves over the charging surface.

29

【裏面有】

CLAIMS

1. A battery charger system comprising a charging module comprising a primary charging circuit and being formed with a planar charging surface adapted to receive an electronic device to be charged, wherein said primary charging circuit includes the primary winding of a transformer, said primary winding being substantially parallel to said planar charging surface, wherein said primary winding is provided with electromagnetic shielding on the side of said winding opposite from said planar charging surface, and wherein said electronic device is formed with a secondary winding.

2. A battery charger system as claimed in claim 1 wherein said transformer primary winding is formed on a printed circuit board.

3. A battery charging system as claimed in claim 1 wherein the magnetic flux generated by said primary winding is substantially uniform over at least a major part of said planar charging surface.

4. A battery charging system as claimed in claim 1 wherein said charging module comprises a plurality of primary windings.

5. A battery charging system as claimed in claim 4 wherein said primary windings are disposed in a regular array.

6. A battery charging system as claimed in claim 4 wherein said primary windings are formed in a multi-layer structure comprising at least two layers and with each said layer including an array of primary windings.

7. A battery charging system as claimed in claim 6 wherein the array of a first said layer is offset relative to the array of a second said layer whereby regions of said first layer generating maximum magnetic flux coincide with regions of said second layer that generate minimum magnetic flux.

8. A battery charging system as claimed in claim 6 comprising three layers of hexagonal windings.

9. A battery charging system as claimed in claim 6 comprising four layers of square windings.

10. A battery charging system as claimed in claim 5 wherein said primary windings are hexagonal, circular, rectangular, square or polygonal in shape.

11. A battery charger system as claimed in claim 1 wherein said shielding includes a sheet of ferrite material.

12. A battery charging system as claimed in claim 11 wherein said shielding further includes a second sheet of conductive material.

31

13. A battery charging system as claimed in claim 1 wherein said planar charging surface is large enough to receive two or more electronic devices, and wherein said primary charging circuit is adapted to charge two or more devices simultaneously.

14. A battery charging system as claimed in claim13 wherein said planar charging surface is divided into a plurality of charging regions.

15. A battery charging system as claimed in claim 14 wherein said primary charging circuit comprises a plurality of primary transformer windings arranged in a regular array and wherein said windings are connected in groups to define said charging regions.

16. A battery charging system as claimed in claim 1 wherein said primary charging circuit comprises an array of primary windings, and wherein when a device is placed on said charging surface charging energy is transferred to said device from only those primary windings closely adjacent to said device.

17. A battery charging system as claimed in claim 1 wherein said planar charging surface is large enough to enable a said device to be moved over said charging surface while being charged.

18. A charging module for a battery charging system, said module comprising a primary charging circuit and being formed with a charging surface for receiving

an electronic device to be charged, wherein said charging module comprises a plurality of transformer primary windings arranged in a regular array.

19. A charging module as claimed in claim 18 wherein when an electronic device to be charged is placed on said charging surface charging energy is transferred to said device from only those primary windings closely adjacent to said device.

20. A charging module as claimed in claim 18 wherein said transformer primary windings are connected to each other in series and/or in parallel.

21. A charging module as claimed in claim 18 wherein said primary transformer windings are planar and substantially parallel to a planar charging surface.

22. A charging module as claimed in claim 21 wherein said primary windings are formed in at least two planes, each said plane including an array of said windings.

23. A charging module as claimed in claim 22 wherein the array of a first said plane is offset relative to the array of a second said plane whereby regions of said first array that generate maximum magnetic flux coincide with regions of said second array that generate minimum magnetic flux.

24. A charging module as claimed in claim 22 comprising three layers of hexagonal windings.

25. A charging module as claimed in claim 22 comprising four layers of square windings.

26. A charging module as claimed in claim 21 wherein said primary windings are formed on a printed circuit board.

27. A charging module as claimed in claim 21 wherein electromagnetic shielding is provided on the side of said primary windings opposite from said planar charging surface.

28. A charging module as claimed in claim 27 wherein said shielding comprises a sheet of ferrite material.

29. A charging module as claimed in claim 28 wherein said shielding further comprises a second sheet of conductive material.

30. A charging module as claimed in claim 18 wherein said charging surface is large enough to allow two or more devices to be charged thereon simultaneously.

31. A charging module as claimed in claim 18 wherein said charging surface is large enough to allow a device to be moved over the charging surface while being charged.

32. A battery powered portable electronic device comprising a rechargeable battery, and wherein said device includes a planar secondary winding for receiving

electrical energy from a battery charger, and electromagnetic shielding between said winding and the major electronic components of said device.

33. An electronic device as claimed in claim 32 wherein said shielding comprises a sheet of ferrite material and a sheet of conductive material.

34. An electronic device as claimed in claim 32 wherein said winding is formed integrally with a back cover of said device.

35. A battery charging system comprising a primary module and at least one secondary module, said primary module comprising means for connecting to a mains supply, and at least one primary winding adjacent a charging surface of said primary module, and wherein said secondary module comprises a secondary winding adjacent a surface of said secondary module, circuit means for converting alternating current generated in said secondary winding to a regulated DC output, and a charging connector for connection to the charging socket of an electronic device.

36. A battery charging system as claimed in claim 35 wherein said primary charging module comprises a plurality of primary windings each associated with a respective charging surface whereby said primary charging module is able to receive a plurality of secondary charging modules simultaneously.

37. A battery charging system as claimed in claim 36 wherein said charging surfaces are provided with engagement means for engaging a secondary module.

38. A battery charging system as claimed in claim 37 wherein said engagement means include a mechanical switch whereby power is supplied to said primary winding only when a secondary module is engaged by a charging surface.

39. A battery charging system as claimed in claim 35 wherein said primary winding is formed by a coil.

40. A battery charging system as claimed in claim 39 wherein said coil is wound on a magnetic structure.

41. A battery charging system as claimed in claim 39 wherein said coil is parallel to said charging surface.

42. A battery charging system as claimed in claim 35 wherein said primary winding is printed in a printed circuit board.

43. A battery charging system as claimed in claim 42 wherein said printed circuit board is parallel to said charging surface.

44. A battery charging system as claimed in claim 35 wherein said secondary winding is formed by a coil.

45. A battery charging system as claimed in claim 44 wherein said coil is parallel to said charging surface.

46. A battery charging system as claimed in claim 1 wherein said secondary winding is printed on a printed circuit board.

47. A battery charging system as claimed in claim 46 wherein said printed circuit board is parallel to said charging surface.

48. A secondary module for a battery charging system, comprising: a housing having at least one charging surface, a winding provided in said housing adjacent to said surface and adapted to receive magnetic flux when said surface is brought adjacent to a primary winding, circuit means for converting alternating current in said secondary winding to a regulated DC output, and a connector means for connecting said DC output to the charging socket of an electronic device.

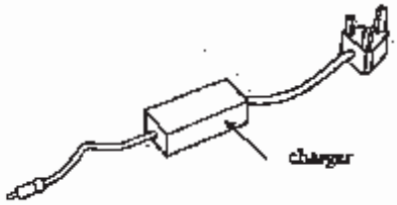


FIG.1 (PRIOR ART)

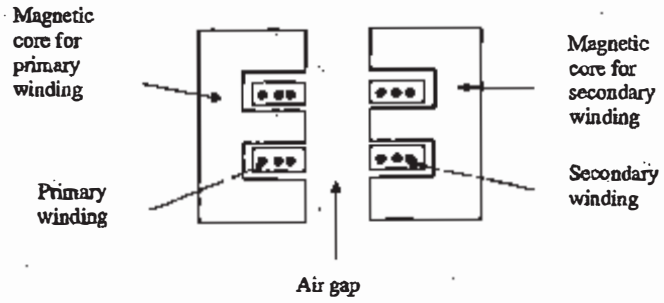


FIG.2 (PRIOR ART)

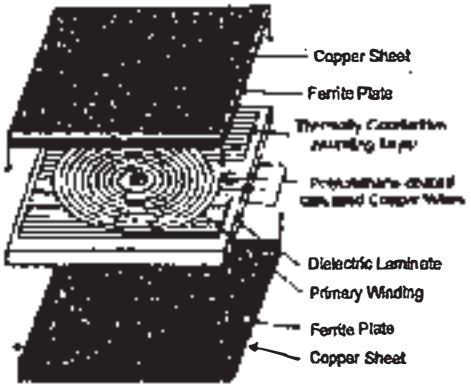


FIG.3 (PRIOR ART)

FIG.4(a)

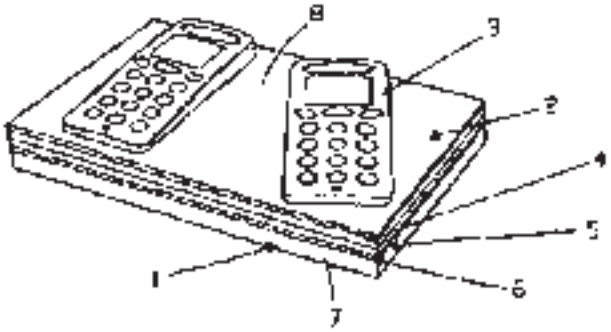
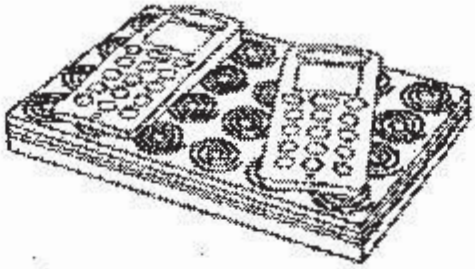


FIG.4(b)



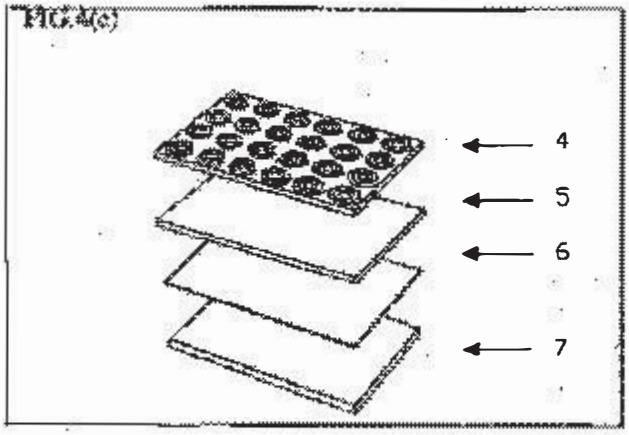


FIG.5(a)

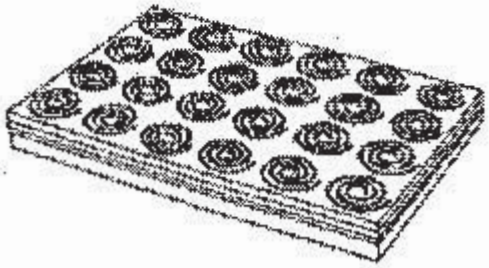


FIG.5(b)

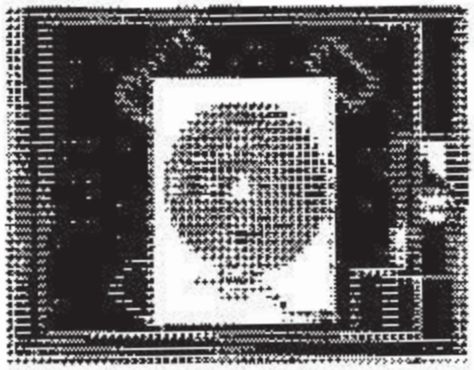


FIG.6(a)

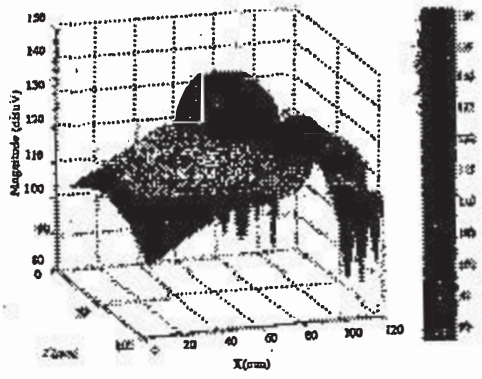


FIG.6(b)

FIG.7(a)

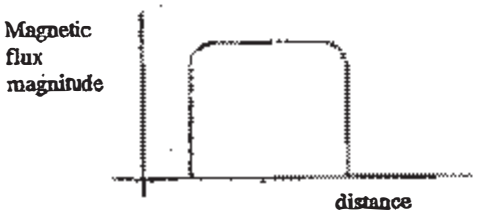


FIG.7(b)

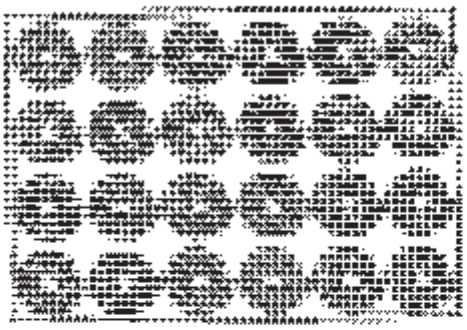


FIG.8

FIG.9(a)

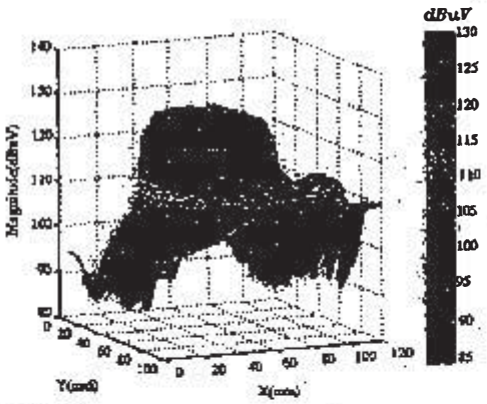


FIG.9(b)

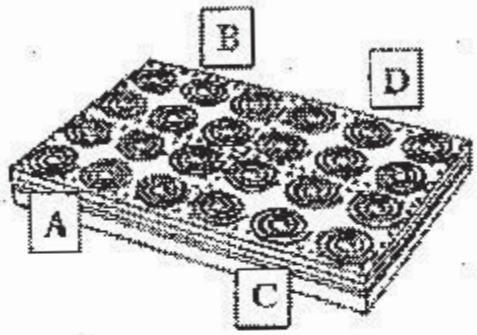


FIG.10(a)

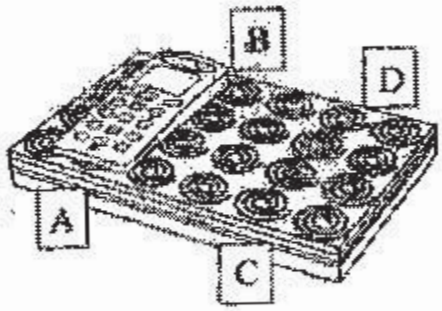


FIG.10(b)

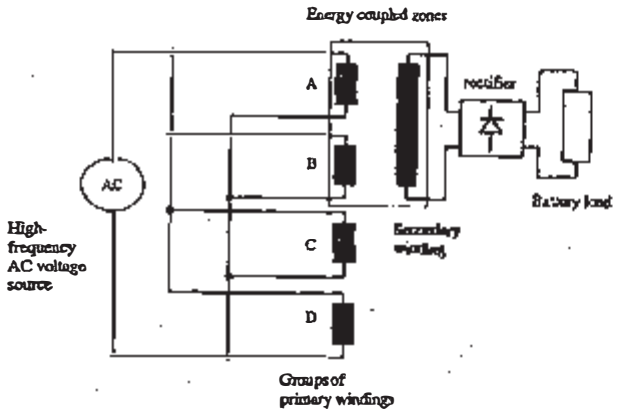


FIG.10(c)

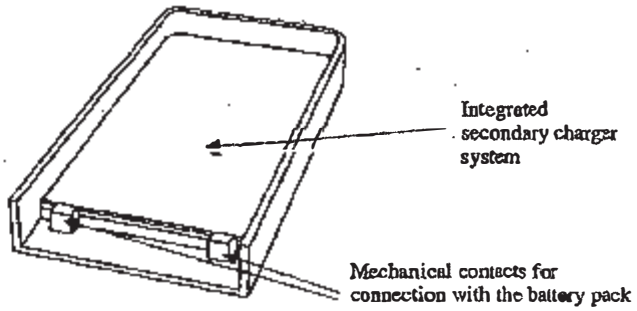


FIG.11

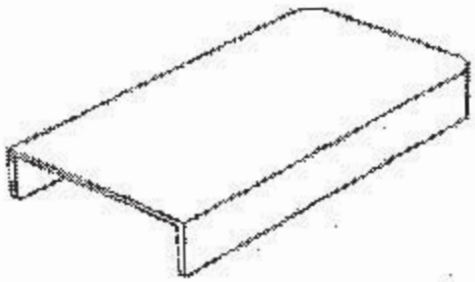


FIG.12(a)

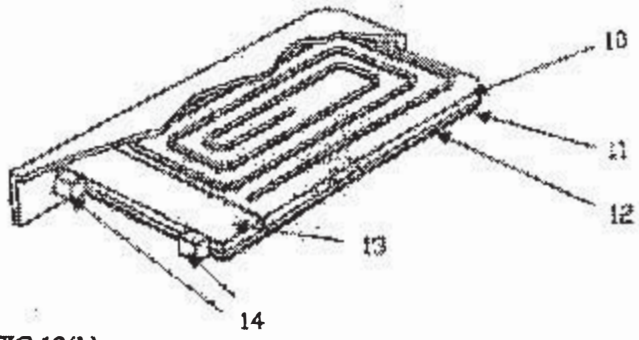


FIG.12(b)

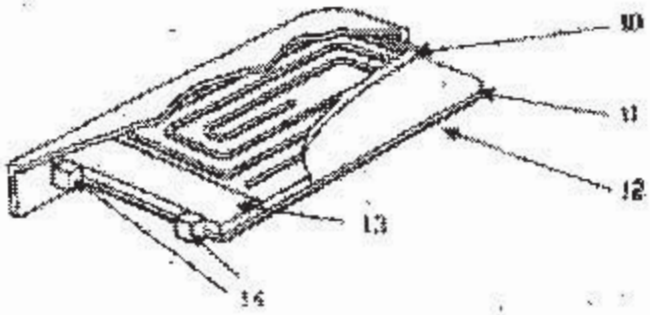


FIG.12(c)

46

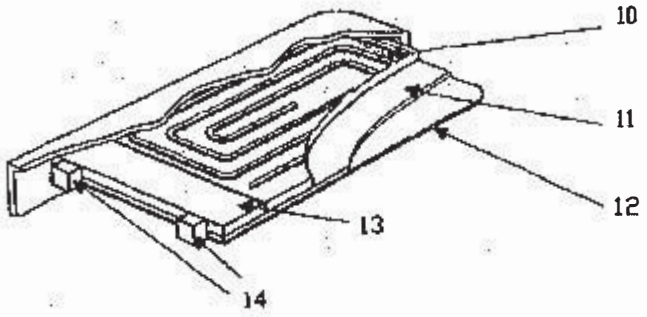


FIG.12(d)

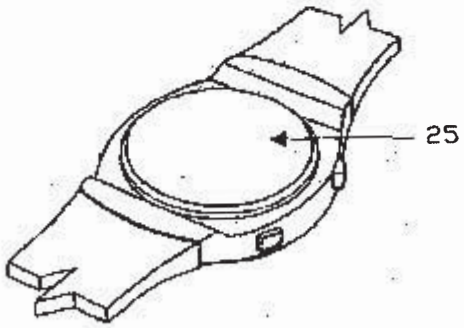


FIG.13(a)

47

【裏面有】

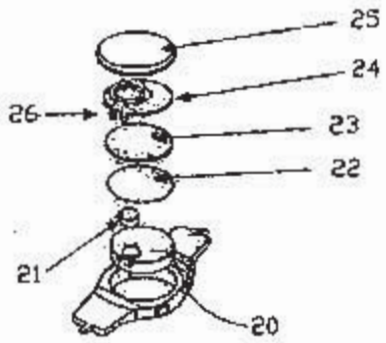


FIG.13(b)

48

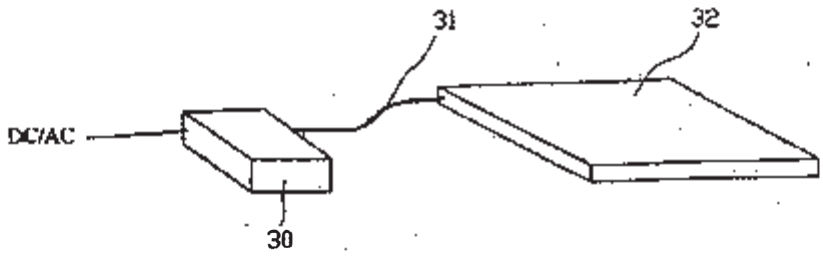


FIG.14

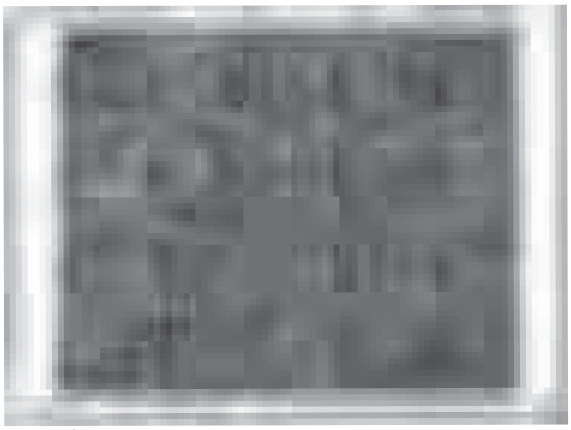


FIG.15

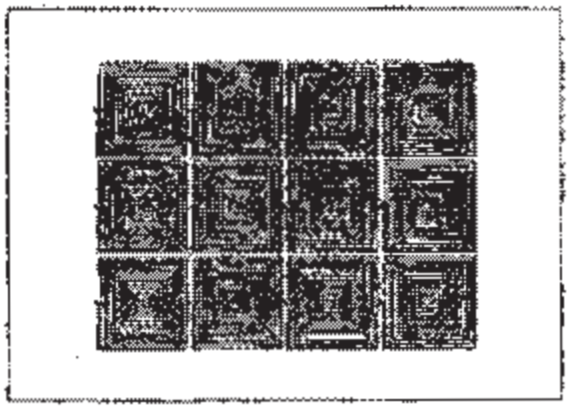


FIG.16

5

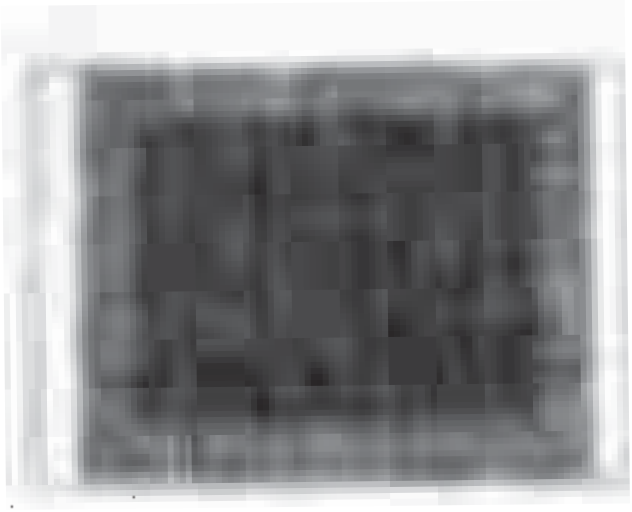


FIG.17

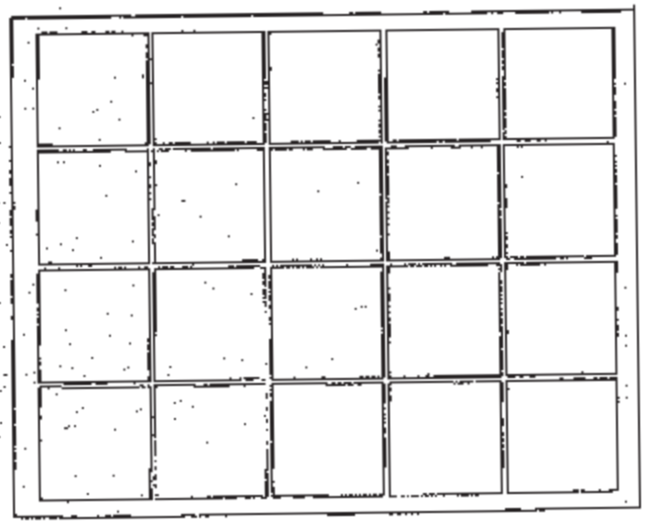


FIG.18

51

【裏面有】

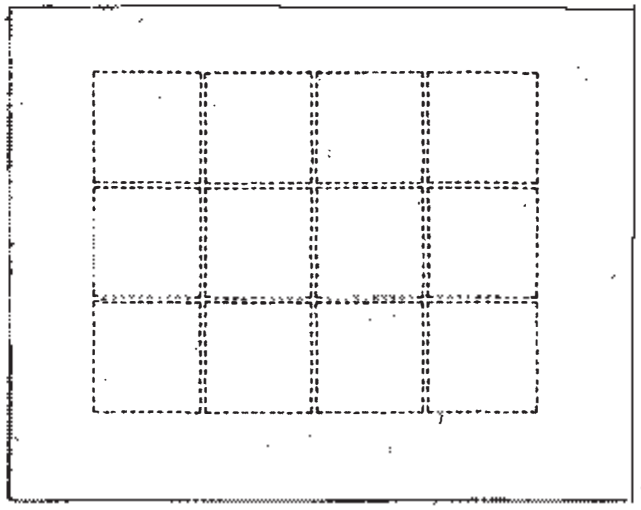
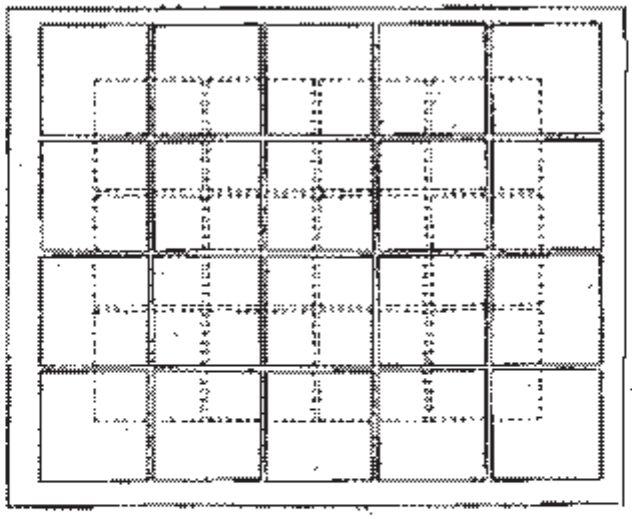


FIG.19



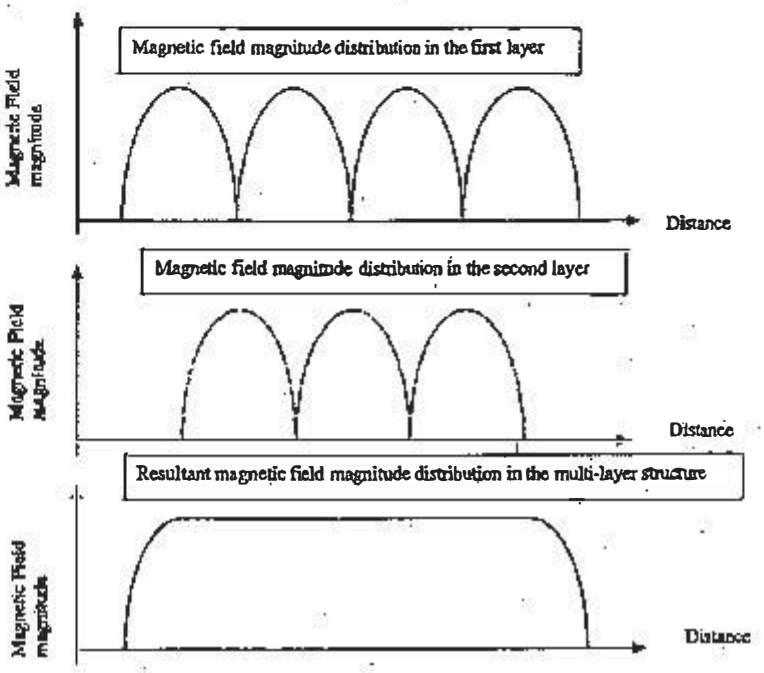


FIG.21

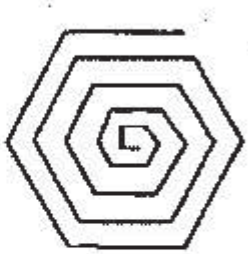


FIG.22

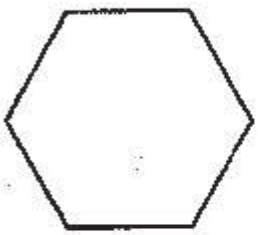


FIG.23

【裏面有】

53

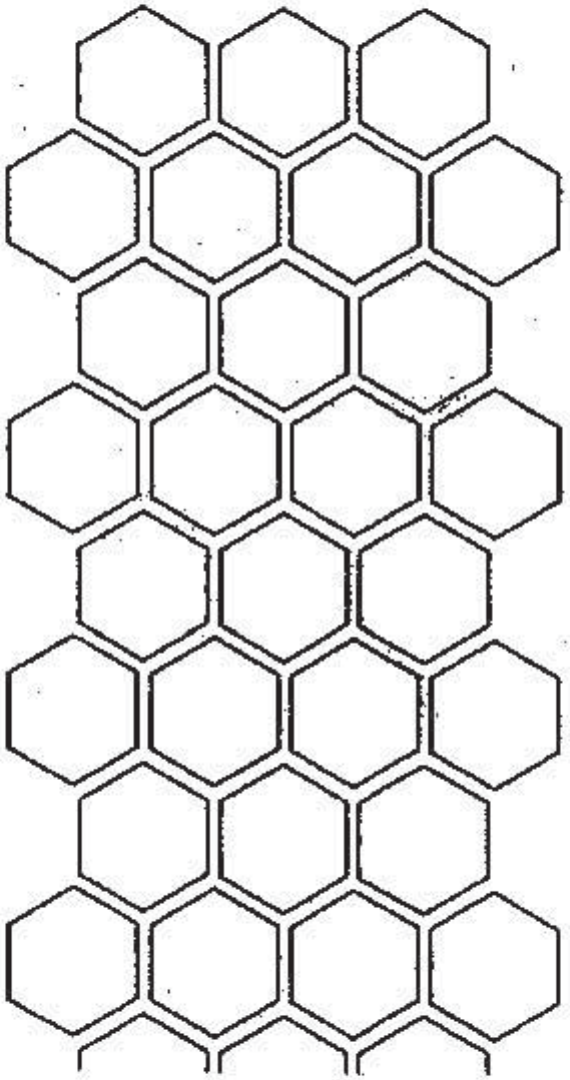


FIG.24

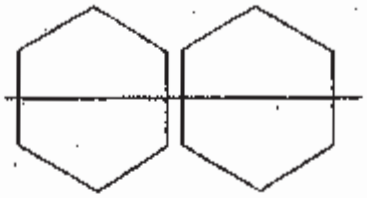


FIG.25

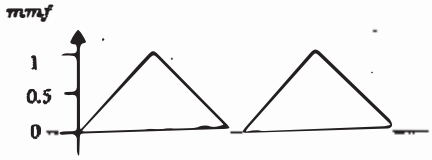


FIG.26

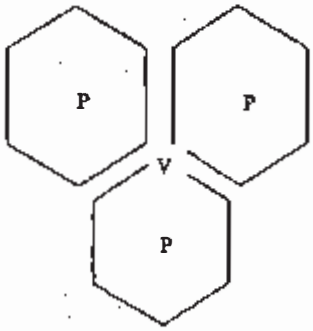


FIG.27

55

【書面有】

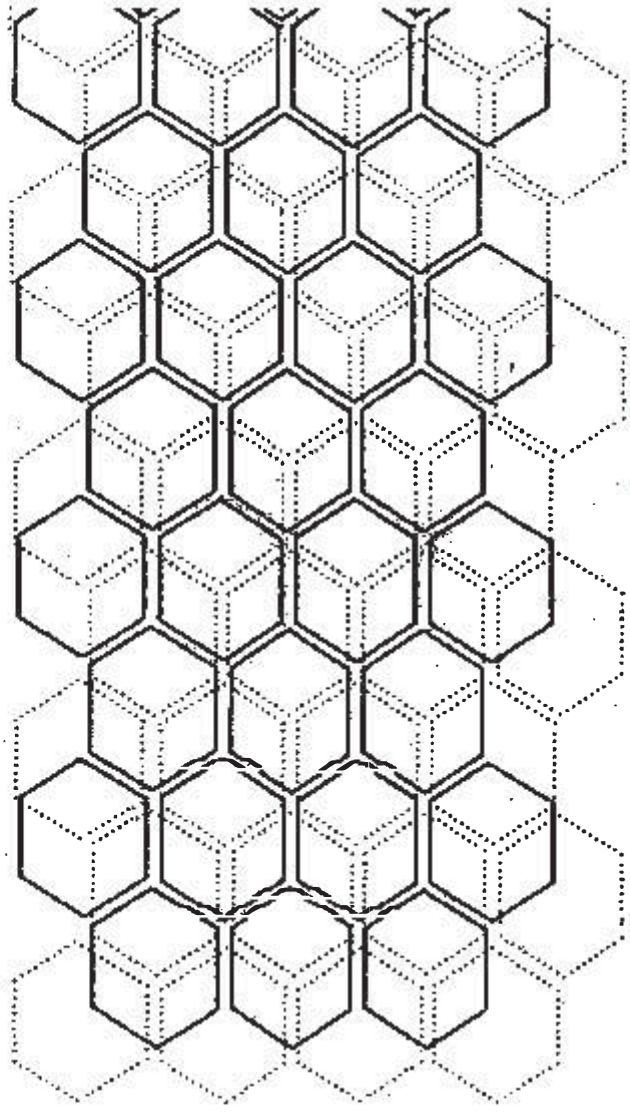


FIG.28

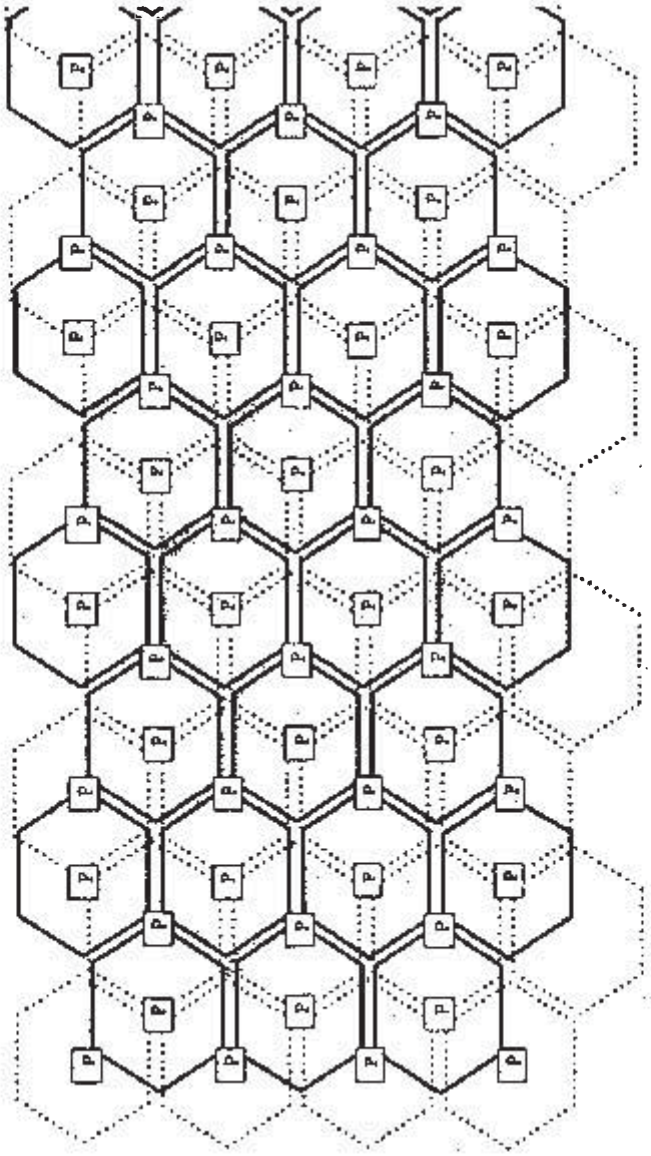


FIG.29

【裏面有】

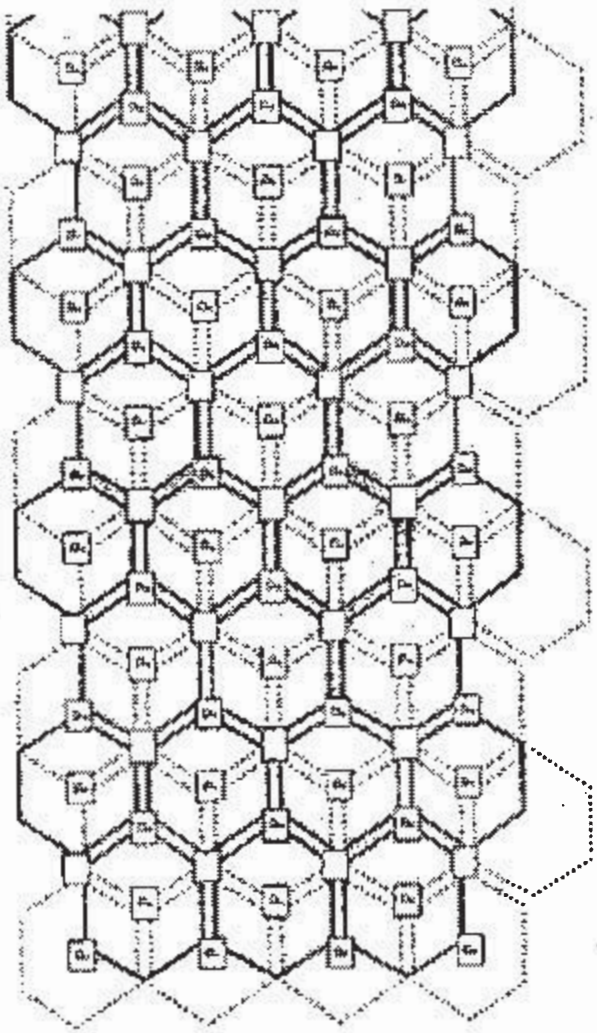


FIG.30

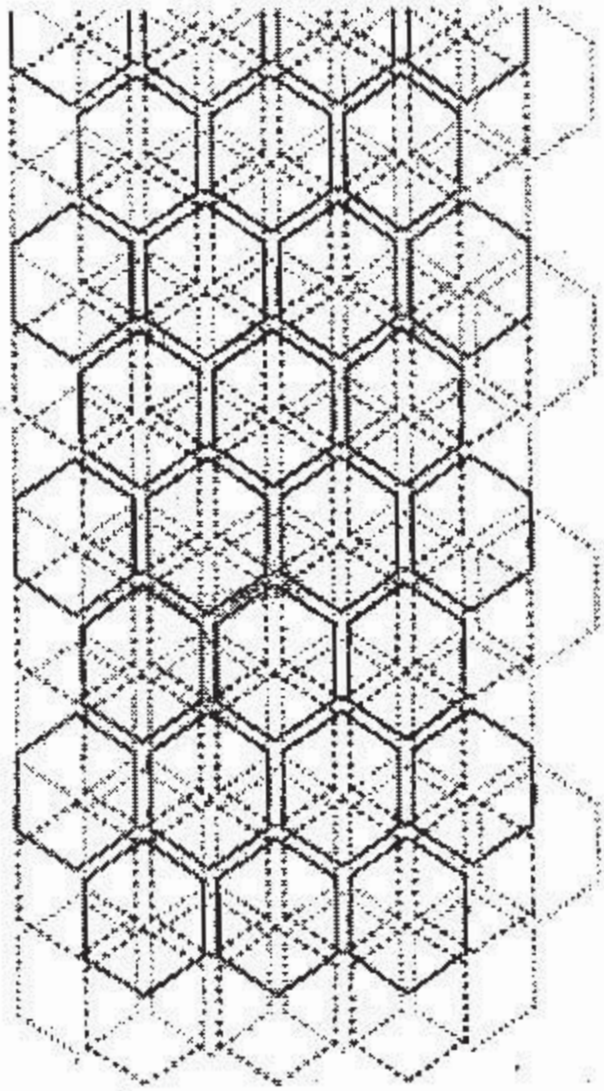


FIG.31

59

【裏面有】

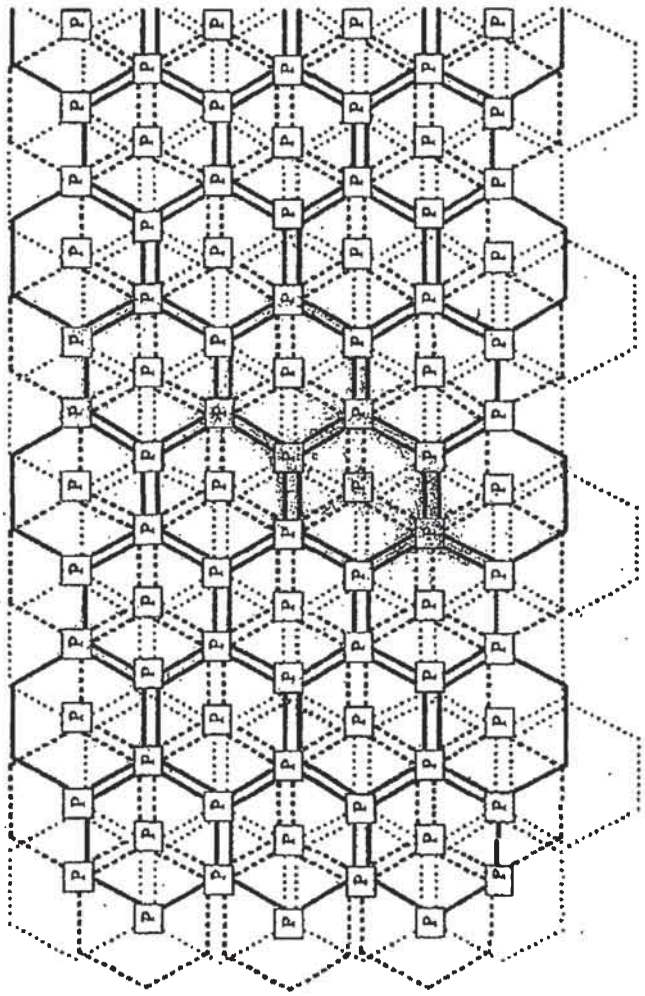


FIG.32

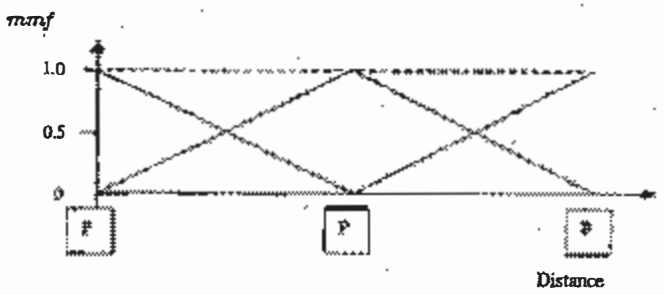


FIG.33

FIG.34

FIG.35

61

【裏面有】

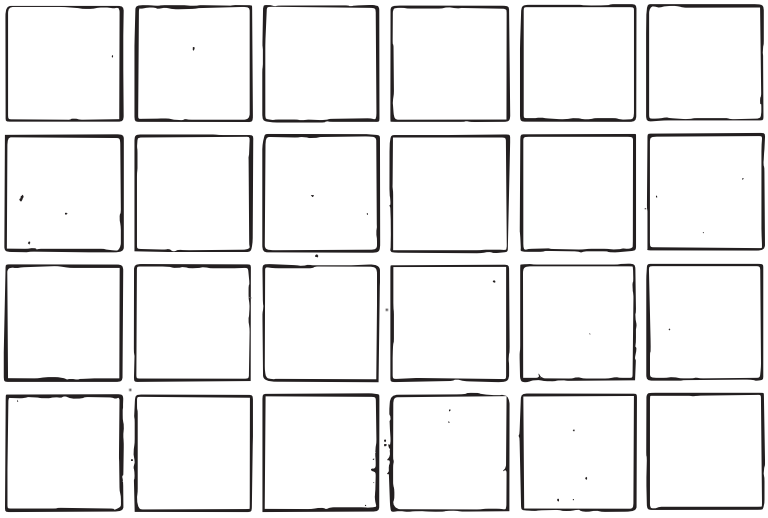


FIG.36

62

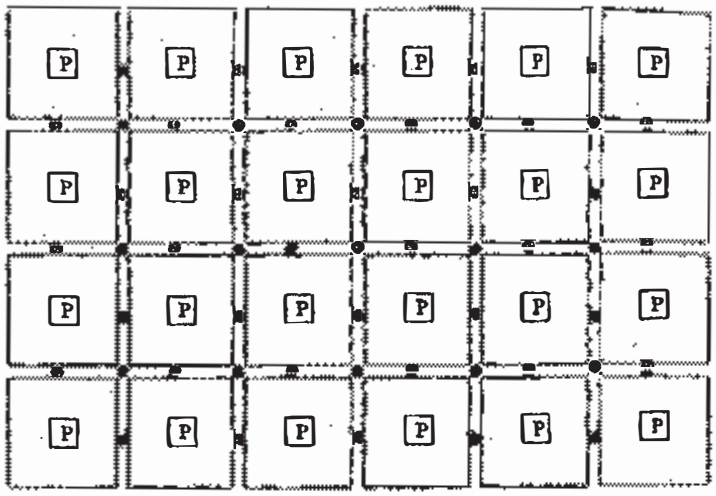


FIG.37

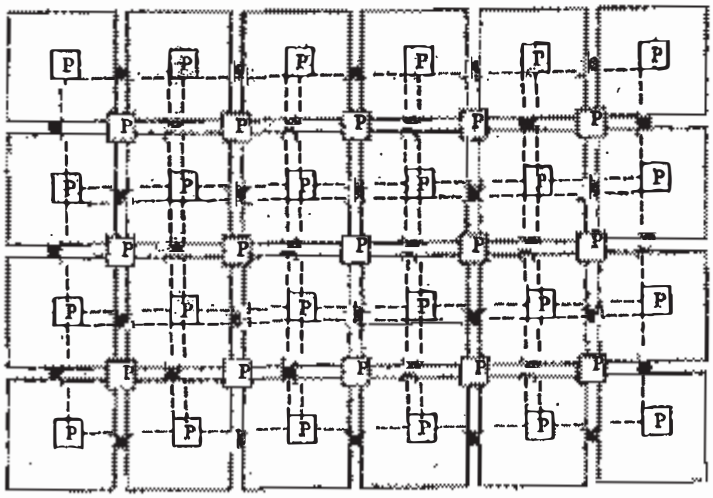


FIG.38

63

【裏面有】

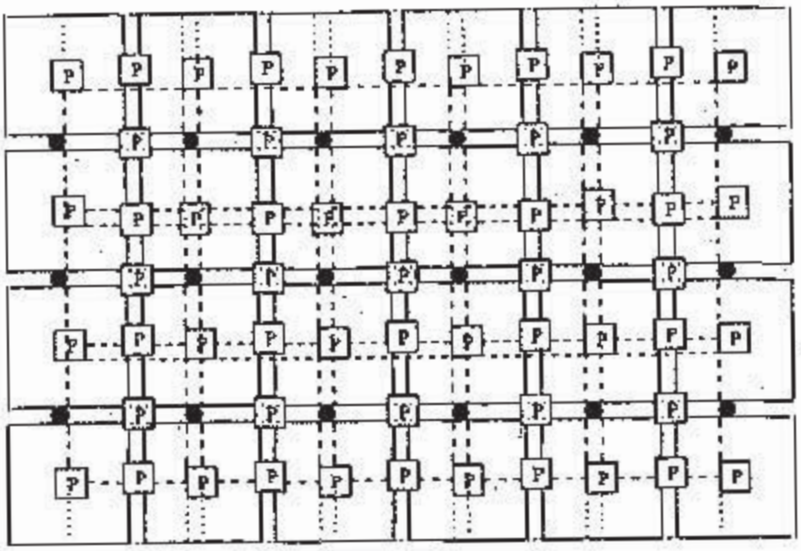


FIG.39

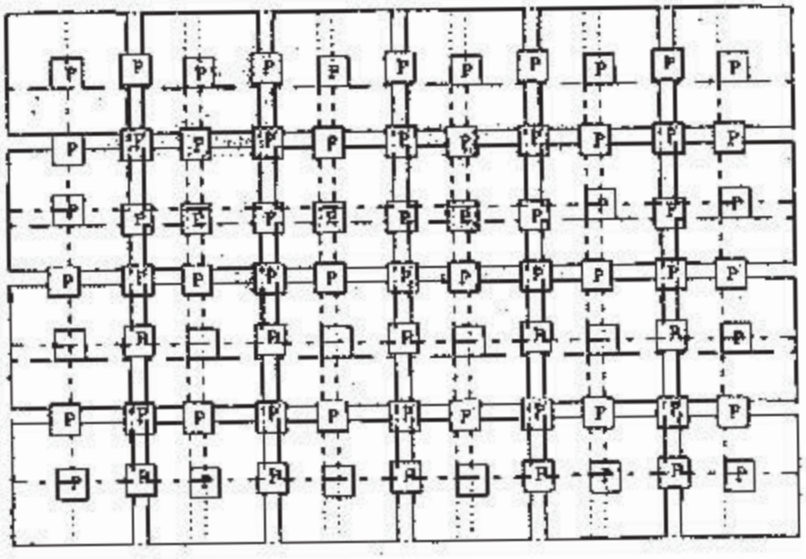


FIG.40

64

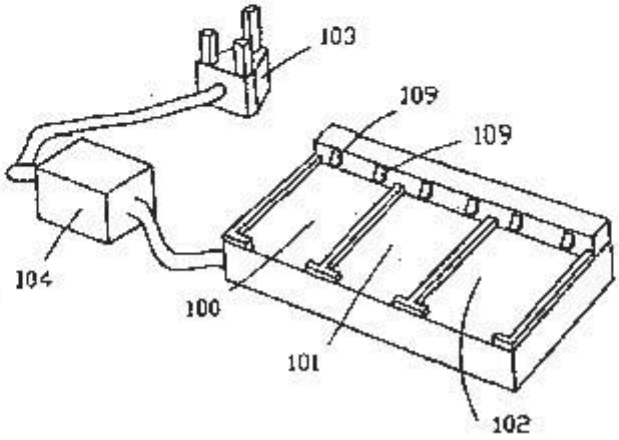


FIG.41

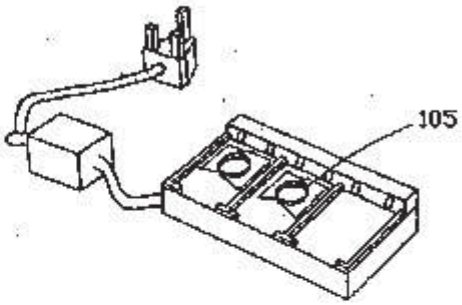


FIG.42

65

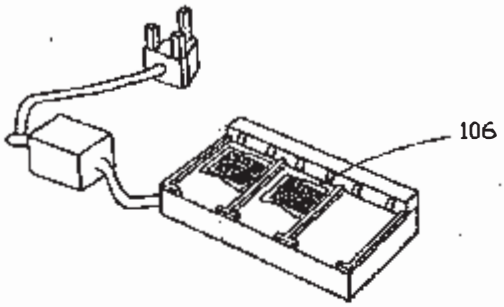


FIG.43

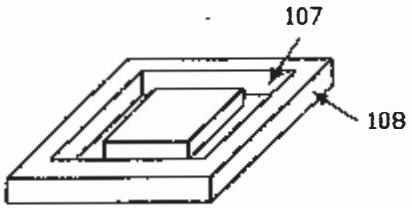


FIG.44(a)

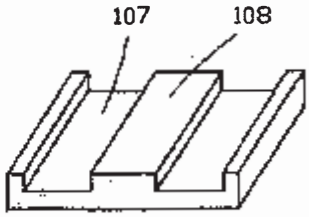


FIG.44(b)

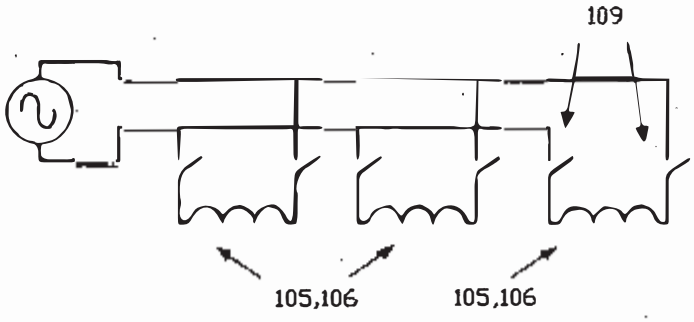


FIG.45

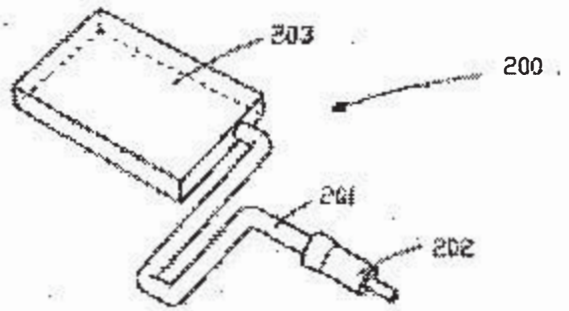


FIG.46

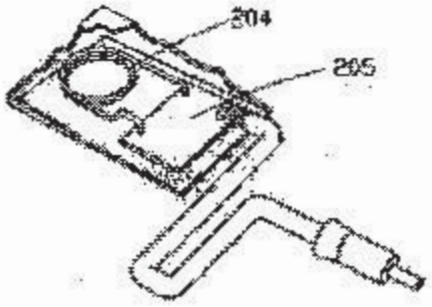


FIG.47

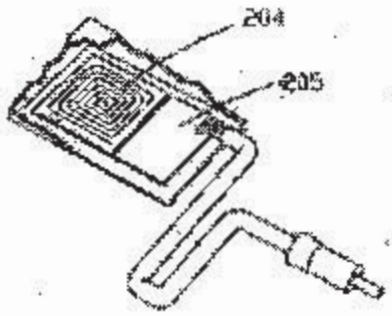


FIG.48

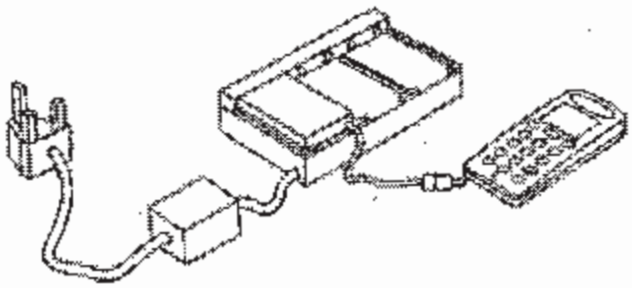


FIG.49

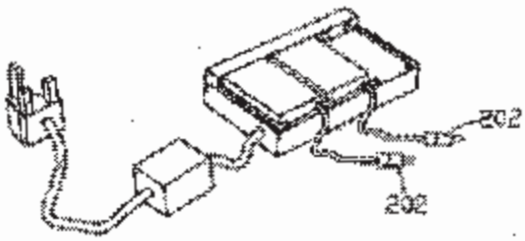


FIG.50

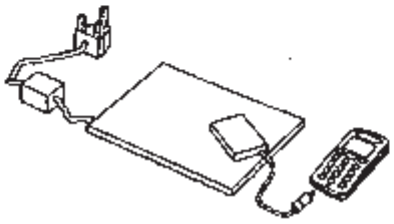


FIG.51

【裏面有】

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU03/00721

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl [7]: H02J 7/00, H01F 38/14

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)
DWPI, IEEE (battery, charger, coils, flat, shield)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	HATANAKA, K. et al. "Power Transmission of a desk with a cord-free power supply" IEEE Transactions on Magnetics Volume: 38, Issue: 5, September 2002 Pages 3329-3331	18-21,31
X	HATANAKA, K. et al. "Characteristics of the desk with cord-free power supply" INTERMAG 2002. DIGEST OF TECHNICAL PAPERS 28 April-2 May 2002 Abstract, whole document	18
X	EP 298707 B (SEIKO EPSON CORPORATION) 28 September 1994 Whole document	1,4,11,32
Y	Column 4 line17-22, column 3 lines 11-26	2,3

[X] Further documents are listed in the continuation of Box C [X] 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
"E" 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
1 July 2003	- 9 JUL 2003
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized officer DALE E. SIVER Telephone No : (02) 6283 2196

Form PCT/ISA/210 (second sheet) (July 1998)

70

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU03/00721

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6008622 A (NAKAWATASE) 28 December 1999 Column 1 lines 39-43, column 2 lines 5-17, 21-23, 49-55	1,4,11,32
Y	US 6265789 B (HONDA et al.) 24 July 2001 Abstract, figures, claim 8, column 7 lines 8-23, column 11 lines 62-66	2,3
Y	WO 00/02212 A (ABIOMED, INC.) 13 January 2000 Abstract, Figure 1,7, page 2 lines 5-9	1,11,32,33
A	US 6172884 B (LANNI) 9 January 2001 Abstract, figures, column 18 line 63 to column 19 line 60	35-36,42,48

Form PCT/ISA/210 (continuation of Box C) (July 1998)

71

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/AU03/00721

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					
EP	298707	JP	62260735	EP	245999	ES	2003287
		US	5246734				
US	6008622	JP	11103531				
US	6265789	EP	977297	WO	9927603		
WO	200002212	AU	48613/99	CA	2336725	EP	1095384
		US	6324430	US	2002055763	US	6389318
		US	2002058971				
US	6172884	US	5479331	US	5636110	US	5838554
		US	5949213	US	6091611	US	6266261
		US	2003042881	AU	200153089	CA	2403856
		EP	1273093	WO	200176051		

END OF ANNEX

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 NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
14/120,197	05/05/2014	John Talbot Boys	1172/69068-Div. 2

CONFIRMATION NO. 4659

14443
The Law Office of Richard F. Jaworski, PC
273 Walt Whitman Road
Suite 327
Huntington Station, NY 11746-4149

PUBLICATION NOTICE

Title: Multi power sourced electric vehicle

Publication No.US-2015-0008752-A1
Publication Date:01/08/2015

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/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Office of Public Records. The Office of Public Records can be reached by telephone at (703) 308-9726 or (800) 972-6382, by facsimile at (703) 305-8759, by mail addressed to the United States Patent and Trademark Office, Office of Public Records, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently http://pair.uspto.gov/. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Office of Data Managment, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

TFW

Dkt. 1172/69068-Div. 2

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of : John Talbot BOYS et al.

Serial No. : 14/120,197 Examiner:

Date Filed : May 5, 2014 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

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.

The listed documents were cited in a corresponding Australian application. 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.

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 — February 6, 2015
Reg. No. 33,515 — 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.

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 prior to receipt of an action on the merits. Accordingly, it is believed that no fee is required for consideration of the present Information Disclosure Statement. However, if a fee is deemed to be required, the Office is authorized to charge any 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

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-Div. 2	14/120,197
Applicant	
John Talbot BOYS et al.	
Filing Date	**Group**
May 5, 2014	

U.S. PATENT DOCUMENTS

Exami Initial		Document Number	Date	Name	Class	Subclass	Filing Date if Appropriate
	AA	5 2 0 2 6 1 7	Apr. 13, 1993	NOR			
	AB	7 1 6 4 2 5 5	Jan. 16, 2007	HUI			
	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							
	AR							
	AS							
	AT							

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

	AU	
	AV	
	AW	
	AX	

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.

Dkt. 1172/69068-Div. 2

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of : John Talbot BOYS et al.

Serial No. : 14/120,197 Examiner:

Date Filed : May 5, 2014 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

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.

Several of the listed documents were cited in one or more corresponding foreign applications. 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.

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

Dec. 3, 2015
Richard F. Jaworski Date
Reg. No. 33,515

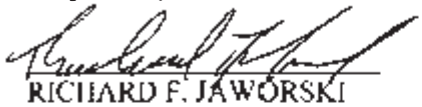
The citation of the listed items is not a representation that they constitute a complete or exhaustive listing of the relevant art or that these items are prior art. The items listed are submitted in good faith, but are not intended to substitute for the Examiner's search. It is hoped, however, that 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 prior to receipt of an action on the merits. Accordingly, it is believed that no fee is required for consideration of the present Information Disclosure Statement. However, if a fee is deemed to be required, the Office is authorized to charge any 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

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-Div. 2	14/120,197
Applicant	
John Talbot BOYS et al.	
Filing Date	**Group**
May 5, 2014	2832

U.S. PATENT DOCUMENTS

Examiner Initial		Document Number	Date	Name	Class	Subclass	Filing Date if Appropriate
	AA	20 06 02 19 4 4 8	Oct. 5, 2006	Grieve et al.			
	AB	5 8 2 1 7 3 1	Oct. 13, 1998	Kuki et al.			
	AC	6 3 8 9 3 1 8	May 14, 2002	Zarinetchi et al.			
	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	9 -2 1 3 3 7 8	Aug. 1997	Japan			Yes	
AR	10 20 04 00 28 31 2	April 2004	Korea			Yes	
AS	20 06 20 3 9 5 9	Aug. 2006	Japan			Yes	
AT							

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

AU

AV

AW

AX

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.

일본 공개특허공보 특개평09-213378호(1997.08.15.) 1부.

(19)日本国特許庁(JP)　(12)公開特許公報(A)　(11)特許出願公開番号

特開平9－213378

(43)公開日　平成9年(1997)8月15日

(51)Int.Cl.⁶	識別記号	庁内整理番号	FI	技術表示箇所
H01M 10/46			H01M 10/46	
B60L 11/18			B60L 11/18	C
H01F 38/14			H02J 7/00	P
H02J 7/00				301D
	301			B

審査請求 未請求　請求項の数8　OL　(全16頁)　最終頁に続く

(21)出願番号　特願平8－14092

(22)出願日　平成8年(1996)1月30日

(71)出願人　000183406
住友電装株式会社
三重県四日市市西末広町1番14号

(71)出願人　000002130
住友電気工業株式会社
大阪府大阪市中央区北浜四丁目5番33号

(72)発明者　田中　努
三重県四日市市西末広町1番14号　住友電装株式会社内

(72)発明者　渡辺　邦彦
三重県四日市市西末広町1番14号　住友電装株式会社内

(74)代理人　弁理士　稲岡　和男　(外1名)

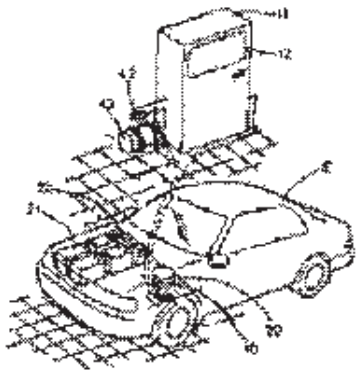
最終頁に続く

(54)【発明の名称】　電気自動車用充電システム

(57)【要約】

【課題】　電気自動車の充電を簡単に行うことができる電気自動車用充電システムを提供する。

【解決手段】　電気自動車Eには、走行用モータの主電源であるバッテリ21と、車体底部にあって前記バッテリ21と連なる二次コイル20とが設けられている。駐車場には、一次コイル10とこれを励磁する外部電源装置11とが設けられ、一次コイルは駐車場の床面に埋設されたエアシリンダ40にて昇降可能である。充電を行うには、電気自動車を一次コイル10の上方に駐車し、二次コイル20を上昇させて二次コイル20と磁気結合可能な状態とする。



10…一次コイル
11…外部電源
20…二次コイル
21…バッテリ

15-1

【特許請求の範囲】
【請求項１】　車体底部に動力用蓄電装置に連なる二次コイルが設けられた電気自動車を、その駐車中に外部充電用電源によって充電するためのものであって、前記外部充電用電源に連なる一次コイルを前記電気自動車の駐車箇所に設け、その一次コイルを前記電気自動車の車体底部の二次コイルに電磁結合させて前記動力用蓄電装置に電力を供給することを特徴とする電気自動車用充電システム。
【請求項２】　上記一次コイル及び二次コイルの少なくとも一方が昇降駆動可能なコイル移動手段にて支持されていることを特徴とする上記請求項１に記載の電気自動車用充電システム。
【請求項３】　駐車した電気自動車が所定の充電位置にあることを検出する駐車位置検出手段を設け、前記電気自動車が充電位置にあることを検出したことを条件に前記一次コイルを励磁する構成としたことを特徴とする請求項１又は請求項２記載の電気自動車用充電システム。
【請求項４】　前記一次コイルに対して所定の位置関係をもって設けられた車輪ガイドが更に備えられ、その車輪ガイドによって前記電気自動車の車輪を案内することにより電気自動車の二次コイルと前記一次コイルとを電磁結合位置に誘内することを特徴とする請求項１ないし請求項３のいずれかに記載の電気自動車用充電システム。
【請求項５】　前記車輪ガイドと前記一次コイルとの相対位置を異ならせる位置調整装置と、駐車する電気自動車の車種を判別する車種判別装置とが更に設けられ、前記車種判別装置によって判別された車種に応じて前記位置調節装置を駆動することにより前記電気自動車の二次コイルと前記一次コイルとを電磁結合位置に案内することを特徴とする請求項４記載の電気自動車用充電システム。
【請求項６】　前記車輪ガイドと前記一次コイルとの相対位置を異ならせる位置調整装置と、駐車する電気自動車の二次コイルと車輪との位置関係を測定する二次コイル位置測定装置とが更に設けられ、その二次コイル位置測定装置によって測定された二次コイルの位置に応じて前記位置調節装置を駆動することにより前記電気自動車の二次コイルと前記一次コイルとを電磁結合位置に案内することを特徴とする請求項４記載の電気自動車用充電システム。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は電気自動車に充電するための充電システムに関する。
【０００２】
【従来の技術】従来、この種の充電システムとして実用化されている構成は図２２に示すようである。電気自動車１の車体には動力用バッテリーに接続された車両側コネクタ２が設けられ、ここに車外から給電コネクタ３が接続される。その給電コネクタ３は車両外に設置された充電用電源４からのケーブル５先端に設けられており、充電用電源４からの電力は両コネクタ２，３を通して動力用バッテリーに供給されて充電が行われる。
【０００３】
【発明が解決しようとする課題】上述の充電システムでは、給電コネクタ３を充電設備から取り出し、これをケーブル５を引き出しながら自動車１側まで運び、そして車体のコネクタ蓋１ａを開けて車両側コネクタ２に接続するという作業が必要で、相当に面倒である。しかも、従来の充電コネクタは端子を相互に嵌合接触させて通電路を確立する構成であるから、その嵌合操作の抵抗が大きく、比較的大きな力でコネクタの嵌合操作を行う必要があるという問題があった。
【０００４】本発明は上記事情に鑑みてなされ、その目的は、簡単に電気自動車の充電をすることができる電気自動車の充電システムを提供することにある。
【０００５】
【課題を解決するための手段】
＜請求項１の発明＞上記目的を達成するため、請求項１に係る発明は、車体底部に動力用蓄電装置に連なる二次コイルが設けられた電気自動車を、その駐車中に外部充電用電源によって充電するためのものであって、外部充電用電源に連なる一次コイルを電気自動車の駐車箇所に設け、その一次コイルを電気自動車の車体底部の二次コイルに電磁結合させて動力用蓄電装置に電力を供給するところに特徴を有する。
【０００６】＜請求項２の発明＞また、請求項２に係る発明は、上記請求項１に記載の電気自動車用充電システムにおいて、一次コイル及び二次コイルの少なくとも一方が昇降駆動可能なコイル移動手段にて支持されているところに特徴を有する。
＜請求項３の発明＞さらに、請求項３に係る発明は、請求項１又は請求項２記載の電気自動車用充電システムにおいて、駐車した電気自動車が所定の充電位置にあることを検出する駐車位置検出手段を設け、電気自動車が充電位置にあることを検出したことを条件に一次コイルを励磁する構成としたところに特徴を有する。
【０００７】＜請求項４の発明＞さらに、請求項４に係る発明は、請求項１ないし請求項３のいずれかに記載の電気自動車用充電システムにおいて、一次コイルに対して所定の位置関係をもって設けられた車輪ガイドが更に備えられ、その車輪ガイドによって電気自動車の車輪を案内することにより電気自動車の二次コイルと一次コイルとを電磁結合位置に案内するところに特徴を有する。
＜請求項５の発明＞さらに、請求項５に係る発明は、請求項４記載の電気自動車用充電システムにおいて、車輪ガイドと一次コイルとの相対位置を異ならせる位置調整装置と、駐車する電気自動車の車種を判別する車種判別

15-2

装置とが更に設けられ、車種判別装置によって判別された車種に応じて位置調節装置を駆動することにより電気自動車の二次コイルと一次コイルとを電磁結合位置に案内するところに特徴を有する。

【０００８】＜請求項６の発明＞さらに、請求項６に係る発明は、請求項４記載の電気自動車用充電システムにおいて、車輪ガイドと一次コイルとの相対位置を異ならせる位置調整装置と、駐車する電気自動車の二次コイルと車輪との位置関係を測定する二次コイル位置測定装置とが更に設けられ、その二次コイル位置測定装置によって測定された二次コイルの位置に応じて位置調節装置を駆動することにより電気自動車の二次コイルと一次コイルとを電磁結合位置に誘内するところに特徴を有する。

【０００９】

【発明の作用・効果】

＜請求項１の発明＞請求項１の構成とすると、電気自動車の底部に二次コイルが設けられているから、電気自動車を所定箇所に駐車することによって一次及び二次の両コイルを対向状態とすることができ、電気自動車の充電のための準備作業が極めて簡単である。

【００１０】＜請求項２の発明＞請求項２の構成とすれば、コイル移動手段によってコイルが昇降駆動されるから、対向状態の両コイルを十分に接近させて電磁的な結合度を高めることができ、電力伝送効率が向上する。

＜請求項３の発明＞請求項３の構成では、電気自動車が充電位置にあることを条件に、充電動作がなされるため、一次コイルと二次コイルがずれた状態で充電してしまうようなことを防止し、両コイルを正しく電磁結合させて充電効率を良い状態に保つことができる。

＜請求項４の発明＞請求項４の構成では、車輪ガイドに沿って電気自動車を進めると、自ずと両コイルが電磁結合される電磁結合位置に案内されるから、電気自動車の充電のための準備作業がいっそう簡単になり、かつ、ばらつきがなくなる。

【００１１】＜請求項５の発明＞請求項５の構成では、車種判別装置の判別結果に基づき、車輪ガイドと一次コイルの相対位置が位置調整装置によって調整される。従って、電気自動車の車種によっては、その車輪と二次コイルとの位置関係が様々に異なるという事情があったとしても、各車種の電気自動車を、それぞれに応じて適切な充電位置に導くことができ、車種に依存しない汎用的な電気自動車用充電システムとすることができる。

＜請求項６の発明＞請求項６の構成では、電気自動車の底部に設けられている二次コイルの位置が、車輪との位置関係として測定され、その測定結果に基づき車輪ガイドと一次コイルの相対位置が位置調整装置によって調整される。従って、これによっても各車種の電気自動車を、それぞれに応じて適切な充電位置に導くことができ、車種に依存しない汎用的な電気自動車用充電システムを提供できるという効果が得られる。

【００１２】

【発明の実施の形態】

＜第１実施形態＞以下、図１ないし図５を参照して本発明の第１実施形態を説明する。図１は、一次コイル１０を備えた駐車場に二次コイル２０を備えた電気自動車Ｅを進入させるところを示したものである。この電気自動車Ｅは、動力用蓄電装置であるバッテリ２１を主電力供給源とし、これから電力を供給されて走行用モータや各種電気機器が機能する。このバッテリ２１には充電回路２２を介して上記二次コイル２０が接続されており　コイルに誘導された交流を直流に変換してバッテリ２１が充電されるようになっている。

【００１３】同二次コイル２０は、例えばフェライト製の磁芯に電線を巻回してなる偏平板状に形成され、例えば合成樹材料製の保護ケース内に収容されており、磁芯の軸方向を垂直方向に向けて車体底部において地面に面するように取り付けてある。一方、駐車場には外部充電用電源である外部電源装置１１が備え付けられ、この外部電源装置１１に連なる一次コイルユニットが駐車場床面に設けてある。この一次コイルユニットは、図４に示すように、やはり例えばフェライト製の磁芯に電線を巻回してなる偏平板状に形成されて保護ケース内に収容された一次コイル１０を備え、この一次コイル１０の磁芯を垂直方向にしてエアシリンダ４０の駆動シャフト４１の先端に支持したものである。このエアシリンダ４０は駐車場の床面に形成した凹所Ｃ内に埋め込むように設けられ、一次コイル１０のみが床面から突出している。また、エアシリンダ４０には電磁弁４２を介してコンプレッサ４３から圧縮空気が供給され、外部電源装置１１に備えた操作盤１２にて上記電磁弁４２の開閉操作を行うことで、駆動シャフト４１を上下に駆動操作可能となっている。この駆動シャフト４１を下方に駆動すると、一次コイル１０は電気自動車Ｅの底部と干渉しない高さに位置し、上方に駆動すると、両コイル１０，２０の保護ケース同士が当接して両コイル１０，２０の磁気的結合度が極めて大きくなる。なお、両コイル１０，２０が当接した状態でエアシリンダ４０には圧縮空気が供給され続けて両コイル１０，２０は互いに押し付けられた状態にあるが、そのシリンダ４０の駆動力は両コイル１０，２０に無理な力がかからない程度の大きさに設定されている。

【００１４】次に、この実施形態において電気自動車Ｅの充電手順について説明する。電気自動車Ｅを駐車場に進入させる際には、図１及び図３に示すように、エアシリンダ４０の駆動シャフト４１を下げて一次コイル１０を電気自動車Ｅの底部と干渉しないようにしておく。次に、電気自動車Ｅを充電位置に駐車し、電気自動車Ｅの底部に備えた二次コイル２０を、駐車場に床面に備えた一次コイル１０の上方に対面させる。ここにおいて、電気自動車Ｅの車高は駐車場の床面に対し、常に一定の高

15-3

さになっているため，一次コイル１０を跨ぐようにして電気自動車Ｅを駐車するだけで，一定の間隔を隔てて両コイル１０，２０を対面させることができる．すなわち，コイル同士を近づけ過ぎて衝突させてしまったり，コイル同士の衝突をおそれるために，コイル同士を離して駐車して充電できない状態となることはない．また，各コイルは，共にその磁芯の軸方向を上下方向にしてあり，電気自動車Ｅの底部は駐車場に床面に対して平行となっているため，電気自動車Ｅをどのような向きにしても，コイルの磁芯の軸が斜めになって向き合うようなことはない．すなわち，駐車姿勢によらず，コイル同士の間隔及び向きを一定にして，充電に備えた駐車を容易に行うことができる．

【００１５】所定の位置に電気自動車Ｅを駐車したら，外部電源装置１１に備えた操作盤１２にて一次コイルユニットを操作し，エアシリンダ４０にて一次コイル１０を上方に移動させる．すると，図４及び図５に示すように，上方で待ち受けている二次コイル２０と一次コイル１０との各保護ケース同士が当接した状態で保持される．なお，上記動作は，電気自動車Ｅの車体の下でなされるため，当接し合うコイル間に障害物が入り込むような心配はない．この両コイルが対面して当接した状態で，外部電源装置１１を操作して一次コイル１０を励磁する．すると，二次コイル２０に電磁誘導現象により電圧が発生し，これに基づき充電回路２２により電気自動車Ｅのバッテリ２１が充電される．バッテリ２１が一定量充電されたら，一次コイル１０の励磁を停止し，一次コイル１０を下げて充電作業を終了する．

【００１６】尚，本実施形態では，このコイル移動手段としてエアー駆動のシリンダ方式のものを採用しているが，例えば，図６に示す平行リンク機構４４や，図７に示すパンタグラフ機構４６等の昇降機構をモータ４５またはモータ４７にて駆動させるものでもよい．上記平行リンク機構４４やパンタグラフ機構４６を備えたものでは，シリンダ方式に比べて装置全体の高さ寸法を低く抑えることができる．また，本実施形態では両コイル１０，２０が当接した状態でも圧縮空気をエアシリンダ４０に供給し続けるようにしたが，必ずしも両コイル１０，２０の当接後にも両コイル１０，２０を押し付けなくとも，例えば一次コイル１０側に感圧センサ等を設けてコイル同士の当接を検出し，その当接位置で上昇動作を停止させる構成でもよい．この場合，コイル同士の当接を検出したことを，電力供給のトリガとして外部電源装置１１を自動起動させて自動充電することもできる．

【００１７】＜第２実施形態＞この実施形態は，電気自動車Ｅを充電位置に駐車したことを検出する駐車位置検出手段を備えた電気自動車用充電システムである．以下，その内容を図８ないし図１１を参照して説明する．駐車場の床面には前記第１実施形態と同様な一次コイル１０が設けられ，その前方（図示左側）の床面には，上方から荷重がかったことを検知する感圧センサ５０が凹所内に埋設されている．この感圧センサ５０は，一次コイル１０と二次コイル２０を対面させて電気自動車Ｅを駐車したときに，その前輪の真下となる位置に設けられている．すなわち，この感圧センサ５０は，電気自動車Ｅが正規の充電位置に駐車されているか否かを検出する駐車位置検出手段を構成している．

【００１８】感圧センサ５０からの信号線は，図９のブロック図に示すように，外部電源装置１１に備えた主制御回路１３に接続されており，この信号に基づいて，エアシリンダ４０を操作する電磁弁開閉回路１４や，一次コイル１０を励磁する一次電源回路１５を制御するようになっている．さらに，感圧センサ５０が反応して電気自動車Ｅが正規の充電位置にあることを運転者に知らしめるために，外部電源にランプ５１を設けて，感圧センサ５０が反応したときに点灯するように主制御回路１３で制御している．ここにおいて，ランプの代わりにブザー等を用いることもできる．

【００１９】なお，その他の構造に関しては，第１実施形態と同様であり，同一部位については同一符号を付すことで重複した説明は省略し，続いて上記充電システムの動作を説明する．駐車場に電気自動車Ｅを駐車する．電気自動車Ｅが正規の充電位置に達すれば，感圧センサ５０上に電気自動車Ｅの前輪が位置するから，同感圧センサ５０に大きな荷重が作用して電気自動車の検出信号が主制御回路１３に送られる．すると，その検出信号が出力されたことを条件に，例えば充電可能であることのフラグが立てられて前述のようにエアシリンダ４０の駆動やコイルの励磁の一連の充電動作が可能となる．また，感圧センサ５０上に電気自動車Ｅの前輪が到達しなかったり，通過してしまったりすると，感圧センサ５０から検出信号が送信されないから，主制御回路１３は電気自動車Ｅが所定の充電位置にないと判断し，充電動作はなされない，従って，コイル同士がずれた位置で充電動作が開始されてしまうようなことはない．

【００２０】なお，本第２実施形態では，駐車位置検出手段として，感圧センサ５０を電気自動車Ｅの前輪で踏ませる方式を採用しているが，その他に例えば，電気自動車Ｅのバンパをリミットスイッチに当接させて駐車位置を検出するもの等でもよい．また，感圧センサを用いたものでは，図１０に示すようにその周縁に突起５２を設けたり，図１１に示すように，感圧センサ５０を収容する凹所Ｘの開口周縁にテーパ状の落とし込み部Ｙを形成してもよい．さらに，図１２に示すようにストッパ５３を駐車場に据えつけ，そのストッパ５３の側面に感圧センサ５０を備えてそこに車輪が当接させてもよい．以上，図１０ないし図１２に示すものでは，運転者は正規の充電位置に達したことをタイヤから伝わる感覚としても認識することができる．

【００２１】＜第３実施形態＞この実施形態は，車輪ガ

15-4

イドによって電気自動車を充電位置に案内する電気自動車用充電システムである．以下，その内容を図１３ないし図１５を参照して説明する．図１３は，上記車輪ガイド６０を備えた駐車場に電気自動車Ｅを進入させるところを示す斜視図である．同車輪ガイド６０は「Ｌ」字状に形成された二つのレールを，左右対称の背合わせ状態にして駐車場の床面に取り付けられている．この背合わせとなった長辺６０ａ，６０ａは，丁度，電気自動車Ｅの左右の車輪の内側に入り込む間隔となっており，その先端は車輪を導き易いように先細り状に間隔が狭くなっている．短辺６０ｂ，６０ｂは長辺６０ａ，６０ａから逆方向に延びており　電気自動車Ｅの左右の前輪がそれぞれ当接できる長さとなっている．従って，上記長辺６０ａ，６０ａを左右の両輪で跨ぐようにして電気自動車Ｅを駐車場に進入させると，その前輪が短辺６０ｂ，６０ｂに当接する位置で停車することとなる．すなわち，電気自動車Ｅは車輪ガイド６０によってその向き及び位置が一義的に決められて駐車されることとなる．

【００２２】一次コイルユニットは，上記長辺６０ａ，６０ａの間の床面に取り付けられており，上記車輪ガイド６０に従って電気自動車Ｅを駐車させたときに，二次コイル２０と一次コイル１０とが対面するようになっている．さらに，上記短辺６０ｂにおいて前輪が当接する部分には，感圧センサ５０が備えられており，電気自動車Ｅが車輪ガイド６０に沿って駐車されていることを検出可能とし，その検出情報を外部電源装置１１内に備えた主制御回路１３に取り込んでいる．なお，その他の構造に関しては，第１実施形態ないし第２実施形態と同様であり，同一部位については同一符号を付すことで重複した説明は省略し，続いて上記充電システムの動作を説明する．

【００２３】車輪ガイド６０の長辺６０ａを跨ぐようにして駐車場に電気自動車Ｅを進入させると，長辺６０ａ，６０ａによって進行方向が規制されて案内される．電気自動車Ｅは，その前輪が短辺６０ｂに当接する位置まで進むとそれ以上は前進できなくなり，運転者は充電位置であることを知ることができる．また，このとき感圧センサが前輪により押され，外部電源装置１１に備えたランプ点灯することによっても，この位置が充電位置であるということが判る．この位置で電気自動車Ｅを停車させると，二次コイル２０と一次コイル１０とが対面した状態となり，続いて，第１実施形態で述べたと同様に，一次コイル１０が上昇して二次コイル２０に当接し，その状態で電気自動車Ｅのバッテリが充電される．

【００２４】このように，電気自動車Ｅを車輪ガイドに進入すれば，あとは運転者の駐車技術に左右されず，しかも容易に充電位置に駐車することが可能となる．なお，本第３実施形態では，車輪ガイドと一次コイルとを別々にして，両者を所定の位置関係に設置したが，予め一次コイルと車輪ガイドとを一体的な装置とし，駐車場に取り付けてもよい．また，本第３実施形態では，電気自動車Ｅの左右の両輪を案内しているが，図１４に示すように，細長い「コ」字状の車輪ガイド６１により電気自動車Ｅの片側の車輪の内外の側面を規制して案内するものでもよい．さらに，図１５に示すように，この「コ」字状の車輪ガイド６１を一次コイルユニットの左右に設けて対称とし，同駐輪ガイドに電気自動車Ｅを進入させ易くしてもよい．

【００２５】＜第４実施形態＞この実施形態は，駐車される電気自動車Ｅの車種を車種判別装置にて判別し，その車種に応じて正規の充電位置に電気自動車を導くように車輪ガイドと一次コイルとの相対位置を自動調整する電気自動車用充電システムである．以下，図１６及び図１７を参照して説明する．図１６は，上記車種判別装置と，車輪ガイド６３及び一次コイル１０の位置調整装置とを備えた駐車場に，電気自動車Ｅを進入させる状態を示す斜視図である．上記一次コイル１０は，駐車場の床面に固定された背の低い箱形のベース７０に備えられ，内部に備えた昇降駆動装置にて上下に移動可能としてある．この昇降駆動装置は，前述の図７に示すように，パンタグラフ機構から構成され，一次コイル１０を下げたときにはベース７０内に収まるようになっている．

【００２６】上記ベース７０の両側面には，細長い「コ」字状の車輪ガイド６３が，それぞれの開口を同方向に向けて取り付けられている．図１５に示した車輪ガイド６１と同様に車輪の内外の側面を規制して電気自動車Ｅを所定の駐車位置に案内する機能を有する．また，ベース７０内部には，左右に一対づつのスライド駆動装置７１（例えば，アブソリュートエンコーダ付モータとボールネジを組み合わせたもの）が内蔵され，その駆動シャフト７２を両側面に突出させて前記車輪ガイド６３と連結してあり，同車輪ガイド６３を左右にスライド移動できるようにしてある．さらに，車輪ガイド６３における「コ」字の結合辺の部分にも，同じようにスライド駆動装置７３が内蔵され，その駆動シャフト７４を当接板６４に取り付けて同車輪ガイド６３の奥行きを自由に変更できるようにしてある．すなわち，上記スライド駆動装置７１，７３が一次コイルと車輪ガイドの相対位置を変更可能とする位置調整装置をなし，これによって，一次コイル１０を備えたベース７０に対して任意の位置に二次コイル２０を備えた電気自動車Ｅを位置決めすることが可能となる．なお，上記車輪ガイド６３の底面には図示しないキャスタを備えてあり，駆動シャフト７２に無理な曲げ荷重がかからないようにしてある．

【００２７】一方，前記車種判別装置は，電気自動車Ｅに搭載された発信器８０と，駐車場に設置された受信器８１とを備え，その間で車種情報を無線交信できるようになっている．また，受信器８１は外部電源装置１１に備えた通信制御回路８２に接続されていて本システムを統合する主制御回路１３に連なっている．また，図１７

15-5

に示すように，主制御回路１３には車種別の車輪対二次コイルの位置関係を記憶させた記憶装置８３が連結されており，受信した車種情報に基づいて上記位置関係を主制御回路１３に取り込み，これにて，主制御回路１３は上述した位置調整装置を駆動し，各電気自動車Ｅに合うように車輪ガイド６３を位置決めするようになっている．

【００２８】なお，その他の構造に関しては，第１実施形態ないし第３実施形態と同様であり，同一部位については同一符号を付すことで重複した説明は省略し，続いて上記充電システムの動作を説明する．駐車場に電気自動車Ｅが近づくと，電気自動車Ｅの発信器８０から車種情報が発信される，すると，駐車場に備えた受信器８１にてその車種情報が受信され，主制御回路１３に車種情報が取り込まれる，主制御回路１３は，記憶装置８３にアクセスし，その車種における車輪と二次コイルの位置関係情報を取り込む．この位置関係情報に基づいてスライド駆動装置７１，７３を駆動し，一次コイル１０に対する車輪ガイド６３の相対位置を車輪に対する車体底部の二次コイルの位置関係に対応させる．すると，車輪ガイド６３，６３同士の間隔も，電気自動車Ｅの左右の車輪の間隔となり，電気自動車Ｅを駐車場に進入可能な状態となる．そこで，電気自動車Ｅを車輪ガイドの奥の当接板６４に前輪が当接する位置まで進めると，一次コイルと二次コイルとが対面する．以下，第１実施形態ないし第３実施形態で説明したと同様な一連の充電作業を行う．この電気自動車Ｅが駐車場を離れ，別の車種の電気自動車が駐車場に進入してくると，その車種に合わせて車輪ガイドと一次コイルの位置関係を調整し直す．

【００２９】このように，本充電システムでは，同じ駐車場で複数車種の充電に対応することができる．なお本第４実施形態では，通信手段によって車種情報を制御回路に取り込んでいるが，駐車場の所定の箇所に備えた入力装置にてその情報を入力するようなものでもよい．例えば，図１８に示すように，充電料金を徴収する料金箱９０を駐車場に備え付けたものであれば，その料金箱９０に設けたテンキー９１から車種情報を入力する構成でもよいし，それと合わせてプリペードカード等に車種情報を記録させてするカード入力させるようにしてもよい．また，この場合は，車輪ガイド６３を駐車場に固定して一次コイル１０側を移動できるようにすれば，電気自動車Ｅを車輪ガイド６３内に駐車してから入力された車種情報に応じて一次コイル１０を二次コイル２０と結合可能な位置に合わせることができる．この車輪ガイド６３は，「コ」字状に形成されてその側面にベース７０に備えたスライド駆動装置の駆動シャフト７２を連結してある．また，この車輪ガイド６３は地面に固定され，ベース７０は底部にはキャスタを設けてある．さらに，ベース７０の内部には，昇降駆動装置を具備した一次コイルユニットを前記駆動シリンダとは直交する方向にスライド駆動装置で位置決可能に支持している．

【００３０】上記構成の動作としては，下記のようである．「コ」字状の車輪ガイド６３内に電気自動車Ｅの片側車輪を奥に突き当たるまで進入させて駐車する．突き当たると，感圧センサ５０によりそのことを検知され料金箱９０に備えたランプ５１が点灯して運転者に知らせる．運転者は，料金箱９０のテンキー９１にて希望の充電量を入力すると共に車種を入力し，その充電料金および駐車料金を支払う．又は，テンキー入力の代わりに，プリペードカードで上記車種入力と料金支払いを行ってもよい．充電が終了したら，ランプ６１が再び点灯して，その旨を知らせる．また，駐車時間を超過した場合には，ランプ６１が点滅して警告するようにしてもよい．

【００３１】なお，その他の構造に関しては，第１実施形態ないし第４実施形態と同様であり，同一部位については同一符号を付すことで重複した説明は省略する．

＜第５実施形態＞本実施形態は，上述した第４実施形態のように車種判別をせず，電気自動車の車輪と二次コイルとの位置関係を測定装置にて測定し，その測定結果に基づいて車輪ガイドと一次コイルとの相対位置を自動調整する電気自動車用充電システムである．以下，図１９ないし図２０を参照して説明する．図１９は，上記測定装置を備えた駐車場に，電気自動車Ｅを進入させる状態を示す斜視図である．この車輪ガイド６３及びベース７０は第４実施形態の変形例（図１８）で説明したものと主要部は同一であり，その上に，車輪の位置を検出する車輪位置センサ１００と二次コイルの位置を検出するコイル位置センサ１０１とを備えている．

【００３２】上記両センサ１００，１０１は共にフォトセンサをライン状に並べて形成され，車輪位置センサ１００においては，車輪ガイド６３に沿うようにしてその内側面に取り付けてあり，コイル位置センサ１０１においては，ベース７０の手前の駐車場床面に横方向にして埋設してある．また，電気自動車Ｅの二次コイル２０には，フォトセンサの射光を反射する反射部（図示せず）を設けて他の部分により反射光が大きくなるようにしてあるため，上記コイル位置センサ１０１は，二次コイル２０の位置を検出できる．両センサ１００，１０１は，外部電源装置１１に備えた主制御回路１３内で，それぞれが検出したデータを結合させて電気自動車Ｅにおける車輪と二次コイル２０の位置関係を割り出す．具体的には，図２０に示すように，各フォトセンサにデータ処理用の番号を付してあり，図２１のフローチャートに従い以下のようにして位置検出を行う．

【００３３】ステップ２００で，コイル位置センサ１０１の受光量が一定値Ｋ以上であるか否かを比較する．二次コイル２０の反射ミラーが通過すると，一定値Ｋ以上の受光量となるため，この比較結果が「ＹＥＳ」となり，ステップ２０１に進む．ステップ２０１では，上記

15-6

一定以上の受光量となったときの、車輪の通過位置のフォトセンサ番号「ｉ」と、二次コイル２０に備えた反射部が通過することにより最も受光量が大きかったフォトセンサ番号「ｊ」をメモリーＭ．Ｎに記憶する．次にステップ２０２で、記憶装置８３に備えたディメンジョンマップＤ（Ｍ、Ｎ）から、車輪ガイド６３と一次コイル１０の各スライド駆動装置を駆動すべき量（Ｘ．Ｙ）を取り込む．そして．そのデータに基づき．ステップ２０３で各スライド駆動装置を駆動する．このとき、電気自動車Ｅは車輪ガイド６３の奥まで進んで奥壁に当接して駐車されており．丁度一次コイル１０の上方に二次コイル２０が位置する．

【００３４】上記のようにして一次コイル１０を位置あわせした後に．上述したと同様な一連の充電動作を行う．なお、その他の構造に関しては、第１実施形態ないし第４実施形態と同様であり、同一部位については同一符号を付すことで重複した説明は省略する．

【図面の簡単な説明】

【図１】本発明の第１実施形態を示す斜視図である．

【図２】同じく第１実施形態を示す平面図である．

【図３】同じく第１実施形態を示す側面図である．

【図４】同じく第１実施形態を示す一部拡大側面図である．

【図５】同じく第１実施形態のコイルが電磁結合した状態を示す斜視図である．

【図６】同じく第１実施形態のコイル移動手段の第１変形例を示す側面図である．

【図７】同じく第１実施形態のコイル移動手段の第２変形例を示す側面図である．

【図８】本発明の第２実施形態を示す側面図である．

【図９】同じく第２実施形態を示すブロック図である．

【図１０】同じく第２実施形態の駐車位置検出手段の第１変形例を示す側面図である．

【図１１】同じく第２実施形態の駐車位置検出手段の第２変形例を示す側面図である．

【図１２】同じく第２実施形態の駐車位置検出手段の第３変形例を示す側面図である．

【図１３】本発明の第３実施形態を示す斜視図である．

【図１４】同じく第３実施形態の車輪ガイドの第１変形例を示す斜視図である．

【図１５】同じく第３実施形態の車輪ガイドの第２変形例を示す斜視図である．

【図１６】本発明の第４実施形態を示す斜視図である．

【図１７】同じく第４実施形態を示すブロック図である．

【図１８】同じく第４実施形態の変形例を示す斜視図である．

【図１９】本発明の第５実施形態を示す斜視図である．

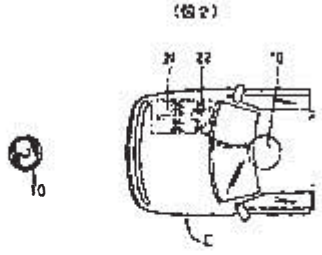
【図２０】同じく第５実施形態のセンサの配列を示す概略平面図である．

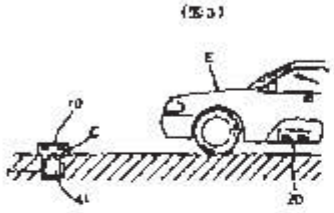
【図２１】同じく第５実施形態の位置決動作を示すフローチャートである．

【図２２】従来の充電システムを示す側面図である．

【符号の説明】

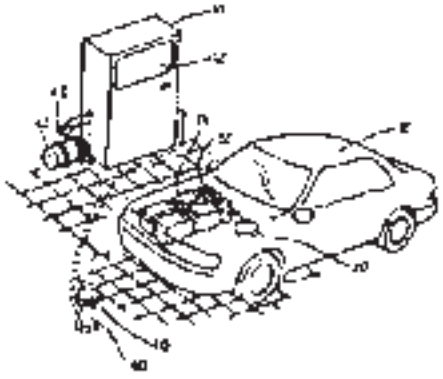
１０…一次コイル
１１…外部電源
２０…二次コイル
２１…バッテリ
４０…エアシリンダ
５０…感圧センサ
６０…車輪ガイド
６１…車輪ガイド
６３…車輪ガイド
７１…スライド駆動装置
７３…スライド駆動装置
８０…発信器
８１…受信機
１００…車輪位置センサ
１０１…コイル位置センサ



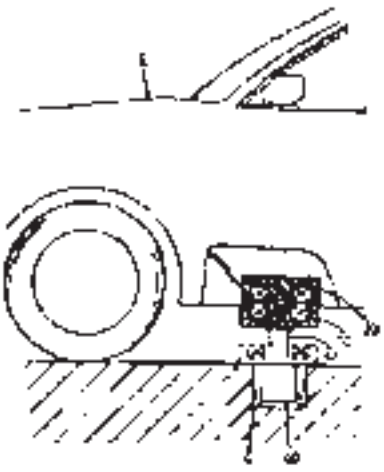


15-7

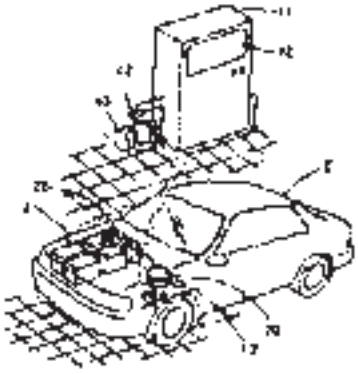
【図１】



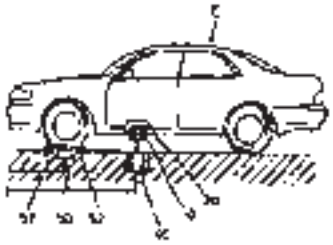
【図４】



【図５】

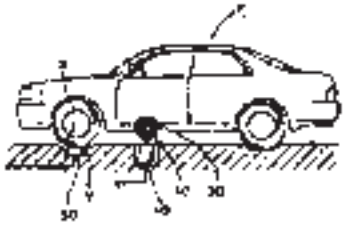


【図１０】



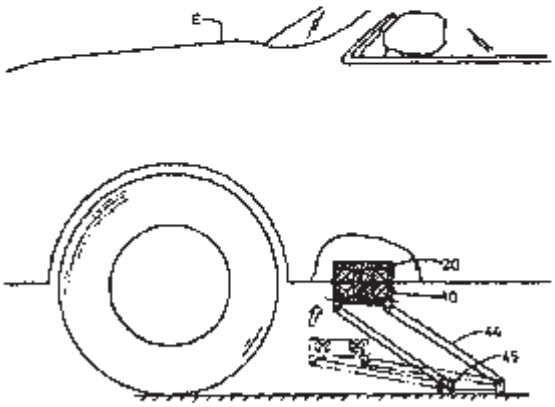
１０－一次コイル
１１－外部電源
２０－二次コイル
２１－バッテリ

【図１１】

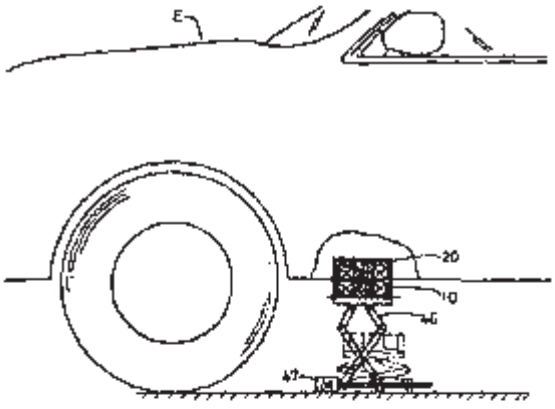


15-8

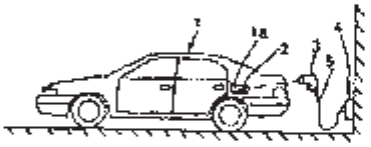
【図６】



【図７】

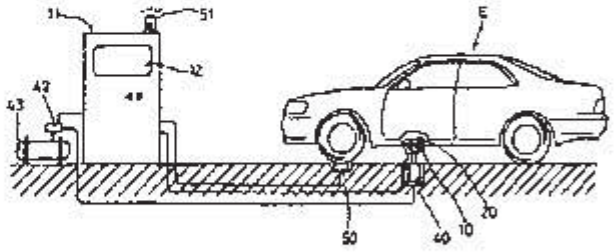


【図２２】

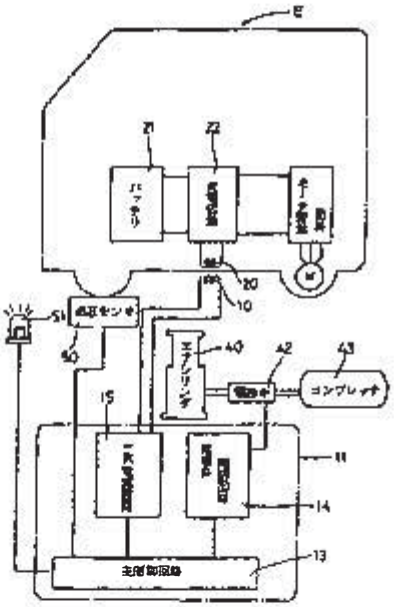


15-9

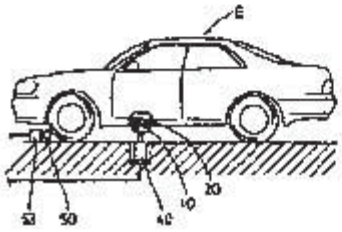
【図８】



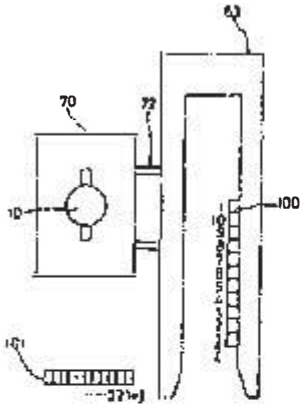
【図９】



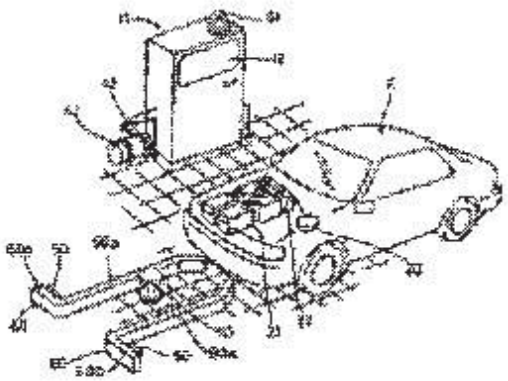
【図１２】

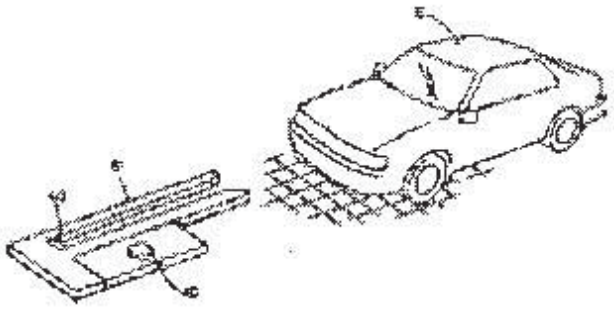


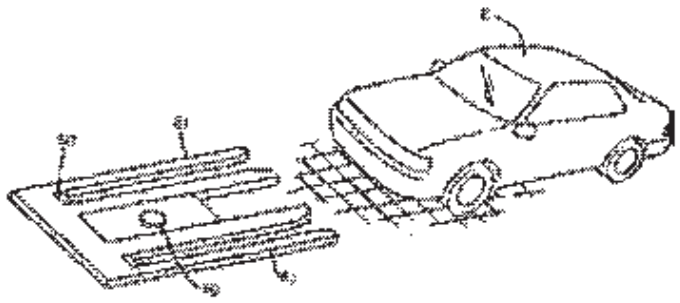
【図２０】



15-10







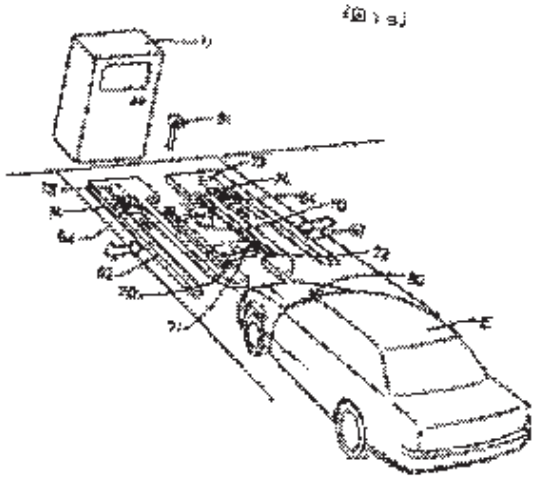
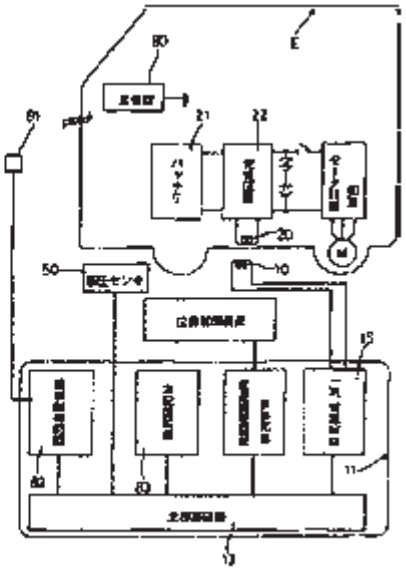


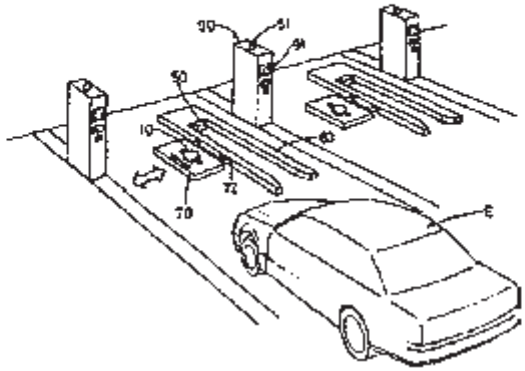
FIG. 12

FIG. 13

【図１７】

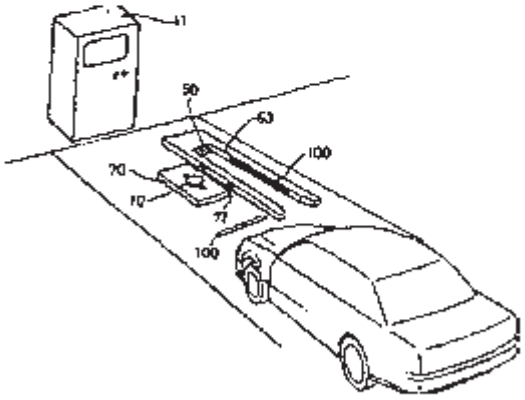


【図１８】



15-13

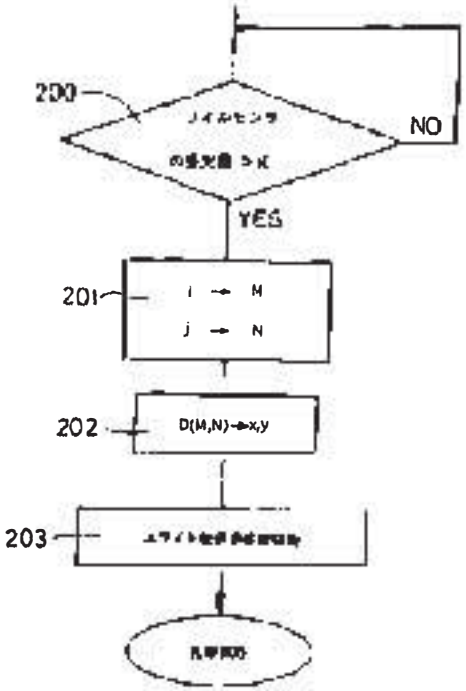
【図１９】



15-14

15-14

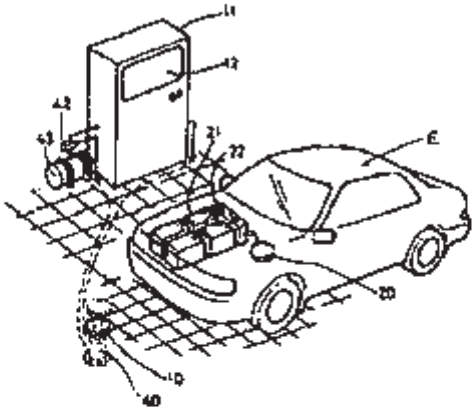
【図２１】



(51)Int.Cl.[6]　　識別記号　　庁内整理番号　　FI　　技術表示箇所
H02J　17/00　　H01F　23/00　　B

(72)発明者　金川　収一
三重県四日市市西末広町１番14号　住友電装株式会社内
(72)発明者　結石　友宏
大阪府大阪市此花区島屋１丁目１番３号
住友電気工業株式会社内
(72)発明者　出口　洋成
大阪府大阪市此花区島屋１丁目１番３号
住友電気工業株式会社内
(72)発明者　有坂　稔司
大阪府大阪市此花区島屋１丁目１番３号
住友電気工業株式会社内

15-15



[English Translation of JP H09-213378]

(54) **CHARGE SYSTEM FOR ELECTRIC VEHICLE**

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a charge system for an electric vehicle capable of facilitating charging of the electric vehicle.
SOLUTION: In an electric vehicle E, a battery 21, of main power source for a running motor and a secondary coil 20 provided in a car body bottom part to be connected to the battery 21 are provided. In a parking lot, a primary coil 10 and an external power unit 11 exciting this primary coil are provided, and the primary coil can be lifted by an air cylinder 40 buried in a floor surf ace of the parking lot. In order to perform charging, the electric vehicle is parked in the upward of the primary coil 10, the secondary coil 20 is lifted, the primary coil is placed in a condition capable of magnetic coupling to the secondary coil 20.

CLAIMS

[Claim(s)]

[Claim 1]An electric vehicle with which a secondary coil which stands in a row in an accumulating electricity device for power at a vehicle body bottom part was provided, It is for charging according to a power supply for external charge during the parking, A charging system for electric vehicles providing a primary coil which stands in a row to the aforementioned power supply for external charge in a parking part of the aforementioned electric vehicle, carrying out inductive coupling of the primary coil to a secondary coil of a

vehicle body bottom part of the aforementioned electric vehicle, and supplying electric power to the aforementioned accumulating electricity device for power.

[Claim 2]A charging system for electric vehicles of a description to above-mentioned Claim 1 currently supporting in a coil transportation device which at least 1 side of the above-mentioned primary coil and a secondary coil can rise-and-fall drive.

[Claim 3]The charging system for electric vehicles according to claim 1 or 2 having composition which excites the aforementioned primary coil on condition that it detected that provided a parking position detection means to detect that a parked electric vehicle is located in a predetermined charging position, and the aforementioned electric vehicle was located in a charging position.

[Claim 4]It has further a wheel guide provided with position relations to the aforementioned primary coil, The charging system for electric vehicles according to any one of claims 1 to 3 showing a secondary coil and the aforementioned primary coil of an electric vehicle to an electromagnetic connecting position by guiding a wheel of the aforementioned electric vehicle with the wheel guide.

[Claim 5]A positioning apparatus which changes a relative position of the aforementioned wheel guide and the aforementioned primary coil, A vehicle type discriminating device which distinguishes a vehicle type of an electric vehicle to park is provided further, The charging system for electric vehicles according to claim 4 showing a secondary coil and the aforementioned primary coil of the aforementioned electric vehicle to an electromagnetic connecting position by driving the aforementioned centering control equipment according to a vehicle type distinguished by the aforementioned vehicle type discriminating device.

[Claim 6]A positioning apparatus which changes a relative position of the aforementioned wheel guide and the aforementioned primary coil, A secondary-coil position measuring device which measures positional relationship of a secondary coil of an electric vehicle to park and a wheel is provided further, The charging system for electric vehicles according to claim 4 showing a secondary coil and the aforementioned primary coil of the aforementioned electric vehicle to an electromagnetic connecting position by driving the aforementioned centering control equipment according to a

position of a secondary coil measured by the secondary-coil position measuring device.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]The present invention relates to the charging system for charging an electric vehicle.

[0002]

[Description of the Prior Art]It seems that the composition put in practical use as this kind of a charging system is conventionally shown in Fig.22. The vehicles side connector 2 connected to the battery for power is provided by the vehicle body of the electric vehicle 1, and the feeding connector 3 is connected here from the outside of a car. The feeding connector 3 is provided from the power supply 4 for charge installed out of vehicles to cable 5 tip, the electric power from the power supply 4 for charge is supplied to the battery for power through both the connectors 2 and 3, and charge is performed.

[0003]

[Problem to be solved by the invention]In an above-mentioned charging system, the feeding connector 3 is taken out from a charging equipment, this is carried to the automobile 1 side, pulling out the cable 5, the work of opening the connector lid 1a of a vehicle body, and connecting with the vehicles side connector 2 is required, and it is fairly troublesome. And since the conventional charge connector was the composition of having carried out fitting contact of the terminal mutually, and establishing an energization way, it had the problem that resistance of the fitting operation needed to perform fitting operation of a connector by large force comparatively largely.

[0004]The present invention is made in light of the above-mentioned circumstances, and the purpose is to provide the charging system of the electric vehicle which can charge an electric vehicle easily.

[0005]

[Means for solving problem]

In order to attain the <invention of Claim 1> above-mentioned purpose, invention concerning Claim 1, The electric vehicle with which the secondary

coil which stands in a row in the accumulating electricity device for power at a vehicle body bottom part was provided, It is for charging according to the power supply for external charge during the parking, and the primary coil which stands in a row to the power supply for external charge is provided in the parking part of an electric vehicle, and it has the characteristics at the place which carries out inductive coupling of the primary coil to the secondary coil of the vehicle body bottom part of an electric vehicle, and supplies electric power to the accumulating electricity device for power.

[0006]<Invention of Claim 2> and invention concerning Claim 2 have the characteristics at the place currently supported in the coil transportation device which at least 1 side of a primary coil and a secondary coil can rise-and-fall drive in the charging system for electric vehicles of the description to above-mentioned Claim 1.

Invention which relates to a <invention of Claim 3> pan at Claim 3, A parking position detection means to detect that the parked electric vehicle is located in a predetermined charging position in the charging system for electric vehicles according to claim 1 or 2 is provided, and it has the characteristics at the place considered as the composition which excites a primary coil on condition that it detected that an electric vehicle was located in a charging position.

[0007]Invention which relates to a <invention of Claim 4> pan at Claim 4, In the charging system for electric vehicles according to any one of claims 1 to 3, It has further the wheel guide provided with position relations to the primary coil, and has the characteristics by guiding the wheel of an electric vehicle with the wheel guide at the place which shows the secondary coil and primary coil of an electric vehicle to an electromagnetic connecting position.

Invention which relates to a <invention of Claim 5> pan at Claim 5, A positioning apparatus which changes the relative position of a wheel guide and a primary coil in the charging system for electric vehicles according to claim 4, The vehicle type discriminating device which distinguishes the vehicle type of the electric vehicle to park is provided further, and it has the characteristics at the place which shows the secondary coil and primary coil of an electric vehicle to an electromagnetic connecting position by driving centering control equipment according to the vehicle type distinguished by the vehicle type discriminating device.

[0008]Invention which relates to a <invention of Claim 6> pan at Claim 6, A positioning apparatus which changes the relative position of a wheel guide

and a primary coil in the charging system for electric vehicles according to claim 4, The secondary-coil position measuring device which measures the positional relationship of the secondary coil of the electric vehicle to park and a wheel is provided further, It has the characteristics at the place which shows the secondary coil and primary coil of an electric vehicle to an electromagnetic connecting position by driving centering control equipment according to the position of the secondary coil measured by the secondary-coil position measuring device.

[0009]

[Function and Effect of the Invention]

If it has composition of <invention of Claim 1> Claim 1, since the secondary coil is provided by the bottom part of the electric vehicle, by parking an electric vehicle at a prescribed spot, both primary and secondary coils can be made into an opposed state, and the preparatory work for charge of an electric vehicle is very easy.

[0010]If it has composition of <invention of Claim 2> Claim 2, since the rise-and-fall drive of the coil is carried out by the coil transportation device, both the coils of an opposed state can be made to be able to approach sufficiently, electromagnetic degree of coupling can be raised, and power transmission efficiency will improve.

In the composition of <invention of Claim 3> Claim 3, since charging operation is made on condition that an electric vehicle is located in a charging position, what charges after the primary coil and the secondary coil have deviated can be prevented, inductive coupling of both the coils can be carried out correctly, and charging efficiency can be maintained at a good state.

In the composition of <invention of Claim 4> Claim 4, if you can proceed an electric vehicle along with a wheel guide, since both coils will be guided naturally in the electromagnetic connecting position by which inductive coupling is carried out, the preparatory work for charge of an electric vehicle becomes still easier, and dispersion is lost.

[0011]In the composition of <invention of Claim 5> Claim 5, the relative position of a wheel guide and a primary coil is adjusted with a positioning apparatus based on the discriminated result of a vehicle type discriminating device. Therefore, even if there is a situation that the positional relationship of the wheel and secondary coil differs variously depending on the vehicle type of an electric vehicle, the electric vehicle of each vehicle type can be led to a

suitable charging position according to each, and it can be considered as the general-purpose charging system for electric vehicles independent of a vehicle type.

In the composition of <invention of Claim 6> Claim 6, the position of the secondary coil currently provided by the bottom part of the electric vehicle is measured as positional relationship with a wheel, and the relative position of a wheel guide and a primary coil is adjusted with a positioning apparatus based on the measurement result. Therefore, the electric vehicle of each vehicle type can be led to a suitable charging position according to each, and the effect that the general-purpose charging system for electric vehicles independent of a vehicle type can be provided is acquired by this.

[0012]

[Mode for carrying out the invention]

Below <a 1st embodiment> describes a 1st embodiment of the present invention with reference to Fig.1 thru/or Fig.5.Fig.1 shows the place which makes the electric vehicle E provided with the secondary coil 20 advance into the motor pool provided with the primary coil 10. This electric vehicle E uses as a principal voltage supply source the battery 21 which is an accumulating electricity device for power, electric power is supplied to it after this, and a drive motor and various electric appliances function. The above-mentioned secondary coil 20 is connected to this battery 21 via the charge circuit 22, the exchange derived to the coil is converted to a direct current, and the battery 21 is charged.

[0013]the secondary coil 20 winds an electric wire around the magnetic core made from a ferrite, for example -- flat -- it is formed in plate-like form, for example, is accommodated in the protective case made from synthesis tree material, and it has attached so that the axial direction of a magnetic core may be turned perpendicularly and a ground surface may be faced in a vehicle body bottom part. On the other hand, a motor pool is equipped with the external power unit 11 which is a power supply for external charge, and the primary coil unit which stands in a row in this external power unit 11 is provided to the motor pool floor line. This primary coil unit is too provided with the primary coil 10 which winds an electric wire around the magnetic core made from a ferrite and which was formed flatly plate-like and accommodated in the protective case, as shown in Fig.4, The magnetic core of this primary coil 10 is carried out perpendicularly, and it supports at the tip of

the driving shaft 41 of the air cylinder 40. This air cylinder 40 was provided so that it might embed in the concave portion C formed in the floor line of a motor pool, and only the primary coil 10 has projected it from the floor line. Driving operation is possible up and down in the driving shaft 41 by performing switching operation of the above-mentioned electromagnetic valve 42 with the distribution power board 12 with which compressed air was supplied to the air cylinder 40 from the compressor 43 via the electromagnetic valve 42, and the external power unit 11 was equipped. If the primary coil 10 will be placed at the bottom part of the electric vehicle E, and the height in which it does not interfere if this driving shaft 41 is driven caudad, and it drives up, it will abut in the protective cases of both the coils 10 and 20, and the degree of magnetic combination of both the coils 10 and 20 will become very largely. Although it is in the state where compressed air continued being supplied to the air cylinder 40 in the state where both the coils 10 and 20 abutted, and both the coils 10 and 20 of each other were pressed, the driving force of the cylinder 40 is set as the size of the degree which does not require power with both the coils 10 and 20 impossible for.

[0014]Next, in this embodiment, it describes about the charge procedure of the electric vehicle E. When making the electric vehicle E advance into a motor pool, the driving shaft 41 of the air cylinder 40 is lowered, and it is made not to interfere in the primary coil 10 with the bottom part of the electric vehicle E, as shown in Fig.1 and Fig.3.Next, the electric vehicle E is parked at a charging position, and the secondary coil 20 with which the bottom part of the electric vehicle E was equipped is made to meet above the primary coil 10 with which the motor pool was equipped in the floor line. Since the car height of the electric vehicle E always has fixed height to the floor line of a motor pool, as the primary coil 10 is straddled, it only parks the electric vehicle E, it can separate a fixed interval, and can make both the coils 10 and 20 meet in here. Namely, since bring coils close too much, and they are made to collide or the collision of coils is feared, it will not be in the state where coils are detached and parked and it cannot charge. Each coil has made [both] the axial direction of the magnetic core the vertical direction, since the bottom part of the electric vehicle E is parallel to a motor pool to a floor line, the axis of the magnetic core of a coil becomes slanting as for what kind of direction, and it does not face the electric vehicle E each other. That is, it cannot be based on a parking attitude, but the interval of coils and direction can be fixed,

and parking in preparation for charge can be performed easily.

[0015]If the electric vehicle E is parked at a position, a primary coil unit will be operated with the distribution power board 12 with which the external power unit 11 was equipped, and the primary coil 10 will be moved up by the air cylinder 40. Then, as shown in Fig.4 and Fig.5, each protective cases of the secondary coil 20 currently awaited in the upper part and the primary coil 10 are held in the state where it abutted.Since the above-mentioned operation is made by Shimo of the vehicle body of the electric vehicle E, there is no fear of an obstacle entering between the coils which it abuts for each other. In the state where it met and abutted, both this coil operates the external power unit 11, and excites the primary coil 10. Then, voltage occurs according to electromagnetic induction phenomena in the secondary coil 20, and the battery 21 of the electric vehicle E is charged by the charge circuit 22 based on this. If the battery 21 is charged in fixed quantity, excitation of the primary coil 10 will be stopped, the primary coil 10 will be lowered, and charging operation will be ended.

[0016]Although the thing of the cylinder mode of an air drive is adopted as this coil transportation device, for example, the rising and falling mechanism of the parallel linkage 44 shown in Fig.6, the pantograph mechanism 46 shown in Fig.7, etc. may be made to drive by the motor 45 or the motor 47 in this embodiment.In the thing provided with the above-mentioned parallel linkage 44 or the pantograph mechanism 46, the height measurement of the whole equipment can be low stopped compared with the cylinder mode. Although both the coils 10 and 20 continued supplying compressed air to the air cylinder 40 also in the state where it abutted, at this embodiment, Even if it does not necessarily force both the coils 10 and 20 after the abutment of both the coils 10 and 20, the composition of providing a pressure-sensitive sensor etc., detecting the abutment of coils, and stopping motion moving, for example to the primary coil 10 side in the contact position may be used. In this case, the external power unit 11 can be started automatically as a trigger of an electric power supply, and automatic battery charge of having detected the abutment of coils can also be carried out.

[0017]<A 2nd embodiment> This embodiment is the charging system for electric vehicles provided with a parking position detection means to detect having parked the electric vehicle E at the charging position. Hereafter, the contents are described with reference to Fig.8 thru/or Fig.11.The same

primary coil 10 as 1st above-mentioned embodiment is provided by the floor line of a motor pool, and the pressure-sensitive sensor 50 which detects what load cut from the upper part in the floor line of the front (graphic display left-hand side) is embedded in the concave portion. This pressure-sensitive sensor 50 is provided by the position which becomes just under that front wheel, when the primary coil 10 and the secondary coil 20 are made to meet and the electric vehicle E is parked. That is, a parking position detection means to detect whether the electric vehicle E has parked this pressure-sensitive sensor 50 at the regular charging position is constituted.

[0018]The signal wire from the pressure-sensitive sensor 50 is connected to the main control circuit 13 with which the external power unit 11 was equipped as shown in the block diagram of Fig.9, Based on this signal, the electromagnetic valve-opening closed circuit 14 which operates the air cylinder 40, and the primary power supply circuit 15 which excites the primary coil 10 are controlled. In order to make a driver know that the pressure-sensitive sensor 50 reacts and the electric vehicle E is located in a regular charging position, it is controlling by the main control circuit 13 to switch on the light, when the lamp 51 is provided to an external power and the pressure-sensitive sensor 50 reacts. In here, a buzzer etc. can also be used instead of a lamp.

[0019]About other structures, it is the same as that of a 1st embodiment, and it omits, and the description duplicate by attaching identical codes about the same part continues, and describes operation of the above-mentioned charging system. The electric vehicle E is parked at a motor pool. If the electric vehicle E arrives at a regular charging position, since the front wheel of the electric vehicle E is placed on the pressure-sensitive sensor 50, big load will act on the agreement pressure sensor 50, and the detecting signal of an electric vehicle will be sent to the main control circuit 13. Then, on condition that the detecting signal was outputted, Flagg can charge, for example is set, and the drive of the air cylinder 40 and a series of charging operation of excitation of a coil become possible as mentioned above. If the front wheel of the electric vehicle E does not reach on the pressure-sensitive sensor 50 or it passes, since a detecting signal is not transmitted from the pressure-sensitive sensor 50, it will judge that the main control circuit 13 does not have the electric vehicle E in a predetermined charging position, and charging operation will not be made. As [start / therefore, / in the position from which coils deviated / charging

operation]

[0020]Although the system which makes the pressure-sensitive sensor 50 step on by the front wheel of the electric vehicle E is adopted as a parking position detection means in a 2nd embodiment, a limit switch may be made to abut the bumper of for example, the electric vehicle E, and a parking position may be detected. In the thing using a pressure-sensitive sensor, as shown in Fig.10, the projection 52 may be provided to the periphery, or as shown in Fig.11, tapered shape may drop into the periphery of an opening of the concave portion X in which the pressure-sensitive sensor 50 is accommodated, and the part Y may be formed.As shown in Fig.12, the stopper 53 may be installed in a motor pool, and you may equip the side surface of the stopper 53 with the pressure-sensitive sensor 50, and a wheel may make it abut there. As mentioned above, in what is shown in Fig.10 thru/or Fig.12, the driver can recognize having arrived at the regular charging position also as feeling which it is transmitted from a tire.

[0021]<A 3rd embodiment> This embodiment is a charging system for electric vehicles which shows a charging position to an electric vehicle with a wheel guide. Hereafter, the contents are described with reference to Fig.13 thru/or Fig.15.Fig.13 is a perspective view showing the place which makes the electric vehicle E advance into the motor pool provided with the above-mentioned wheel guide 60. The wheel guide 60 changes into a symmetrical back doubling state two rails formed in the shape of an "L" character, and is attached to the floor line of a motor pool. The long sides 60a and 60a used as this back doubling serve as an interval which enters inside the right and left wheel of the electric vehicle E exactly, and the interval is narrow at the tapered form so that that tip may tend to draw a wheel. The shorter sides 60b and 60b are extended to the opposite direction from the long sides 60a and 60a, and serve as length on which the right and left front wheel of the electric vehicle E can abut, respectively. Therefore, as the above-mentioned long sides 60a and 60a are straddled with right and left both wheels, when the electric vehicle E is made to advance into a motor pool, the front wheel will stop at the position to which the shorter sides 60b and 60b are abutted. That is, with the wheel guide 60, the direction and position will be decided uniquely and the electric vehicle E will be parked.

[0022]The primary coil unit is attached to the floor line between the above-mentioned long sides 60a and 60a, and when parking the electric vehicle E

according to the above-mentioned wheel guide 60, the secondary coil 20 and the primary coil 10 meet. The portion which a front wheel abuts in the above-mentioned shorter side 60b is equipped with the pressure-sensitive sensor 50, and it made it detectable that the electric vehicle E had parked a car along with the wheel guide 60, and has incorporated into the main control circuit 13 provided with the detection information in the external power unit 11. About other structures, it is the same as that of a 1st embodiment thru/or a 2nd embodiment, and it omits, and the description duplicate by attaching identical codes about the same part continues, and describes operation of the above-mentioned charging system.

[0023]A moving direction will be restricted and shown by the long sides 60a and 60a, if the electric vehicle E is made to advance into a motor pool as the long side 60a of the wheel guide 60 is straddled. When the front wheel proceeds to the position to which the shorter side 60b is abutted, it becomes impossible for the electric vehicle E to move forward more, and the driver can know that it is a charging position. A pressure-sensitive sensor is pushed by a front wheel at this time, and by [which prepared for the external power unit 11] carrying out lamp lighting shows that this position is a charging position. If the electric vehicle E is stopped in this position, it will be in the state where the secondary coil 20 and the primary coil 10 met, then with a 1st embodiment having described, the primary coil 10 will go up, the secondary coil 20 will be abutted similarly, and the battery of the electric vehicle E will be charged in that state.

[0024]Thus, it becomes possible not to be influenced by a driver's parking technology after that, but to park the electric vehicle E at a charging position easily moreover, if it advances into a wheel guide. Although the wheel guide and the primary coil were made separate and both were installed in position relations in a 3rd embodiment, previously, a primary coil and a wheel guide may be used as integral equipment, and may be attached to a motor pool. In a 3rd embodiment, although right and left both wheels of the electric vehicle E are guided, as shown in Fig.14, the internal and external side surface of the wheel of one side of the electric vehicle E may be restricted with the long and slender U-shaped wheel guide 61, and it may show around. As shown in Fig.15, this U-shaped wheel guide 61 may be provided to the right and left of a primary coil unit, and it may suppose that it is symmetrical, and may carry out that it is easy to make the electric vehicle E advance into the wheel guide.

[0025]<A 4th embodiment> This embodiment is a charging system for electric vehicles which adjusts the relative position of a wheel guide and a primary coil automatically so that the vehicle type of the electric vehicle E to park may be distinguished with a vehicle type discriminating device and an electric vehicle may be led to a regular charging position according to that vehicle type. Hereafter, it describes with reference to Fig.16 and Fig.17.Fig.16 is a perspective view showing the state of making the electric vehicle E advancing into the motor pool provided with the above-mentioned vehicle type discriminating device and the positioning apparatus of the wheel guide 63 and the primary coil 10. The above-mentioned primary coil 10 is made movable up and down with the hoisting drive device with which the box-like base 70 where the back fixed to the floor line of the motor pool is low was equipped with, and the inside was equipped. This hoisting drive device is settled in the base 70, when it comprises a pantograph mechanism and the primary coil 10 is lowered, as shown in the above-mentioned Fig.7.

[0026]The long and slender U-shaped wheel guide 63 turns each opening in the direction, and is attached to the both side surfaces of the above-mentioned base 70. It has the function to restrict the internal and external side surface of a wheel like the wheel guide 61 shown in Fig.15, and to show a predetermined parking position to the electric vehicle E. To base 70 inside, at right and left The slide drive 71 of every a couple. (For example, the thing which combined the motor with an absolute encoder and the ball screw) is built in, and the driving shaft 72 is made to project to both side surfaces, and it has connected with the aforementioned wheel guide 63, and can be made to carry out to right and left slide movement of the wheel guide 63. The slide drive 73 is similarly built in the portion of the joint side of the "KO" character in the wheel guide 63, the driving shaft 74 is attached to the contact board 64, and it enables it to have changed the depth of the wheel guide 63 freely. That is, it becomes possible to position the electric vehicle E which equipped any position with the secondary coil 20 to the base 70 which the above-mentioned slide drives 71 and 73 formed the positioning apparatus whose change of the relative position of a primary coil and a wheel guide is enabled, resembled this, and was therefore provided with the primary coil 10. The bottom surface of the above-mentioned wheel guide 63 is equipped with the caster which is not illustrated, and a bending load with the driving shaft 72 impossible for is kept from being applied.

[0027]The aforementioned vehicle type discriminating device is provided with the transmitter 80 mounted on the electric vehicle E, and the receiver 81 installed in the motor pool, and has come to be, able to carry out the radio traffic of the vehicle type information in the meantime on the other hand. The receiver 81 stands in a row in the main control circuit 13 which is connected to the communication control circuit 82 with which the external power unit 11 was equipped, and unifies this system. As shown in Fig.17, the memory storage 83 which made the positional relationship of a wheel versus the secondary coil according to vehicle type memorize is connected with the main control circuit 13, The above-mentioned positional relationship is incorporated into the main control circuit 13 based on the received vehicle type information, and now, the main control circuit 13 drives the positioning apparatus mentioned above, and it positions the wheel guide 63 so that each electric vehicle E may be suited.

[0028]About other structures, it is the same as that of a 1st embodiment thru/or a 3rd embodiment, and it omits, and the description duplicate by attaching identical codes about the same part continues, and describes operation of the above-mentioned charging system. If the electric vehicle E approaches a motor pool, the transmitter 80 empty-vehicle species information of the electric vehicle E will be sent. Then, the vehicle type information is received by the receiver 81 with which the motor pool was equipped, and vehicle type information is incorporated into the main control circuit 13. The main control circuit 13 accesses the memory storage 83, and incorporates the positional relationship information on a wheel and a secondary coil in the vehicle type. The slide drives 71 and 73 are driven based on this positional relationship information, and the relative position of the wheel guide 63 to the primary coil 10 is made to correspond to the positional relationship of the secondary coil of the vehicle body bottom part to a wheel. Then, the interval of the wheel guide 63 and 63 comrades also turns into an interval of the right and left wheel of the electric vehicle E, and will be in the state which can advance into a motor pool about the electric vehicle E. Then, if you can proceed the electric vehicle E to the position to which a front wheel abuts the contact board 64 in the inner part of a wheel guide, a primary coil and a secondary coil will meet. Hereafter, a series of same charging operation is performed with having described by 1st embodiment thru/or a 3rd embodiment. If this electric vehicle E leaves a motor pool and the electric

vehicle of another vehicle type advances into a motor pool, the positional relationship of a wheel guide and a primary coil will be readjusted in accordance with that vehicle type.

[0029]Thus, in this charging system, it can respond to charge of two or more vehicle types in the same motor pool. It seems that the information may be input in a 4th embodiment with the input device with which the predetermined part of the motor pool was equipped although vehicle type information is incorporated into the control circuit by the means of communication. For example, if a motor pool is equipped with the coin box 90 which collects a charging fee as shown in Fig.18, the composition of inputting the ten key 91 empty-vehicle species information provided to the coin box 90 may be used -- it carries out and carries out by making vehicle type information record on a prepaid card etc. together with it -- it may be made to carry out a card input. If the wheel guide 63 is fixed to a motor pool and it enables it to move the primary coil 10 side in this case, according to the vehicle type information input after parking the electric vehicle E in the wheel guide 63, the primary coil 10 can be set by the position in which the secondary coil 20 and combination are possible. This wheel guide 63 has connected the driving shaft 72 of the slide drive which was formed in U-shape and with which that side surface was equipped at the base 70. This wheel guide 63 is fixed to a ground surface, and the base 70 has provided the caster at the bottom part. The primary coil unit which possesses a hoisting drive device inside the base 70 is supported with the slide drive at positioning **** in the direction which intersects perpendicularly with the aforementioned driving cylinder.

[0030]As operation of the above-mentioned composition, it is as follows. In the U-shaped wheel guide 63, the single-sided wheel of the electric vehicle E is made to advance until it runs against the back, and it is parked. If it runs, the lamp 51 with which that was detected by the pressure-sensitive sensor 50, and the coin box 90 was equipped will light up, and a driver will be told. The charge of hope is input with the ten key 91 of the coin box 90, and a driver inputs a vehicle type, and pays the charging fee and parking fee. Or a prepaid card may perform the above-mentioned vehicle type input and charge payment instead of a ten key input. If charge is completed, the lamp 51 will light up again and that will be told. When parking duration is exceeded, the lamp 51 blinks and it may be made to warn.

[0031]About other structures, it is the same as that of a 1st embodiment

thru/or a 4th embodiment, and the description duplicate by attaching identical codes about the same part is omitted.

The <5th embodiment> book embodiment is a charging system for electric vehicles which was mentioned above and which does not carry out vehicle type distinction like a 4th embodiment, but measures the positional relationship of the wheel of an electric vehicle, and a secondary coil with a measuring device, and adjusts the relative position of a wheel guide and a primary coil automatically based on the measurement result. Hereafter, it describes with reference to Fig.19 thru/or Fig.20.Fig.19 is a perspective view showing the state of making the electric vehicle E advancing into the motor pool provided with the above-mentioned measuring device. This wheel guide 63 and base 70 of what was described in the modification (Fig.18) of a 4th embodiment, and the principal part are the same, and it has the wheel position sensor 100 which detects the position of a wheel on it, and the coil position sensor 101 which detects the position of a secondary coil.

[0032]In [both the above-mentioned sensors 100,101 of both arrange photosensor in a form line, are formed, and] the wheel position sensor 100, As it is along the wheel guide 63, it has attached to the inner side surface, and in the coil position sensor 101, a transverse direction is used and it has embedded under the motor pool floor line before the base 70. Since the reflection part (not shown) which reflects the light reflection of photosensor is provided to the secondary coil 20 of the electric vehicle E and it is made for the reflected light to be it largely by other portions, as for the above-mentioned coil position sensor 101, the position of the secondary coil 20 is detectable. Both the sensors 100,101 combine the data which each detected in the main control circuit 13 with which the external power unit 11 was equipped, and deduce the positional relationship of the wheel in the electric vehicle E, and the secondary coil 20. Specifically, as shown in Fig.20, the number for data processing is given to each photosensor, and a detecting position is performed as follows according to the flow chart of Fig.21.

[0033]Step 200 compares whether the light income of the coil position sensor 101 is beyond the constant value K. Since it will become the light income beyond the constant value K if the reflective mirror of the secondary coil 20 passes, this comparison result serves as "YES" and proceeds to Step 201. Step 201 -- the above -- when the reflection part with which the secondary coil 20 was equipped passes, the photosensor number "j" which was the largest is

remembered to be a photosensor number "i" of the passing position of a wheel when it becomes light income more than fixed level in the memories M and N. Next, at Step 202, the quantity (X, Y) which should drive each slide drive of the wheel guide 63 and the primary coil 10 is incorporated from the dimension map D (M, N) with which the memory storage 83 was equipped. And based on the data, each slide drive is driven at Step 203. At this time, it went to the back of the wheel guide 63, and the back wall was abutted, the electric vehicle E is parked, and the secondary coil 20 is placed above the primary coil 10 exactly.

[0034]After carrying out position ****** of the primary coil 10 as mentioned above, a series of same charging operation is performed with having mentioned above. About other structures, it is the same as that of a 1st embodiment thru/or a 4th embodiment, and the description duplicate by attaching identical codes about the same part is omitted.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]It is a perspective view showing a 1st embodiment of the present invention.

[Drawing 2]It is a plan view showing a 1st embodiment similarly.

[Drawing 3]It is a side view showing a 1st embodiment similarly.

[Drawing 4]similarly a 1st embodiment is shown -- it is an expansion side view in part.

[Drawing 5]It is a perspective view showing the state where the coil of a 1st embodiment similarly carried out inductive coupling.

[Drawing 6]It is a side view showing the 1st modification of the coil transportation device of a 1st embodiment similarly.

[Drawing 7]It is a side view showing the 2nd modification of the coil transportation device of a 1st embodiment similarly.

[Drawing 8]It is a side view showing a 2nd embodiment of the present invention.

[Drawing 9]It is a block diagram showing a 2nd embodiment similarly.

[Drawing 10]It is a side view showing the 1st modification of the parking position detection means of a 2nd embodiment similarly.

[Drawing 11]It is a side view showing the 2nd modification of the parking position detection means of a 2nd embodiment similarly.
[Drawing 12]It is a side view showing the 3rd modification of the parking position detection means of a 2nd embodiment similarly.
[Drawing 13]It is a perspective view showing a 3rd embodiment of the present invention.
[Drawing 14]It is a perspective view showing the 1st modification of the wheel guide of a 3rd embodiment similarly.
[Drawing 15]It is a perspective view showing the 2nd modification of the wheel guide of a 3rd embodiment similarly.
[Drawing 16]It is a perspective view showing a 4th embodiment of the present invention.
[Drawing 17]It is a block diagram showing a 4th embodiment similarly.
[Drawing 18]It is a perspective view showing the modification of a 4th embodiment similarly.
[Drawing 19]It is a perspective view showing a 5th embodiment of the present invention.
[Drawing 20]It is an outline plan view showing the arrangement of the sensor of a 5th embodiment similarly.
[Drawing 21]It is a flow chart which similarly shows positioning operation of a 5th embodiment.
[Drawing 22]It is a side view showing the conventional charging system.
[Explanations of letters or numerals]
10 -- Primary coil
11 -- External power
20 -- Secondary coil
21 -- Battery
40 -- Air cylinder
50 -- Pressure-sensitive sensor
60 -- Wheel guide
61 -- Wheel guide
63 -- Wheel guide
71 -- Slide drive
73 -- Slide drive
80 -- Transmitter
81 -- Receiver

100 -- Wheel position sensor
101 -- Coil position sensor

(19)대한민국특허청(KR)
(12) 공개특허공보(A)

(51) 。Int. Cl.[7]
H02J 7/00

(11) 공개번호 10-2004-0028312
(43) 공개일자 2004년04월03일

(21) 출원번호 10-2002-0059462
(22) 출원일자 2002년09월30일

(71) 출원인 한국과학기술원
대전 유성구 구성동 373-1

(72) 발명자 조규형
대전광역시서구둔산1동크로바아파트117동201호

이민철
대구광역시수성구황금동신천지타운203-1102

(74) 대리인 이관이

심사청구 없음

(54) 유도 결합에 의한 비접촉식 충전 시스템

요약

본 발명은 고주파 자계를 발생시켜 유도 결합을 통하여 휴대형 장치의 축전지를 충전하기 위한 시스템에 관한 것으로, 유도 결합을 위한 고주파 변압기의 1차 측은 동심원 형태의 페라이트 코어를 사용하여 권선을 감아서 구성하고, 2차 측은 1차측과는 일정한 간극을 사이에 두고 얇고 편평한 페라이트 시트 상에 역시 얇은 평면형으로 권선을 설치해서 구성하여 휴대폰과 같이 부피와 무게가 작고 가벼운 장치에 설치가 용이하도록 하였으며, 휴대용 위한 에너지는 1차 측으로부터 2차측으로 전기적 접촉점이 없이 전자 유도결합에 의해 비접촉 방식에 의하여 전달된다. 또한, 축전지의 충전상태는 2차 측으로부터 1차 측으로 무선으로 전달하는 방식을 사용하되 역시 평면형의 1차 및 2차권선을 각각 감아서 서로 약간의 간극을 사이에 두고 대향시켜 배치함으로써 송신과 수신이 이루어지도록 하였다.

대표도

도 2

색인어

[illegible]

명세서

도면의 간단한 설명

도 1a는 본 발명에 따른 비접촉식 충전 시스템의 충전 모체 위에 휴대형 장치를 올려놓은 상태에서 변압기를 중심으로 하여 도시한 단면도(102) 및 각각의 평면도(101, 103),

도 1b는 휴대형 장치내의 분리형 변압기 2차권선을 얇은 박막형태의 권선으로 구현하기 위한 방안으로 얇은 플렉시블(flexible) 기판 상에 양면을 이용하여 구현한 모습을 예시한 도면,

도1c는 휴대형 장치내의 2차권선을 충전 모체의 1차권선으로부터의 거리(d2)가 어긋나게 하면서, 1차권선에 일정 크기의 고주파 교류전압을 인가할 때 2차권선 양단에 나타나는 단자전압을 도시한 그래프,

도 2a는 본 발명에 따른 비접촉식 충전 시스템의 구성 및 제어방식을 보여주는 블록도,

도 2b는 저주파 AC/DC 정류기의 회로를 예시한 도면,

도 4a는 4개 MOSFET을 사용하여 구성한 프리휠링 DC/DC 컨버터의 회로를 예시한 도면,

도 5a는 고주파 정류기용 인버터의 회로를 도시한 도면,

도 6a은 도 5a의 게이트구동부의 구조를 예시한 도면,

도 7a 내지 도 7c는 휴대형 장치 내의 분리형 변압기 2차권선에 연결하여 설치한 고주파 AC/DC 정류기의 세가지 다른 구조를 예시한 도면,

도 8a은 휴대형 장치에서 측정된 전압값에 따라 충전하도록 하기 위한 제어회로를 도시한 도면,

도 9a는 본 발명에 따른 BIF 방식 및 충전회로를 예시한 도면,

도 10a은 본 발명의 BIF 구성 및 작동파형을 예시한 도면,

도 11a 및 도 11b는 리튬 PWM 제어회로의 구성 및 회로를 예시한 도면.

발명의 상세한 설명

발명의 목적

발명이 속하는 기술 및 그 분야의 종래기술

본 발명은 휴대형 장치에 사용되는 축전지를 비접촉으로 충전하기 위한 소형경량화된 충전 시스템에 관한 것으로, 더욱 상세하게는 충전 모체로부터 축전지측에 고주파 자계를 발생시켜 얇은 평면형의 분리형 변압기 사이에 상호유도결합을 통하여 에너지를 전달하는 방식을 사용함으로써 휴대형 장치내의 축전지에 접촉단자를 통하지 않고 충전하기 위한 비접촉식 충전 시스템에 관한 것이다.

일반적인 휴대형 장치에는 축전지가 장착되어 있어서 사용자가 이동하면서 사용할 수 있도록 되어 있다. 이러한 축전지를 충전하기 위해서는 일반 전원과 연결하여 휴대형 장치의 축전지에 에너지를 제공하기 위한 충전 모체가 필요하다. 통상적으로 충전 모체와 축전지에는 외부에 각각 별도의 접촉 단자가 구성되어 있어서, 두 접촉 단자를 서로 접속시킴으로써 필요에 따라 선택적으로 축전지를 충전할 수 있도록 되어 있다.

그러나, 축전지와 충전 모체에 접촉 단자를 구성하면 접촉 단자가 외부에 돌출됨에 따라 미관상 좋지 않고, 접촉단자가 외부의 이물질에 오염되어 접촉 상태가 불량해질 수 있는 단점이 있다. 또한, 사용자의 부주의로 인해 축전지에 단락이 발생하거나 습기에 노출되면 충전 에너지가 소실될 수 있다.

종래에도 이러한 문제점을 해결하기 위하여, 축전지와 충전 모체에 각각 접촉 단자를 구성하지 않고 비접촉식으로 충전할 수 있는 방식이 개발되어 있으며, 일부 응용 분야 (예를 들어, 전동 칫솔, 전기 면도기 등)에서 이용되고 있다. 이러한 종래의 비접촉식 충전 방법도 역시 고주파로 동작하는 변압기의 1차 회로를 충전 모체에 구성하고, 2차 회로를 휴대형 장치 내에 구성함으로써 충전 모체로부터 에너지를 자기 결합에 의하여 휴대형 장치의 축전지에 제공하는 방식이라는 점에서는 본 발명과 공통되는 점이 있다.

그러나 상기의 비접촉식 충전 방식은 통상적으로 변압기의 1차 회로뿐만 아니라 2차 회로에도 무게와 부피가 있는 페라이트 코어가 이용되며, 페라이트 코어의 무게와 부피 때문에 휴대폰과 같이 초소형 기기에 적용하기에는 적합하지 못하다는 문제가 있었다.

발명이 이루고자 하는 기술적 과제

본 발명은 상기 문제점의 해결을 위해, 충전 모체와 휴대형 장치 사이에 약간의 간극을 두고 고주파로 변환시킨 자기장의 유도 결합을 이용하여 휴대형 장치 내의 축전지를 충전하기 위한 충전 시스템에 있어서, 휴대형 장치 측에 설치되는 결합부를 평면형으로 제작하여 소형경량화한 비접촉식 충전 시스템을 제공함을 목적으로 한다.

또한, 축전지의 충방전 상태를 체크하여 실시간으로 제어하는 비접촉식 방식의 충전 장치를 제공함을 목적으로 한다

발명의 구성 및 작용

본 발명은 상기 목적의 해결을 위해, 유도 결합 방식을 사용하여 충전 모체로부터 휴대형 장치에 장착된 축전지를 충전하는 비접촉식 충전 시스템에 있어서, 상기 충전 모체는, 저주파 교류입력 전압을 받아 직류전압으로 변환하여 출력하는 저주파 AC/DC 정류기; 상기 직류전압의 크기에 관계없이 일정한 직류전압을 만들어 출력하는 프리볼트 DC/DC 컨버터; 상기 일정한 직류전압을 받아 고주파 교류 전력으로 변환하여 출력하는 고주파 병렬공진형 인버터; 상기 고주파 병렬공진형 인버터에 연결되는 페라이트 코어; 및 상기 페라이트 코어의 중앙돌출부와 외곽돌출부 사이에 설치되고, 상기 고주파 교류 전력을 받아 유도결합에 의해 상기 휴대형 장치 측으로 전달하는 1차권선;을 구비하고, 상기 휴대형 장치는, 얇은 페라이트 시트; 상기 1차권선으로부터 상기 교류 전력을 수수하기 위하여 상기 1차권선에 대향 하도록 상기 페라이트 시트 상에 설치되는 얇은 박막형의 2차권선; 및 상기 2차권선이 수수한 교류 전력을 직류 전력으로 변환하여 축전지에 제공하는 고주파 AC/DC 정류기를 구비하는 것을 특징으로 하는 비접촉식 충전 시스템을 제공한다.

또한, 상기 휴대형 장치는, 상기 축전지의 충전상태를 검사하여 제어신호를 생성하고 출력하는 충전제어회로; 및 상기 제어신호를 받아 RF 신호로 변조하여 무선 송출하는 RF 변조 및 송신회로;를 더 구비하고, 상기 충전 모체는, 상기 RF 신호를 수신하고 복조하여 상기 제어신호를 검출하여 출력하는 RF 수신 및 복조회로; 및 상기 제어신호를 받아 펄스폭 변조 신호를 만들어 상기 프리볼트 DC/DC 컨버터에 인가함으로써 직류전압을 조정하도록 하는 PWM 제어회로를 더 구비하는 것을 특징으로 하는 비접촉식 충전 시스템을 제공한다.

이하에서 첨부된 도면을 참조하여 본 발명의 실시예들을 설명한다.

도 1a는 본 발명에 따른 충전 시스템에 있어서 변압기의 원리인 자력선을 매개로 하여 비접촉 방법으로 에너지를 전달하기 위한 코어 부분에 대한 단면도(102)와 평면도(101, 103)를 동시에 도시하고 있다.

본 발명에서 제안하는 충전 시스템은 단면도(102)에 도시된 바와 같이 충전 모체(1) 측과 휴대형 장치(2) 측으로 나누어서 생각할 수 있다. 충전 모체(1)에는 에너지 송출을 위한 분리형 변압기의 1차권선이 설치되는데, 자계를 형성하는 주권선(4)과 주권선에 의해 형성된 자계로부터 교류 전력을 유도하는 보조권선(10)으로 구성된다. 또한, RF(고주파)신호 수신을 위한 4차권선(6)이 1차권선(4)과 일정한 간격을 두고 설치된다. 한편, 휴대형 장치(2)에는 에너지 수수를 위한 변압기의 2차권선(5)이 설치되며 RF신호 송출을 위한 3차권선(7)이 일정한 간격을 두고 설치된다.

평면도(101)는 휴대형 장치(2)에 설치된 각각의 변압기 권선(5, 7)의 형태를 도시한 것이고, 단면도(102)는 충전 모체(1) 위에 휴대형 장치(2)를 올려놓은 상태에서 변압기를 중심으로 하여 절단한 모습을 도시한 것이며, 평면도(103)는 충전 모체(1)에 설치된 각각의 변압기 권선(4, 6)을 도시한 것이다.

에너지 송출을 위한 변압기의 1차 측은 충전 모체에 중앙 돌출부(3-1)와 외곽 돌출부(3-2)로 구성되는 원통형의 페라이트 코어(3)로 구현된다. 페라이트 코어(3)의 중앙 돌출부(3-1)와 외곽 돌출부(3-2) 사이에는 변압기의 2차 측으로 에너지를 전달하기 위한 변압기의 1차 측의 주권선(4)과 전력회로의 제어를 위한 수단으로서의 보조권선(10)이 권취된다.

이에 대응하는 에너지 수수를 위한 변압기 2차권선(5)은 휴대형 장치 하부의 페라이트 시트(8) 상에 구성된다. 2차권선(5)은 충전 모체(1)의 에너지 송출용 변압기 1차권선(4)과 대향하는 위치에 수직으로 약간의 간격을 두고 형성된다. 이 수직 간격은 작을수록 바람직하지만, 페라이트 시트(8)가 휴대형 장치(2) 내부에 장착되게 됨으로써 휴대형 장치의 케이스 외벽 두께에 의하여 불가피하게 발생하는 공간 때문에 약 1mm 내외의 간격을 두게 된다.

페라이트 시트(8) 위에서 에너지 수수용 변압기의 2차권선(5)이 권취되는 위치는 원통형 페라이트 코어(3)의 중앙 돌출부(3-1)와 외곽 돌출부(3-2) 사이에 대응하는 위치에 설치된다. 때문에, 2차권선(5)으로는 얇은 박막형태의 권선을 이용하는 것이 바람직하다.

RF신호의 송신을 위한 3차권선(7)은 휴대형 장치(2)의 페라이트 시트(8) 상에 에너지 수수용 변압기의 2차권선(5)과 수평으로 일정한 거리를 두고 별도로 설치되며, 1차 또는 2차권선과는 가급적 자기적인 결합을 최소화할 수 있도록 하여야 한다. 한편, RF신호의 수신을 위한 4차권선(6)은 충전 모체(1) 측에 설치하되 3차권선(7)과는 자기적으로 잘 결합될 수 있도록 하여야 하며, 보통의 PCB기판(9) 상에 설치가 가능하다. 이 두 권선(6, 7)은 배터리의 충전 상태에 관한 정보를 RF신호로 변조시켜 송수신하기 위한 목적으로 설치되는 것이며, 전력의 [illegible] 목적으로 하지 않기 때문에 가느다란 권선을 사용하여 작은 크기의 원형 또는 다각형으로 구현할 수 있다.

도 1b는 2차권선(5)을 얇은 박막형태의 권선으로 구현하기 위한 방안으로 얇은 플렉시블(flexible) 기판 상에 양면을 이용하여 구현한 모습을 예시한 것이다. 특히, 도시된 바와 같이 2차권선(5)의 권선과 권선사이에 일정한 간격을 [illegible] 형성시킨다면 하나의 바람직한 특성을 얻는데 도움이 된다. 실제 상황에서 사용자가 휴대형 장치(2)내의 축전지를 충전하기 위하여 충전 모체(1) 위에 휴대형 장치(2)를 올려놓는다고 할 때, 충전 모체(1)의 1차권선(4) 위치 위에 휴대형 장치(2)의 2차권선(5) 위치를 정확하게 일치시켜서 올려놓는 일이 쉽지 않다. 이 두 권선 간의 위치가 어긋나게 되면 1차 [illegible]서 2차 [illegible]의 에너지 전달 효율이 나빠지게 된다. 본 발명에서는 이와 [illegible] 경우를 미리 고려하여 2차권선(5)의 권선과 권선 사이에 일정한 간격을 [illegible] 형성시킴으로써, 사용자가 휴대형 장치를 충전 모체 위에 [illegible] 때 상당한 위치의 오차가 존재하는 경우에도 불구하고 충전에 미치는 영향을 최소화하도록 하였다.

도 1c는 휴대형 장치(2)의 2차권선(5)을 충전 모체(1)의 1차권선(4)으로부터의 거리(가로축:d2)가 각각 0mm에서 6 mm 까지 어긋나게 위치시키면서, 1차권선(4)에 일정 크기의 고주파 교류전압을 인가할 때 2차권선(5) 양단에 나타나는 단자전압(V_O)을 도시한 그래프이다. 또한, a, b, c, d는 각각 2차권선(5)의 권선과 권선사이에 간격을 몇가지 값으로 변화시킨 경우를 도시한 것이다. 도시된 바와 같이 d2 의 변화에 대하여 가장 변화가 적은 것은 c의 경우이며, 이는 2차권선(5)의 권선과 권선사이에 간격을 4mm 정도로 하는 것이 가장 바람직함을 의미한다.

도 2는 본 발명에 따른 비접촉식 충전 시스템의 구조 및 제어회로를 [illegible] 블록의 구성 및 기능에 대하여 상술한다.

저주파 AC/DC 정류기(11)는 상용의 110V 또는 220V 등의 저주파 교류입력 전압을 받아서 직류로 변환하기 위한 것이며, 이렇게 변환된 직류전압(Vdc)은 입력전압의 변화에 따라 달라진다.

프리볼트(Free Volt) DC/DC 컨버터(12)는 상기 저주파 AC/DC 정류기로(11)부터 얻어지는 직류전압(Vdc)의 변화에도 불구하고 일정한 직류전압(Vs)을 [illegible]한다.

고주파 병렬공진형 인버터(13)는 상기 프리볼트 DC/DC 컨버터(12)에서 입력 되는 직류전압(Vs)을 받아서 고주파 교류 전력으로 변환한다.

이렇게 변환된 고주파 교류 [illegible] 충전 모체(1)에 속한 것이며, 이 에너지를 공간적으로 분리되어 있는 휴대형 장치(2)에 전달하기 위해서는 [illegible] 장치간에 존재하고 있는 간격을 극복하여야 한다. 이 것은 자기 [illegible]를 통하여 가능하며, 이러한 목적으로 충전 모체(1) 측에는 1차 코어(3)에 권취된 1차권선(4)이 설치되어 상기 [illegible] 전력에 의한 자계를 형성하며, 이에 대향하는 위치에 상기 1차권선(4)으로부터의 상기 교류 전력을 수수하기 위한 휴대형 장치(2)의 2차권선(5)이 페라이트 시트(8) 상부에 설치되어 있다.

고주파 AC/DC 정류기(15)는 상기 2차권선(5)을 통하여 수수한 고주파 교류 전력을 직류 전력으로 변환하여 휴대형 장치(2)내의 축전지(16)로 제공하는 역할을 한다.

충전제어회로(17)는 상기 축전지(16)의 충전상태를 나타내는 정보를 검출하여 [illegible]모드를 제어하기 위한 [illegible] 고주파 AC/DC 정류기(15)에 흐르는 전류와 축전지(16) 양단의 전압을 검출하고 전류모드 또는 전압모드 중 어느 하나로 제어할 것인지를 결정하여 제어신호를 만들어 출력한다.

RF 변조 및 송신회로(18)는 상기 충전제어회로(17)로부터 입력받은 충전상태를 무선 송출하기 위한 것으로, 입력 데이터를 무선신호로 변조하고 이렇게 변조된 신호를 3차권선(7)에 인가한다. 3차권선(7)은 페라이트 시트(8) 상의 일정 위치에 고주파 자계를 형성하도록 하기 위한 것이다.

RF 수신 및 복조회로(20)는 상기 3차권선(7)과 분리되어 있고, 3차권선에 의 해 형성된 상기 고주파 자계로부터 RF 신호를 수신하기 위한 4차권선(6)을 통하여 신호를 수신하고 복조한다.

PWM(Pulse Width Modulation) 제어회로(21)는 상기 RF 수신 및 복조회로(20)에서 복조된 신호를 입력 받고, 상기 프리볼트 DC/DC 컨버터(12)를 제어하기 위하여 펄스폭 변조된 신호를 만든다.

[illegible] 상기 프리볼트 DC/DC 컨버터(12)의 출력전압(Vs)의 크기를 나타내는 PWM 제어회

로(21)에 직접 귀환시켜 줌으로써 리플성분을 제거한다. 예컨대, 저주파 AC/DC 정류기(11)의 출력파형에서 저주파 교류 입력 전원 주파수가 60Hz라고 할 때 120Hz에 해당하는 리플성분이 주로 발생하는데, 보상회로(14)는 이 성분이 축전지(16)의 충전 전류에 영향을 주는 현상을 방지하기 위하여 이를 미리 제거하는 것이다.

도 3은 저주파 AC/DC 정류기(11)의 회로를 예시한 것이다. 이것은 기존에 많이 사용되는 회로로서 교류입력 전원이 네 개의 다이오드(D1-D4)를 통하여 정류되어 캐패시터(C1) 양단에 직류전원(Vdc)으로 변환된다.

도 4는 파워 MOSFET(Metal-Oxide-Semiconductor Field-Effect-Transistor: M1)을 사용하여 구현한 프리볼트 DC/DC 컨버터(12)의 구체적인 회로를 예시한 것이다. 이와 같은 회로 역시 기존에 많이 사용되는 구조로서, 플라이백(flyback) 컨버터라고 부르기도 한다. 플라이백 컨버터는 MOSFET(M1)이 도통할 때 변압기(22)의 1차(N11) 측에 Vdc가 인가되어 전류가 증가하면서 변압기(22)의 여자 인덕턴스 내에 에너지가 저장된다. MOSFET(M1)이 꺼지면 2차(N12) 측에서 전류가 다이오드 D6를 통하여 흐르고 캐퍼시터 C2의 전압은 상승한다. 이와 같은 방식으로, 1차 회로에서 여자 인덕턴스 내에 저장되는 에너지가 2차 회로로 방출되면서 C2 양단에 직류전압(Vs)을 발생시킨다. 직류전압(Vs)의 크기는 PWM 제어회로(21)에 의해서 MOSFET(M1)의 도통시간을 조절하여 제어가 가능하다.

도 5는 고주파 병렬공진형 인버터(13)의 구체적인 구조를 도시한 것이다. 이 회로의 역할은 상기 프리볼트 DC/DC 컨버터(12)의 직류출력 전압(Vs)을 받아서 고주파 교류 전력으로 변환하는 것이다. 병렬공진형 인버터는 두 개의 MOS 트랜지스터 M2, M3를 구비하고 있고, 이 두 트랜지스터에 분리형 변압기의 1차 측(4) 자화인덕턴스와 캐퍼시터(C3)로 구성된 L-C 공진회로가 연결되어 있다. 분리형 변압기의 1차권선(4)의 중앙점은 인덕터(L1)에 연결되며, 이 인덕터(L1)의 다른 단자는 프리볼트 DC/DC 컨버터(12)의 출력전압(Vs)에 연결된다.

병렬공진형 인버터(13)의 동작은 다음과 같다. 두 개의 트랜지스터 M1, M2는 교대로 온/오프되며, 전원측에 연결된 인덕터(L1)가 충분히 클 경우 구형파에 가까운 전류가 변압기의 1차권선(4)에 흐르게 한다. L-C 공진회로는 이와 같은 구형파 전류에 포함되어 있는 기본파 성분의 전압만 변압기 양단에 잘 나타나도록 한다. 따라서, 1차권선(4) 양단에 나타나는 전압파형은 정현파 형태가 되며 두 개의 트랜지스터 M1, M2의 스위칭이 공진주기와 일치하여 일어나도록 하면 스위칭 손실이 극소화되고 스위칭 주파수를 크게 높일 수 있다. 현존하는 파워 MOS 스위치의 동작 주파수를 고려할 때, 이 동작 주파수는 대략 수백 kHz 이상 수 MHz의 범위가 적당하다고 할 수 있다.

이 병렬공진형 인버터(13)가 만일 바이폴라 트랜지스터로 구성되어 있다면, 분리형 변압기의 보조권선(10)에 의해 자려식으로 동작할 수 있다. 그러나, 본 발명에서와 같이 MOS 트랜지스터를 사용하여 구현하고자 하는 경우에는 자려식 동작이 잘 되지 않는다. 그 이유는 첫째, 이와 같은 병렬 공진형 인버터에서는 1차권선(4) 양단에 매우 높은 전압이 나타나는데 MOS 트랜지스터는 바이폴라 트랜지스터에 비해서 고압에 약한 단점이 있다. 둘째, MOS 트랜지스터는 게이트 소스간의 임계전압이 높기 때문에 보조권선(10) 양단에 나타나는 전압파형 만으로는 쉽게 구동하기가 어렵다는 단점이 있기 때문이다. 이상의 이유로 병렬공진형 인버터에서는 바이폴라 트랜지스터를 주로 사용하여 왔다고 할 수 있다.

본 발명의 특징 중 하나는 병렬공진형 인버터에 MOS 트랜지스터를 사용하여 동작 가능하도록 구현한 것이며, 그렇게 한 이유는 다음과 같다. 첫째는, 본 발명에서 구현하고자 하는 전력이 수W 정도에 불과하므로 전달하고자 하는 전력이 크지 않기 때문에 MOS 트랜지스터가 적당하기 때문이다. 둘째는, 프리볼트 DC/DC 컨버터(12)를 앞에 두는 방식을 채택함으로써 교류입력전원의 변화에도 불구하고 일정한 직류출력전압(Vs)을 얻을 수 있을 뿐아니라, 직류전압(Vs)을 낮게 제어함으로써 MOS 트랜지스터(M1, M2)의 내압범위에서 동작가능하도록 제어가 가능하다는 점 때문이다. 마지막으로 가장 중요한 이유는, MOS 트랜지스터가 바이폴라 트랜지스터에 비해서 스위칭 속도가 빠르기 때문에 더욱 높은 고주파에서 동작시키는 것이 가 능하다는 점이다. 즉 수MHz에서 동작하도록 하는데는 MOS 트랜지스터가 유리한데, 공간적으로 분리되어 있는 휴대형기기에 무게와 부피가 작으면서 고밀도로 에너지를 전달하기 위해서는 고주파 자계의 주파수가 높을수록 효과적이기 때문이다.

그러나, MOS 트랜지스터를 사용한 회로가 자려식으로 동작하기 위해서는 보조권선(10)과 연계시킨 별도의 게이트 증폭기(A1, A2)가 추가로 필요하게 된다. 여기에서 게이트 증폭기의 역할은 크게 두가지이다. 하나는, 1차권선(4)에서 발생되는 전압파형이 정현파 형태이기 때문에 보조권선(10)에서 나타나는 신호 또한 정현파의 형태인데, 이것이 그대로 MOS 트랜지스터의 게이트에 인가되는 경우에는 MOS의 도통과 차단 상태를 결정하는 게이트의 경계전압인 문턱 전압이 높아서 회로가 잘 동작하지 않는다. 따라서, 이 회로에서 게이트 증폭기의 역할은 정현파 구형 파로 바꾸어줌으로써 MOS 트랜지스터의 온/오프 상태를 빠른 속도로 변화시키면서 확실하게 스위칭하여 주는 것이다. 두 번째는 정상동작시 MOS 트랜지스터의 게이트에 인가되는 최대전압이 게이트가 견딜 수 있는 최대정격 이하에서 안전한 동작이 이루어지도록 하기 위하여 적절한 값으로 인가해 주는 역할을 하는 것이다.

도 6은 도 5의 병렬공진형 인버터에서 사용될 수 있는 게이트 증폭기(A1, A2)의 구조를 예시한 것으로서, 기존에 상용화되어 있는 고속의 아날로그 비교기 칩을 사용해서도 구현이 가능하지만, 여기에서는 바이폴라 트랜지스터를 사용하여 구성한 형태를 한가지 예시한 것이다. 트랜지스터 Q1이 증폭을 담당하며, Q2 및 Q3는 전류 증폭을 위한 출력

트랜지스터이다. 분리형 변압기의 보조권선(10)과 트랜지스터 Q1의 베이스 사이에는 두 개의 저항(R2, R3)을 직렬로 연결하고, 그 중간 은 다이오드(D7)가 접지와의 사이에 연결되며, 저항 R2 양단에는 하나의 캐패시터(C4)가 병렬로 연결되어 있다. 또한, 보조권선(10)의 중앙점은 저항(R1)을 통하여 제어회로의 전원(Vcc)에 연결되어 있다. 따라서, 초기에는 Vcc 로부터 저항 R1, R2, R3 및 Q1의 베이스로 형성되는 경로를 통해서 흐르는 전류에 의하여 병렬공진회로의 충전이 시작되면서 자려발진이 시동된다. 정상상태의 스위칭 동작에서는 C4의 역할에 의해서 Q1의 턴온 또는 턴오프가 빠른 속도로 가능하게 되므로 고주파 동작이 가능하게 된다.

도 7a 내지 7c는 휴대형 장치 측 분리형 변압기의 2차권선(5)에 연결하여 설치한 고주파 AC/DC 정류기(15)의 세가지 구조를 예시한 것이다. 이 회로들 역시 본 발명의 특징적인 회로들로서, 도 7a는 분리형 변압기의 2차권선(5)의 중앙점을 이용하여 다이오드(D8, D9) 두 개를 사용하여 전파정류한 구조이고, 도 7b는 중앙점이 없는 2차권선(5)을 사용하되, 네 개의 다이오드(D81, D82, D91, D92)를 사용하여 전파정류한 구조를 보인 것이다. 한편, 도 7c는 앞의 두 구조와는 약간 다른 형태로서 두 개의 다이오드(D81, D91)와 두 개의 캐패시터(C61, C62)를 사용하여 출력전압파형을 전파정류한 형태로 얻으면서 동시에 2배로 상승시켜 배압 정류한 구조이다.

상술한 바와 같은 전파정류 또는 배압정류 회로의 구조는 이미 기존에 잘 알려진 방식이나, 본 발명에서는 수동소자로 구성된 형태를 사용함에 그 특징이 있다. 즉, 2차권선(5)의 양단간에 연결한 R5 및 C5를 포함하여 직류로 변환된 뒤에 연결된 필터로서 C6(또는 C61, C62)와 L2로 형성된 필터부의 구성에 본 발명의 특징이 있다. 이러한 구성을 고주파 병렬공진형 인버터부(13)와 연계하여 동작할 때 그 특징이 나타난다. 일반적인 필터의 구성은 다이오드 정류부 바로 다음에 인덕터가 연결되고 그 다음에 캐패시터가 연결되는 것이 보통이나, 본 발명에서 이렇게 순서를 서로 바꾸어 놓은 이유는 이렇게 함으로써 고주파 병렬공진형 인버터부(13)와 연계하여 동작할 때 C6(또는 C61, C62)양단의 전압이 기존의 구조를 채택하는 경우에 비해서 훨씬 낮아지게 되며, 캐패시턴스의 크기 또한 작아지면서 인덕터(L2)에 흐르는 전류의 리플을 더욱 작게 하는데 효과적이기 때문이다. 캐패시터 C6(또는 C61, C62) 양단의 전압이 낮아지는 것은 고주파 병렬공진형 인버터(13) 측에서도 1차권선(4) 양단간의 전압을 낮아지게 하는 효과가 있으며, 이것은 또 MOS 스위치(M2, M3) 양단의 최대 전압 스트레스를 낮추어 주는 효과가 있게 된다.

또한, 도 7a 내지 7c에서 2차권선(5) 양단에 연결한 R5와 C5는 정류다이오드들이 온 상태에서 오프 상태로 변화하는 순간 역회복전류가 흐르면서 차단되게 되는데, 이와 연계하여 발생할 수 있는 고압 스파이크 전압을 줄이면서 동시에 다이오드들의 턴오프 손실을 줄여주기위한 스너버 작용을 담당하는 역할을 한다. 마지막으로 배압정류 회로에 있어서의 캐패시터(C61, C62) 역할은 출력의 직류전압을 두배로 한다는 점이 상이하지만, 나머지의 역할은 C6의 그것과 동일하다. 이와 같은 배압정류회로를 채택한다면 2차권선(5)의 권수를 최소화 할 수 있다는 장점이 있다.

도 7a 내지 7c에서 마지막으로 언급할 사안은 인덕터(L2)의 구조에 대한 것이다. 즉 인덕터(L2)의 인덕턴스는 필터의 역할을 수행해야 하기 때문에 상당히 큰 값의 인덕턴스가 요구된다. 그러나 이 인덕터(L2)에는 충전전류가 흐르기 때문에 큰 충전전류가 흐르는 상황에서도 포화상태에 빠져서는 안 된다. 공진회로를 구현함에 있어서 이러한 조건을 만족하는 인덕터(L2)를 별도로 개별소자를 사용하여 구현하고자 한다면 크기가 커지는 문제로 인하여 휴대기기의 경박단소화를 추구함에 있어서 큰 장애요소가 된다. 따라서, 본 발명에서는 도 1b에 예시한 바와 같이, 인덕터(L2)를 분리형변압기의 2차권선(5)과 동일한 평면상에서 일정한 거리를 두고 분리시킨 형태로 평면형으로 구현함으로써 상기 문제를 해결하였다. 이와 같은 방식으로 구현함으로써 충전을 위한 큰 직류전류가 흐르는 상황에서도 인덕터(L2)가 포화되지 않으므로 상당한 크기의 인덕턴스를 유지하는 것이 가능하게 되며 필터로서의 역할을 훌륭하게 수행할 수 있게 된다.

도 8은 충전제어회로(17)를 상세히 도시한 것으로서, 기존의 축전지를 충전하는 회로에서 일반적으로 사용되는 개념을 구현한 것이라고 할 수 있다.

즉, 축전지의 전압(Vbb)이 기준전압(Vr) 보다 낮은 상태라면 전압비교기(31)의 출력은 'high' 상태에 있게 되며, 따라서 게이트(33)의 출력신호(Vf)는 전류비교기(32)의 출력을 그대로 따라가게 된다. 이런 경우에는 전류비교기(32)의 역할에 의하여 정전류원 형태로 충전되며, 충전전류(Ibb)는 기준전류원(Ir)의 값으로 일정하게 제어된다.

한편, 축전지의 전압(Vbb)이 상승하여 기준전압(Vr) 보다 높아지려고 하면 전압비교기(31)의 역할이 나타나면서 정전압원의 형태로 충전모드가 바뀌게 된다. 이 때에는 충전전류(Ibb)의 크기가 기준전류원(Ir)의 값보다 작아지게 되며 전류비교기(32)의 출력이 'high' 상태에 머물러 있게 되므로, 이 경우의 게이트(33) 출력신호(Vf)는 전압비교기(31)의 출력을 그대로 따라가게 된다.

도 9는 RF 변조 및 송신회로(18)를 예시한 것으로서, 충전제어회로(17)의 출력신호(Vf)에 따라서 RF발생기(36)의 고주파신호를 변조하여 버퍼(35)에 보내주기위한 게이트(34)가 연결되어 있다. 버퍼(35)의 출력은 휴대형 장치(2)의 페라이트 시트(8) 상에 설치된 3차권선(7)에 인가된다.

도 10은 RF 수신 및 복조회로부(20)를 예시한 것으로서, 본 도면 또한 페라이트(9) 상에 설치되어 있는 4차권선(6)

을 통하여 RF신호를 수신하고 복조하여, 최종출력신호(Vp)는 충전제어회로(17)에서 보내준 제어신호(Vf)를 복원한 것이 되도록 한다. 여기에서 신호처리를 위한 회로는 고역필터(HPF)와 피크검출기(PD) 및 비교기(36)로 구성되며 각각의 동작은 다음과 같다. 먼저 고역필터(HPF)가 필요한 이유는 4차권선(6)을 통하여 수신한 RF신호에는 저주파 대역의 잡음이 포함되어 있는데, 특히 고주파 병렬공진형 인버터(13)로부터 스위칭 주파수가 큰 값으로 수신되게 되므로 이 성분을 제거하기 위해서 필요하게 된다. 즉, 인버터(13)가 고주파로 동작한다고 하더라도 RF신호에 비해서는 저주파에 해당되므로, RF신호를 분리수신하기 위해서는 고역필터가 필요한 것이다. 이렇게 한 다음에 피크검출기(PD)와 비교기(36)를 거치면 출력(Vp)에서는 충전제어회로(17)의 제어신호(Vf)를 복원할 수 있게 된다.

도 11a 및 11b는 각각 PWM(Pulse Width Modulation) 제어회로(21)의 블록도와 회로도를 예시한 것이며, 상기 RF 수신 및 복조회로(20)로부터 복조된 신호(Vp)를 받아서 프리볼트 DC/DC 컨버터(12)를 제어하기 위한 펄스폭 변조(PWM)된 신호를 만들어 낸다. 이 회로는 적분기(41), 삼각파발생기(42), 비교기(43)로 이루어져 있다. 적분기(41)에서는 복조신호(Vp)를 받아서 적분하는 역할을 하며 적분기(41)의 출력은 비교기(43)에서 삼각파발생기(42)의 출력과 비교되어 PWM 신호를 발생시킨다. 이렇게 하여 발생된 PWM 신호는 프리볼트 DC/DC 컨버터(12)의 MOSFET(M1) 게이트에 인가되어 직류출력전압(Vs)을 제어하게 된다.

발명의 효과

본 발명에 따른 비접촉식 충전 시스템은, 충전 장치의 소형경량화를 위하여 유도결합을 이루는 분리형 변압기의 2차측을 평면상에 구성하여 휴대형 장치의 축전지에 장착하기 쉽게 하였고, 축전지의 충전상태를 무선으로 충전 모체에 전달하여 제어될 수 있도록 하였다. 따라서, 본 발명에 따른 충전 시스템은 앞으로 더욱 더 소형화, 경량화될 휴대폰, MP3 플레이어 등과 같은 휴대형 장치에 대하여 편리성과, 안전성 그리고 미관의 수려함을 위한 디자인의 다양성을 제공하는 효과가 크다고 할 수 있다.

(57) 청구의 범위

청구항 1.
유도 결합 방식을 사용하여 충전 모체로부터 휴대형 장치에 장착된 축전지를 충전하는 비접촉식 충전 시스템에 있어서,

상기 충전 모체는, 저주파 교류전압을 입력 받아 직류전압으로 변환하여 출력하는 저주파 AC/DC 정류기;

상기 직류전압의 크기에 관계없이 일정한 직류전압을 만들어 출력하는 프리볼트 DC/DC 컨버터;

상기 일정한 직류전압을 받아 고주파 교류전력으로 변환하여 출력하는 고주파 병렬공진형 인버터;

상기 고주파 병렬공진형 인버터에 연결되는 페라이트 코어; 및

상기 페라이트 코어의 중앙돌출부와 외곽돌출부 사이에 설치되고, 상기 고주파 교류전력을 받아 유도 결합을 통해 상기 휴대형 장치 측으로 전달하는 1차권선을 구비하고,

상기 휴대형 장치는, 얇은 페라이트 시트;

상기 1차권선으로부터 상기 교류전력을 수수하기 위하여 상기 1차권선에 대향하도록 상기 페라이트 시트 상에 설치되는 얇은 박막형의 2차권선; 및

상기 2차권선이 수수한 교류전력을 직류전력으로 변환하여 축전지에 제공하는 고주파 AC/DC 정류기를 구비하는 것을 특징으로 하는 비접촉식 충전 시스템.

청구항 2.
제 1 항에 있어서,

상기 휴대형 장치는, 상기 축전지의 충전상태를 검사하여 제어신호를 생성하고 출력하는 충전제어회로; 및

상기 제어신호를 받아 RF 신호로 변조하여 무선 송출하는 RF 변조 및 송신회로를 더 구비하고,

상기 충전 모체는, 상기 RF 신호를 수신하고 복조하여 상기 제어신호를 검출하고 출력하는 RF 수신 및 복조회로; 및

상기 제어신호를 받아 펄스폭 변조 신호를 만들어 상기 프리볼트 DC/DC 컨버터에 인가함으로써 직류전압을 조정하도록 하는 PWM 제어회로를 더 구비하는 것을 특징으로 하는 비접촉식 충전 시스템.

청구항 3.
제 2 항에 있어서,

상기 휴대형 장치는, 상기 페라이트 시트 상에 상기 2차권선과 일정한 거리를 두고 설치되고 상기 RF 변조 및 송신회로에 연결되어 상기 RF 신호에 의해 고주파 자계를 형성하는 3차권선;을 더 구비하고,

상기 충전 모체는, 상기 3차권선에 대향하는 위치에 설치되고 상기 RF 수신 및 복조회로에 연결되어 상기 고주파 자계를 무선으로 수신하여 상기 RF 수신 및 복조회로에 전달하는 4차권선;을 더 구비하는 것을 특징으로 하는 비접촉식 충전 시스템.

청구항 4.
제 2 항에 있어서,

상기 충전 모체는 상기 프리볼트 DC/DC 컨버터의 출력전압으로부터 리플성분을 검출하여 상기 PWM 제어회로에 귀환시키는 보상회로를 더 구비하는 것을 특징으로 하는 비접촉식 충전 시스템.

청구항 5.
제 2 항에 있어서,

상기 RF 수신 및 복조회로는, 상기 RF 신호에서 제어신호를 복조하기 전에 상기 RF 신호와 함께 입력된 상기 고주파 병렬공진형 인버터의 구동 주파수 성분을 제거하는 고역필터를 구비하는 것을 특징으로 하는 비접촉식 충전 시스템.

청구항 6.
제 1 항 또는 제 2 항에 있어서,

상기 고주파 병렬공진형 인버터는 인덕터(L1); 캐패시터(C3); 두 개의 MOS 트랜지스터(M2, M3); 및 두 개의 게이트 증폭기(A1, A2);를 구비하고,

상기 1차권선의 세 단자 중 중간단자에는 상기 인덕터를 통하여 직류전원(Vs)이 연결되고, 상기 1차권선의 양끝단자에는 공진을 형성하기 위한 상기 캐패시터와 상기 두 MOS 트랜지스터의 드레인(Drain)이 연결되며,

상기 두 MOS 트랜지스터의 소스는 접지되며,

상기 두 게이트증폭기는 각각 상기 1차권선의 주권선과 보조권선으로부터 수신된 신호를 증폭하여 인가하도록, 상기 두 MOS 트랜지스터의 게이트에 각각 연결되는 것을 특징으로 하는 비접촉식 충전 시스템.

청구항 7.
제 6 항에 있어서,

상기 게이트증폭기는 상기 보조권선에서 발생하는 정현파 형태의 전압파형을 구형파 형태로 바꾸어 주는 것을 특징으로 하는 비접촉식 충전 시스템.

청구항 8.
제 1 항에 있어서,

상기 2차권선은 중앙점이 있으며, 상기 고주파 AC/DC 정류기는 상기 중앙점을 이용함으로써 두 개의 다이오드(D8, D9)를 사용하여 전파정류하는 것을 특징으로 하는 비접촉식 충전 시스템.

청구항 9.
제 1 항에 있어서,

상기 2차권선은 중앙점이 없으며, 상기 고주파 AC/DC 정류기는 네 개의 다이오드(D81, D82, D91, D92)를 사용하여 전파정류하는 것을 특징으로 하는 비접촉식 충전 시스템.

청구항 10.
제 8 항 또는 제 9 항에 있어서,

상기 고주파 AC/DC 정류기는 상기 다이오드의 정류부 뒤에 연결되는 캐패시터(C6)와 상기 캐패시터 뒤에 연결되는 인덕터(L2)로 구성된 필터를 더 구비하는 것을 특징으로 하는 비접촉식 충전 시스템.

청구항 11.
제 10 항에 있어서,

상기 인덕터(L2)는 상기 2차권선과 동일한 평면상에서 일정한 거리를 두고 분리시킨 형태의 평면형 구조인 것을 특징으로 하는 비접촉식 충전 시스템.

청구항 12.
제 8 항 또는 제 9 항에 있어서,

[illegible]

청구항 13.
제 1 항에 있어서,

상기 고주파 AC/DC 정류기는 두 개의 다이오드(D81,D91)와 두 개의 캐패시터(C61,C62)를 구비하여, 출력전압파형을 전파정류한 형태를 얻음과 동시에 2배로 상승시켜 배압정류하는 것을 특징으로 하는 비접촉식 충전 시스템.

청구항 14.
제 13 항에 있어서,

상기 고주파 AC/DC 정류기는 상기 다이오드의 정류부 뒤에 연결되는 두 개의 캐패시터(C61,C62)와 상기 캐패시터 뒤에 연결되는 인덕터(L2)로 구성된 필터를 더 구비하는 것을 특징으로 하는 비접촉식 충전 시스템.

청구항 15.
제 14 항에 있어서,

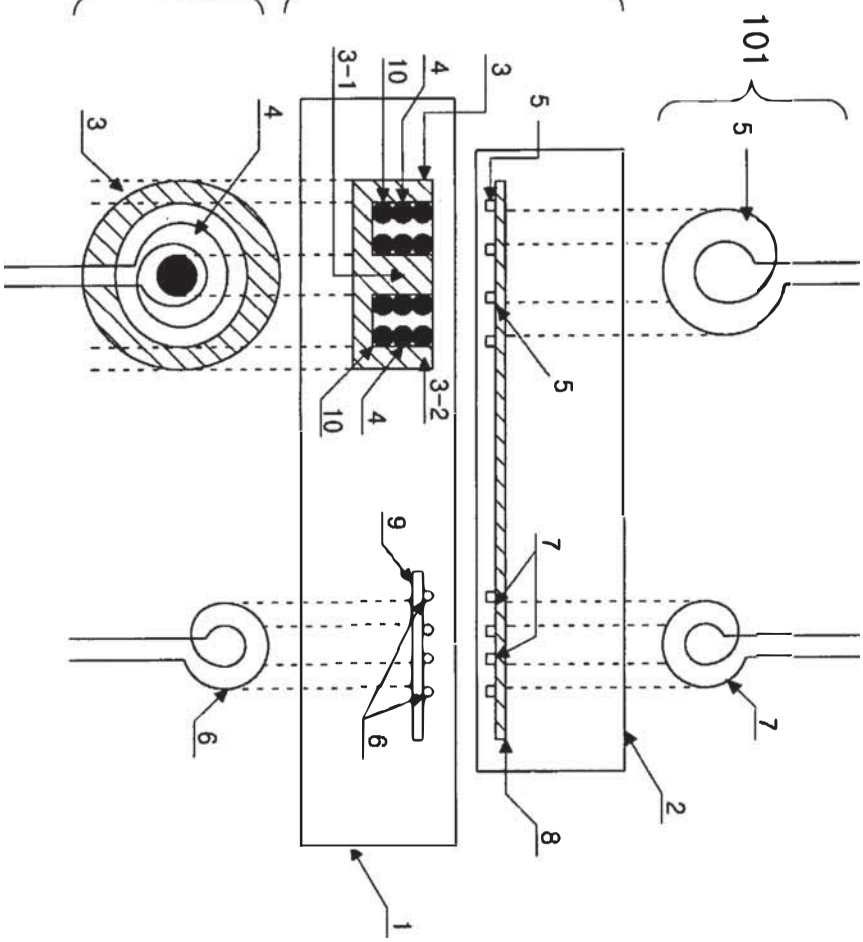
상기 인덕터(L2)는 상기 2차권선과 동일한 평면상에서 일정한 거리를 두고 분리시킨 형태의 평면형 구조인 것을 특징으로 하는 비접촉식 충전 시스템.

청구항 16.
제 15 항에 있어서,

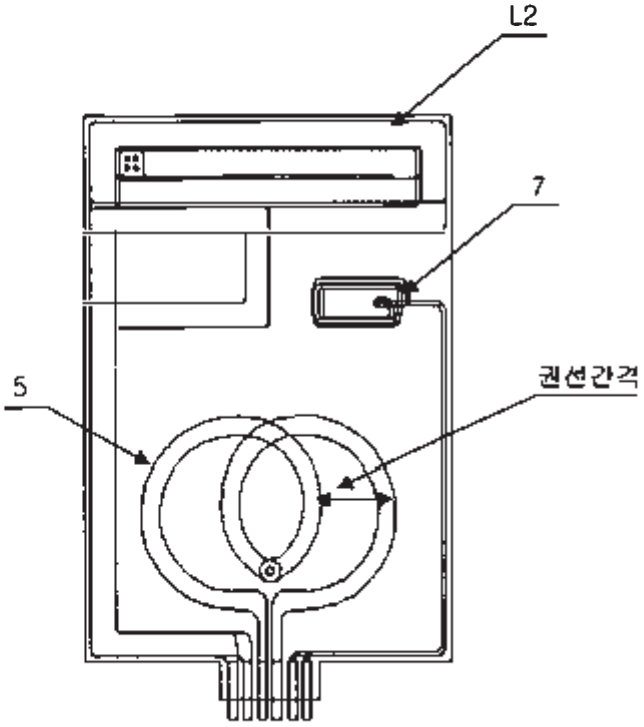
상기 고주파 AC/DC 정류기는 직렬로 연결된 저항(R5)과 캐패시터(C5)를 더 구비하는 것을 특징으로 하는 비접촉식 충전 시스템.

도면

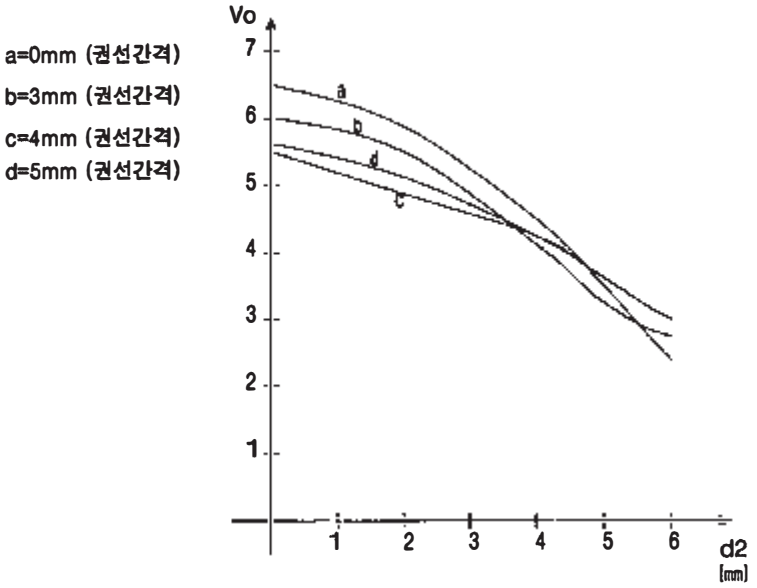
도면1a



도면1b

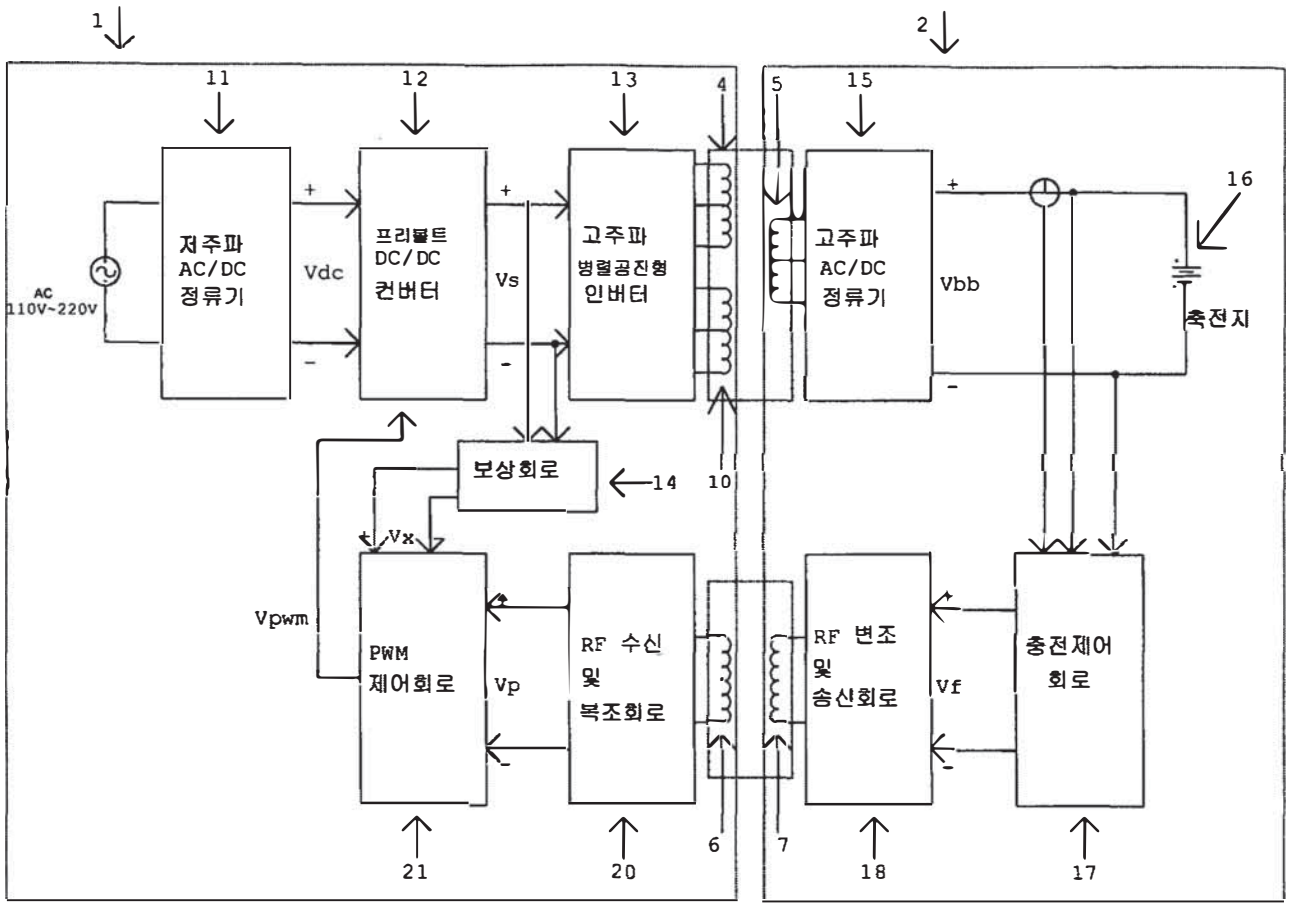


도면1c

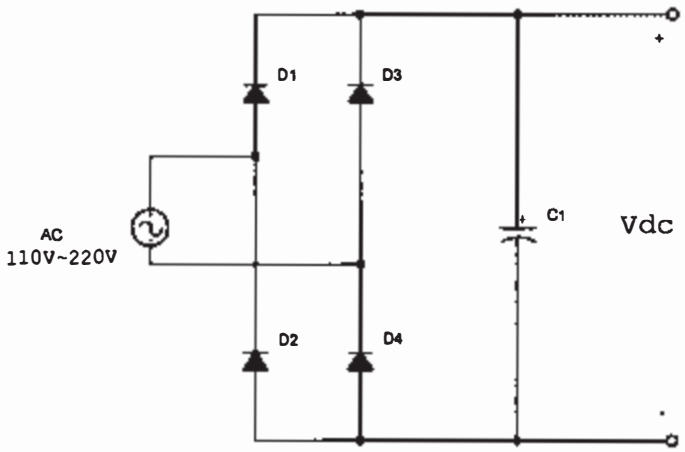


d2= (오차간격)

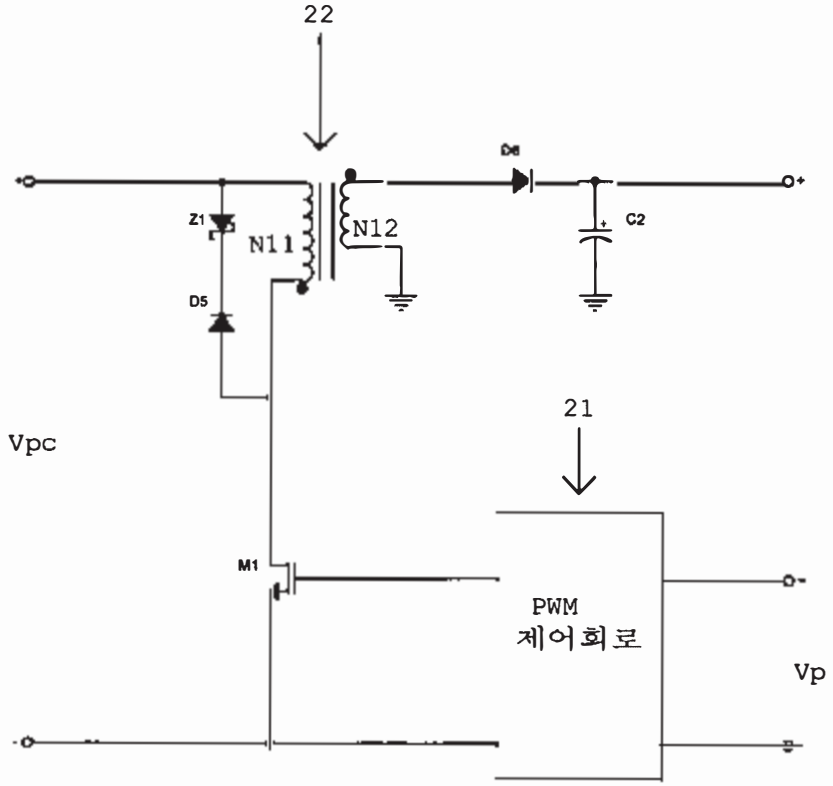
도면2



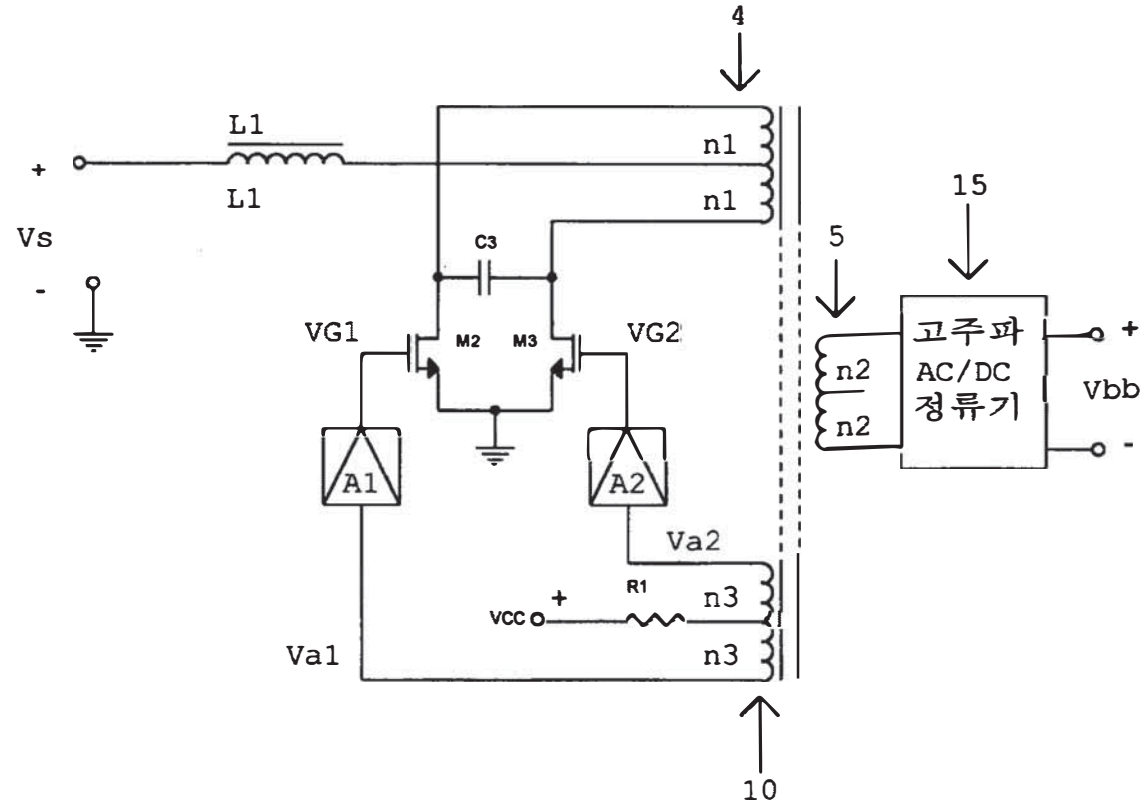
도면3



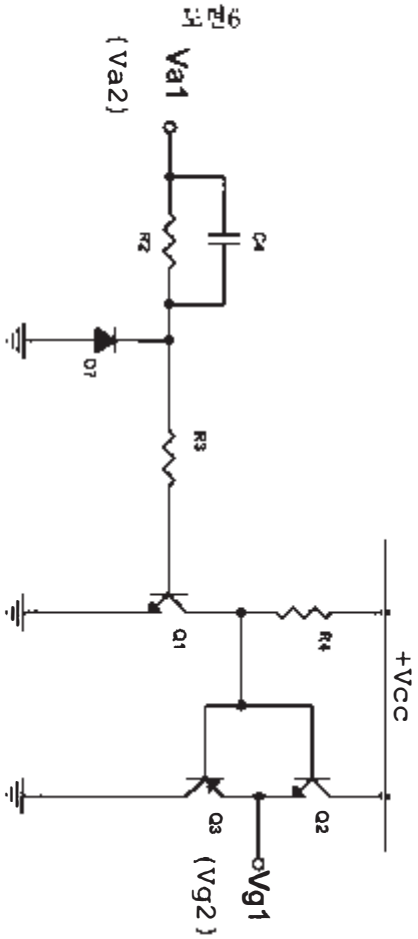
도면4



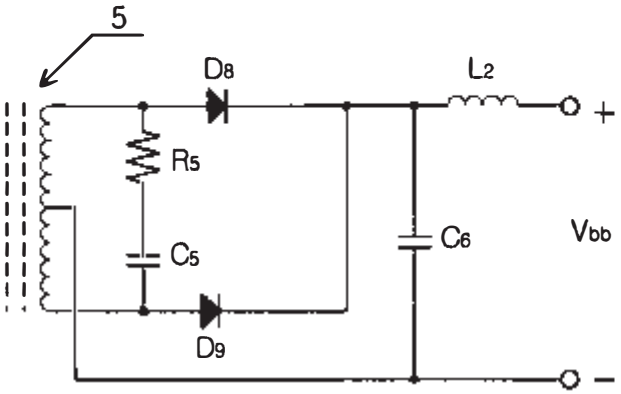
도면5



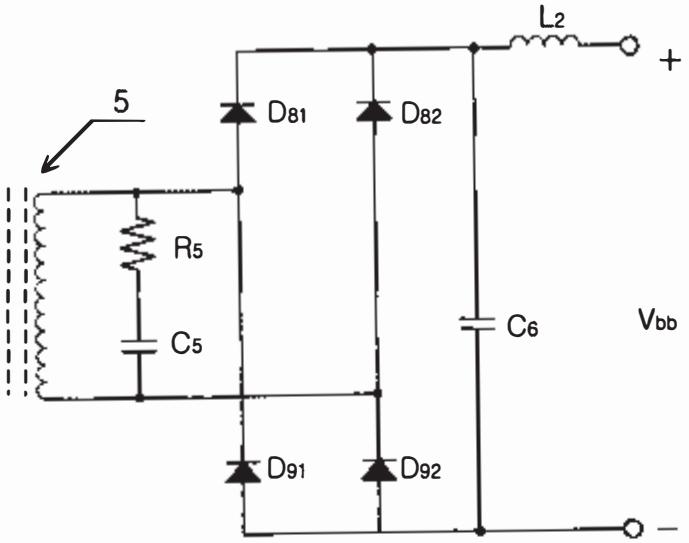
도면6



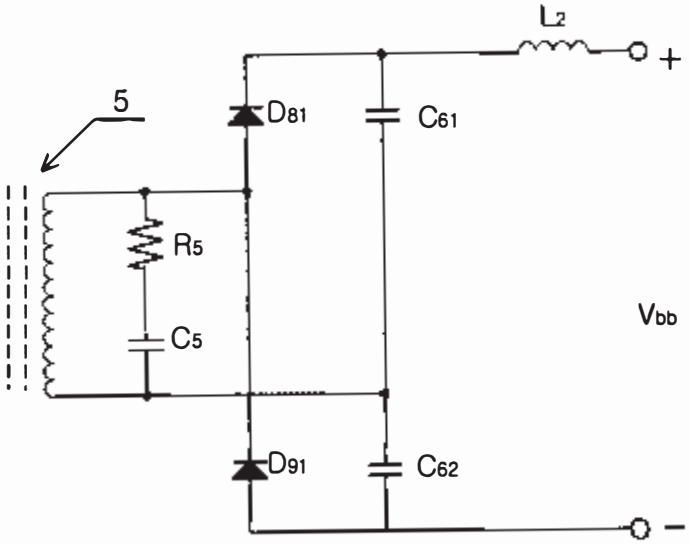
도면7a



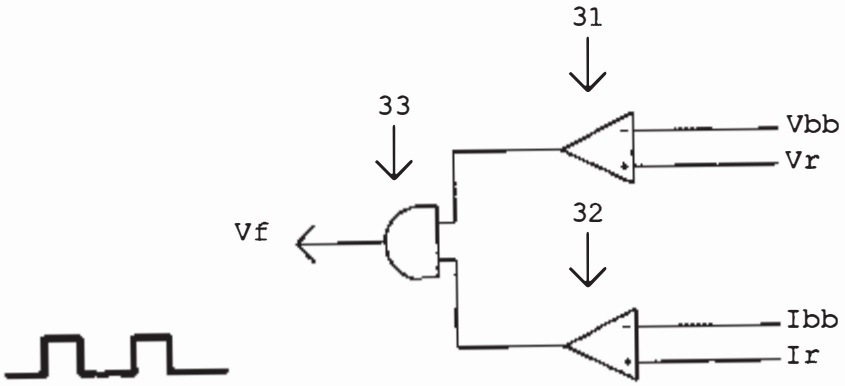
도면7b



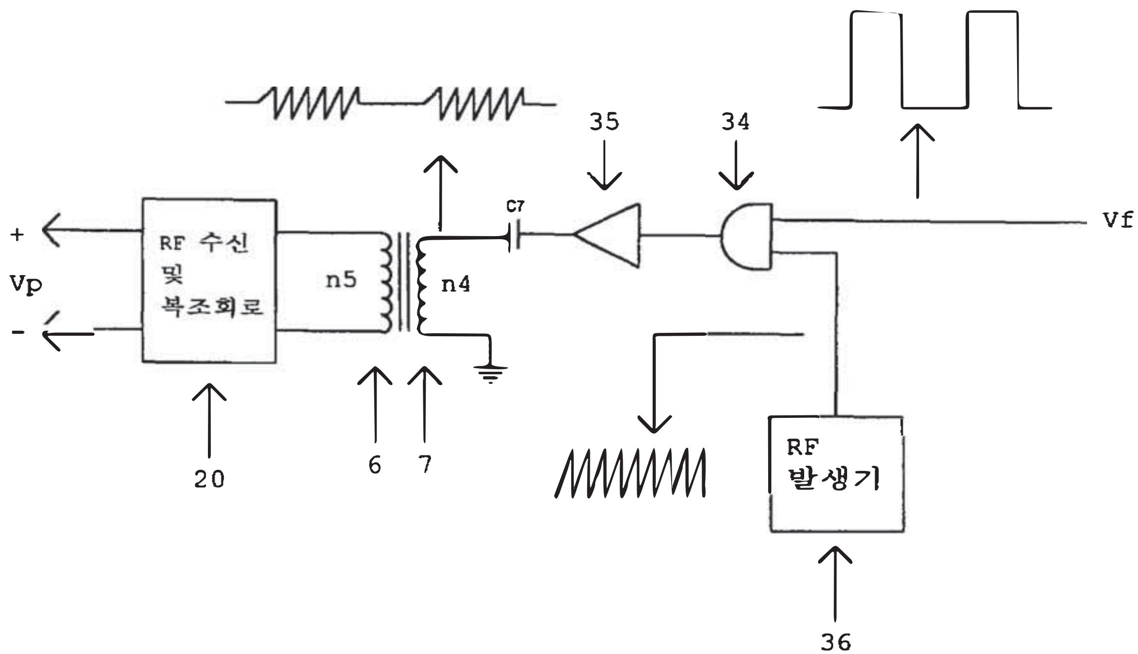
도면7c



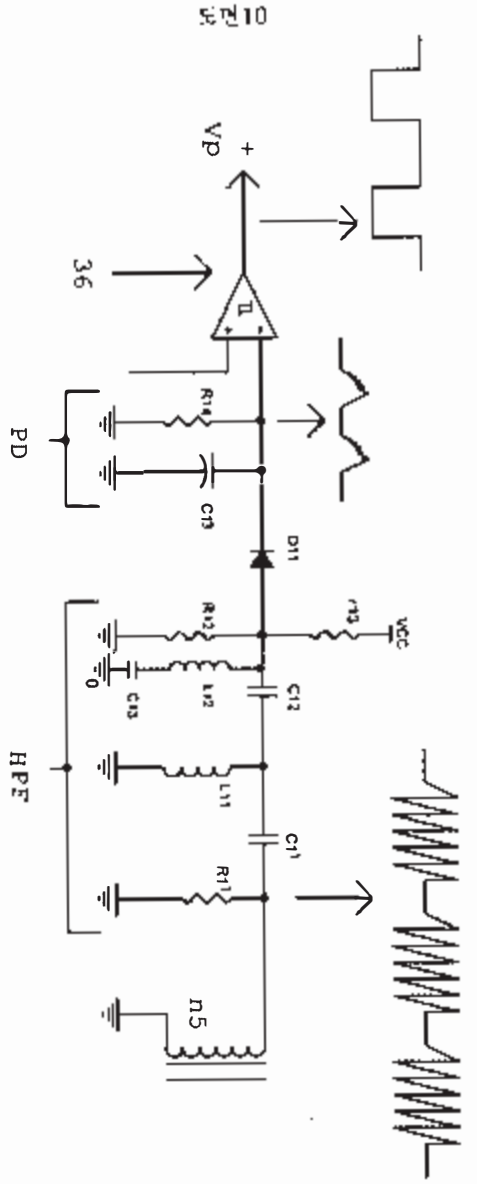
도면8



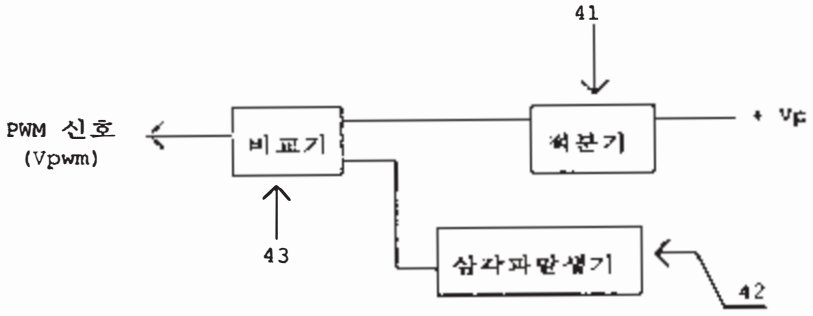
도면9



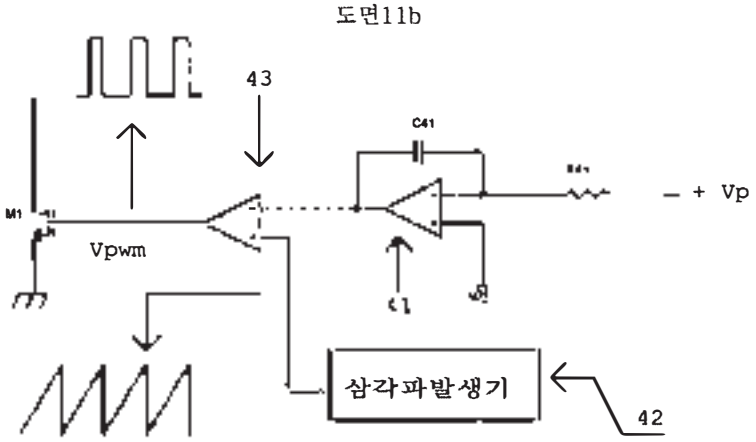
도면10



도면11a



도면11b



Bibliographic Data

Int.Cl.	H02J 7/00
Published Date	20041008
Registration No.	1004516060000
Registration Date	20040923
Application No.	1020020059462
Application Date	20020930
Unexamined Publication No.	1020040028312
Unexamined Publication Date	20040403
Requested Date of Examination	20020930
Agent.	LEE, Won Hee
Inventor	CHO,GyuHyeong | LEE,MinChul
Rightholder	GwonRi ByeonDong ItEum

발명의 명칭

유도 결합에 의한 비접촉식 충전 시스템

Title of Invention

The contactless battery charging system by the inductance coupling.

요약

본 발명은 고주파 자계를 발생시켜 유도 결합을 통하여 휴대형 장치의 축전지를 충전하기 위한 시스템에 관한 것으로, 유도 결합을 위한 고주파 변압기의 1차 측은 동심원 형태의 페라이트 코어를 사용하여 권선을 감아서 구성하고, 2차 측은 1차측과는 일정한 간극을 사이에 두고 얇고 편평한 페라이트 시트 상에 역시 얇은 평면형으로 권선을 설치해서 구성하여 휴대폰과 같이 부피와 무게가 작고 가벼운 장치에 설치가 용이하도록 하였으며, 충전을 위한 에너지는 1차측으로부터 2차측으로 전기적 접촉정이 없이 전자 유도결합에 의해 비접촉 방식에 의하여 전달된다. 또한, 축전지의 충전상태는 2차 측으로부터 1차 측으로 무선으로 전달하는 방식을 사용하되 역시 평면형의 1차 및 2차 권선을 각각 감아서 서로 약간의 간극을 사이에 두고 대향시켜 배치함으로써 송신과 수신이 이루어지도록 하였다.

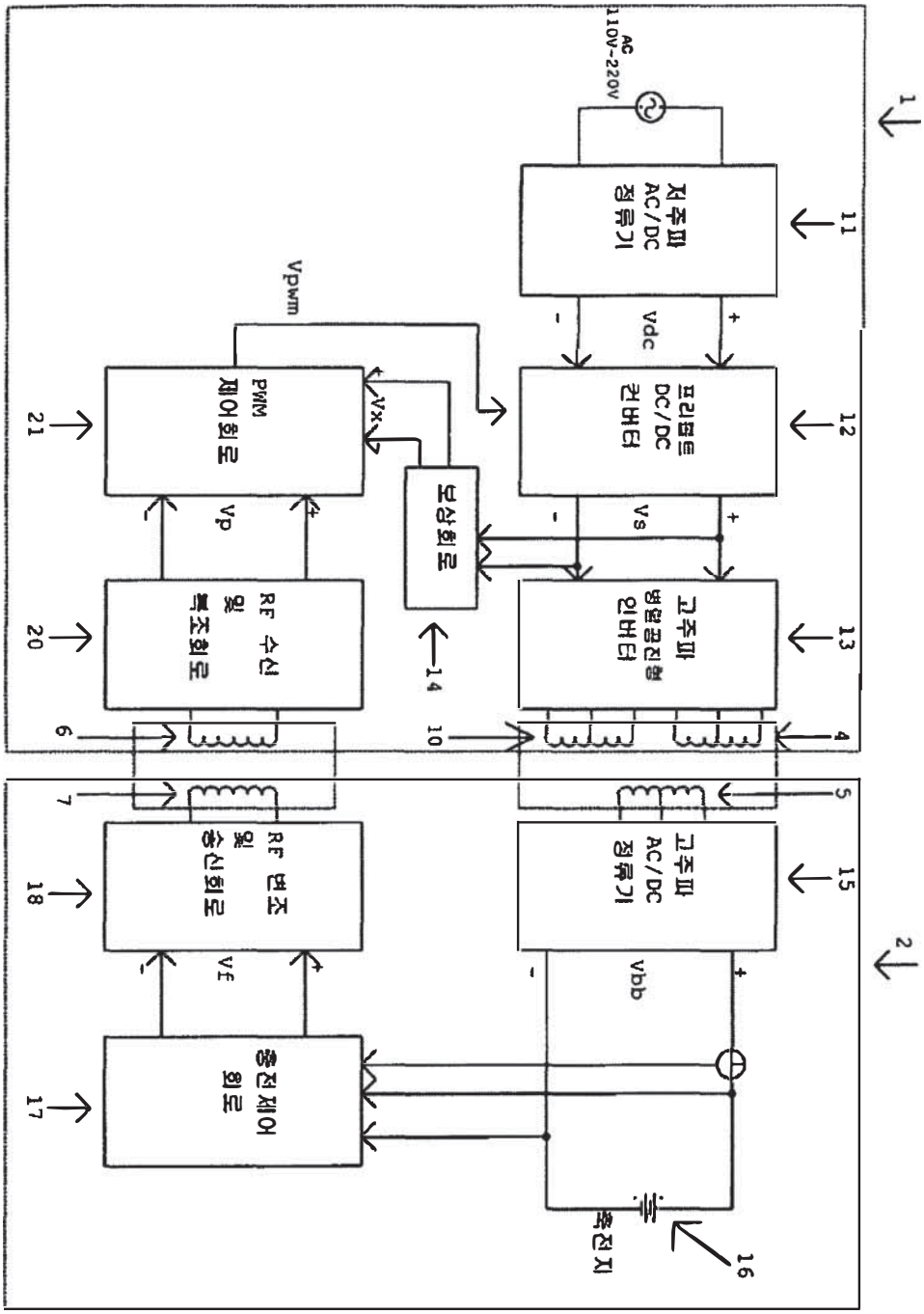
충전기, 유도 결합, 비접촉식, 고주파 병렬공진형 인버터, 무선통신

Abstract

The invention relates to the system for generating the high-frequency magnetic field and charging the storage battery of the hand-held device with electricity through the inductance coupling. And it is delivered by without the energy for the charge is the secondary side from the primary side the electrical contact point the primary side of the high-frequency transformer for the inductance coupling wound the coil using the ferrite core of the concentric and it organized electromagnetic induction bond with the non-contact way. Moreover, since the mode which the state of charge of the storage battery wirelessly delivered from the secondary side to the primary side was used and also the first and the secondary winding of the flat type were wound and the some gap was placed in the interval and it faced and it arranged the transmission and reception were comprised.

The battery charger, the inductance coupling, the contactless, the high frequency parallel resonant inverter, the wireless telecommunication .

대표도면(Representative drawing)



청구의 범위

청구 1항:

유도 결합 방식을 사용하여 충전 모체로부터 휴대형 장치에 장착된 축전지를 충전하는 비접촉식 충전 시스템에 있어서,상기 충전 모체는, 저주파 교류전압을 입력 받아 직류전압으로 변환하여 출력하는 저주파 AC/DC 정류기;상기 직류전압의 크기에 관계없이 일정한 직류전압을 만들어 출력하는 프리볼트 DC/DC 컨버터;상기 일정한 직류전압을 받아 고주파 교류전력으로 변환하여 출력하는 고주파 병렬공진형 인버터;상기 고주파 병렬공진형 인버터에 연결되는 페라이트 코어; 및상기 페라

Scope of Claims

Claim 1:

The contactless battery charging system including the low frequency AC / DC rectifier in which the low frequency AC voltage is input to the charge parent and which converts into the DC voltage as to the contactless battery charging system charging the storage battery mounted on the hand-held device from the charge parent using the inductively coupled method and outputted; the free voltage DC/DC

이트 코어의 중앙돌출부와 외곽돌출부 사이에 설치되고, 상기 고주파 교류전력을 받아 유도 결합을 통해 상기 휴대형 장치 측으로 전달하는 1차권선;을 구비하고,상기 휴대형 장치는, 얇은 페라이트 시트; 상기 1차권선으로부터 상기 교류전력을 수수하기 위하여 상기 1차권선에 대향하도록 상기 페라이트 시트 상에 설치되는 얇은 박막형의 2차권선; 및상기 2차권선이 수수한 교류전력을 직류전력으로 변환하여 축전지에 제공하는 고주파 AC/DC 정류기;를 구비하는 것을 특징으로 하는 비접촉식 충전 시스템.

converter which makes the DC voltage fixed regardless of the size of the DC voltage and outputted; the high frequency parallel resonant inverter receiving the fixed DC voltage as described above and converts into the high frequency alternating current electricity and outputs; the ferrite core connected to the high frequency parallel resonant inverter; and the thin secondary winding: which is installed on the ferrite sheet it is faced with the AC power from the primary winding in the primary winding it is unpretending and the high frequency AC / DC rectifier which converts the AC power which the secondary winding is ordinary looking into the DC power and provided to the storage battery of the ferrite sheet: thin film type in which the hand-held device is thin it includes the primary winding which it delivers to the hand-held device through the inductance coupling it receives the high frequency alternating current electricity it is installed between the central projecting part and outside protrusion part of the ferrite core.

청구 3항:

제 2 항에 있어서,상기 휴대형 장치는, 상기 페라이트 시트 상에 상기 2차권선과 일정한 거리를 두고 설치되고 상기 RF 변조 및 송신회로에 연결되어 상기 RF 신호에 의해 고주파 자계를 형성하는 3차권선;을 더 구비하고,상기 충전 모체는, 상기 3차권선에 대향하는 위치에 설치되고 상기 RF 수신 및 복조회로에 연결되어 상기 고주파 자계를 무선으로 수신하여 상기 RF 수신 및 복조회로에 전달하는 4차권선;을 더 구비하는 것을 특징으로 하는 비접촉식 충전 시스템.

Claim 3:

As for claim 2, the contactless battery charging system which further includes the tertiary winding forming the high-frequency magnetic field by the radio frequency signal the hand-held device is spaced apart on the ferrite sheet and it is installed and it is connected to the RF modulation and transmitting circuit ; and the charge parent is installed at the position facing the tertiary winding and it is connected to the RF reception and demodulation circuit and it wirelessly receives the high-frequency magnetic field and further includes 4 pari-mutuel ticket for car racing line which delivers to the RF reception and demodulation circuit.

청구 5항:

제 2 항에 있어서,상기 RF 수신 및 복조회로는, 상기 RF 신호에서 제어신호를 복조하기 전에 상기 RF 신호와 함께 입력된 상기 고주파 병렬공진형 인버터의 구동 주파수 성분을 제거하는 고역필터를 구비하는 것을 특징으로 하는 비접촉식 충전 시스템.

Claim 5:

As for claim 2, the contactless battery charging system wherein the RF reception and demodulation circuit comprise the high pass filter which removes the driving frequency component of the high frequency parallel resonant inverter inputted with the radio frequency signal before demodulating the control signal in the radio frequency signal.

청구 6항:

제 1 항 또는 제 2 항에 있어서,상기 고주파 병렬공진형 인버터는 인덕터(L1); 캐패시터(C3); 두 개의 MOS 트랜지스터(M2, M3); 및 두 개의 게이트증폭기(A1, A2);를 구비하고,상기 1차권선의 세 단자 중 중간단자에는 상기 인덕터를 통하여 직류전원(Vs)이 연결되고, 상기 1차권선의 양끝단자에는 공진을 형성하기 위한 상기 캐패시터와 상기 두 MOS 트랜지스터의 드레인(Drain)이 연결되며,상기 두 MOS 트랜지스터의 소스는 모두 접지되고, 상기 두 게이트증폭기는 각각 상기 1차권선의 주권선과 보조권선으로부터 수신된 신호를 증폭하여 인가하도록, 상기 두 MOS 트랜지스터의 게이트에 각각 연결되는 것을 특징으로 하는 비접촉식 충전 시스템.

Claim 6:

As for claim 1 or 2, the respective connected contactless battery charging system in the gate of two MOS transistors the high frequency parallel resonant inverter includes inductor (L1), capacitor (C3), two MOS transistor (M2, M3), and two gate amplifier (A1, A2) ; the DC power supply (Vs) is connected among the force terminal of the primary winding in the intermediate terminal through the inductor ; the drain of two MOS transistors and the capacitor for forming resonance is connected in both ends person of the primary winding ; and the source of two MOS transistors is earthed to the altogether.

청구 7항:

제 6 항에 있어서,상기 게이트증폭기는 상기 보조권선에서 발

Claim 7:

As for claim 6, the contactless battery charging

생하는 정현파 형태의 전압파형을 구형파 형태로 바꾸어 주는 것을 특징으로 하는 비접촉식 충전 시스템.

system changing the voltage waveform of the sinusoidal wave generated in the gate amplifier is the auxiliary winding into the sphere shape wave form.

청구 8항:

Claim 8:

제 1 항에 있어서,상기 2차권선은 중앙점이 있으며, 상기 고주파 AC/DC 정류기는 상기 중앙점을 이용함으로써 두 개의 다이오드(D8, D9)를 사용하여 전파정류하는 것을 특징으로 하는 비접촉식 충전 시스템.

As for claim 1, the contactless battery charging system which the center point has the secondary winding ; and it full wave-rectifies using two diode (D8, D9) since the high frequency AC / DC rectifier uses the center point.

청구 9항:

Claim 9:

제 1 항에 있어서,상기 2차권선은 중앙점이 없으며, 상기 고주파 AC/DC 정류기는 네 개의 다이오드(D81, D82, D91, D92)를 사용하여 전파정류하는 것을 특징으로 하는 비접촉식 충전 시스템.

As for claim 1, the contactless battery charging system which there the center point is no secondary winding ; and the high frequency AC / DC rectifier full wave-rectifies using four diode (D81, D82, D91, D92).

청구 10항:

Claim 10:

제 8 항 또는 제 9 항에 있어서,상기 고주파 AC/DC 정류기는 상기 다이오드의 정류부 뒤에 연결되는 캐패시터(C6)와 상기 캐패시터 뒤에 연결되는 인덕터(L2)로 구성된 필터를 더 구비하는 것을 특징으로 하는 비접촉식 충전 시스템.

As for claim 8 or 9, the contactless battery charging system which further includes the filter comprised of the capacitor (C6) in which the high frequency AC / DC rectifier is connected after the rectifier of the diode and the inductor (L2) connected after the capacitor.

청구 12항:

Claim 12:

제 8 항 또는 제 9 항에 있어서,상기 고주파 AC/DC 정류기는 직렬로 연결된 저항(R5)과 캐패시터(C5)를 더 구비하는 것을 특징으로 하는 비접촉식 충전 시스템.

As for claim 8 or 9, the resistance (R5) in which the high frequency AC / DC rectifier is serially connected and the contactless battery charging system which further includes the capacitor (C5).

청구 13항:

Claim 13:

제 1 항에 있어서,상기 고주파 AC/DC 정류기는 두 개의 다이오드(D81,D91)와 두 개의 캐패시터(C61,C62)를 구비하여, 출력전압파형을 전파정류한 형태를 얻음과 동시에 2배로 상승시켜 배압정류하는 것을 특징으로 하는 비접촉식 충전 시스템.

As for claim 1, the contactless battery charging system which the high frequency AC / DC rectifier includes two diode (D81,D91) and two capacitor (C61,C62) ; and it increases to two times with obtaining the form which full wave-rectifies the output voltage waveform and rectifies back pressure.

청구 14항:

Claim 14:

제 13 항에 있어서,상기 고주파 AC/DC 정류기는 상기 다이오드의 정류부 뒤에 연결되는 두 개의 캐패시터(C61,C62)와 상기 캐패시터 뒤에 연결되는 인덕터(L2)로 구성된 필터를 더 구비하는 것을 특징으로 하는 비접촉식 충전 시스템.

As for claim 13, two capacitor (C61,C62) in which the high frequency AC / DC rectifier is connected after the rectifier of the diode and the contactless battery charging system which further includes the filter comprised of the inductor (L2) connected after the capacitor.

청구 16항:

Claim 16:

제 15 항에 있어서,상기 고주파 AC/DC 정류기는 직렬로 연결된 저항(R5)과 캐패시터(C5)를 더 구비하는 것을 특징으로 하는 비접촉식 충전 시스템.

As for claim 15, the resistance (R5) in which the high frequency AC / DC rectifier is serially connected and the contactless battery charging system which further includes the capacitor (C5).

청구 16항:

Claim 16:

제 15 항에 있어서,상기 고주파 AC/DC 정류기는 직렬로 연결된 저항(R5)과 캐패시터(C5)를 더 구비하는 것을 특징으로 하는 비접촉식 충전 시스템.

As for claim 15, the resistance (R5) in which the high frequency AC / DC rectifier is serially connected and the contactless battery charging system which further

includes the capacitor (C5).

배경기술

본 발명은 휴대형 장치에 사용되는 축전지를 비접축식으로 충전하기 위한 소형경량화된 충전 시스템에 관한 것으로, 더욱 상세하게는 충전 모체로부터 축전지축에 고주파 자계를 발생시켜 얇은 평면형의 분리된 공간을 사이에 두고 유도 결합을 통하여 에너지를 전달하는 방식을 사용함으로써 휴대형 장치내의 축전지에 접촉단자를 통하지 않고 충전하기 위한 비접축식 충전 시스템에 관한 것이다.

일반적인 휴대형 장치에는 축전지가 장착되어 있어서 사용자가 이동하면서 사용할 수 있도록 되어 있다. 이러한 축전지를 충전하기 위해서는 일반 전원과 연결하여 휴대형 장치의 축전지에 에너지를 제공하기 위한 충전 모체가 필요하다. 통상적으로 충전 모체와 축전지에는 외부에 각각 별도의 접촉 단자가 구성되어 있어서, 두 접촉 단자를 서로 접속시킴으로써 필요에 따라 선택적으로 축전지를 충전할 수 있도록 되어 있다.

그러나, 축전지와 충전 모체에 접촉 단자를 구성하면 접촉 단자가 외부에 돌출됨에 따라 미관상 좋지 않고, 접촉 단자가 외부의 이물질에 오염되어 접촉 상태가 불량해질 수 있는 단점이 있다. 또한, 사용자의 부주의로 인해 축전지에 단락이 발생하거나 습기에 노출되면 충전 에너지가 소실될 수 있다.

종래에도 이러한 문제를 해결하기 위하여, 축전지와 충전 모체에 각각 접촉 단자를 구성하지 않고 비접촉식으로 충전할 수 있는 방식이 개발되어 있으며, 일부 응용 분야 (예를 들어, 전동 칫솔, 전기 면도기 등)에서 이용되고 있다. 이러한 종래의 비접촉식 충전 방법도 역시 고주파로 동작하는 변압기의 1차 회로를 충전 모체에 구성하고, 2차 회로를 휴대형 장치 내에 구성함으로써 충전 모체로부터 에너지를 자기 결합에 의하여 휴대형 장치의 축전지에 제공하는 방식이라는 점에서는 본 발명과 공통되는 점이 있다.

그러나 상기의 비접촉식 충전 방식은 통상적으로 변압기의 1차 회로뿐만 아니라 2차 회로에도 무게와 부피가 있는 페라이트 코어가 이용되며, 페라이트 코어의 무게와 부피 때문에 휴대폰과 같이 초소형 기기에 적용하기에는 적합하지 못하다는 문제가 있었다.

Background Art

The invention relates to the lightened charging system for contactlessly charging the storage battery used in the hand-held device, and more specifically, to the contactless battery charging system for nots being put through the contact terminal and charging to the storage battery within the hand-held device by using the mode delivering the energy through the inductance coupling the high-frequency magnetic field is generated from the charge parent in the storage battery and the thin and separated space of the flat type is put in the interval.

In the general hand-held device, while the storage battery is mounted and the user moves the user can use. It is necessary to have the charge parent it connects to the regular power in order to charge this storage battery with electricity and for providing energy to the storage battery of the hand-held device. Generally, in the charge parent and storage battery, the respective separate contact terminal is comprised in the outside. The storage battery can be selectively charged with electricity as necessary by connecting two contact terminals in each other.

But if the contact terminal is organized in the storage battery and charge parent as the contact terminal is protruded in the outside it for the sake of appearance is not good. The contact terminal is polluted in the external foreign substance and it has the disadvantage that the contacting state is bad. Moreover, if the short circuit occurs in the storage battery due to the carelessness of the user or the user is exposed to moisture the charge energy can be destroyed by fire.

Conventionally, in a sense, the mode which can not organize the respective contact terminal and which it contactlessly can charge to to resolve the above problems, the storage battery and such charge parent is developed. And it is used of the some field of application (for example, the power toothbrush, the electric shaver etc) the primary circuit of the transformer which this conventional non-contact type charge method operates to the high frequency is organized in the charge parent. It is common in point with the invention. It is the mode which provides energy to the storage battery of the hand-held device from the charge parent with the magnetism bond by organizing the secondary circuit within the hand-held device.

But the non-contact type charge mode described in the above has the problem that generally the ferrite core in which weight and volume are in not only the primary circuit of the transformer but also the secondary circuit is used. And it is unable to be suitable to therefore apply to the micro type instrument like the cellular phone with weight and volume of the ferrite core.

발명의 내용

발명의 효과

본 발명에 따른 비접촉식 충전 시스템은, 충전 장치의 소형경량화를 위하여 유도결합을 이루는 분리형 변압기의 2차 측을 평면상에 구성하여 휴대형 장치의 축전지에 장착하기 쉽게 하였고, 축전지의 충전상태를 무선으로 충전 모체에 전달하여 제어될 수 있도록 하였다. 따라서, 본 발명에 따른 충전 시스템은 앞으로 더욱 더 소형화, 경량화될 휴대폰, MP3 플레이어 등과 같은 휴대형 장치에 대하여 편리성과, 안전성 그리고 미관의 수려함을 위한 디자인의 다양성을 제공하는 효과가 크다고 할 수 있다.

Summary of Invention

Effects of the Invention

The contactless battery charging system according to the present invention made easy to organize the secondary side of the decoupling-type transformer which was the inductance coupling comprised for small and light conversion of the charging apparatus on plane and mount to the storage battery of the hand-held device. It wirelessly delivered the state of charge of the storage battery to the charge parent and it was controlled. Therefore, the charging system according to the present invention more and more obtains a big effect providing the diversity which is to be handsome of the design of the convenience, and safety and aesthetics concerning the hand-held device including the miniaturization, the lightened cellular phone, the MP3 player etc. in the future.

기술적 과제

본 발명은 상기 문제점의 해결을 위해, 충전 모체와 휴대형 장치 사이에 약간의 간극을 두고 고주파로 변환시킨 자기장의 유도 결합을 이용하여 휴대형 장치 내의 축전지를 충전하기 위한 충전 시스템에 있어서, 휴대형 장치 측에 설치되는 결합부를 평면형으로 제작하여 소형경량화한 비접촉식 충전 시스템을 제공함을 목적으로 한다.

또한, 축전지의 충방전 상태를 체크하여 실시간으로 제어하는 비접촉식 방식의 충전 장치를 제공함을 목적으로 한다.

Technical Task

The invention provides the contactless battery charging system which makes the joint installed at the hand-held device with the flat type and lightened in the charging system for charging the storage battery within the hand-held device with electricity using the inductance coupling of the magnetic field which puts the some gap for the resolution of the problem between the charge parent and hand-held device and changed to the high frequency.

Moreover, charge and discharge status of the storage battery are checked and the providing is to the purpose it controls on a real time basis.

발명의 구성 및 작용

본 발명은 상기 목적의 해결을 위해, 유도 결합 방식을 사용하여 충전 모체로부터 휴대형 장치에 장착된 축전지를 충전하는 비접촉식 충전 시스템에 있어서, 상기 충전 모체는, 저주파 교류입력 전압을 받아 직류전압으로 변환하여 출력하는 저주파 AC/DC 정류기; 상기 직류전압의 크기에 관계없이 일정한 직류전압을 만들어 출력하는 프리볼트 DC/DC 컨버터; 상기 일정한 직류전압을 받아 고주파 교류 전력으로 변환하여 출력하는 고주파 병렬공진형 인버터; 상기 고주파 병렬공진형 인버터에 연결되는 페라이트 코어; 및 상기 페라이트 코어의 중앙돌출부와 외곽돌출부 사이에 설치되고, 상기 고주파 교류 전력을 받아 유도결합에 의해 상기 휴대형 장치 측으로 전달하는 1차 권선;을 구비하고, 상기 휴대형 장치는, 얇은 페라이트 시트; 상기 1차권선으로부터 상기 교류 전력을 수수하기 위하여 상기 1차권선에 대향하도록 상기 페라이트 시트 상에 설치되는 얇은 박막형의 2차권선; 및 상기 2차권선이 수수한 교류 전력을 직류 전력으로 변환하여 축전지에 제공하는 고주파 AC/DC 정류기;를 구비하는 것을 특징으로 하는 비접촉식 충전 시스템을 제공한다.

Structure & Operation of the Invention

The invention provides the contactless battery charging system including the thin secondary winding: which is installed on the ferrite sheet it is faced with the AC power from the primary winding in the primary winding it is unpretending and the high frequency AC / DC rectifier which converts the AC power which the secondary winding is ordinary looking into the DC power and provided to the storage battery of the ferrite sheet: thin film type in which the hand-held device is thin it includes the low frequency AC / DC rectifier outputted, the free voltage DC/DC converter, the high frequency parallel resonant inverter receiving the fixed DC voltage as described above and converts into the high frequency alternating current electricity and outputs, the ferrite core connected to the high frequency parallel resonant inverter, and the primary winding it converts into the DC voltage as to the contactless battery charging system charging the storage battery mounted on the hand-held device from the charge parent using the inductively coupled method for the resolution of the purpose the charge parent receives the low frequency alternating current input voltage. The free voltage DC/DC converter makes the DC voltage fixed regardless of the size of the DC voltage and outputted. The primary winding is installed between the central projecting part and outside

protrusion part of the ferrite core and which receives the high frequency alternating current electricity and delivered to the hand-held device with the inductance coupling.

또한, 상기 휴대형 장치는, 상기 축전지의 충전상태를 검사하여 제어신호를 생성하고 출력하는 충전제어회로; 및 상기 제어신호를 받아 RF 신호로 변조하여 무선 송출하는 RF 변조 및 송신회로;를 더 구비하고, 상기 충전 모체는, 상기 RF 신호를 수신하고 복조하여 상기 제어신호를 검출하여 출력하는 RF 수신 및 복조회로; 및 상기 제어신호를 받아 펄스폭 변조 신호를 만들어 상기 프리볼트 DC/DC 컨버터에 인가함으로써 직류전압을 조정하도록 하는 PWM 제어회로;를 더 구비하는 것을 특징으로 하는 비접촉식 충전 시스템을 제공한다.

Moreover, the hand-held device inspects the state of charge of the storage battery and it creates the control signal and it further includes the charge control circuit outputted, and the RF modulation and the transmitting circuit. It provides the contactless battery charging system which receives the radio frequency signal and which demodulates and in which the charge parent detects the control signal and which further includes the RF reception and the demodulation circuit outputted, and the pulse width modulation control circuit. The RF modulation and the transmitting circuit gets a the control signal and which is the RF signal modulation and which it wirelessly transmits. The pulse width modulation control circuit controls the DC voltage by getting a the control signal and making the pulse-width modulating signal and authorizing in the free voltage DC/DC converter.

이하에서 첨부된 도면을 참조하여 본 발명의 실시예들을 설명한다.

Hereinafter, the attached embodiment of the present invention is explained.

도 1a는 본 발명에 따른 충전 시스템에 있어서 변압기의 원리인 자력선을 매개로 하여 비접촉 방법으로 에너지를 전달하기 위한 코어 부분에 대한 단면도(102)와 평면도(101, 103)를 동시에 도시하고 있다.

At the same time, the cross-sectional view (102) and plane views (101, 103) about the core portion for the drawing 1a the line of magnetic force called the principles of the transformer as to the charging system according to the present invention to the intermediation and delivering energy to the non contact method are shown.

본 발명에서 제안하는 충전 시스템은 단면도(102)에 도시된 바와 같이 충전 모체(1) 측과 휴대형 장치(2) 측으로 나누어서 생각할 수 있다. 충전 모체(1)에는 에너지 송출을 위한 분리형 변압기의 1차권선이 설치되는데, 자계를 형성하는 주권선(4)과 주권선에 의해 형성된 자계로부터 교류 전력을 유도하는 보조권선(10)으로 구성된다. 또한, RF(고주파)신호 수신을 위한 4차권선(6)이 1차권선(4)과 일정한 간격을 두고 설치된다. 한편, 휴대형 장치(2)에는 에너지 수수를 위한 변압기의 2차권선(5)이 설치되며 RF신호 송출을 위한 3차권선(7)이 일정한 간격을 두고 설치된다.

In the present invention, the charging system suggested divides into the charge parent (1) and hand-held device (2) as shown in the cross-sectional view (102) and it can think. It is comprised of the auxiliary winding (10) inducing the AC power from the main winding (4) forming the magnetic field the primary winding of the decoupling-type transformer for the energy transmission is installed in the charge parent (1) and the magnetic field formed with the main winding. Moreover, 4 pari-mutuel ticket for car racing line (6) for the RF (high frequency) signal receive is equipped with space it is fixed with the primary winding (4). In the meantime, the secondary winding (5) of the transformer for the energy transfer is installed in the hand-held device (2). And equipped with space the tertiary winding (7) for the radio frequency signal transmission is fixed.

평면도(101)는 휴대형 장치(2)에 설치된 각각의 변압기 권선(5, 7)의 형태를 도시한 것이고, 단면도(102)는 충전 모체(1) 위에 휴대형 장치(2)를 올려놓은 상태에서 변압기를 중심으로 하여 절단한 모습을 도시한 것이며, 평면도(103)는 충전 모체(1)에 설치된 각각의 변압기 권선(4, 6)을 도시한 것이다.

The plane view (101) represents the form of each transformer windings (5, 7) installed at the hand-held device (2). And the display cutting in the state where the cross-sectional view (102) puts on the hand-held device (2) on the charge parent (1) centering around the transformer is shown. And the plane view (103) exhibits each transformer windings (4, 6) installed at the charge parent (1).

에너지 송출을 위한 변압기의 1차 측은 충전 모체에 중앙 돌출부(3-1)와 외곽 돌출부(3-2)로 구성되는 원통형의 페라이트 코어(3)로 구현된다. 페라이트 코어(3)의 중앙 돌출부(3-1)와

It is implemented as the ferrite core (3) of cylinder comprised of the primary side of the transformer for the energy transmission is the central projecting part

외곽 돌출부(3-2) 사이에는 변압기의 2차 측으로 에너지를 전달하기 위한 변압기의 1차 측의 주권선(4)과 전력회로의 제어를 위한 수단으로서의 보조권선(10)이 권취된다.

(3-1) in the charge parent and outside protrusion part (3-2). The auxiliary winding (10) as the means for the control of the main winding (4) of the primary side of the central projecting part (3-1) of the ferrite core (3) and the transformer for delivering energy between the outside protrusion part (3-2) to the secondary side of the transformer and power circuitry are reeled.

이에 대응하는 에너지 수수를 위한 변압기 2차권선(5)은 휴대형 장치 하부의 페라이트 시트(8) 상에 구성된다. 2차권선(5)은 충전 모체(1)의 에너지 송출용 변압기 1차권선(4)과 대향하는 위치에 수직으로 약간의 간격을 두고 형성된다. 이 수직 간격은 작을수록 바람직하지만, 페라이트 시트(8)가 휴대형 장치(2) 내부에 장착되게 됨으로써 휴대형 장치의 케이스 외벽 두께에 의하여 불가피하게 발생하는 공간 때문에 약 1mm 내외의 간격을 두게 된다.

The transformer secondary winding (5) for the corresponding energy transfer is comprised on the ferrite sheet (8) of the hand-held device lower part. It is perpendicularly formed in the position facing the secondary winding (5) is the transformer primary winding (4) for the energy transmission of the charge parent (1) the little. This vertical gap is the be desirable it is small. And since the ferrite sheet (8) is mounted inside the hand-held device (2) the gap of about 1mm in and out is therefore put with space inevitably generated with the case outer wall thickness of the hand-held device.

페라이트 시트(8) 위에서 에너지 수수용 변압기의 2차권선(5)이 권취되는 위치는 원통형 페라이트 코어(3)의 중앙 돌출부(3-1)와 외곽 돌출부(3-2) 사이에 대응하는 위치에 설치된다. 때문에, 2차권선(5)으로는 얇은 박막형태의 권선을 이용하는 것이 바람직하다.

The position in which the secondary winding (5) of the transformer for the energy transfer is reeled in the ferrite sheet (8) is installed at the corresponding position between the central projecting part (3-1) and outside protrusion part (3-2) of the cylinder ferrite core (3). Therefore, the coil of the thin film type which is thin to the secondary winding (5) may be referred to the be desirable it uses.

RF신호의 송신을 위한 3차권선(7)은 휴대형 장치(2)의 페라이트 시트(8) 상에 에너지 수수용 변압기의 2차권선(5)과 수평으로 일정한 거리를 두고 별도로 설치되며, 1차 또는 2차권선과는 가급적 자기적인 결합을 최소화할 수 있도록 하여야 한다. 한편, RF신호의 수신을 위한 4차권선(6)은 충전 모체(1) 측에 설치하되 3차권선(7)과는 자기적으로 잘 결합될 수 있도록 하여야 하며, 보통의 PCB기판(9) 상에 설치가 가능하다. 이 두 권선(6, 7)은 배터리의 충전 상태에 관한 정보를 RF신호로 변조시켜 송수신하기 위한 목적으로 설치되는 것이며, 전력의 전달을 목적으로 하지 않기 때문에 가느다란 권선을 사용하여 작은 크기의 원형 또는 다각형으로 구현할 수 있다.

The tertiary winding (7) for the transmission of the radio frequency signal is spaced apart on the ferrite sheet (8) of the hand-held device (2) and it is separately installed. And the bond it if possible magnetics is minimized with the first or the secondary winding. In the meantime, 4 pari-mutuel ticket for car racing line (6) for the reception of the radio frequency signal sets up in the charge parent (1) and it magnetically well combines with the tertiary winding (7). And the installation is usually possible on the PCB substrate (9). It is installed in the purpose of this two coils (6, 7) modulating the information about the state of charge of the battery as the radio frequency signal and sending and receiving. And because of noting to deliver the transmission of electricity to the purpose it can implement using the slender coil as the circular form or the polygon of the small size.

도 1b는 2차권선(5)을 얇은 박막형태의 권선으로 구현하기 위한 방안으로 얇은 플렉시블(flexible) 기판 상에 양면을 이용하여 구현한 모습을 예시한 것이다. 특히, 도시된 바와 같이 2차권선(5)의 권선과 권선사이에 일정한 간격을 두고 형성시킨다면 하나의 바람직한 특성을 얻는데 도움이 된다. 실제 상황에서 사용자가 휴대형 장치(2)내의 축전지를 충전하기 위하여 충전 모체(1) 위에 휴대형 장치(2)를 올려놓는다고 할 때, 충전 모체(1)의 1차권선(4) 위치 위에 휴대형 장치(2)의 2차권선(5) 위치를 정확하게 일치시켜서 올려놓는 일이 쉽지 않다. 이 두 권선 간의 위치가 어긋나게 되면 1차 측에서 2차 측으로의 에너지 전달 효율이 나빠지게 된다. 본 발명에서는 이와 같은 경우를 미리 고려하여 2차권선(5)의 권선과 권선사이에 일정한 간격을 두고 형성시킴으로써, 사용자가 휴대형 장치를 충전 모체 위에 올려놓을 때 상당한 위치의 오차가 존재하는 경우에도 불구하고 충전에 미치는 영향을 최소화하도록 하였다.

The display implemented as the plan in which the drawing 1b implements the secondary winding (5) in terms of the coil of the thin thin film type on the thin flexible substrate using both sides is exemplified. Particularly, as shown in the figure, it is helpful to obtain the property of doing with one desirable if it forms putting the regular interval between the coil and coil of the secondary winding (5). In the real situation, when the user does to put on the hand-held device (2) on the charge parent (1) so that the user charge the storage battery within the hand-held device (2) with electricity the task which is accurately conformed the secondary winding (5) position of the hand-held device (2) and put on the primary winding (4) position of the charge parent (1) is not easy. The energy transmission efficiency to the secondary side becomes bad in the primary side if the position between this two coils cross