AO 120 (Rev. 08/10)

TO:	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Eastern District of Texas on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
1:22-cv-00433	10/7/2022	Eastern District of Texas

PLAINTIFF	DEFENDANT
Mojo Mobility Inc.	Samsung Electronics Co., Ltd and Samsung Electronics America, Inc.

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	US 7,948,208	5/24/2011	Mojo Mobility Inc.
2	US 9,577,440	2/21/2017	Mojo Mobility Inc.
3	US 11,292,349	4/5/2022	Mojo Mobility Inc.
4	US 11,201,500	12/14/2021	Mojo Mobility Inc.
5	US 11,316,371	4/26/2022	Mojo Mobility Inc.

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
2		
3		
4		
5		

In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

Copy 1—Upon initiation of action, mail this copy to Director Copy 3—Upon termination of action, mail this copy to Director
Copy 2—Upon filing document adding patent(s), mail this copy to Director Copy 4—Case file copy

ATTACHMENT TO FORM AO-120
REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
(Mojo Mobility Inc. v. Samsung Electronics Co., Ltd and Samsung Electronics America, Inc.)

PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
6 US 11,342,777	5/24/2022	Mojo Mobility Inc.
7 US 11,462,942	10/4/2022	Mojo Mobility Inc.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/467,032	04/05/2022	11292349	AFPA-01039US4	1075

33438 7590 03/16/2022

TERRILE, CANNATTI & CHAMBERS, LLP
P.O. BOX 203518
AUSTIN, TX 78720

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 0 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Patents Stakeholder Experience (OPSE), Stakeholder Support Division (SSD) at (571)-272-4200.

INVENTOR(s) (Please see PAIR WEB site http://pair.uspto.gov for additional inventors):

Afshin Partovi, Palo Alto, CA;

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

Mojo Mobility Inc., Palo Alto, CA

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit SelectUSA.gov.

IR103 (Rev. 10/09)

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	17467032
Filing Date	2021-09-03
First Named Inventor	Afshin Partovi
Art Unit	2859
Examiner Name	Undetermined
Attorney Docket Number	AFPA-01039US4

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	4873677		1989-10-10	Sakamoto et al	
	2	5455466		1995-10-03	Parks et al	
	3	5600225		1997-02-04	Goto, Masataka	
	4	5734254		1998-03-31	Stephens, Charles S.	
	5	6118249		2000-09-12	Brockman, et al	
	6	6184651	B1	2001-02-06	Fernandez et al	
	7	6301128	B1	2001-10-19	Jang et al	
	8	6803744	B1	~~2014-10-12~~ 10/2004	Sabo, Anthony	

Change(s) applied to document,
/S.D./
2/28/2022

EFS Web 2.1.18

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	20	9793738	B2	2017-10-17	Jacobs et al	

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
Change(s) applied to document, /S.D./ 2/28/2022	1	20040145342	A1	2004-07-29	~~Hewlett Packard Company~~ Lyon	
	2	20040150934	A1	2004-08-05	Baarman et al	
	3	20050068019	A1	2005-03-31	Nakamura et al	
	4	20050189910	A1	2005-09-01	Shu-yuen, Ron Hui	
	5	20080272889	A1	2008-11-06	Symons, Peter Robert	

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	2396901	EP	B1	2019-12-25	Kirby et al		

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	53	6489745		2002-12-03	Koreis	
	54	6331744		2001-12-18	Chen	
	55	7336054		~~2005-03-08~~ 02/2008	Crisp	
Change(s) applied to document, /S.D./ 2/28/2022	56	5803744	B1	~~2014-10-12~~ 09/1998	~~Anthony Sabo~~ Yen	
	57	6636017		2003-10-21	Zink et al	
	58	6586909		2003-07-01	Trepka	
	59	6462509		2002-10-08	Abe	
	60	6844702		2005-01-28	Giannopoulos	
	61	4311953		1982-01-19	Fukuda	
	62	6016046		2000-01-18	Kaile et al.	
	63	7164255	B2	2007-01-16	Shu-Yuen Ron Hui	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

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
17/467,032	09/03/2021	Afshin Partovi	AFPA-01039US4

CONFIRMATION NO. 1075

33438
TERRILE, CANNATTI & CHAMBERS, LLP
P.O. BOX 203518
AUSTIN, TX 78720

PUBLICATION NOTICE

OC000000132042282

Title: System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes

Publication No.US-2022-0055489-A1
Publication Date:02/24/2022

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 Public Records Division. The Public Records Division can be reached by telephone at (571) 272-3150 or (800) 972-6382, by facsimile at (571) 273-3250, by mail addressed to the United States Patent and Trademark Office, Public Records Division, 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 https://portal.uspto.gov/pair/PublicPair. 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

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

33438 7590 02/02/2022
TERRILE, CANNATTI & CHAMBERS, LLP
P.O. BOX 203518
AUSTIN, TX 78720

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

Kent Chambers	(Typed or printed name)
/Kent Chambers/	(Signature)
February 23, 2022	(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/467,032	09/03/2021	Afshin Partovi	AFPA-01039US4	1075

TITLE OF INVENTION: System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$600	$0.00	$0.00	$600	05/02/2022

EXAMINER	ART UNIT	CLASS-SUBCLASS
AISAKA, BRYCE M	2851	320-108000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: Mojo Mobility Inc.

(B) RESIDENCE: (CITY and STATE OR COUNTRY): Palo Alto, California

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ☒ Corporation or other private group entity ❑ Government

4a. Fees submitted: ☒ Issue Fee ❑ Publication Fee (if required) ❑ Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

☒ Electronic Payment via EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. 502264

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /Kent B. Chambers/ Date February 23, 2022

Typed or printed name Kent B. Chambers Registration No. 38,839

Electronic Patent Application Fee Transmittal

Application Number:	17467032
Filing Date:	03-Sep-2021
Title of Invention:	System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes
First Named Inventor/Applicant Name:	Afshin Partovi
Filer:	Kent Bryan Chambers
Attorney Docket Number:	AFPA-01039US4

Filed as Small Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
UTILITY APPL ISSUE FEE	2501	1	600	600

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**600**

Electronic Acknowledgement Receipt	
EFS ID:	45070635
Application Number:	17467032
International Application Number:	
Confirmation Number:	1075
Title of Invention:	System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes
First Named Inventor/Applicant Name:	Afshin Partovi
Customer Number:	33438
Filer:	Kent Bryan Chambers
Filer Authorized By:	
Attorney Docket Number:	AFPA-01039US4
Receipt Date:	23-FEB-2022
Filing Date:	03-SEP-2021
Time Stamp:	22:22:50
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$600
RAM confirmation Number	E20222MM23070110
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	AFPA-1039US4_IssueFeeXmtl_2022-05-02.pdf	112288 34d955a6b59bdde7e2d77f875115ae56614dd7e5	no	1
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	38146 6a33be5b78ea83354b2aeba0b1f95424c18e345e	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	150434		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/467,032	09/03/2021	Afshin Partovi	AFPA-01039US4	1075

33438 7590 02/23/2022

TERRILE, CANNATTI & CHAMBERS, LLP
P.O. BOX 203518
AUSTIN, TX 78720

EXAMINER	
AISAKA, BRYCE M	

ART UNIT	PAPER NUMBER
2851	

NOTIFICATION DATE	DELIVERY MODE
02/23/2022	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

USPTO@dockettrak.com
anita@tcciplaw.com
tmunoz@tcciplaw.com

Corrected ***Notice of Allowability***	**Application No.** 17/467,032	**Applicant(s)** Partovi, Afshin	
	Examiner BRYCE M AISAKA	**Art Unit** 2851	**AIA (FITF) Status** Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to the papers filed 2/16/22.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 21-50 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some* c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☐ Examiner's Statement of Reasons for Allowance
7. ☑ Other PTO-271.

/BRYCE M AISAKA/
Primary Examiner, Art Unit 2851

Response to Rule 312 Communication	Application No.	Applicant(s)	
	17/467,032	Partovi, Afshin	
	Examiner	Art Unit	AIA (FITF) Status
	BRYCE M AISAKA	2851	Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

1. ☑ The amendment filed on 16 February 2022 under 37 CFR 1.312 has been considered, and has been:

a) ☐ entered.

b) ☑ entered as directed to matters of form not affecting the scope of the invention.

c) ☐ disapproved because the amendment was filed after the payment of the issue fee.

Any amendment filed after the date the issue fee is paid must be accompanied by a petition under 37 CFR 1.313(c)(1) and the required fee to withdraw the application from issue.

d) ☐ disapproved. See explanation below.

e) ☐ entered in part. See explanation below.

f) ☐ not entered because the supplemental or corrected Application Data sheet (ADS)

☐ was not accompanied by a petition to accept an unintentionally delayed claim under 37 CFR 1.55 or 27 CFR 1.78;

☐ did not identify the information being changed in accordance with 37 CFR 1.76(c)(2);

☐ was not properly signed in accordance with 37 CFR 1.76(e) (or 37 CFR 1.33(b) for applications filed prior to September 16, 2012).

/BRYCE M AISAKA/
Primary Examiner, Art Unit 2851

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s):	Afshin Partovi		
Applicant:	Mojo Mobility Inc.		
Title:	System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes		
Application No.:	17/467,032	Filed:	September 3, 2021
Confirmation No.	1075		
Examiner:	Bryce M. Aisaka	Group Art Unit:	2851
Docket No.:	AFPA-01039US4	Customer No.:	33438

ELECTRONICALLY FILED

Austin, Texas
February 16, 2022

AMENDMENT UNDER 37 C.F.R. § 1.312

This paper is submitted under and in compliance with 37 C.F.R. § 1.312. As explained in more detail below, Applicant respectfully submits that this amendment complies with 37 C.F.R. § 1.312 and MPEP §714.16. Entry of the amendment is respectfully requested.

The USPTO is also authorized to charge any underpayment of fees to Deposit Account No. 502264.

OK TO ENTER: /B.M.A/

AMENDMENTS TO THE SPECIFICATION

Please amend Paragraph 0004 as follows:

[0004] In at least one embodiment, a system for inductive power transfer includes a charger. The charger is an inductive charger. The system also includes a first mobile device that includes a receiver to inductively receive power for the first mobile device. In at least one embodiment, a charger for inductive charging includes a printed circuit board having a charger coil, a substantially planar magnetic layer, a charger drive circuit, and means for positioning a receiver in a power transfer position. In at least one embodiment, a mobile device that receives power inductively includes a receiver to inductively receive power for the mobile device. In at least one embodiment, a method for inductive power transfer to a mobile device, which includes a receiver includes positioning the receiver in a power transfer position to inductively receive power from an inductive charger. The method further includes inductively transferring power from the charger to the receiver of the first mobile device. Described herein are systems and methods for enabling transfer of power, from a wireless charger or power supply, to one or more receivers placed on or near the wireless charger or power supply, including powering or charging one or multiple receivers or devices having small surface areas or volumes. In accordance with an embodiment, a receiver coil can be generally shaped as a blade or thin solenoid, which receives power inductively, which is then used to power or charge one or more electronic devices. Applications include inductive or magnetic charging and power, and particularly usage in mobile, electronic, electric, lighting, or other devices, batteries, power tools, kitchen, industrial, medical or dental, or military applications, vehicles, robots, trains, and other usages.

Please amend the Abstract on page 33 as follows:

Abstract:

A system for inductive power transfer includes a charger. The charger is an inductive charger. The system also includes a first mobile device that includes a receiver to inductively receive power for the first mobile device. A charger for inductive charging includes a printed circuit board having a charger coil, a substantially planar magnetic layer, a charger drive circuit, and means for positioning a receiver in a power transfer position. A mobile device that receives power inductively includes a receiver to inductively receive power for the mobile device. A method for inductive power transfer to a mobile device, which includes a receiver, includes

positioning the receiver in a power transfer position to inductively receive power from an inductive charger. The method further includes inductively transferring power from the charger to the receiver of the first mobile device. ~~Systems and methods for enabling transfer of power, from a wireless charger or power supply, to one or more receivers placed on or near the wireless charger or power supply, including powering or charging one or multiple receivers or devices having small surface areas or volumes. In accordance with an embodiment, a receiver coil can be generally shaped as a blade or thin solenoid, which receives power inductively, which is then used to power or charge one or more electronic devices. Applications include inductive or magnetic charging and power, and particularly usage in mobile, electronic, electric, lighting, or other devices, batteries, power tools, kitchen, industrial, medical or dental, or military applications, vehicles, robots, trains, and other usages.~~

AMENDMENTS TO THE CLAIMS

Claims 1-20 are canceled.

21. (Currently Amended) A system for inductive power transfer comprising:

a charger, wherein the charger is an inductive charger, and the charger includes:

a printed circuit board having a charger coil, wherein the charger coil has a substantially planar charger surface;

a substantially planar magnetic layer under the charger coil opposite the charger surface; and

a charger drive circuit, wherein the charger drive circuit includes a resonant capacitor and a FET switch to apply an alternating voltage to the charger coil; and

a first mobile device that includes a receiver to inductively receive power for the first mobile device, wherein the receiver includes:

~~the receiver includes:~~

a solenoid, wherein the solenoid includes:

a magnetic core having a relative magnetic permeability exceeding 1 and having first and second ends; and

Litz wire wrapped around a section of the magnetic core forming a wire wound section around the magnetic core, with the magnetic core extending beyond the wire wound section; and

a receiver electronic circuit, wherein the receiver electronic circuit includes a resonant capacitor and a rectifier; and

wherein:

the charger further includes a means for positioning the receiver in a power transfer position, proximate to the charger surface, to inductively transfer power to the receiver of the first mobile device;

the charger drive circuit is configured to drive the charger coil at one or more operating frequencies to inductively transfer power from the charger to the receiver when the receiver is positioned in the power transfer position,

wherein when the receiver is positioned in the power transfer position, a tuned circuit, including the charger coil and the resonant capacitor of the charger drive circuit and the solenoid and the resonant capacitor of the receiver electronic circuit, has a resonant frequency that allows the charger to transfer the power to the receiver at the one or more operating frequencies;

the charger coil includes a conductor patterned to include multiple, substantially concentric turns for generating a magnetic flux through a first end of the solenoid when the receiver is placed in the power transfer position, wherein an outermost of the concentric turns defines a perimeter of a charger coil area;

the multiple concentric turns, when driven by the charger drive circuit, generate a magnetic field that is substantially perpendicular to the charger surface at a geometric center of the charger coil area;

the charger coil area is larger than an area of the first end and larger than an area of the second end of the magnetic core of the solenoid;

the magnetic layer of the charger extends beyond the charger coil area; and

when the receiver is in the power transfer position, the first end of the magnetic core is located proximate to the charger coil area above the charger surface to receive magnetic flux from the charger coil area and guide the magnetic flux in a closed magnetic loop from the charger coil area through the solenoid and return through the charger magnetic layer to the charger coil area to form the closed magnetic loop.

22. (Previously Presented) The system of claim 21, wherein the charger coil is a single coil.

23. (Previously Presented) The system of claim 21, wherein when positioned in the power transfer position, a winding axis of the solenoid is positioned perpendicular to the charger surface.

24. (Previously Presented) The system of claim 21, wherein when the receiver is positioned in the power transfer position and when the charger is operated at an operating frequency near the resonance frequency of the tuned circuit to inductively transfer power from the charger to the receiver, the transfer of power from the charger to the receiver has a power transfer efficiency that exceeds 50%, wherein the power transfer efficiency is defined by power out of a rectifier in the receiver electronic circuit divided by power into the charger drive circuit.

25. (Previously Presented) The system of claim 21, wherein the charger coil area is at least ten times larger than the area of each of the ends of the magnetic core of the solenoid.

26. (Previously Presented) The system of claim 21, wherein the charger coil area is at least fifty times larger than the area of each of the ends of the magnetic core of the solenoid.

27. (Previously Presented) The system of claim 21, wherein the magnetic core of the solenoid has a cross sectional dimension in at least one end of 1 to 2 mm and has a length along a winding axis of 10 to 20 mm.

28. (Previously Presented) The system of claim 21, wherein the Litz wire is selected for operation at a frequency of greater than 205 kHz.

29. (Previously Presented) The system of claim 21, wherein when the receiver is positioned in the power transfer position, a winding axis of the solenoid is positioned at an angle relative to an axis perpendicular to the charger surface, wherein the angle is one of any angles relative to the axis perpendicular to the charger surface.

30. (Previously Presented) The system of claim 21, wherein the magnetic core of the solenoid comprises Ferrite material and the charger magnetic layer comprises Ferrite material.

31. (Previously Presented) The system of claim 21, wherein a center of the first end of the solenoid is positioned 1 mm or more away from the charger surface when the receiver is positioned in the power transfer position.

32. (Currently Amended) The system of claim 21, wherein when the receiver is positioned in the power transfer position, the magnetic core of the solenoid extends beyond the charger coil area in a preferential direction and the charger magnetic layer is also ~~elongated~~ extended in the preferential direction so that the magnetic flux returned during the provision of power to the mobile device flows from the solenoid back to the charger coil to close the magnetic loop.

33. (Previously Presented) The system of claim 21, wherein:

the charger is incorporated into a second mobile device;

the second mobile device includes an internal, rechargeable battery;

the second mobile device uses the internal battery to transfer power to and operate the charger for a period of time; and

the first and second mobile devices comprise Bluetooth communication systems to communicate with each other during non-power transfer operations.

34. (Currently Amended) The system of claim [[21]] 33, wherein no communication between the charger and the receiver occurs during power transfer.

35. (Currently Amended) The system of claim [[21]] 33, wherein the second mobile device further includes:

an additional inductive charger, wherein the additional inductive charger includes an additional charger coil to transfer power to additional mobile devices.

36. (Currently Amended) The system of claim [[21]] 33, wherein the receiver of the first mobile device is a first receiver, and the second mobile device includes a second receiver to inductively receive power to charge the internal, rechargeable battery of the second mobile device.

37. (Previously Presented) The system of claim 21, wherein:

the receiver and the charger include communication and control electronics circuits to communicate, between the receiver and the charger, information associated with the transfer of power to the first mobile device; and

the communication is through a charger antenna that includes the charger coil and a receiver antenna that includes the solenoid.

38. (Previously Presented) The system of claim 21, wherein the charger is incorporated into an enclosed volume for placement of the receiver in the power transfer position to receive inductive power.

39. (Currently Amended) The system of claim 21, wherein the charger initiates transferring power to the mobile device when a presence of [[a]] the receiver in the power transfer position is detected.

40. (Previously Presented) The system of claim 21, wherein the magnetic field from the system is guided and contained so that residual electromagnetic emissions near the system are within safe compliance values.

41. (Previously Presented) The system of claim 21 further comprising:

an energy storage device coupled to the receiver, wherein when the transfer of power to the receiver occurs, the transferred power charges the energy storage device.

42. (Currently Amended) The system of claim [[21]] 41 wherein the energy storage device includes a battery.

43. (Currently Amended) The system of claim 21, wherein the first mobile device is a member of a group consisting of: a remote controller, a mouse, a wearable electronic glass, [[or]] and a head-mounted display device.

44. (Previously Presented) The system of claim 21, wherein the means for positioning includes one or more magnets to position the receiver in the power transfer position.

45. (Previously Presented) The system of claim 21, wherein the means for positioning includes one or more members of a group consisting of visual, physical, or magnetic means to assist in positioning the receiver in the power transfer position.

46. (Currently Amended) A charger for inductive charging, the charger comprising:

a printed circuit board having a charger coil, wherein the charger coil has a substantially planar charger surface;

a substantially planar magnetic layer under the charger coil opposite the charger surface;

a charger drive circuit, wherein the charger drive circuit includes a resonant capacitor and a FET switch to apply an alternating voltage to the charger coil; and

means for positioning a receiver in a power transfer position, which is proximate to the charger surface, to inductively transfer power to the receiver, ~~of a mobile device,~~ wherein the receiver is included in a mobile device to inductively receive power for the mobile device, and the receiver includes:

a solenoid, wherein the solenoid includes:

a magnetic core having a relative magnetic permeability exceeding 1 and having first and second ends; and

Litz wire wrapped around a section of the magnetic core forming a wire wound section around the magnetic core, with the magnetic core extending beyond the wire wound section; and

a receiver electronic circuit, wherein the receiver electronic circuit includes a resonant capacitor and a rectifier; and

wherein:

the charger drive circuit is configured to drive the charger coil at one or more operating frequencies to inductively transfer power from the charger to the receiver when the receiver is positioned in the power transfer position, wherein when the receiver is positioned in the power transfer position, a turned circuit, which includes the charger coil and the resonant capacitor of the charger drive circuit and the solenoid and the resonant capacitor of the receiver electronic circuit, has a resonant frequency that allows the charger to transfer the power to the receiver at the one or more operating frequencies;

the charger coil includes a conductor patterned to include multiple, substantially concentric turns for generating a magnetic flux through a first end of the solenoid when the receiver is placed in the power transfer position,

wherein an outermost of the concentric turns defines a perimeter of a charger coil area;

the multiple substantially concentric turns, when driven by the charger drive circuit, generate a magnetic field that is substantially perpendicular to the charger surface at a geometric center of the charger coil area;

the charger coil area is larger than an area of the first end and larger than the area of the second end of the magnetic core of the solenoid;

the magnetic layer of the charger extends beyond the charger coil area; and

when the receiver is in the power transfer position, the first end of the magnetic core is located proximate to the charger coil area above the charger surface to receive magnetic flux from the charger coil area and guide the magnetic flux in a closed magnetic loop from the charger coil area through the solenoid and return through the charger magnetic layer to the charger coil area to form the closed magnetic loop.

47. (Previously Presented) The charger of claim 46, wherein the charger coil is a single coil.

48. (Previously Presented) The charger of claim 46, wherein when positioned in the power transfer position, a winding axis of the solenoid is positioned at an angle relative to an axis perpendicular to the charger surface, wherein the angle is one of any angle relative to the axis perpendicular to the charger surface.

49. (Currently Amended) A mobile device that receives power inductively, the mobile device comprising:

a receiver to inductively receive power for the mobile device; wherein:

the receiver includes:

a solenoid, wherein the solenoid includes:

a magnetic core having a relative magnetic permeability exceeding 1 and having first and second ends; and

a Litz wire wrapped around a section of the magnetic core forming a wire wound section around the magnetic core, with the

magnetic core extending beyond the wire wound section; and

a receiver electronic circuit, wherein the receiver electronic circuit includes a resonant capacitor and a rectifier; and

when the receiver is positioned proximate to a charger surface of an inductive charger, the receiver receives power from the charger, and the charger includes:

a printed circuit board having a charger coil, wherein the charger surface is a substantially planar surface of the charger coil;

a substantially planar magnetic layer under the charger coil opposite the charger surface;

a charger drive circuit, wherein the charger drive circuit includes a resonant capacitor and a FET switch to apply an alternating voltage to the charger coil; and

means for positioning the receiver in a power transfer position, which is proximate to the charger, to inductively transfer power to the receiver of the [[first]] mobile device;

wherein:

the charger drive circuit is configured to drive the charger coil at one or more operating frequencies to inductively transfer power from the charger to the receiver when the receiver is positioned in the power transfer position, wherein when the receiver is positioned in the power transfer position, a tuned circuit, which includes the charger coil and the resonant capacitor of the charger drive circuit and the solenoid and the resonant capacitor of the receiver electronic circuit, has a resonant frequency that allows the charger to transfer the power to the receiver at the one or more operating frequencies;

the charger coil includes a conductor patterned to include multiple, substantially concentric turns for generating a magnetic

flux through a first end of the solenoid when the receiver is placed in the power transfer position, wherein an outermost of the concentric turns defines a perimeter of a charger coil area;

the multiple concentric turns, when driven by the charger drive circuit, generate a magnetic field that is substantially perpendicular to the charger surface at the charger surface at a geometric center of the charger coil area;

the charger coil area is larger than an area of the first end and larger than an area of the second end of the magnetic core of the solenoid;

the magnetic layer of the charger extends beyond the charger coil area; and

when the receiver is in the power transfer position, the first end of the magnetic core is located proximate to the charger coil area above the charger surface to receive magnetic flux from the charger coil area and guide the magnetic flux in a closed magnetic loop from the charger coil area through the solenoid and return through the charger magnetic layer to the charger coil area to form the closed magnetic loop.

50. (Currently Amended) A method for inductive power transfer to a mobile device, wherein the mobile device includes a receiver, the method comprising:

positioning the receiver in a power transfer position to inductively receive power from an inductive charger; and

inductively transferring power from the charger to the receiver of the [[first]] mobile device;

wherein:

the charger includes:

a printed circuit board having a charger coil, wherein the charger coil has a substantially planar charger surface, and the charger coil includes a

conductor patterned to include multiple, substantially concentric turns and an outermost of the concentric turns defines a perimeter of a charger coil area;

a substantially planar magnetic layer under the charger coil opposite the charger surface, wherein the magnetic layer of the charger extends beyond the charger coil area; and

a charger drive circuit, wherein the charger drive circuit includes a resonant capacitor and a FET switch to apply an alternating voltage to the charger coil;

the receiver includes:

a solenoid, wherein the solenoid includes:

a magnetic core having a relative magnetic permeability exceeding 1 and having first and second ends; and

Litz wire wrapped around a section of the magnetic core forming a wire wound section around the magnetic core, with the magnetic core extending beyond the wire wound section; and

a receiver electronic circuit, wherein the receiver electronic circuit includes a resonant capacitor and a rectifier; and

inductively transferring power from the charger to the receiver comprises:

driving the charger coil with the charger driver circuit at one or more operating frequencies to inductively transfer power from the charger to the receiver when the receiver is positioned in the power transfer position, wherein when the receiver is positioned in the power transfer position, a turned circuit, which includes the charger coil and the resonant capacitor of the charger drive circuit and the solenoid and the resonant capacitor of the receiver electronic circuit, has a resonant frequency that allows the charger to transfer the power to the receiver at the one or more operating frequencies;

generating a magnetic field that is substantially perpendicular to the charger surface at a geometric center of the charger coil area; and

generating magnetic flux through the charger coil and through a first end of the solenoid when the receiver is placed in the power transfer position; and

when the receiver is in the power transfer position, the first end of the magnetic core is located proximate to the charger coil area above the charger surface to receive the magnetic flux from the charger coil area and guide the magnetic flux in a closed magnetic loop from the charger coil area through the solenoid and return through the charger magnetic layer to the charger coil area to form the closed magnetic loop.

REMARKS

Claims 21-50 are pending in the application.

Claims 21-50 have been allowed.

Claims 21, 32, 34-36, 39, 42, 43, 46, 49, and 50 have been amended.

The issue fee has not been paid.

Amendment to the Specification

The Summary, paragraph 0004 and the Abstract have been amended. No new matter has been added.

37 C.F.R. § 1.312 and MPEP §714.16 permit an applicant to amend an application after allowance and before payment of the issue fee (unless the amendment is required by the Office of Data Management). The MPEP §714.16 states that "where amendments of the type noted [below] are shown (A) to be needed for proper disclosure or protection of the invention, and (B) to require no substantial amount of additional work on the part of the Office, they may be considered and, if proper, entry may be recommended by the primary examiner." Types of amendments permitted under 37 C.F.R. § 1.312 include:

- **an amendment to the specification.**

The allowed claims differ from the claims filed in the original priority patent application for the *Present Application*. Applicant has amended the Summary paragraph 0004 and the Abstract to reflect the differences.

The amended Summary in paragraph 0004 incorporates elements directly from allowed claims 21, 46, 49, and 50.

The amended Abstract also incorporates elements directly from allowed claims 21, 46, 49, and 50.

Accordingly, the amendments to the Summary and Abstract are shown (i) to be needed for proper disclosure or protection of the invention, and (ii) to require no substantial amount of

additional work on the part of the Office, and, thus, comply with the requirements of 37 C.F.R. § 1.312 and MPEP §714.16.

Accordingly, Applicant respectfully requests entry of the amendments.

Amendment to the Claims

Types of amendments permitted under 37 C.F.R. § 1.312 and MPEP §714.16 also include:

- **an amendment to the claims.**

As shown below, the amendments to the claims also comply with 37 C.F.R. § 1.312 and MPEP §714.16.

- Claim 21 has been amended to:
    - properly indent lines 3-9 which follow "the charger includes:" on line 2;
    - for grammatical reasons to insert "and" at the end of line 9; and
    - move "the receiver includes" on line 12 to line 11 for clarity.
- Claim 32, line 3 has been amended to replace "elongated extended" with "extended" for clarity.
- Claims 34-36 have been amended to depend from claim 33 for proper antecedent basis.
    - Claim 34 refers to "communication," and claim 33, lines 6 and 7 first mentions "communication systems" and "to communicate."
    - Claims 35 and 36 refer to "the second mobile device," and claim 33, line 2 first mentions "a second mobile device."

- Claim 39 depends from claim 21. Claim 39, line 2 has been amended to recite "the receiver" for proper antecedent basis to "a receiver" as first mentioned in claim 21, line 10.

- Claim 42 has been amended to depend from claim 41 for proper antecedent basis. Claim 42, line 1 refers to "the energy storage device," and claim 41, line 2 first mentions "an energy storage device."

- Claim 43 includes a Markush group, and "or" on line 3 has been properly replaced with "and" in accordance with MPEP § 2117.

- Claim 46 has been amended for clarity. Line 8 has been amended to replace "to inductively transfer power to the receiver of a mobile device," with "to inductively transfer power to the receiver." Line 9 states "wherein the receiver is included in a mobile device." Thus, "of a mobile device" in line 8 is redundant.

- Claim 49, line 26 has been amended for clarity to replace "the first mobile device" with "the mobile device" because claim 49, line 1 refers to "A mobile device" and does not otherwise mention "a first" mobile device.

- Claim 50, line 5 has been amended for clarity to replace "the first mobile device" with "the mobile device" because claim 50, line 1 refers to "a mobile device" and does not otherwise mention "a first" mobile device.

Accordingly, the amendments to the claims are shown (A) to be needed for proper disclosure or protection of the invention, and (B) to require no substantial amount of additional work on the part of the Office, and, thus, comply with the requirements of 37 C.F.R. § 1.312 and MPEP §714.16.

Accordingly, Applicant respectfully requests entry of the amendments to the Specification and the Claims.

CERTIFICATE OF TRANSMISSION

I hereby certify that on February 16, 2022 this correspondence is being transmitted via the U.S. Patent & Trademark Office's electronic filing system.

/Kent B. Chambers/

Respectfully submitted,

/Kent B. Chambers/

Kent B. Chambers
Attorney for Applicant(s)
Reg. No. 38,839

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	17467032
Filing Date	2021-09-03
First Named Inventor	Afshin Partovi
Art Unit	2851
Examiner Name	Bryce M. Aisaka
Attorney Docket Number	AFPA-01039US4

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	4720667	A	1988-01-19	Lee et al.	
	2	6057668	A	2000-05-02	Chao	
	3	6028413	A	2000-02-22	Brockmann	

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20070103110	A1	2007-05-10	Sagoo	

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2]	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2851
	Examiner Name	Bryce M. Aisaka
	Attorney Docket Number	AFPA-01039US4

If you wish to add additional Foreign Patent Document citation information please click the Add button [Add]

NON-PATENT LITERATURE DOCUMENTS [Remove]

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1		

If you wish to add additional non-patent literature document citation information please click the Add button [Add]

EXAMINER SIGNATURE

Examiner Signature	/BRYCE M AISAKA/	Date Considered	02/16/2022

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

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2851
	Examiner Name	Bryce M. Aisaka
	Attorney Docket Number	AFPA-01039US4

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Kent B. Chambers/	Date (YYYY-MM-DD)	2022-01-31
Name/Print	Kent B. Chambers	Registration Number	38839

This collection of information is required by 37 CFR 1.97 and 1.98. 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 1 hour to complete, including gathering, preparing and submitting the completed application 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.**

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	17467032
Filing Date	2021-09-03
First Named Inventor	Afshin Partovi
Art Unit	2851
Examiner Name	Bryce M. Aisaka
Attorney Docket Number	AFPA-01039US4

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20080061733	A1	2008-03-13	Toya	

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							

If you wish to add additional Foreign Patent Document citation information please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2851
	Examiner Name	Bryce M. Aisaka
	Attorney Docket Number	AFPA-01039US4

	1	

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature	/BRYCE M AISAKA/	Date Considered	02/16/2022

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

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2851
	Examiner Name	Bryce M. Aisaka
	Attorney Docket Number	AFPA-01039US4

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Kent B. Chambers/	Date (YYYY-MM-DD)	2022-01-31
Name/Print	Kent B. Chambers	Registration Number	38839

This collection of information is required by 37 CFR 1.97 and 1.98. 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 1 hour to complete, including gathering, preparing and submitting the completed application 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.**

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

Electronic Acknowledgement Receipt	
EFS ID:	45016586
Application Number:	17467032
International Application Number:	
Confirmation Number:	1075
Title of Invention:	System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes
First Named Inventor/Applicant Name:	Afshin Partovi
Customer Number:	33438
Filer:	Kent Bryan Chambers
Filer Authorized By:	
Attorney Docket Number:	AFPA-01039US4
Receipt Date:	16-FEB-2022
Filing Date:	03-SEP-2021
Time Stamp:	18:08:12
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Amendment after Notice of Allowance (Rule 312)	AFPA-01039US4_1-312_Amendment_2022-02-16.pdf	154940 9d8ee0d6be34d56cffcb987f15501f229ab3d8da	no	18

Warnings:

Information:	
Total Files Size (in bytes):	154940

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s):	Afshin Partovi		
Applicant:	Mojo Mobility Inc.		
Title:	System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes		
Application No.:	17/467,032	Filed:	September 3, 2021
Confirmation No.	1075		
Examiner:	Bryce M. Aisaka	Group Art Unit:	2851
Docket No.:	AFPA-01039US4	Customer No.:	33438

ELECTRONICALLY FILED

Austin, Texas
February 16, 2022

AMENDMENT UNDER 37 C.F.R. § 1.312

This paper is submitted under and in compliance with 37 C.F.R. § 1.312. As explained in more detail below, Applicant respectfully submits that this amendment complies with 37 C.F.R. § 1.312 and MPEP §714.16. Entry of the amendment is respectfully requested.

The USPTO is also authorized to charge any underpayment of fees to Deposit Account No. 502264.

AMENDMENTS TO THE SPECIFICATION

Please amend Paragraph 0004 as follows:

[0004] In at least one embodiment, a system for inductive power transfer includes a charger. The charger is an inductive charger. The system also includes a first mobile device that includes a receiver to inductively receive power for the first mobile device. In at least one embodiment, a charger for inductive charging includes a printed circuit board having a charger coil, a substantially planar magnetic layer, a charger drive circuit, and means for positioning a receiver in a power transfer position. In at least one embodiment, a mobile device that receives power inductively includes a receiver to inductively receive power for the mobile device. In at least one embodiment, a method for inductive power transfer to a mobile device, which includes a receiver includes positioning the receiver in a power transfer position to inductively receive power from an inductive charger. The method further includes inductively transferring power from the charger to the receiver of the first mobile device. Described herein are systems and methods for enabling transfer of power, from a wireless charger or power supply, to one or more receivers placed on or near the wireless charger or power supply, including powering or charging one or multiple receivers or devices having small surface areas or volumes. In accordance with an embodiment, a receiver coil can be generally shaped as a blade or thin solenoid, which receives power inductively, which is then used to power or charge one or more electronic devices. Applications include inductive or magnetic charging and power, and particularly usage in mobile, electronic, electric, lighting, or other devices, batteries, power tools, kitchen, industrial, medical or dental, or military applications, vehicles, robots, trains, and other usages.

Please amend the Abstract on page 33 as follows:

Abstract:

A system for inductive power transfer includes a charger. The charger is an inductive charger. The system also includes a first mobile device that includes a receiver to inductively receive power for the first mobile device. A charger for inductive charging includes a printed circuit board having a charger coil, a substantially planar magnetic layer, a charger drive circuit, and means for positioning a receiver in a power transfer position. A mobile device that receives power inductively includes a receiver to inductively receive power for the mobile device. A method for inductive power transfer to a mobile device, which includes a receiver, includes

positioning the receiver in a power transfer position to inductively receive power from an inductive charger. The method further includes inductively transferring power from the charger to the receiver of the first mobile device. ~~Systems and methods for enabling transfer of power, from a wireless charger or power supply, to one or more receivers placed on or near the wireless charger or power supply, including powering or charging one or multiple receivers or devices having small surface areas or volumes. In accordance with an embodiment, a receiver coil can be generally shaped as a blade or thin solenoid, which receives power inductively, which is then used to power or charge one or more electronic devices. Applications include inductive or magnetic charging and power, and particularly usage in mobile, electronic, electric, lighting, or other devices, batteries, power tools, kitchen, industrial, medical or dental, or military applications, vehicles, robots, trains, and other usages.~~

AMENDMENTS TO THE CLAIMS

Claims 1-20 are canceled.

21. (Currently Amended) A system for inductive power transfer comprising:

a charger, wherein the charger is an inductive charger, and the charger includes:

a printed circuit board having a charger coil, wherein the charger coil has a substantially planar charger surface;

a substantially planar magnetic layer under the charger coil opposite the charger surface; and

a charger drive circuit, wherein the charger drive circuit includes a resonant capacitor and a FET switch to apply an alternating voltage to the charger coil; and

a first mobile device that includes a receiver to inductively receive power for the first mobile device, wherein the receiver includes:

~~the receiver includes:~~

a solenoid, wherein the solenoid includes:

a magnetic core having a relative magnetic permeability exceeding 1 and having first and second ends; and

Litz wire wrapped around a section of the magnetic core forming a wire wound section around the magnetic core, with the magnetic core extending beyond the wire wound section; and

a receiver electronic circuit, wherein the receiver electronic circuit includes a resonant capacitor and a rectifier; and

wherein:

the charger further includes a means for positioning the receiver in a power transfer position, proximate to the charger surface, to inductively transfer power to the receiver of the first mobile device;

the charger drive circuit is configured to drive the charger coil at one or more operating frequencies to inductively transfer power from the charger to the receiver when the receiver is positioned in the power transfer position,

wherein when the receiver is positioned in the power transfer position, a tuned circuit, including the charger coil and the resonant capacitor of the charger drive circuit and the solenoid and the resonant capacitor of the receiver electronic circuit, has a resonant frequency that allows the charger to transfer the power to the receiver at the one or more operating frequencies;

the charger coil includes a conductor patterned to include multiple, substantially concentric turns for generating a magnetic flux through a first end of the solenoid when the receiver is placed in the power transfer position, wherein an outermost of the concentric turns defines a perimeter of a charger coil area;

the multiple concentric turns, when driven by the charger drive circuit, generate a magnetic field that is substantially perpendicular to the charger surface at a geometric center of the charger coil area;

the charger coil area is larger than an area of the first end and larger than an area of the second end of the magnetic core of the solenoid;

the magnetic layer of the charger extends beyond the charger coil area; and

when the receiver is in the power transfer position, the first end of the magnetic core is located proximate to the charger coil area above the charger surface to receive magnetic flux from the charger coil area and guide the magnetic flux in a closed magnetic loop from the charger coil area through the solenoid and return through the charger magnetic layer to the charger coil area to form the closed magnetic loop.

22. (Previously Presented) The system of claim 21, wherein the charger coil is a single coil.

23. (Previously Presented) The system of claim 21, wherein when positioned in the power transfer position, a winding axis of the solenoid is positioned perpendicular to the charger surface.

24. (Previously Presented) The system of claim 21, wherein when the receiver is positioned in the power transfer position and when the charger is operated at an operating frequency near the resonance frequency of the tuned circuit to inductively transfer power from the charger to the receiver, the transfer of power from the charger to the receiver has a power transfer efficiency that exceeds 50%, wherein the power transfer efficiency is defined by power out of a rectifier in the receiver electronic circuit divided by power into the charger drive circuit.

25. (Previously Presented) The system of claim 21, wherein the charger coil area is at least ten times larger than the area of each of the ends of the magnetic core of the solenoid.

26. (Previously Presented) The system of claim 21, wherein the charger coil area is at least fifty times larger than the area of each of the ends of the magnetic core of the solenoid.

27. (Previously Presented) The system of claim 21, wherein the magnetic core of the solenoid has a cross sectional dimension in at least one end of 1 to 2 mm and has a length along a winding axis of 10 to 20 mm.

28. (Previously Presented) The system of claim 21, wherein the Litz wire is selected for operation at a frequency of greater than 205 kHz.

29. (Previously Presented) The system of claim 21, wherein when the receiver is positioned in the power transfer position, a winding axis of the solenoid is positioned at an angle relative to an axis perpendicular to the charger surface, wherein the angle is one of any angles relative to the axis perpendicular to the charger surface.

30. (Previously Presented) The system of claim 21, wherein the magnetic core of the solenoid comprises Ferrite material and the charger magnetic layer comprises Ferrite material.

31. (Previously Presented) The system of claim 21, wherein a center of the first end of the solenoid is positioned 1 mm or more away from the charger surface when the receiver is positioned in the power transfer position.

32. (Currently Amended) The system of claim 21, wherein when the receiver is positioned in the power transfer position, the magnetic core of the solenoid extends beyond the charger coil area in a preferential direction and the charger magnetic layer is also ~~elongated~~ extended in the preferential direction so that the magnetic flux returned during the provision of power to the mobile device flows from the solenoid back to the charger coil to close the magnetic loop.

33. (Previously Presented) The system of claim 21, wherein:
the charger is incorporated into a second mobile device;
the second mobile device includes an internal, rechargeable battery;
the second mobile device uses the internal battery to transfer power to and operate the charger for a period of time; and
the first and second mobile devices comprise Bluetooth communication systems to communicate with each other during non-power transfer operations.

34. (Currently Amended) The system of claim [[21]] 33, wherein no communication between the charger and the receiver occurs during power transfer.

35. (Currently Amended) The system of claim [[21]] 33, wherein the second mobile device further includes:
an additional inductive charger, wherein the additional inductive charger includes an additional charger coil to transfer power to additional mobile devices.

36. (Currently Amended) The system of claim [[21]] 33, wherein the receiver of the first mobile device is a first receiver, and the second mobile device includes a second receiver to inductively receive power to charge the internal, rechargeable battery of the second mobile device.

37. (Previously Presented) The system of claim 21, wherein:
the receiver and the charger include communication and control electronics circuits to communicate, between the receiver and the charger, information associated with the transfer of power to the first mobile device; and

the communication is through a charger antenna that includes the charger coil and a receiver antenna that includes the solenoid.

38. (Previously Presented) The system of claim 21, wherein the charger is incorporated into an enclosed volume for placement of the receiver in the power transfer position to receive inductive power.

39. (Currently Amended) The system of claim 21, wherein the charger initiates transferring power to the mobile device when a presence of [[a]] the receiver in the power transfer position is detected.

40. (Previously Presented) The system of claim 21, wherein the magnetic field from the system is guided and contained so that residual electromagnetic emissions near the system are within safe compliance values.

41. (Previously Presented) The system of claim 21 further comprising:

an energy storage device coupled to the receiver, wherein when the transfer of power to the receiver occurs, the transferred power charges the energy storage device.

42. (Currently Amended) The system of claim [[21]] 41 wherein the energy storage device includes a battery.

43. (Currently Amended) The system of claim 21, wherein the first mobile device is a member of a group consisting of: a remote controller, a mouse, a wearable electronic glass, [[or]] and a head-mounted display device.

44. (Previously Presented) The system of claim 21, wherein the means for positioning includes one or more magnets to position the receiver in the power transfer position.

45. (Previously Presented) The system of claim 21, wherein the means for positioning includes one or more members of a group consisting of visual, physical, or magnetic means to assist in positioning the receiver in the power transfer position.

46. (Currently Amended) A charger for inductive charging, the charger comprising:

a printed circuit board having a charger coil, wherein the charger coil has a substantially planar charger surface;

a substantially planar magnetic layer under the charger coil opposite the charger surface;

a charger drive circuit, wherein the charger drive circuit includes a resonant capacitor and a FET switch to apply an alternating voltage to the charger coil; and

means for positioning a receiver in a power transfer position, which is proximate to the charger surface, to inductively transfer power to the receiver, ~~of a mobile device,~~ wherein the receiver is included in a mobile device to inductively receive power for the mobile device, and the receiver includes:

a solenoid, wherein the solenoid includes:

a magnetic core having a relative magnetic permeability exceeding 1 and having first and second ends; and

Litz wire wrapped around a section of the magnetic core forming a wire wound section around the magnetic core, with the magnetic core extending beyond the wire wound section; and

a receiver electronic circuit, wherein the receiver electronic circuit includes a resonant capacitor and a rectifier; and

wherein:

the charger drive circuit is configured to drive the charger coil at one or more operating frequencies to inductively transfer power from the charger to the receiver when the receiver is positioned in the power transfer position, wherein when the receiver is positioned in the power transfer position, a turned circuit, which includes the charger coil and the resonant capacitor of the charger drive circuit and the solenoid and the resonant capacitor of the receiver electronic circuit, has a resonant frequency that allows the charger to transfer the power to the receiver at the one or more operating frequencies;

the charger coil includes a conductor patterned to include multiple, substantially concentric turns for generating a magnetic flux through a first end of the solenoid when the receiver is placed in the power transfer position,

wherein an outermost of the concentric turns defines a perimeter of a charger coil area;

the multiple substantially concentric turns, when driven by the charger drive circuit, generate a magnetic field that is substantially perpendicular to the charger surface at a geometric center of the charger coil area;

the charger coil area is larger than an area of the first end and larger than the area of the second end of the magnetic core of the solenoid;

the magnetic layer of the charger extends beyond the charger coil area; and

when the receiver is in the power transfer position, the first end of the magnetic core is located proximate to the charger coil area above the charger surface to receive magnetic flux from the charger coil area and guide the magnetic flux in a closed magnetic loop from the charger coil area through the solenoid and return through the charger magnetic layer to the charger coil area to form the closed magnetic loop.

47. (Previously Presented) The charger of claim 46, wherein the charger coil is a single coil.

48. (Previously Presented) The charger of claim 46, wherein when positioned in the power transfer position, a winding axis of the solenoid is positioned at an angle relative to an axis perpendicular to the charger surface, wherein the angle is one of any angle relative to the axis perpendicular to the charger surface.

49. (Currently Amended) A mobile device that receives power inductively, the mobile device comprising:

a receiver to inductively receive power for the mobile device; wherein:

the receiver includes:

a solenoid, wherein the solenoid includes:

a magnetic core having a relative magnetic permeability exceeding 1 and having first and second ends; and

a Litz wire wrapped around a section of the magnetic core forming a wire wound section around the magnetic core, with the

magnetic core extending beyond the wire wound section; and

a receiver electronic circuit, wherein the receiver electronic circuit includes a resonant capacitor and a rectifier; and

when the receiver is positioned proximate to a charger surface of an inductive charger, the receiver receives power from the charger, and the charger includes:

a printed circuit board having a charger coil, wherein the charger surface is a substantially planar surface of the charger coil;

a substantially planar magnetic layer under the charger coil opposite the charger surface;

a charger drive circuit, wherein the charger drive circuit includes a resonant capacitor and a FET switch to apply an alternating voltage to the charger coil; and

means for positioning the receiver in a power transfer position, which is proximate to the charger, to inductively transfer power to the receiver of the [[first]] mobile device;

wherein:

the charger drive circuit is configured to drive the charger coil at one or more operating frequencies to inductively transfer power from the charger to the receiver when the receiver is positioned in the power transfer position, wherein when the receiver is positioned in the power transfer position, a tuned circuit, which includes the charger coil and the resonant capacitor of the charger drive circuit and the solenoid and the resonant capacitor of the receiver electronic circuit, has a resonant frequency that allows the charger to transfer the power to the receiver at the one or more operating frequencies;

the charger coil includes a conductor patterned to include multiple, substantially concentric turns for generating a magnetic

flux through a first end of the solenoid when the receiver is placed in the power transfer position, wherein an outermost of the concentric turns defines a perimeter of a charger coil area;

the multiple concentric turns, when driven by the charger drive circuit, generate a magnetic field that is substantially perpendicular to the charger surface at the charger surface at a geometric center of the charger coil area;

the charger coil area is larger than an area of the first end and larger than an area of the second end of the magnetic core of the solenoid;

the magnetic layer of the charger extends beyond the charger coil area; and

when the receiver is in the power transfer position, the first end of the magnetic core is located proximate to the charger coil area above the charger surface to receive magnetic flux from the charger coil area and guide the magnetic flux in a closed magnetic loop from the charger coil area through the solenoid and return through the charger magnetic layer to the charger coil area to form the closed magnetic loop.

50. (Currently Amended) A method for inductive power transfer to a mobile device, wherein the mobile device includes a receiver, the method comprising:

positioning the receiver in a power transfer position to inductively receive power from an inductive charger; and

inductively transferring power from the charger to the receiver of the [[first]] mobile device;

wherein:

the charger includes:

a printed circuit board having a charger coil, wherein the charger coil has a substantially planar charger surface, and the charger coil includes a

conductor patterned to include multiple, substantially concentric turns and an outermost of the concentric turns defines a perimeter of a charger coil area;

a substantially planar magnetic layer under the charger coil opposite the charger surface, wherein the magnetic layer of the charger extends beyond the charger coil area; and

a charger drive circuit, wherein the charger drive circuit includes a resonant capacitor and a FET switch to apply an alternating voltage to the charger coil;

the receiver includes:

a solenoid, wherein the solenoid includes:

a magnetic core having a relative magnetic permeability exceeding 1 and having first and second ends; and

Litz wire wrapped around a section of the magnetic core forming a wire wound section around the magnetic core, with the magnetic core extending beyond the wire wound section; and

a receiver electronic circuit, wherein the receiver electronic circuit includes a resonant capacitor and a rectifier; and

inductively transferring power from the charger to the receiver comprises:

driving the charger coil with the charger driver circuit at one or more operating frequencies to inductively transfer power from the charger to the receiver when the receiver is positioned in the power transfer position, wherein when the receiver is positioned in the power transfer position, a turned circuit, which includes the charger coil and the resonant capacitor of the charger drive circuit and the solenoid and the resonant capacitor of the receiver electronic circuit, has a resonant frequency that allows the charger to transfer the power to the receiver at the one or more operating frequencies;

generating a magnetic field that is substantially perpendicular to the charger surface at a geometric center of the charger coil area; and

generating magnetic flux through the charger coil and through a first end of the solenoid when the receiver is placed in the power transfer position; and

when the receiver is in the power transfer position, the first end of the magnetic core is located proximate to the charger coil area above the charger surface to receive the magnetic flux from the charger coil area and guide the magnetic flux in a closed magnetic loop from the charger coil area through the solenoid and return through the charger magnetic layer to the charger coil area to form the closed magnetic loop.

REMARKS

Claims 21-50 are pending in the application.

Claims 21-50 have been allowed.

Claims 21, 32, 34-36, 39, 42, 43, 46, 49, and 50 have been amended.

The issue fee has not been paid.

Amendment to the Specification

The Summary, paragraph 0004 and the Abstract have been amended. No new matter has been added.

37 C.F.R. § 1.312 and MPEP §714.16 permit an applicant to amend an application after allowance and before payment of the issue fee (unless the amendment is required by the Office of Data Management). The MPEP §714.16 states that "where amendments of the type noted [below] are shown (A) to be needed for proper disclosure or protection of the invention, and (B) to require no substantial amount of additional work on the part of the Office, they may be considered and, if proper, entry may be recommended by the primary examiner." Types of amendments permitted under 37 C.F.R. § 1.312 include:

- **an amendment to the specification.**

The allowed claims differ from the claims filed in the original priority patent application for the *Present Application*. Applicant has amended the Summary paragraph 0004 and the Abstract to reflect the differences.

The amended Summary in paragraph 0004 incorporates elements directly from allowed claims 21, 46, 49, and 50.

The amended Abstract also incorporates elements directly from allowed claims 21, 46, 49, and 50.

Accordingly, the amendments to the Summary and Abstract are shown (i) to be needed for proper disclosure or protection of the invention, and (ii) to require no substantial amount of

additional work on the part of the Office, and, thus, comply with the requirements of 37 C.F.R. § 1.312 and MPEP §714.16.

Accordingly, Applicant respectfully requests entry of the amendments.

Amendment to the Claims

Types of amendments permitted under 37 C.F.R. § 1.312 and MPEP §714.16 also include:

- **an amendment to the claims.**

As shown below, the amendments to the claims also comply with 37 C.F.R. § 1.312 and MPEP §714.16.

- Claim 21 has been amended to:
    - properly indent lines 3-9 which follow "the charger includes:" on line 2;
    - for grammatical reasons to insert "and" at the end of line 9; and
    - move "the receiver includes" on line 12 to line 11 for clarity.
- Claim 32, line 3 has been amended to replace "elongated extended" with "extended" for clarity.
- Claims 34-36 have been amended to depend from claim 33 for proper antecedent basis.
    - Claim 34 refers to "communication," and claim 33, lines 6 and 7 first mentions "communication systems" and "to communicate."
    - Claims 35 and 36 refer to "the second mobile device," and claim 33, line 2 first mentions "a second mobile device."

- Claim 39 depends from claim 21. Claim 39, line 2 has been amended to recite "the receiver" for proper antecedent basis to "a receiver" as first mentioned in claim 21, line 10.

- Claim 42 has been amended to depend from claim 41 for proper antecedent basis. Claim 42, line 1 refers to "the energy storage device," and claim 41, line 2 first mentions "an energy storage device."

- Claim 43 includes a Markush group, and "or" on line 3 has been properly replaced with "and" in accordance with MPEP § 2117.

- Claim 46 has been amended for clarity. Line 8 has been amended to replace "to inductively transfer power to the receiver of a mobile device," with "to inductively transfer power to the receiver." Line 9 states "wherein the receiver is included in a mobile device." Thus, "of a mobile device" in line 8 is redundant.

- Claim 49, line 26 has been amended for clarity to replace "the first mobile device" with "the mobile device" because claim 49, line 1 refers to "A mobile device" and does not otherwise mention "a first" mobile device.

- Claim 50, line 5 has been amended for clarity to replace "the first mobile device" with "the mobile device" because claim 50, line 1 refers to "a mobile device" and does not otherwise mention "a first" mobile device.

Accordingly, the amendments to the claims are shown (A) to be needed for proper disclosure or protection of the invention, and (B) to require no substantial amount of additional work on the part of the Office, and, thus, comply with the requirements of 37 C.F.R. § 1.312 and MPEP §714.16.

Accordingly, Applicant respectfully requests entry of the amendments to the Specification and the Claims.

CERTIFICATE OF TRANSMISSION

I hereby certify that on February 16, 2022 this correspondence is being transmitted via the U.S. Patent & Trademark Office's electronic filing system.

/Kent B. Chambers/

Respectfully submitted,

/Kent B. Chambers/

Kent B. Chambers
Attorney for Applicant(s)
Reg. No. 38,839

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

NOTICE OF ALLOWANCE AND FEE(S) DUE

33438 7590 02/02/2022

TERRILE, CANNATTI & CHAMBERS, LLP
P.O. BOX 203518
AUSTIN, TX 78720

EXAMINER	
AISAKA, BRYCE M	
ART UNIT	PAPER NUMBER
2851	

DATE MAILED: 02/02/2022

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/467,032	09/03/2021	Afshin Partovi	AFPA-01039US4	1075

TITLE OF INVENTION: System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$600	$0.00	$0.00	$600	05/02/2022

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

33438 7590 02/02/2022
TERRILE, CANNATTI & CHAMBERS, LLP
P.O. BOX 203518
AUSTIN, TX 78720

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/467,032	09/03/2021	Afshin Partovi	AFPA-01039US4	1075

TITLE OF INVENTION: System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$600	$0.00	$0.00	$600	05/02/2022

EXAMINER	ART UNIT	CLASS-SUBCLASS
AISAKA, BRYCE M	2851	320-108000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ❑Issue Fee ❑Publication Fee (if required) ❑Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/467,032	09/03/2021	Afshin Partovi	AFPA-01039US4	1075

33438 7590 02/02/2022

TERRILE, CANNATTI & CHAMBERS, LLP
P.O. BOX 203518
AUSTIN, TX 78720

EXAMINER	
AISAKA, BRYCE M	

ART UNIT	PAPER NUMBER
2851	

DATE MAILED: 02/02/2022

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. 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 30 minutes to complete, including gathering, preparing, and submitting the completed application 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, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 17/467,032	Applicant(s) Partovi, Afshin	
	Examiner BRYCE M AISAKA	Art Unit 2851	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to the papers filed 1/10/22.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 21-50 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some* c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☐ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/BRYCE M AISAKA/
Primary Examiner, Art Unit 2851

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/467,032	Partovi, Afshin
	Examiner	**Art Unit**
	BRYCE M AISAKA	2851

CPC						
Symbol					**Type**	**Version**
B60L	/	53	/	12	F	2019-02-01
H02J	/	50	/	12	I	2016-02-01
H02J	/	50	/	40	I	2016-02-01
H02J	/	50	/	70	I	2016-02-01
H02J	/	50	/	90	I	2016-02-01
H01F	/	38	/	14	I	2013-01-01

CPC Combination Sets							
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	30	
/BRYCE M AISAKA/ Primary Examiner, Art Unit 2851	14 January 2022	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	21	1

U.S. Patent and Trademark Office — Part of Paper No.: 20220114

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/467,032	Partovi, Afshin
	Examiner	**Art Unit**
	BRYCE M AISAKA	2851

INTERNATIONAL CLASSIFICATION				
CLAIMED				
H02J50/12	/	50	/	12
H02J50/40	/	50	/	40
H02J50/70	/	50	/	70
H02J50/90	/	50	/	90

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**
320	108

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					
320	107	114	115			

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	30	
/BRYCE M AISAKA/ Primary Examiner, Art Unit 2851	14 January 2022	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	21	1

U.S. Patent and Trademark Office — Part of Paper No.: 20220114

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/467,032	Partovi, Afshin
	Examiner	**Art Unit**
	BRYCE M AISAKA	2851

☐ Claims renumbered in the same order as presented by applicant ☑ CPA ☐ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	21	10	30	19	39	28	48								
2	22	11	31	20	40	29	49								
3	23	12	32	21	41	30	50								
4	24	13	33	22	42										
5	25	14	34	23	43										
6	26	15	35	24	44										
7	27	16	36	25	45										
8	28	17	37	26	46										
9	29	18	38	27	47										

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	30	
/BRYCE M AISAKA/ Primary Examiner, Art Unit 2851	14 January 2022	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	21	1

U.S. Patent and Trademark Office Part of Paper No.: 20220114

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/467,032	Partovi, Afshin
	Examiner	Art Unit
	BRYCE M AISAKA	2851

CPC - Searched*		
Symbol	Date	Examiner
H02J	12/21/2021	BA

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner
320	108	12/21/2021	BA

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
Inventor Search	12/21/2021	BA
PLUS Search	12/21/2021	BA
PE2E Keyword Search	12/21/2021	BA
IEEE Search	12/21/2021	BA

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
320	107, 108, 114, 115	01/14/2022	BA

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	17467032
Filing Date	2021-09-03
First Named Inventor	Afshin Partovi
Art Unit	2851
Examiner Name	Bryce M. Aisaka
Attorney Docket Number	AFPA-01039US4

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	8169185	B2	2012-05-01	Partovi et al.	
	2	8947047	B2	2015-02-03	Partovi et al	
	3	9276437	B2	2016-03-01	Partovi et al	
	4	9601943	B2	2017-03-21	Partovi et al	
	5	10044229	B2	2018-08-07	Partovi et al	

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

EFS Web 2.1.18

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2851
	Examiner Name	Bryce M. Aisaka
	Attorney Docket Number	AFPA-01039US4

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2]	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							

If you wish to add additional Foreign Patent Document citation information please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1		

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature	/BRYCE M AISAKA/	Date Considered	01/14/2022

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

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2851
	Examiner Name	Bryce M. Aisaka
	Attorney Docket Number	AFPA-01039US4

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

☒ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Kent B. Chambers/	Date (YYYY-MM-DD)	2022-01-10
Name/Print	Kent B. Chambers	Registration Number	38839

This collection of information is required by 37 CFR 1.97 and 1.98. 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 1 hour to complete, including gathering, preparing and submitting the completed application 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.**

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

PE2E SEARCH - Search History (Prior Art)

There are no Prior Art searches to show.

PE2E SEARCH - Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
N35	14	(receiver with (solenoid helix helical)) and (((induct$3 wireless contactless) with charg$3)) and (320/107,108,114,115.ccls.)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/01/14 04:36 PM
N36	0	(wireless SAME charging SAME solenoid SAME magnetic SAME concentric SAME flux).clm.	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/01/14 04:38 PM

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	17467032
Filing Date	2021-09-03
First Named Inventor	Afshin Partovi
Art Unit	2851
Examiner Name	Bryce M. Aisaka
Attorney Docket Number	AFPA-01039US4

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	4720667	A	1988-01-19	Lee et al.	
	2	6057668	A	2000-05-02	Chao	
	3	6028413	A	2000-02-22	Brockmann	

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20070103110	A1	2007-05-10	Sagoo	

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2851
	Examiner Name	Bryce M. Aisaka
	Attorney Docket Number	AFPA-01039US4

If you wish to add additional Foreign Patent Document citation information please click the Add button [Add]

NON-PATENT LITERATURE DOCUMENTS [Remove]

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1		

If you wish to add additional non-patent literature document citation information please click the Add button [Add]

EXAMINER SIGNATURE

Examiner Signature		Date Considered	

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

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2851
	Examiner Name	Bryce M. Aisaka
	Attorney Docket Number	AFPA-01039US4

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Kent B. Chambers/	Date (YYYY-MM-DD)	2022-01-31
Name/Print	Kent B. Chambers	Registration Number	38839

This collection of information is required by 37 CFR 1.97 and 1.98. 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 1 hour to complete, including gathering, preparing and submitting the completed application 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.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	17467032
Filing Date	2021-09-03
First Named Inventor	Afshin Partovi
Art Unit	2851
Examiner Name	Bryce M. Aisaka
Attorney Docket Number	AFPA-01039US4

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20080061733	A1	2008-03-13	Toya	

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							

If you wish to add additional Foreign Patent Document citation information please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2851
	Examiner Name	Bryce M. Aisaka
	Attorney Docket Number	AFPA-01039US4

	1	

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature		Date Considered	

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

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2851
	Examiner Name	Bryce M. Aisaka
	Attorney Docket Number	AFPA-01039US4

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Kent B. Chambers/	Date (YYYY-MM-DD)	2022-01-31
Name/Print	Kent B. Chambers	Registration Number	38839

This collection of information is required by 37 CFR 1.97 and 1.98. 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 1 hour to complete, including gathering, preparing and submitting the completed application 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.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Patent Application Fee Transmittal					
Application Number:	17467032				
Filing Date:	03-Sep-2021				
Title of Invention:	System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes				
First Named Inventor/Applicant Name:	Afshin Partovi				
Filer:	Kent Bryan Chambers/Anita Chambers				
Attorney Docket Number:	AFPA-01039US4				
Filed as Large Entity					
Filing Fees for Utility under 35 USC 111(a)					
Description		**Fee Code**	**Quantity**	**Amount**	**Sub-Total in USD($)**
Basic Filing:					
Pages:					
Claims:					
Miscellaneous-Filing:					
Petition:					
Patent-Appeals-and-Interference:					
Post-Allowance-and-Post-Issuance:					
Extension-of-Time:					

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
SUBMISSION- INFORMATION DISCLOSURE STMT	1806	1	260	260
		Total in USD ($)		**260**

Electronic Acknowledgement Receipt	
EFS ID:	44879009
Application Number:	17467032
International Application Number:	
Confirmation Number:	1075
Title of Invention:	System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes
First Named Inventor/Applicant Name:	Afshin Partovi
Customer Number:	33438
Filer:	Kent Bryan Chambers/Anita Chambers
Filer Authorized By:	Kent Bryan Chambers
Attorney Docket Number:	AFPA-01039US4
Receipt Date:	31-JAN-2022
Filing Date:	03-SEP-2021
Time Stamp:	15:26:32
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$260
RAM confirmation Number	E20221UF28153095
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	AFPA-01039US4_IDS7_2022-01-31.pdf	1034445 b08ab985131faff29db96c663b67ff86dee92431	no	4
Warnings:					
Information:					
2	Information Disclosure Statement (IDS) Form (SB08)	AFPA-01039US4_IDS9_2022-01-31.pdf	1034346 b4f16385a41266d04e7f02d3ef479bb11a20c0ec	no	4
Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	38394 c847d6b2b55b0575da148c3d7f37ff8ec9f8bef1	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	2107185		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

<u>New Applications Under 35 U.S.C. 111</u>
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
<u>National Stage of an International Application under 35 U.S.C. 371</u>
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
<u>New International Application Filed with the USPTO as a Receiving Office</u>
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	17467032
Filing Date	2021-09-03
First Named Inventor	Afshin Partovi
Art Unit	2851
Examiner Name	Bryce M. Aisaka
Attorney Docket Number	AFPA-01039US4

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	8169185	B2	2012-05-01	Partovi et al.	
	2	8947047	B2	2015-02-03	Partovi et al	
	3	9276437	B2	2016-03-01	Partovi et al	
	4	9601943	B2	2017-03-21	Partovi et al	
	5	10044229	B2	2018-08-07	Partovi et al	

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2851
	Examiner Name	Bryce M. Aisaka
	Attorney Docket Number	AFPA-01039US4

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2]	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							

If you wish to add additional Foreign Patent Document citation information please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1		

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature		Date Considered	

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

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2851
	Examiner Name	Bryce M. Aisaka
	Attorney Docket Number	AFPA-01039US4

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

☒ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Kent B. Chambers/	Date (YYYY-MM-DD)	2022-01-10
Name/Print	Kent B. Chambers	Registration Number	38839

This collection of information is required by 37 CFR 1.97 and 1.98. 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 1 hour to complete, including gathering, preparing and submitting the completed application 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.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Patent Application Fee Transmittal	
Application Number:	17467032
Filing Date:	03-Sep-2021
Title of Invention:	System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes
First Named Inventor/Applicant Name:	Afshin Partovi
Filer:	Kent Bryan Chambers/Anita Chambers
Attorney Docket Number:	AFPA-01039US4
Filed as Large Entity	
Filing Fees for Utility under 35 USC 111(a)	

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
SUBMISSION- INFORMATION DISCLOSURE STMT	1806	1	260	260
		Total in USD ($)		**260**

Electronic Acknowledgement Receipt	
EFS ID:	44710825
Application Number:	17467032
International Application Number:	
Confirmation Number:	1075
Title of Invention:	System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes
First Named Inventor/Applicant Name:	Afshin Partovi
Customer Number:	33438
Filer:	Kent Bryan Chambers/Anita Chambers
Filer Authorized By:	Kent Bryan Chambers
Attorney Docket Number:	AFPA-01039US4
Receipt Date:	10-JAN-2022
Filing Date:	03-SEP-2021
Time Stamp:	18:17:51
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$260
RAM confirmation Number	E202210I18554887
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	AFPA-01039USF_IDS6_2022-01-10.pdf	1034409 eddd4f605942c4bc51bb4e7930b20a5269d616aa	no	4
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	38394 957b7b23ff8028acb62951c883ca1750b17981d1	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	1072803		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 17/467,032	Filing Date 09/03/2021	☐ To be Mailed

ENTITY: ☐ LARGE ☑ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

	(Column 1)	(Column 2)			
FOR	NUMBER FILED	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 $50 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $240 =	
☐ 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

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	01/07/2022	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 30	Minus	** 30	= 0		x $50 =	0
	Independent (37 CFR 1.16(h))	* 4	Minus	*** 4	= 0		x $240 =	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

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ 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.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/TRACEY T BELL/
*** 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.	

This collection of information is required by 37 CFR 1.16. 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 12 minutes to complete, including gathering, preparing, and submitting the completed application 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.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Electronic Acknowledgement Receipt	
EFS ID:	44693803
Application Number:	17467032
International Application Number:	
Confirmation Number:	1075
Title of Invention:	System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes
First Named Inventor/Applicant Name:	Afshin Partovi
Customer Number:	33438
Filer:	Kent Bryan Chambers
Filer Authorized By:	
Attorney Docket Number:	AFPA-01039US4
Receipt Date:	07-JAN-2022
Filing Date:	03-SEP-2021
Time Stamp:	13:21:32
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Amendment/Req. Reconsideration-After Non-Final Reject	AFPA-01039US4_RNFOA_2021-12-27.pdf	114441 913512bf12fe4dd7a4c9c7b93a20fc43075b5097	no	13

Warnings:

Information:	
Total Files Size (in bytes):	114441

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s):	Afshin Partovi		
Applicant:	Mojo Mobility Inc.		
Title:	System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes		
Application No.:	17/467,032	Filed:	September 3, 2021
Confirmation No.	1075		
Examiner:	Bryce M. Aisaka	Group Art Unit:	2851
Docket No.:	AFPA-01039US4	Customer No.:	33438

ELECTRONICALLY FILED

Austin, Texas
January 7, 2022

RESPONSE TO NON-FINAL OFFICE ACTION

This paper is responsive to the Office Action dated December 27, 2021, having a shortened statutory period expiring March 27, 2022.Further examination and reconsideration are respectfully requested.

The USPTO is also authorized to charge any underpayment of fees to Deposit Account No. 502264.

Claims 1-20 are canceled.

21. (Previously Presented) A system for inductive power transfer comprising:

a charger, wherein the charger is an inductive charger, and the charger includes:

a printed circuit board having a charger coil, wherein the charger coil has a substantially planar charger surface;

a substantially planar magnetic layer under the charger coil opposite the charger surface; and

a charger drive circuit, wherein the charger drive circuit includes a resonant capacitor and a FET switch to apply an alternating voltage to the charger coil;

a first mobile device that includes a receiver to inductively receive power for the first mobile device, wherein:

the receiver includes:

a solenoid, wherein the solenoid includes:

a magnetic core having a relative magnetic permeability exceeding 1 and having first and second ends; and

Litz wire wrapped around a section of the magnetic core forming a wire wound section around the magnetic core, with the magnetic core extending beyond the wire wound section; and

a receiver electronic circuit, wherein the receiver electronic circuit includes a resonant capacitor and a rectifier; and

wherein:

the charger further includes a means for positioning the receiver in a power transfer position, proximate to the charger surface, to inductively transfer power to the receiver of the first mobile device;

the charger drive circuit is configured to drive the charger coil at one or more operating frequencies to inductively transfer power from the charger to the receiver when the receiver is positioned in the power transfer position, wherein when the receiver is positioned in the power transfer position, a tuned circuit, including the charger coil and the resonant capacitor of the

charger drive circuit and the solenoid and the resonant capacitor of the receiver electronic circuit, has a resonant frequency that allows the charger to transfer the power to the receiver at the one or more operating frequencies;

the charger coil includes a conductor patterned to include multiple, substantially concentric turns for generating a magnetic flux through a first end of the solenoid when the receiver is placed in the power transfer position, wherein an outermost of the concentric turns defines a perimeter of a charger coil area;

the multiple concentric turns, when driven by the charger drive circuit, generate a magnetic field that is substantially perpendicular to the charger surface at a geometric center of the charger coil area;

the charger coil area is larger than an area of the first end and larger than an area of the second end of the magnetic core of the solenoid;

the magnetic layer of the charger extends beyond the charger coil area; and

when the receiver is in the power transfer position, the first end of the magnetic core is located proximate to the charger coil area above the charger surface to receive magnetic flux from the charger coil area and guide the magnetic flux in a closed magnetic loop from the charger coil area through the solenoid and return through the charger magnetic layer to the charger coil area to form the closed magnetic loop.

22. (Previously Presented) The system of claim 21, wherein the charger coil is a single coil.

23. (Previously Presented) The system of claim 21, wherein when positioned in the power transfer position, a winding axis of the solenoid is positioned perpendicular to the charger surface.

24. (Previously Presented) The system of claim 21, wherein when the receiver is positioned in the power transfer position and when the charger is operated at an operating frequency near the resonance frequency of the tuned circuit to inductively transfer power from

the charger to the receiver, the transfer of power from the charger to the receiver has a power transfer efficiency that exceeds 50%, wherein the power transfer efficiency is defined by power out of a rectifier in the receiver electronic circuit divided by power into the charger drive circuit.

25. (Previously Presented) The system of claim 21, wherein the charger coil area is at least ten times larger than the area of each of the ends of the magnetic core of the solenoid.

26. (Previously Presented) The system of claim 21, wherein the charger coil area is at least fifty times larger than the area of each of the ends of the magnetic core of the solenoid.

27. (Previously Presented) The system of claim 21, wherein the magnetic core of the solenoid has a cross sectional dimension in at least one end of 1 to 2 mm and has a length along a winding axis of 10 to 20 mm.

28. (Previously Presented) The system of claim 21, wherein the Litz wire is selected for operation at a frequency of greater than 205 kHz.

29. (Previously Presented) The system of claim 21, wherein when the receiver is positioned in the power transfer position, a winding axis of the solenoid is positioned at an angle relative to an axis perpendicular to the charger surface, wherein the angle is one of any angles relative to the axis perpendicular to the charger surface.

30. (Previously Presented) The system of claim 21, wherein the magnetic core of the solenoid comprises Ferrite material and the charger magnetic layer comprises Ferrite material.

31. (Previously Presented) The system of claim 21, wherein a center of the first end of the solenoid is positioned 1 mm or more away from the charger surface when the receiver is positioned in the power transfer position.

32. (Previously Presented) The system of claim 21, wherein when the receiver is positioned in the power transfer position, the magnetic core of the solenoid extends beyond the charger coil area in a preferential direction and the charger magnetic layer is also elongated extended in the preferential direction so that the magnetic flux returned during the provision of

power to the mobile device flows from the solenoid back to the charger coil to close the magnetic loop.

33. (Previously Presented) The system of claim 21, wherein:

the charger is incorporated into a second mobile device;

the second mobile device includes an internal, rechargeable battery;

the second mobile device uses the internal battery to transfer power to and operate the charger for a period of time; and

the first and second mobile devices comprise Bluetooth communication systems to communicate with each other during non-power transfer operations.

34. (Previously Presented) The system of claim 21, wherein no communication between the charger and the receiver occurs during power transfer.

35. (Previously Presented) The system of claim 21, wherein the second mobile device further includes:

an additional inductive charger, wherein the additional inductive charger includes an additional charger coil to transfer power to additional mobile devices.

36. (Previously Presented) The system of claim 21, wherein the receiver of the first mobile device is a first receiver, and the second mobile device includes a second receiver to inductively receive power to charge the internal, rechargeable battery of the second mobile device.

37. (Previously Presented) The system of claim 21, wherein:

the receiver and the charger include communication and control electronics circuits to communicate, between the receiver and the charger, information associated with the transfer of power to the first mobile device; and

the communication is through a charger antenna that includes the charger coil and a receiver antenna that includes the solenoid.

38. (Previously Presented) The system of claim 21, wherein the charger is incorporated into an enclosed volume for placement of the receiver in the power transfer position to receive inductive power.

39. (Previously Presented) The system of claim 21, wherein the charger initiates transferring power to the mobile device when a presence of a receiver in the power transfer position is detected.

40. (Previously Presented) The system of claim 21, wherein the magnetic field from the system is guided and contained so that residual electromagnetic emissions near the system are within safe compliance values.

41. (Previously Presented) The system of claim 21 further comprising:

an energy storage device coupled to the receiver, wherein when the transfer of power to the receiver occurs, the transferred power charges the energy storage device.

42. (Previously Presented) The system of claim 21 wherein the energy storage device includes a battery.

43. (Previously Presented) The system of claim 21, wherein the first mobile device is a member of a group consisting of: a remote controller, a mouse, a wearable electronic glass, or a head-mounted display device.

44. (Previously Presented) The system of claim 21, wherein the means for positioning includes one or more magnets to position the receiver in the power transfer position.

45. (Previously Presented) The system of claim 21, wherein the means for positioning includes one or more members of a group consisting of visual, physical, or magnetic means to assist in positioning the receiver in the power transfer position.

46. (Previously Presented) A charger for inductive charging, the charger comprising:

a printed circuit board having a charger coil, wherein the charger coil has a substantially planar charger surface;

a substantially planar magnetic layer under the charger coil opposite the charger surface;

a charger drive circuit, wherein the charger drive circuit includes a resonant capacitor and a FET switch to apply an alternating voltage to the charger coil; and

means for positioning a receiver in a power transfer position, which is proximate to the charger surface, to inductively transfer power to the receiver of a mobile device, wherein the receiver is included in a mobile device to inductively receive power for the mobile device, and the receiver includes:

a solenoid, wherein the solenoid includes:

a magnetic core having a relative magnetic permeability exceeding 1 and having first and second ends; and

Litz wire wrapped around a section of the magnetic core forming a wire wound section around the magnetic core, with the magnetic core extending beyond the wire wound section; and

a receiver electronic circuit, wherein the receiver electronic circuit includes a resonant capacitor and a rectifier; and

wherein:

the charger drive circuit is configured to drive the charger coil at one or more operating frequencies to inductively transfer power from the charger to the receiver when the receiver is positioned in the power transfer position, wherein when the receiver is positioned in the power transfer position, a turned circuit, which includes the charger coil and the resonant capacitor of the charger drive circuit and the solenoid and the resonant capacitor of the receiver electronic circuit, has a resonant frequency that allows the charger to transfer the power to the receiver at the one or more operating frequencies;

the charger coil includes a conductor patterned to include multiple, substantially concentric turns for generating a magnetic flux through a first end of the solenoid when the receiver is placed in the power transfer position, wherein an outermost of the concentric turns defines a perimeter of a charger coil area;

the multiple substantially concentric turns, when driven by the charger drive circuit, generate a magnetic field that is substantially perpendicular to the charger surface at a geometric center of the charger coil area;

the charger coil area is larger than an area of the first end and larger than the area of the second end of the magnetic core of the solenoid;

the magnetic layer of the charger extends beyond the charger coil area; and

when the receiver is in the power transfer position, the first end of the magnetic core is located proximate to the charger coil area above the charger surface to receive magnetic flux from the charger coil area and guide the magnetic flux in a closed magnetic loop from the charger coil area through the solenoid and return through the charger magnetic layer to the charger coil area to form the closed magnetic loop.

47. (Currently Amended) The charger of claim [[21]] 46, wherein the charger coil is a single coil.

48. (Currently Amended) The charger of claim [[21]] 46, wherein when positioned in the power transfer position, a winding axis of the solenoid is positioned at an angle relative to an axis perpendicular to the charger surface, wherein the angle is one of any angle relative to the axis perpendicular to the charger surface.

49. (Previously Presented) A mobile device that receives power inductively, the mobile device comprising:

a receiver to inductively receive power for the mobile device; wherein:

the receiver includes:

a solenoid, wherein the solenoid includes:

a magnetic core having a relative magnetic permeability exceeding 1 and having first and second ends; and

a Litz wire wrapped around a section of the magnetic core forming a wire wound section around the magnetic core, with the magnetic core extending beyond the wire wound section; and

a receiver electronic circuit, wherein the receiver electronic circuit includes a resonant capacitor and a rectifier; and

when the receiver is positioned proximate to a charger surface of an inductive charger, the receiver receives power from the charger, and the charger includes:

a printed circuit board having a charger coil, wherein the charger surface is a substantially planar surface of the charger coil;

a substantially planar magnetic layer under the charger coil opposite the charger surface;

a charger drive circuit, wherein the charger drive circuit includes a resonant capacitor and a FET switch to apply an alternating voltage to the charger coil; and

means for positioning the receiver in a power transfer position, which is proximate to the charger, to inductively transfer power to the receiver of the first mobile device;

wherein:

the charger drive circuit is configured to drive the charger coil at one or more operating frequencies to inductively transfer power from the charger to the receiver when the receiver is positioned in the power transfer position, wherein when the receiver is positioned in the power transfer position, a tuned circuit, which includes the charger coil and the resonant capacitor of the charger drive circuit and the solenoid and the resonant capacitor of the receiver electronic circuit, has a resonant frequency that allows the charger to transfer the power to the receiver at the one or more operating frequencies;

the charger coil includes a conductor patterned to include multiple, substantially concentric turns for generating a magnetic flux through a first end of the solenoid when the receiver is placed in the power transfer position, wherein an outermost

of the concentric turns defines a perimeter of a charger coil area;

the multiple concentric turns, when driven by the charger drive circuit, generate a magnetic field that is substantially perpendicular to the charger surface at the charger surface at a geometric center of the charger coil area;

the charger coil area is larger than an area of the first end and larger than an area of the second end of the magnetic core of the solenoid;

the magnetic layer of the charger extends beyond the charger coil area; and

when the receiver is in the power transfer position, the first end of the magnetic core is located proximate to the charger coil area above the charger surface to receive magnetic flux from the charger coil area and guide the magnetic flux in a closed magnetic loop from the charger coil area through the solenoid and return through the charger magnetic layer to the charger coil area to form the closed magnetic loop.

50. (Previously Presented) A method for inductive power transfer to a mobile device, wherein the mobile device includes a receiver, the method comprising:

positioning the receiver in a power transfer position to inductively receive power from an inductive charger; and

inductively transferring power from the charger to the receiver of the first mobile device;

wherein:

the charger includes:

a printed circuit board having a charger coil, wherein the charger coil has a substantially planar charger surface, and the charger coil includes a conductor patterned to include multiple, substantially concentric turns and an outermost of the concentric turns defines a perimeter of a charger coil area;

a substantially planar magnetic layer under the charger coil opposite the charger surface, wherein the magnetic layer of the charger extends beyond the charger coil area; and

a charger drive circuit, wherein the charger drive circuit includes a resonant capacitor and a FET switch to apply an alternating voltage to the charger coil;

the receiver includes:

a solenoid, wherein the solenoid includes:

a magnetic core having a relative magnetic permeability exceeding 1 and having first and second ends; and

Litz wire wrapped around a section of the magnetic core forming a wire wound section around the magnetic core, with the magnetic core extending beyond the wire wound section; and

a receiver electronic circuit, wherein the receiver electronic circuit includes a resonant capacitor and a rectifier; and

inductively transferring power from the charger to the receiver comprises:

driving the charger coil with the charger driver circuit at one or more operating frequencies to inductively transfer power from the charger to the receiver when the receiver is positioned in the power transfer position, wherein when the receiver is positioned in the power transfer position, a turned circuit, which includes the charger coil and the resonant capacitor of the charger drive circuit and the solenoid and the resonant capacitor of the receiver electronic circuit, has a resonant frequency that allows the charger to transfer the power to the receiver at the one or more operating frequencies;

generating a magnetic field that is substantially perpendicular to the charger surface at a geometric center of the charger coil area; and

generating magnetic flux through the charger coil and through a first end of the solenoid when the receiver is placed in the power transfer position; and

when the receiver is in the power transfer position, the first end of the magnetic core is located proximate to the charger coil area above the charger surface to receive the magnetic flux from the charger coil area and guide the magnetic flux in a closed magnetic loop from the charger coil area through the solenoid and return through the charger magnetic layer to the charger coil area to form the closed magnetic loop.

REMARKS

Claims 21-50 are pending in the application.

Claims 22 and 47 are objected to.

Claims 21, 23-46 and 48-50 are allowed.

Claims 47 and 48 have been amended.

Claim Objections

Claims 22 and 47 are objected to for including the same limitations and both depend from claim 21.

Applicant has amended claim 47 to depend from independent claim 46.

Accordingly, Applicant respectfully requests withdrawal of the objection.

CONCLUSION

Applicant respectfully submits that all pending claims are in condition for allowance. Accordingly, Applicant requests that a Notice of Allowance be issued. Nonetheless, should any issues remain that might be subject to resolution through a telephone interview, the Examiner is requested to telephone the undersigned at 512-338-9100.

CERTIFICATE OF TRANSMISSION

I hereby certify that on January 7, 2022 this correspondence is being transmitted via the U.S. Patent & Trademark Office's electronic filing system.

/Kent B. Chambers/

Respectfully submitted,

/Kent B. Chambers/

Kent B. Chambers
Attorney for Applicant(s)
Reg. No. 38,839

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/467,032	09/03/2021	Afshin Partovi	AFPA-01039US4	1075

33438 7590 12/27/2021

TERRILE, CANNATTI & CHAMBERS, LLP
P.O. BOX 203518
AUSTIN, TX 78720

EXAMINER	
AISAKA, BRYCE M	

ART UNIT	PAPER NUMBER
2851	

NOTIFICATION DATE	DELIVERY MODE
12/27/2021	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

USPTO@dockettrak.com
celeste@tcciplaw.com
tmunoz@tcciplaw.com

Office Action Summary	Application No. 17/467,032	Applicant(s) Partovi, Afshin	
	Examiner BRYCE M AISAKA	Art Unit 2851	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 9/3/21.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 21-50 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☑ Claim(s) 21,23-46 and 48-50 is/are allowed.

7) ☐ Claim(s) _____ is/are rejected.

8) ☑ Claim(s) 22 and 47 is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on 11/22/21 is/are: a)☑ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Claim Objections

2. Claims 22 and 47 objected to because of the following informalities: Claim 22 appears to have the same limitations and dependencies as claim 47. Appropriate correction is required.

3. The examiner notes that claim 48 is not objected to but contains similar, though not identical, language to claim 23 and that claims 47 and 48 may have both been intended to be dependent on claim 46 or another independent claim.

Allowable Subject Matter

4. Claims 21, 23-46, and 48-50 allowed.

5. Claims 22 and 47 would be allowable if rewritten or amended to overcome the objections set forth in this Office action.

6. The following is a statement of reasons for the indication of allowable subject matter:

7. The prior art does not teach or suggest a system or method for wireless charging having the combination of steps or elements in the claims including, among other elements, the receiver coil, core, and wrapper configuration of claims 1, 46, 49, or 50, in combination with the charger and operation details of the claims.

Conclusion

8. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

9. Flowerdew et al. US 7,211,986 B1 discloses a wireless charger including coil and ferrite layers, without the receiver coil, core, and wrapper configuration of claims.

10. Grant et al. US 2012/0047972 A1 discloses an inductive charger including a display and internal battery, without the receiver coil, core, and wrapper configuration of claims.

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to BRYCE M AISAKA whose telephone number is (571)270-5808. The examiner can normally be reached M-F: 6:30AM-5:00PM PT.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jack Chiang can be reached on (571)272-7483. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of published or unpublished applications may be obtained from Patent Center. Unpublished application information in Patent Center is available to registered users. To file and manage patent submissions in Patent Center, visit: https://patentcenter.uspto.gov. Visit https://www.uspto.gov/patents/apply/patent-center for more information about Patent Center and

https://www.uspto.gov/patents/docx for information about filing in DOCX format. For additional questions, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/BRYCE M AISAKA/
Primary Examiner, Art Unit 2851

Notice of References Cited	Application/Control No. 17/467,032	Applicant(s)/Patent Under Reexamination Partovi, Afshin	
	Examiner BRYCE M AISAKA	Art Unit 2851	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20120047972-A1	03-2012	Grant; Jeffrey A.	E05B73/0017	70/77
*	B	US-7211986-B1	05-2007	Flowerdew; Peter M.	H02J7/0045	320/108
	C					
	D					
	E					
	F					
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/467,032	Partovi, Afshin
	Examiner	Art Unit
	BRYCE M AISAKA	2851

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	12/20/2021								
	21	=								
	22	O								
	23	=								
	24	=								
	25	=								
	26	=								
	27	=								
	28	=								
	29	=								
	30	=								
	31	=								
	32	=								
	33	=								
	34	=								
	35	=								
	36	=								
	37	=								
	38	=								
	39	=								
	40	=								
	41	=								
	42	=								
	43	=								
	44	=								
	45	=								
	46	=								
	47	O								
	48	=								
	49	=								
	50	=								

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/467,032	Partovi, Afshin
	Examiner	**Art Unit**
	BRYCE M AISAKA	2851

CPC - Searched*		
Symbol	**Date**	**Examiner**
H02J	12/21/2021	BA

CPC Combination Sets - Searched*		
Symbol	**Date**	**Examiner**

US Classification - Searched*			
Class	**Subclass**	**Date**	**Examiner**
320	108	12/21/2021	BA

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	**Date**	**Examiner**
Inventor Search	12/21/2021	BA
PLUS Search	12/21/2021	BA
PE2E Keyword Search	12/21/2021	BA
IEEE Search	12/21/2021	BA

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**

Bibliographic Data

Application No: 17/467,032

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /BRYCE M AISAKA/ (Examiner's Signature) | (Initials)

Title: System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
09/03/2021	320	2851	AFPA-01039US4
RULE			

APPLICANTS

Mojo Mobility Inc., Palo Alto, CA,

INVENTORS

Afshin Partovi, Palo Alto, CA, UNITED STATES

CONTINUING DATA

This application is a CON of 16819503 03/16/2020 PAT 11114886

16819503 is a CON of 15830411 12/04/2017 PAT 10594155

15830411 is a CON of 14252627 04/14/2014 PAT 9837846

14252627 has PRO of 61811638 04/12/2013

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

09/15/2021

**** SMALL ENTITY ****

STATE OR COUNTRY

UNITED STATES

ADDRESS

TERRILE, CANNATTI & CHAMBERS, LLP

P.O. BOX 203518

AUSTIN, TX 78720

UNITED STATES

FILING FEE RECEIVED

$3,000

PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L33	0	"17467032"	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2021/12/20 06:53 PM
L34	2938	320/108.ccls.	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/12/20 06:53 PM
L35	157	(receiver with coil with (solenoid helix helical)) and ((induct$3 wireless contactless) with charg$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/12/20 07:08 PM
L36	111	(H02J50/12 OR H02J7/025 OR H02J50/70 OR H02J50/90 OR H02J50/80 OR H02J50/50 OR H02J50/40 OR H02J50/10 OR H02J5/005 OR H02J50/60 OR H02J7/0042 OR H02J7/0029 OR H02J7/00 OR H02J7/00034 OR H02J7/0013 OR H02J50/402 OR H02J7/00302 OR H02J50/20 OR H02J50/005 OR H02J50/502 OR H02J7/0027 OR H02J7/00304 OR H02J2310/48 OR H02J7/00308 OR H02J7/0044 OR H02J7/00712 OR H02J7/0031 OR H02J7/007 OR H02J2310/44 OR H02J50/23 OR H02J7/00045 OR H02J7/02 OR H02J2310/40 OR H02J7/00714 OR H02J7/007194 OR H02J7/04 OR H02J7/345 OR H02J2207/50 OR H02J2310/22 OR H02J5/00 OR H02J50/001 OR H02J7/00032 OR	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/12/20 07:09 PM

		H02J7/0019 OR H02J7/0024 OR H02J7/0045 OR H02J7/0047 OR H02J7/0048 OR H02J7/0063).cpc. AND L35					
L37	30	(receiver with coil) same ((solenoid helix helical) with (litz multistrand))	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/12/20 07:25 PM
L38	3301	(power with (cell batter$3) with (source supply) with (internal inside integrated)) same ((induct$3 wireless contactless) with charg$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/12/20 09:10 PM
L39	4165	(coil with ferr$3 with induct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/12/20 09:16 PM
L40	107	L38 AND L39	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/12/20 09:17 PM
L42	50	("5648738" "5663626" "5742209" "5780736" "5892789" "6018644" "6232678" "4278108" "4387324" "4464595" "4475018" "4506350" "4554999" "4570100" "4616148" "4620812" "4628366" "4631419" "4794514" "4796585" "4832787" "4879503" "4881591" "4916408" "4922257" "4952790" "4975924" "5016237" "5021622" RE34295 "5266750" "5291861" "5296922" "5355094" "5393991" "5399905" "5408749" "5488285" "5504414" "5517401" "5541558" "5550353" "5557446" "5621292" "5628130" "5717398" "5769718" "5793339" "5794019" "5834930").pn.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2021/12/21 05:12 PM

PE2E SEARCH - Search History (Interference)

There are no Interference searches to show.

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	17467032
Filing Date	2021-09-03
First Named Inventor	Afshin Partovi
Art Unit	2859
Examiner Name	Undetermined
Attorney Docket Number	AFPA-01039US4

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							

If you wish to add additional Foreign Patent Document citation information please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

EFS Web 2.1.18

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	1	PCT International Search Report in connection with PCT application No. PCT/US2007/61406, 8 pages, dated February 14, 2008.	
	2	PCT International Search Report in connection with PCT application No. PCT/US2008/63084, 8 pages, dated August 8, 2008.	
	3	Office Action in connection with Application No. 13/442,698 dated September 13, 2012, 6 pages.	
	4	Office Action in connection with Application No. 12/116,876 dated May 2, 2011, 5 pages.	
	5	Office Action in connection with Application No. 11/669,113 dated May 13, 2010, 20 pages.	
	6	Office Action in connection with Application No. 11/669,113 dated August 25, 2009, 17 pages.	
	7	Office Action in connection with Application No. 11/669,113 dated October 29, 2008, 11 pages.	
	8	Office Action in connection with Application No. 13/113,977 dated November 9, 2012, 9 pages.	
	9	International Search Report and Written Opinion of the International Searching Authority, Korean Intellectual Property Office, in re International Application No. PCT/US2010/032845 dated December 13, 2010, 10 pages.	
	10	WildCharge Life unplugged!. http://www.wildcharg.com/4/17/2009, 2 pages	
	11	Powermat "the Future of Wireless Power has Arrived", http://www.pwrmal.com,4/15/2009, 2 pages	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	12	eCoupled Wireless Power Technology Fulton Innovation, http://www.ecoupled.com, 4/15/2009, 5 pages	
	13	Qualcomm Products and Services -Wirelss Airlink Technologies, http://www.qualcomm.com/products_services/airlinks, 4/15/2009, 4 pages	
	14	Office Action in connection with Application No. 11/757,067 dated January 26, 2009, 14 pages.	
	15	Office Action in connection with Application No. 11/757,067 dated October 19, 2009, 14 pages.	
	16	Office Action in connection with Application No. 11/757,067 dated May 10, 2010, 15 pages.	

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature	/BRYCE M AISAKA/	Date Considered	12/21/2021

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

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Kent B. Chambers/	Date (YYYY-MM-DD)	2021-11-05
Name/Print	Kent B. Chambers	Registration Number	38839

This collection of information is required by 37 CFR 1.97 and 1.98. 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 1 hour to complete, including gathering, preparing and submitting the completed application 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.**

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	17467032
Filing Date	2021-09-03
First Named Inventor	Afshin Partovi
Art Unit	2859
Examiner Name	Undetermined
Attorney Docket Number	AFPA-01039US4

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	8234189	B2	2012-01-31	Taylor et al.	
	2	8069100	B2	2011-11-29	Taylor et al.	
	3	6040680		2000-03-21	Shoichi Toya et al.	
	4	5311973		1994-05-17	Tseng	
	5	7804054		2010-09-28	Shalom	
	6	5925814		1999-07-20	Tsuzuki	
	7	5744933		1998-04-28	Inoue	
	8	5434493		1995-07-18	Woody	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	9	5963012		1999-10-05	Garcia	
	10	6870089		2005-03-02	Gray	
	11	3938018		1976-02-10	Dahl	
	12	5991170		1999-11-23	Nagai	
	13	5550452		1996-08-27	Shirai	
	14	6310465		2001-10-30	Najima	
	15	7026789		2006-04-11	Bozzone	
	16	7399202		2008-07-15	Dayan	
	17	6184654		2001-02-06	Bachner	
	18	7355150		2008-04-08	Baarman	
	19	7855529		2010-12-21	Xun Liu	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	20	7872445		2011-01-18	Shu-Yuen Ron Hui	
	21	6888438		2005-05-03	Shu-Yuen Ron Hui	
	22	6501364		2002-12-31	Shu-Yuen Ron Hui	
	23	6913477		2005-07-05	Dayan	
	24	4415959		1983-11-15	Vinciarelli	
	25	7311526		2007-12-25	Rohrbach	
	26	7645143		2010-01-12	Rohrbach	
	27	7554316		2009-06-30	Stevens	
	28	7605496		2009-10-20	Stevens	
	29	7164245		2007-01-16	Chen	
	30	8035255		2011-10-11	Kurs	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	31	7825543		2010-11-02	Karalis	
	32	7741734		2010-06-22	Joannopoulos	
	33	8049370		2011-11-01	Azancot	
	34	7906936		2011-03-15	Azancot	
	35	8040103		2011-10-18	Hui	
	36	7495414		2009-02-24	Hui	
	37	5642087		1997-06-24	Crow	
	38	4731585		1988-03-15	Fox	
	39	7781916		2010-08-24	Boys	
	40	8050068		2011-11-01	Hussmann	
	41	D639734		2011-06-14	Ferber	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	42	D625721		2010-10-19	Ferber	
	43	D624316		2010-09-28	Ferber	
	44	D611408		2010-03-09	Ferber	
	45	D611407		2010-03-09	Webb	
	46	D607879		2010-01-12	Ferber	
	47	D603603		2009-11-10	Laine	
	48	D636333		2011-04-19	Kulikowski	
	49	6906495		2005-06-14	Cheng	
	50	5959433		1999-09-28	Rohde	
	51	6208115		2001-03-27	Binder	
	52	5952814		1999-09-14	Van Lerbergne	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	53	6489745		2002-12-03	Koreis	
	54	6331744		2001-12-18	Chen	
	55	7336054		2005-03-09	Crisp	
	56	5803744	B1	2014-10-12	Anthony Sabo	
	57	6636017		2003-10-21	Zink et al	
	58	6586909		2003-07-01	Trepka	
	59	6462509		2002-10-08	Abe	
	60	6844702		2005-01-28	Giannopoulos	
	61	4311953		1982-01-19	Fukuda	
	62	6016046		2000-01-18	Kaile et al.	
	63	7164255	B2	2007-01-16	Shu-Yuen Ron Hui	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	64	6756765		2004-06-29	Bruning	
	65	6917182		2005-07-12	Burton	
	66	6741064		2004-05-25	Liu	
	67	6650088		2003-11-18	Webb	
	68	6697272		2004-02-24	Nanbu	
	69	6008622		1999-12-28	Nakawatase	
	70	6625477		2003-09-23	Wakefield	
	71	6436299		2002-08-20	Baarman	
	72	6673250		2004-01-06	Kuennen	
	73	6731071		2004-05-04	Baarman	
	74	6806649		2004-10-19	Mollema	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	75	6812645		2004-11-02	Baarman	
	76	6825620		2004-11-30	Kuennen	
	77	6831417		2004-12-14	Baarman	
	78	6917163		2005-07-12	Baarman	
	79	6943733		2005-09-13	Vance	
	80	6975198		2005-12-13	Baarman	
	81	7031662		2006-04-18	Suzuki	
	82	7116200		2006-10-03	Baarman	
	83	7118240		2006-10-10	Baarman	
	84	7126450		2006-10-24	Baarman	
	85	7132918		2006-11-07	Baarman	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	86	7162264		2007-01-09	Vance	
	87	7183870		2007-02-27	Takagi	
	88	7184706		2007-02-27	Someya	
	89	7209084		2007-04-24	Lindell	
	90	7221919		2007-05-22	Takagi	
	91	7305258		2007-12-04	Rydgren	
	92	7324051		2008-01-29	Hayes	
	93	7342539		2008-03-11	Rosenberg	
	94	7952322		2011-05-31	Partovi	
	95	7376408		2008-05-20	Hayes	
	96	7382636		2008-06-03	Baarman	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	97	7385357		2008-06-10	Kuennen	
	98	7388543		2008-06-17	Vance	
	99	7415248		2008-08-19	Andersson et al.	
	100	7462951		2008-12-09	Baarman	
	101	7477195		2009-01-13	Vance	
	102	7487921		2009-02-10	Takahashi	
	103	7498871		2009-03-03	Ruuswik	
	104	7948208		2011-05-24	Partovi	
	105	6803774		2004-10-12	Park	
	106	7378817		2008-05-27	Calhoon	
	107	4311853		1982-01-19	Cree	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	108	6798716		2004-09-28	Charych	
	109	5543702		1996-08-06	Pfeiffer	
	110	5991665		1999-11-23	Wang	
	111	6498455		2002-12-24	Zink	
	112	7443135		2008-10-28	Cho	
	113	6906495		2005-06-14	Cheng	
	114	6972543		2005-12-06	Wells	
	115	7042196		2006-05-09	Ka-Lai	
	116	7239110		2007-07-07	Cheng	
	117	5889384		1999-05-30	Hayes	
	118	7525283		2009-04-28	Cheng	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	119	7576514		2009-08-18	Hui	
	120	5237257		1993-08-17	Johnson	
	121	5656917		1997-08-12	Theobald	
	122	5696433		1997-12-09	Palino	
	123	6094119		2000-07-25	Reznik	
	124	6573817		2003-06-03	Gottschalk	
	125	7915858		2011-03-29	Liu	
	126	8169185		2012-05-01	Partovi	
	127	4800328		1989-01-24	Bolger	
	128	5367242		1994-11-22	Hulman	
	129	7151357		2006-12-19	Xian	

EFS Web 2.1.18

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20140339916	A1	2014-11-14	Fells et al.	
	2	20120259735	A1	2012-10-11	Taylor et al.	
	3	20120150670	A1	2012-06-14	Taylor et al.	
	4	20120119588	A1	2112-05-17	Baarman et al.	
	5	20120112552	A1	2012-05-10	Baarman et al.	
	6	20120041843	A1	2012-02-16	Taylor et al.	
	7	20100171369	A1	2010-07-08	Taylor et al.	
	8	20090212637	A1	2009-08-27	Baarman et al.	
	9	20090174263	A1	2009-07-09	Baarman et al.	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	10	20110221387		2011-09-15	Steigerwald	
	11	20040145343	A1	2004-07-29	Naskali	
	12	20070236174	A1	2007-10-11	Kaye	
	13	20090212639	A1	2009-08-27	Johnson	
	14	20100235006		2010-09-16	Brown	
	15	20100314946		2010-12-16	Budde	
	16	20110115430		2011-05-19	Saunamaki	
	17	20120049991		2012-03-01	Baarman	
	18	20120126745		2012-05-24	Partovi	
	19	20110222493		2011-09-15	Mangold	
	20	20120146576		2012-06-14	Partovi	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	21	20060105718		2006-05-18	Ozluturk	
	22	20120235636		2012-09-20	Partovi	
	23	20110193520		2011-08-11	Yamazaki	
	24	20100117596		2010-05-13	Cook	
	25	20100259401		2010-10-14	Azancot	
	26	20100257382		2010-10-07	Azancot	
	27	20100253282		2010-10-07	Azancot	
	28	20100244584		2010-09-30	Azancot	
	29	20100219698		2010-09-02	Azancot	
	30	20100219697		2010-09-02	Azancot et al.	
	31	20100219693		2010-09-02	Azancot	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	32	20100219183		2010-09-02	Azancot	
	33	20100194336		2010-08-05	Azancot	
	34	20100181841		2010-07-22	Azancot	
	35	20100073177		2010-03-25	Azancot	
	36	20100072825		2010-03-25	Azancot	
	37	20100070219		2010-03-18	Azancot	
	38	20100066176		2010-03-18	Azancot	
	39	20090257259		2009-10-15	Leibovitz	
	40	20060021926		2006-02-02	Woodard	
	41	20080067874		2008-03-20	Tseng	
	42	20080164839		2008-07-10	Kato	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	43	20090015075		2009-01-15	Cook	
	44	20090033564		2009-02-05	Cook	
	45	20110217927		2011-09-08	Ben-Shalom	
	46	20110157137		2011-06-30	Ben-Shalom	
	47	20110121660		2011-05-26	Azancot	
	48	20110062793		2011-03-17	Azancot	
	49	20100181845		2010-07-22	Fiorello	
	50	20100181843		2010-07-22	Schatz	
	51	20100187911		2010-07-29	Joannopoulos	
	52	20100171368		2010-07-08	Schatz	
	53	20100164298		2010-07-01	Karalis	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	54	20100164297		2010-07-01	Kurs	
	55	20100164296		2010-07-01	Kurs	
	56	20100148589		2010-06-17	Hamam	
	57	20100141042		2010-06-10	Kesler	
	58	20100133920		2010-06-03	Joannopoulos	
	59	20100133919		2010-06-03	Joannopoulos	
	60	20100133918		2010-06-03	Joannopoulos	
	61	20100127575		2010-05-27	Joannopoulos	
	62	20100127574		2010-05-27	Joannopoulos	
	63	20100127573		2010-05-27	Joannopoulos	
	64	20100123355		2010-05-20	Joannopoulos et al.	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	65	20100123354		2010-05-20	Joannopoulos	
	66	20100123353		2010-05-20	Joannopoulos	
	67	20100117456		2010-05-13	Karalis	
	68	20100117455		2010-05-13	Joannopoulos	
	69	20100109445		2010-05-06	Kurs	
	70	20100102641		2010-04-29	Joannopoulos	
	71	20100102640		2010-04-29	Joannopoulos	
	72	20100102639		2010-04-29	Joannopoulos	
	73	20100096934		2010-04-22	Joannopoulos	
	74	20090284083		2009-11-19	Karalis	
	75	20090267710		2009-10-29	Joannopoulos	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	76	20090267709		2009-10-29	Joannopoulos	
	77	20090224856		2009-09-10	Karalis	
	78	20090195333		2009-08-06	Joannopoulos	
	79	20090195332		2009-08-06	Joannopoulos	
	80	20080278264		2008-11-13	Karalis	
	81	20110266878		2008-11-13	Cook	
	82	20100038970		2010-02-18	Cook	
	83	20090243397		2009-10-01	Cook	
	84	20090224609		2009-09-10	Cook	
	85	20090224608		2009-09-10	Cook	
	86	20090213028		2009-08-27	Cook	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	87	20090212636		2009-08-27	Cook	
	88	20090167449		2009-07-02	Cook	
	89	20090134712		2009-05-28	Cook	
	90	20090102292		2009-04-23	Cook	
	91	20090079268		2009-03-26	Cook	
	92	20090072629		2009-03-19	Cook	
	93	20090072628		2009-03-19	Cook	
	94	20070109708		2007-05-17	Hussman	
	95	20070296393		2007-12-27	Malpas	
	96	20080247210		2008-10-09	Hu	
	97	20090284227		2009-11-19	Mohammadian	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	98	20100109443		2010-05-06	Cook	
	99	20100190435		2010-07-29	Cook	
	100	20100184371		2010-07-22	Cook	
	101	20100207572		2010-08-19	Kirby	
	102	20100253281		2010-10-07	Li	
	103	20060106965		2006-05-18	Falcon	
	104	20080014897		2008-01-17	Cook	
	105	20090127937		2009-05-21	Widmer	
	106	20090058189		2009-03-05	Cook	
	107	20090072627		2009-03-19	Cook	
	108	20020093309		2002-07-18	Peele	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	109	20100201313		2010-08-12	Vorenkamp	
	110	20090043727		2009-02-12	Cohen. Jr.	
	111	20100213895		2010-08-26	Keating	
	112	20100327804		2010-12-30	Takahashi	
	113	20110057606		2011-03-10	Saunamaki	
	114	20070139000		2007-06-21	Kozuma	
	115	20110050164		2011-03-03	Partovi	
	116	20110095617		2011-04-28	Cook	
	117	20100117454		2010-05-13	Cook	
	118	20060202665		2006-09-14	Hsu	
	119	20100127660		2010-05-27	Cook	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	120	20100190436		2010-07-29	Cook	
	121	20100277120		2010-11-04	Cook	
	122	20110090723		2011-04-21	Hu	
	123	20030210106		2003-11-13	Cheng	
	124	20050116683		2005-06-02	Cheng	
	125	20050162125		2005-07-28	Yu	
	126	20050140482		2005-06-30	Cheng	
	127	20050017677		2005-01-27	Burton	
	128	20060238930		2006-10-26	Baarman	
	129	20050135122		2005-06-23	Cheng	
	130	20060038794		2006-02-23	Schneidman	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	131	20070069687		2007-03-29	Suzuki	
	132	20060284593		2006-12-21	Nagy	
	133	20020004167		2002-01-10	Jenson	
	134	20020067238		2002-06-06	Leu	
	135	20050127869		2005-06-16	Calhoon	
	136	20050075696		2005-04-07	Forsberg	
	137	20050063488		2005-03-24	Troyk	
	138	20030214255		2003-11-20	Baarman	
	139	20040130915		2004-07-08	Baarman	
	140	20040130916		2004-07-08	Baarman	
	141	20020089305		2002-07-11	Park	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	142	20040222751		2004-11-11	Mollema	
	143	20040232845		2004-11-25	Baarman	
	144	20050007067		2005-01-13	Baarman	
	145	20050093475		2005-05-05	Kuennen	
	146	20050116650		2005-06-02	Baarman	
	147	20050122058		2005-06-09	Baarman	
	148	20050122059		2005-06-09	Baarman	
	149	20050127849		2005-06-16	Baarman	
	150	20050127850		2005-06-16	Baarman	
	151	20060132045		2006-06-22	Baarman	
	152	20040113589		2004-06-17	Crisp	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	153	20030094921		2003-05-22	Lau	
	154	20030103039		2003-06-05	Burr	
	155	20050127867		2005-06-16	Calhoon	
	156	20110221391		2011-09-15	Won	
	157	20060146517		2006-07-06	Park	
	158	20060205381		2006-09-14	Beart	
	159	20080258679		2008-10-23	Manico	
	160	20070178945		2007-08-02	Cook et al	
	161	20060108977		2006-05-25	Kagermeier	
	162	20100007307		2010-01-14	Baarman	
	163	20070279002		2007-12-07	Partovi	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	164	20100277121		2010-11-04	Hall	
	165	20090096413		2009-04-16	Partovi	
	166	20110012556		2011-01-20	Lai	
	167	20100081473		2010-04-01	Chatterjee	
	168	20110187318		2011-08-04	Hui	
	169	20090049554		2009-02-19	Vuong	

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2]	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	201200116054	WO		2012-08-30	Steele		
	2	2003045731	JP	A1	2003-02-14	NEC Tokin Corp.		
	3	2000341885	JP		2000-12-08	Matsushita Electric Works Ltd.		

EFS Web 2.1.18

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	4	100836634	KR		2008-04-29	Hanrim Postech Co., Ltd.		
	5	2009200174	JP		2009-09-03	Panasonic Electric Works Co., Ltd.		
	6	2005109597	WO		2005-11-17	Splashpower Limited		
	7	2005024865	WO		2005-03-17	Splashpower Limited		
	8	2004055654	WO		2004-07-01	Splashpower Limited		
	9	2004038887	WO		2004-05-06	Splashpower Limited		
	10	2004038888	WO		2004-05-06	Splashpower Limited		
	11	20030105311	WO		2003-12-18	Splashpower Limited		
	12	408000838	JP		1996-08-01	Sudo		
	13	2003096361	WO		2003-11-20	Splashpower Limited		
	14	2004030176	WO		2004-04-08	Splashpower Limited		

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	15	2008137996	WO		2008-11-13	Mojo Mobility. Inc.		
	16	20110156768	WO		2011-12-15	Partovi		
	17	2006500894	JP		2006-01-05	Beart		
	18	2006246633	JP		2006-09-14	Kamitsuma Yosuke		
	19	2003096512	WO		2003-11-20	Splashpower Limited		
	20	2003105308	WO		2003-12-18	City University of Hong Kong		
	21	2005109598	WO		2005-11-17	Splashpower Limited		

If you wish to add additional Foreign Patent Document citation information please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T5
	1	JAPANESE PATENT OFFICE, Office Action for Japanese Patent Application No. 2010-507666, March 9, 2015, 8 pages.	
	2	JAPANESE PATENT OFFICE, Office Action for Japanese Patent Application No. 2014-104181, March 23, 2015, 14 pages.	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	3	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U.S. Patent Application No. 13/830,161, April 16, 2015, 24 pages.	
	4	JAPANESE PATENT OFFICE, Examiner's Reconsideration Report for Japanese Patent Application No. 2010-507666, July 17, 2014, 1 page.	
	5	THE PATENT OFFICE OF THE PEOPLE'S REPUBLIC OF CHINA, 2nd Office Action for Chinese Patent Application No. 200880023854.4, April 15, 2013, 4 pages.	
	6	UNKNOWN AUTHOR, System Description Wireless Power Transfer, Volume 1: Low Power Part 1: Interface Definition, Version 1.0, July 2010, 83 pages.	
	7	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U.S. Patent Application No. 13/829,346, February 12, 2015, 10 pages.	
	8	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U.S. Patent Application No. 13/829,186, January 23, 2015, 12 pages.	
	9	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U.S. Patent Application No. 13/828,933, February 5, 2015, 11 pages.	
	10	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U.S. Patent Application No. 13/352,096, August 18, 2014, 14 pages.	
	11	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U.S. Patent Application No. 13/708,584, January 23, 2015, 25 pages.	
	12	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U.S. Patent Application No. 12/769,586, June 2, 2014, 23 pages.	
	13	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U.S. Patent Application No. 13/708,520, August 14, 2014, 9 pages.	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	14	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U.S. Patent Application No. 13/115,811, August 20, 2014, 20 pages.	
	15	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U.S. Patent Application No. 14/135,082, December 5, 2014, 14 pages.	
	16	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U.S. Patent Application No. 13/708,520, March 11, 2015, 10 pages.	
	17	INTERNATIONAL SEARCHING AUTHORITY AT THE U.S. PATENT AND TRADEMARK OFFICE, International Search Report and Written Opinion for PCT International Patent Application No. PCT/US2013/078534, May 13, 2014, 11 pages.	
	18	INTERNATIONAL SEARCHING AUTHORITY AND WRITTEN OPINION FROM THE U.S. PATENT AND TRADEMARK OFFICE, International Search Report and Written Opinion for PCT International Application No. PCT/US2013/069270, April 4, 2014, 9 pages.	
	19	HUI, "A New Generation of Universal Contactless Battery Charging Platform for Portable Consumer Electronic Equipment", IEEE Transactions on Power Electronics, Vol. 20, No. 3, May 2005, pp. 620-627, 8 pages	
	20	TANG, et al., "Evaluation of the Shielding Effects on Printed-Circuit-Board Transformers Using Ferrite Plates and Copper Sheets", IEEE Transactions on Power Electronics, Vol. 17, No. 6, November 2002, pp. 1080-1088, 9 pages.	
	21	LIU, et al., "An Analysis of a Double-Layer Electromagnetic Shield for a Universal Contactless Battery Charging Platform", Department of Electronic Engineering City University of Hong Kong, IEEE, 2005, pp. 1767-1772, 6 pages.	
	22	LIU, et al., "Equivalent Circuit Modeling of a Multilayer Planar Winding Array Structure for Use in a Universal Contactless Battery Charging Platform, IEEE Transactions on Power Electronics, Vol. 22, No. 1, January 2007, pp. 21-29, 9 pages	
	23	LIU, et al., "Simulation Study and Experimental Verification of a Universal Contactless Battery Charging Platform with Localized Charging Features", IEEE Transactions on Power Electronics, Vol. 22, No. 6, November 2007, pp. 2202-2210, 9 pages	
	24	LIU, et al., "Optimal Design of a Hybrid Winding Structure for Planar Contactless Battery Charging Platform", IEEE Transactions on Power Electronics, Vol. 23, No. 1, January 2008, pp. 455-463, 9 pages.	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	25	KARALIS, et al., "Efficient Wirelss Non-Radiative Mid-Range Energy Transfer", ScienceDirect, Annals of Physics 323, 2008, pp. 34-48, 15 pages.
	26	SU, et al., "Mutual Inductance Calculation of Movable Planar Coils on Parallel Surfaces", IEEE Transactions on Power Electronics, Vol. 24, No. 4, April 2009, pp. 1115-1124, 10 pages.
	27	HUI, et al., "Careless Printed Circuit Board (PCB) Transformers -- Fundamental Characteristics and Application Potential", IEEE Circuits and Systems, Vo. 11, No. 3, Third Quarter 2000, pp. 1-48, 48 pages.
	28	SEKITANI, et al., "A Large-Area Flexible Wireless Power Transmission Sheet Using Printed Plastic MEMS Switches and Organic Field-Effect Transistors", IEEE, Quantum-Phase Electronics Center, School of Engineering, The University of Tokyo, 2006, 4 pages.
	29	CHOI, et al., "A New Contactless Battery Charger for Portable Telecommunication/Compuing Electronics", IEEE, School of Electronic and Electrical Engineering, Kyungpook National University, Taegu, Korea, 2011, pp. 58-59 2 pages.
	30	HUI, et al., "Careless Printed Circuit Board (PCB) Transformers for Power MOSFET/IGBT Gate Drive Circuits", IEEE Transactions on Power Electronics, Vol. 14, No. 3, May 1999, pp. 422-430, 9 pages.
	31	TANG, et al., "Careless Planar Printed-Circuit-Board (PCB) Transformers --A Fundamental Concept for Signal and Energy Transfer", IEEE Transactions on Power Electronics, Vol.15, No. 5, September 2000, pp. 931-941, 11 pages.
	32	HATANAKA. et al.. "Power Transmission of a Desk with Cord-Free Power Supply". IEEE Transactions on Magnetics. Vol. 38. No. 5, September 2002, pp. 3329-3331, 3 pages.
	33	FERNANDEZ, et al., "Design Issues of a Core-less Transformer for a Contact-less Application", IEEE, Universidad Politecnica de Madrid, 2002, pp. 339-345, 7 pages.
	34	Office Action in connection with Application No. 113/155,811 dated March 8, 2013, 13 pages.
	35	LIU, et al., "Optimal Design of a Hybrid Winding Structure for Planar Contactless Battery Charging Platform", IEEE, Department of Electronic Engineering, City University of Hong Kong, 2006, pp. 2568-2575, 8 pages.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	36	TOPFER, et al., "Multi-Pole Magnetization of NdFeB Sintered Magnets and Thick Films for Magnetic Micro-Actuators", ScienceDirect, Sensor and Actuators, 2004, pp. 257-263, 7 pages.	
	37	TOPFER, et al., "Multi-Pole Magnetization of NdFeB Magnets for Magnetic Micro-Actuators and Its Characterization with a Magnetic Field Mapping Device", ScienceDirect, Journal of Magnetism and Magnetic Materials, 2004, 124-129, 6 pages.	
	38	SAKAMOTO, et al., "A Novel High Power Converter for Non-Contact Charging with Magnetic Coupling", IEEE Transactions on Magnetics, Vol. 30, No. 6, November 1994, pp. 4755-4757, 3 pages.	
	39	HUI, et al., "Some Electromagnetic Aspects of Careless PCB Transformers", IEEE Transactions on Power Electronics, Vol. 15, No. 4, July 2000, pp. 805-810, 6 pages.	
	40	WAFFENSCHMIDT, et al., "Limitation of Inductive Power Transfer for Consumer Applications", 13th European Conference on Power Electronics and Applications, Barcelona, 2009. EPE '09. pp. 1 - 10, 10 pages.	
	41	STOKES, "Palm Strikes Back with new OS, Pre Handset at CES, http://arstechnica.com/news.ars/post/20090101-palm-laundhes -new-handset-pre-operating", January 8, 2009, 6 pages.	
	42	SULLIVAN, Visteon to Sell Wireless Gadget Charger, "Wire-Free Technology will Lets Consumers Dump Cords and Chargers", Red Herring, December 29, 2006, 2 pages.	
	43	KIM, "Wireless Charger for New Palm Phone", San Francisco Chronicle and SFGate.com, May 11, 2009, 2 pages.	
	44	COMPEAU, Red Zen Marketing, "Could This be the Mojo Behind the Palm Pre's Touchstone Charger?", http://redzenmarketing.posterous.com/could-this-be-the-mojo-behind-the-palm-pres-t, June 5, 2009, 3 pages.	
	45	Fulton Innovation LLC, "The Big Story for CES 2007: The Public Debut of eCoupled Intelligent Wireless Power", ecoupled, December 27, 2006, 2 pages.	
	46	MILLER, "Palm May Make Pre Scarce", The San Jose Mercury News, April 29, 2009, 1 page.	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	47	MURAKAMI et al., "Consideration on Cordless Power Station Contactless Power Transmission System", IEEE Transactions on Magnets, Vol. 32, No. 5, September 1996, 3 pages.
	48	Epson Air Trans "Wireless Power Transfer", http://www.2k1.co.uk/components/epson_airtrans.asp, 12/8/2008, 2 pages.
	49	CHOI, et al., "A New Contactless Battery Charger for Portable Telecommunication/Compuing Electronics", IEEE, School of Electronic and Electrical Engineering, Kyungpook National University, Taegu, Korea, 2001, pp. 58-59 2 pages.
	50	PCT International Preliminary Report on Patentability dated 10 November 2011 in re International Application No. PCT/US2010/032845, 7 pages.

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature	/BRYCE M AISAKA/	Date Considered	12/21/2021

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

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Kent B. Chambers/	Date (YYYY-MM-DD)	2021-11-05
Name/Print	Kent B. Chambers	Registration Number	38839

This collection of information is required by 37 CFR 1.97 and 1.98. 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 1 hour to complete, including gathering, preparing and submitting the completed application 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.**

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	17467032
Filing Date	2021-09-03
First Named Inventor	Afshin Partovi
Art Unit	2859
Examiner Name	Undetermined
Attorney Docket Number	AFPA-01039US4

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	4873677		1989-10-10	Sakamoto et al	
	2	5455466		1995-10-03	Parks et al	
	3	5600225		1997-02-04	Goto, Masataka	
	4	5734254		1998-03-31	Stephens, Charles S.	
	5	6118249		2000-09-12	Brockman, et al	
	6	6184651	B1	2001-02-06	Fernandez et al	
	7	6301128	B1	2001-10-19	Jang et al	
	8	6803744	B1	2014-10-12	Sabo, Anthony	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	9	6831544	B2	2004-12-14	Patel et al	
	10	7211986	B1	2007-05-01	Flowerdew et al	
	11	7248017	B2	2007-07-24	Cheng et al	
	12	7352567	B2	2008-04-01	Hotelling et al	
	13	7375493	B2	2008-05-20	Calhoon et al	
	14	7733215	B2	2010-06-08	Kozuma et al	
	15	8115448	B2	2012-02-14	John, Michael Sasha	
	16	8234509	B2	2012-07-31	Gioscia et al	
	17	8290463	B2	2012-10-16	Liu et al	
	18	8554165	B2	2013-10-08	Liu et al	
	19	9407327	B2	2016-08-02	Kirby et al	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	20	9793738	B2	2017-10-17	Jacobs et al	

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20040145342	A1	2004-07-29	Hewlett-Packard Company	
	2	20040150934	A1	2004-08-05	Baarman et al	
	3	20050068019	A1	2005-03-31	Nakamura et al	
	4	20050189910	A1	2005-09-01	Shu-yuen, Ron Hui	
	5	20080272889	A1	2008-11-06	Symons, Peter Robert	

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	2396901	EP	B1	2019-12-25	Kirby et al		

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	2	200601557	WO	A1	2006-01-05	Hanrim Postech Co., Ltd.			

If you wish to add additional Foreign Patent Document citation information please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1		

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature	/BRYCE M AISAKA/	Date Considered	12/21/2021

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

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Kent B. Chambers/	Date (YYYY-MM-DD)	2021-11-05
Name/Print	Kent B. Chambers	Registration Number	38839

This collection of information is required by 37 CFR 1.97 and 1.98. 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 1 hour to complete, including gathering, preparing and submitting the completed application 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.**

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	17467032
Filing Date	2021-09-03
First Named Inventor	Afshin Partovi
Art Unit	2859
Examiner Name	Undetremined
Attorney Docket Number	AFPA-01039US4

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20070029965		2007-02-08	Hui	
	2	20100207771		2010-08-19	Trigiani	
	3	20070182367		2007-08-09	Partovi	

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2]	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							

EFS Web 2.1.18

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetremined
	Attorney Docket Number	AFPA-01039US4

If you wish to add additional Foreign Patent Document citation information please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T5
	1	WiPower, Wikipedia, the free encyclopedia, http://en.wikipedia.org/wiki/WiPower, 11/18/2011, 2 pages	
	2	PowerbyProxi, Wireless Power Solutions, http://www.powerbyproxi.com/, 11/18/2011, 2 pages	
	3	Now charge your iPhone 4 and 4S with Powermat!, Wireless charging mats and receivers for your iPhone, iPod, Blackberry ... http://www.powermat.com/, 11/18/2011, 1 page	
	4	Witricity. Wireless Electricity Delivered Over Distance, http://www.witricity.com, 11/18/2011, 1 page	
	5	ConvenientPower, ConvenientPower HK Limited, http://www.convenientpower.com/1/about.php, 11/18/2011, 1 page	
	6	Nigel Power LLC: Private Company Information - Business Week, http://investing.businessweek.com/research/stocks/private/snapshot.asp? p ... , 11/18/2011, 2 pages	
	7	SAKAMOTO, et al., "A Novel Circuit for Non-Contact Charging Through Electro-Magnetic Coupling", 1992, IEEE, pp. 165-17 4.	
	8	ABE, et al., "A Non-Contact Charger Using a Resonant Converter with Parallel Capacitor of the Secondary Coil", April 2000, IEEE, Vo.l. 36, No. 2, pp. 444-451.	
	9	SAKAMOTO, et al. "Large Air-Gap Coupler for Inductive Charger", September 1999, IEEE, Vol. 35, No. 5, pp. 3526-3528.	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetremined
	Attorney Docket Number	AFPA-01039US4

	10	SAKAMOTO, et al. "A Novel Converter for Non-Contact Charging with Electromagnetic Coupling", November 1993, IEEE, Vol. 29, No. 6, pp. 3228-3230	
	11	KIM, et al. "Design of a Contactless Battery Charger for Cellular Phone", December 2001, IEEE, Vol. 48, No. 6, pp. 1238-1247.	
	12	HUI, et al." Careless Printed-Circuit Board Transformers for Signal and Energy Transfer", Electronics Letters, May 1998, Vol. 34, No. 11, pp. 1052-1054	
	13	HUI, et al. "Optimal Operation of Careless PCB Transformer-Isolated Gate Drive Circuits with Wide Switching Frequency Range", May 1999, IEEE Transactions of Power Electronics, Vol. 14, No. 3, pp. 506-514	
	14	TANG, et al. "Characterization of Careless Printed Circuit Board (PCB) Transformers", November 2000, IEEE Transactions of Power Electronics, Vol. 15, No. 6, pp. 1275-1282	
	15	TANG, et al. "Careless Printed Circuit Board (PCB) Transformers with Multiple Secondary Windings for Complementary Gate Drive Circuits", May 1999, IEEE Transactions of Power Electronics, Vol. 14, No. 3, pp. 431-437	
	16	TANG, et al." Careless Printed Circuit Board (PCB) Transformers with High Power Density and High Efficiency", May 2000, Electronics Letters, Vol. 36, No. 11, pp. 943-944	
	17	BORENSTEIN, "Man Tries Wirelessly Boosting Batteries"', November 2006, USA Today, http://www.usatoday.com/tech/wireless/data/2006-11-16-wireless-recharging_x.htm, 5 pages.	
	18	MURPH, "WildCharger Charges Your Gadgetry Sans Wires", December 2006, Misc. Gadgets, 2 pages	
	19	Gizmo Watch, "Pitstop: A Table Top Recharging Solution by Belkin", http://www.gizmowatch.com/entry/pitstop-a-table-top-recharging-solution-by-belkin, December 2006, 5 pages.	
	20	UNKNOWN AUTHOR, "Cutting the Cord", April 2007, The Economist, 1 page.	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetremined
	Attorney Docket Number	AFPA-01039US4

	21	BISHOP, "Microsoft Surface Brings Computing to the Table", May 2007, http://seattlepi.nwsource.com/ business/317737 msftdevic30.html, 7 pages.	
	22	WILDCHARGE, "The Wire-Free Power Revolution is Only Days Away, and WildCharge, Inc. Is Leading the Charge", September 2007, 3 pages.	
	23	Economist.com Science Technology Quarterly, "Wireless Charging", http://www.economist.com/science/tq/ PrinterFriendly.cfm?story_id=13174387, 4/15/2009, 4 pages.	
	24	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U. S. Patent Application No. 13/708,548, November 20, 2013, 5 pages	
	25	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U. S. Patent Application No. 13/115,811, September 23, 2013, 17 pages.	
	26	UNITED STATES PATENT AND TRADEMARK OFFICE. Office Action for U. S. Patent Application No. 13/708,584, September 13, 2013, 16 pages.	
	27	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U. S. Patent Application No. 13/158,134 January 22, 2014, 43 pages.	
	28	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U. S. Patent Application No. 13/708,827 February 5, 2014, 28 pages.	
	29	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U. S. Patent Application No. 13/708,520, February 5, 2014, 8 pages.	
	30	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U. S. Patent Application No. 13/115,811, March 4, 2014, 15 pages.	
	31	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U. S. Patent Application No. 13/709,983, February 27, 2014, 10 pages.	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetremined
	Attorney Docket Number	AFPA-01039US4

	32	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U. S. Patent Application No. 13/710,062, February 27, 2014, 9 pages.	
	33	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U. S. Patent Application No. 13/710,017, February 27, 2014, 11 pages.	
	34	Office Action in connection with Application No. 13/708,520 dated May 24, 2013, 7 pages.	
	35	Office Action in connection with Application No. 13/158,134 dated June 12, 2013, 15 pages.	
	36	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U. S. Patent Application No. 13/708,838, March 14, 2014, 30 pages.	
	37	Office Action in connection with Application No. 13/709,983 dated June 7, 2013, 7 pages.	
	38	International Search Report dated June 14, 2013, International Application No. PCT/US2013/033352 filed March 21, 2013, 3 pages	
	39	INTERNATIONAL SEARCHING AUTHORITY, International Search Report and Written Opinion for PCT/US2012/021729, August 31, 2012, 9 pages.	
	40	Office Action in connection with Application No. 13/710,017 dated June 11, 2013, 7 pages.	
	41	European Search Report and Search Opinion in connection with Europe Application 08747863.2 (European National Stage application of PCT/US2008/063084) dated April 2, 2013, 7 pages.	
	42	Office Action in connection with Chinese Application 200880023854.4 (Chinese National Stage application of PCT/US2008/063084) dated August 28, 2012, 18 pages.	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetremined
	Attorney Docket Number	AFPA-01039US4

	43	Office Action in connection with Japanese Application JP/2010-50766 (Japanese National Stage application of PCT/US2008/063084) dated December 3, 2012, 4 pages.
	44	Office Action in connection with Application No. 13/709,937 dated September 12, 2013, 7 pages.
	45	Office Action in connection with Application No. 12/769,586 dated December 13, 2012, 19 pages.
	46	Office Action in connection with Application No. 13/708,827 dated June 26, 2013, 22 pages.
	47	Office Action in connection with Application No. 13/708,838 dated June 24, 2013, 27 pages.
	48	PCT International Search Report in connection with PCT Application No. PCT/US2011/040062 dated February 17, 2012, 9 pages.
	49	Office Action in connection with Application No. 13/708,548 dated June 7, 2013, 5 pages.
	50	Office Action in connection with Application No. 13/115,811 dated March 28, 2013, 13 pages.

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature	/BRYCE M AISAKA/	Date Considered	12/21/2021

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

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

EFS Web 2.1.18

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetremined
	Attorney Docket Number	AFPA-01039US4

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Kent B. Chambers/	Date (YYYY-MM-DD)	2021-11-05
Name/Print	Kent B. Chambers	Registration Number	38839

This collection of information is required by 37 CFR 1.97 and 1.98. 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 1 hour to complete, including gathering, preparing and submitting the completed application 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.**

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.M.A/

PLUS Search Results for S/N 17467032, Searched Tue Dec 21 06:50:32 EST 2021

The Patent Linguistics Utility System (PLUS) is a USPTO automated search system for U.S. Patents from 1971 to the present PLUS is a query-by-example search system which produces a list of patents that are most closely related linguistically to the application searched. This search was prepared by the staff of the Scientific and Technical Information Center, SIRA.

5648738 74
5663626 74
5742209 74
5780736 74
5892789 74
6018644 74
6232678 74
4278108 74
4387324 74
4464595 74
4475018 74
4506350 74
4554999 74
4570100 74
4616148 74
4620812 74
4628366 74
4631419 74
4794514 74
4796585 74
4832787 74
4879503 74
4881591 74
4916408 74
4922257 74
4952790 74
4975924 74
5016237 74
5021622 74
RE34295 74
5266750 74
5291861 74
5296922 74
5355094 74
5393991 74
5399905 74
5408749 74
5488285 74
5504414 74
5517401 74
5541558 74
5550353 74
5557446 74
5621292 74
5628130 74
5717398 74
5769718 74
5793339 74
5794019 74
5834930 74

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/467,032	09/03/2021	Afshin Partovi	AFPA-01039US4	1075

33438 7590 12/13/2021

TERRILE, CANNATTI & CHAMBERS, LLP
P.O. BOX 203518
AUSTIN, TX 78720

EXAMINER	
CENTRAL, DOCKET	

ART UNIT	PAPER NUMBER
2851	

NOTIFICATION DATE	DELIVERY MODE
12/13/2021	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

USPTO@dockettrak.com
celeste@tcciplaw.com
tmunoz@tcciplaw.com

Decision Granting Request for Prioritized Examination (Track I)	**Application No.** 17/467,032	**Applicant(s)** Partovi, Afshin	
	Examiner DIANE C GOODWYN	**Art Unit** OPET	**AIA (FITF) Status** Yes

1. THE REQUEST FILED 03 September 2021 IS **GRANTED** .

   The above-identified application has met the requirements for prioritized examination
   - A. ☑ for an original nonprovisional application (Track I).
   - B. ☐ for an application undergoing continued examination (RCE).

2. **The above-identified application will undergo prioritized examination**. The application will be accorded special status throughout its entire course of prosecution until one of the following occurs:
   - A. filing a **petition for extension of time** to extend the time period for filing a reply;
   - B. filing an **amendment to amend the application to contain more than four independent claims, more than thirty total claims** , or a multiple dependent claim;
   - C. filing a **request for continued examination** ;
   - D. filing a notice of appeal;
   - E. filing a request for suspension of action;
   - F. mailing of a notice of allowance;
   - G. mailing of a final Office action;
   - H. completion of examination as defined in 37 CFR 41.102; or
   - I. abandonment of the application.

Telephone inquiries with regard to this decision should be directed to DIANE GOODWYN at (571) 272-6735. In his/her absence, calls may be directed to Petition Help Desk at (571) 272-3282.

/DIANE C GOODWYN/ Paralegal Specialist, OPET	

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
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 17/467,032	Filing Date 09/03/2021	☐ 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 $50 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $240 =	
☐ 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

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	11/22/2021	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 30	Minus	** 20	= 10		x $50 =	500
	Independent (37 CFR 1.16(h))	* 4	Minus	*** 3	= 1		x $240 =	240
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	740

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ 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.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/TERRANCE R LAWRENCE/
*** 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.	

This collection of information is required by 37 CFR 1.16. 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 12 minutes to complete, including gathering, preparing, and submitting the completed application 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.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

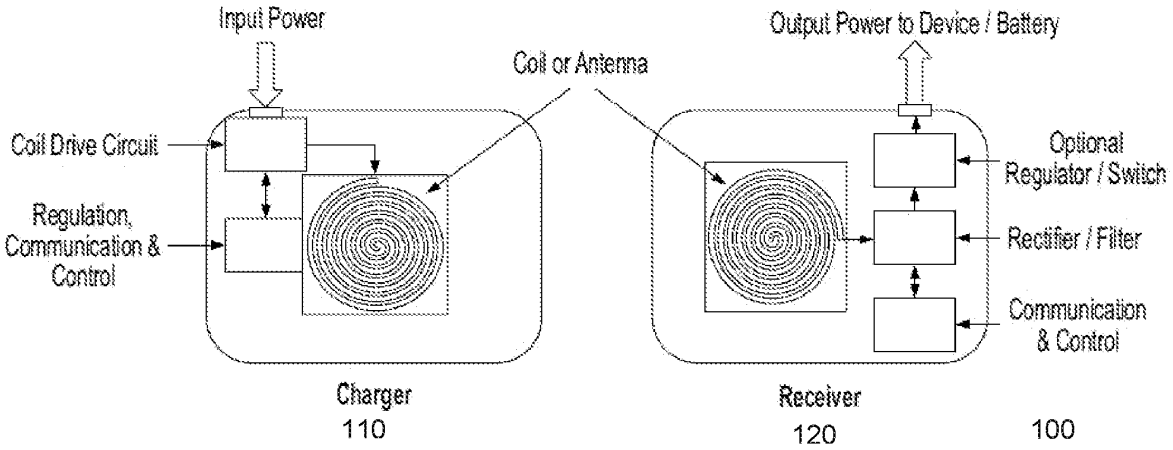


FIGURE 1

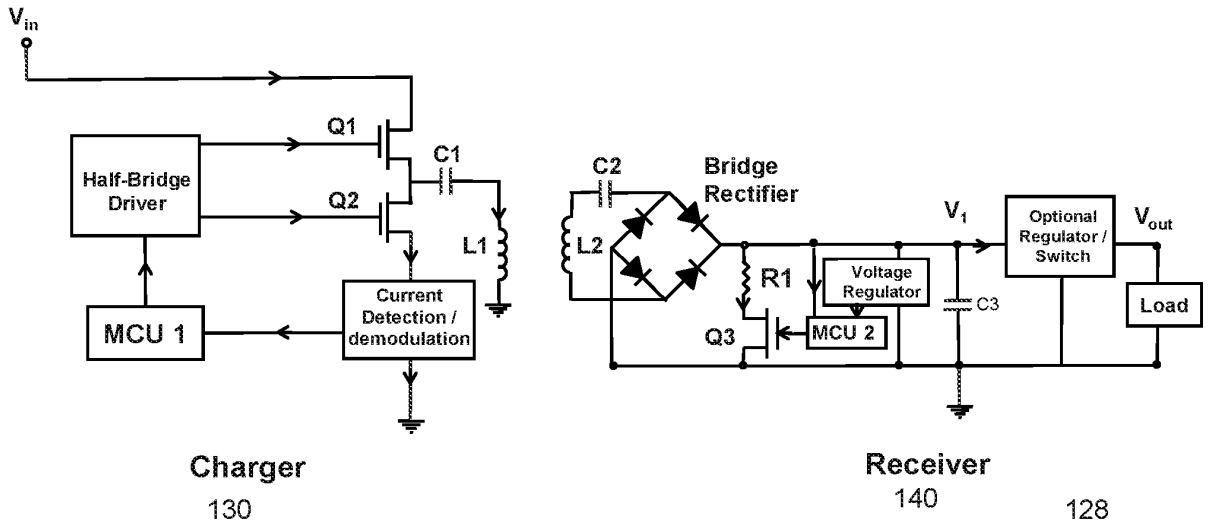


FIGURE 2

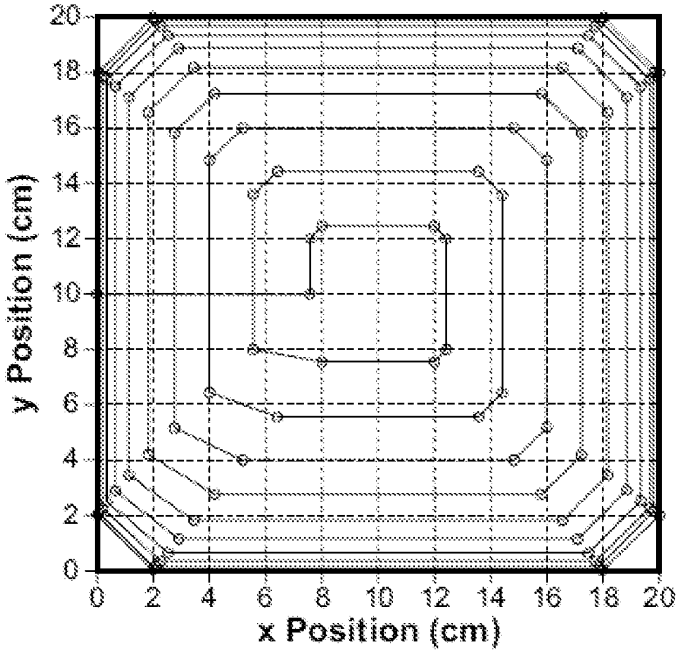


FIGURE 3

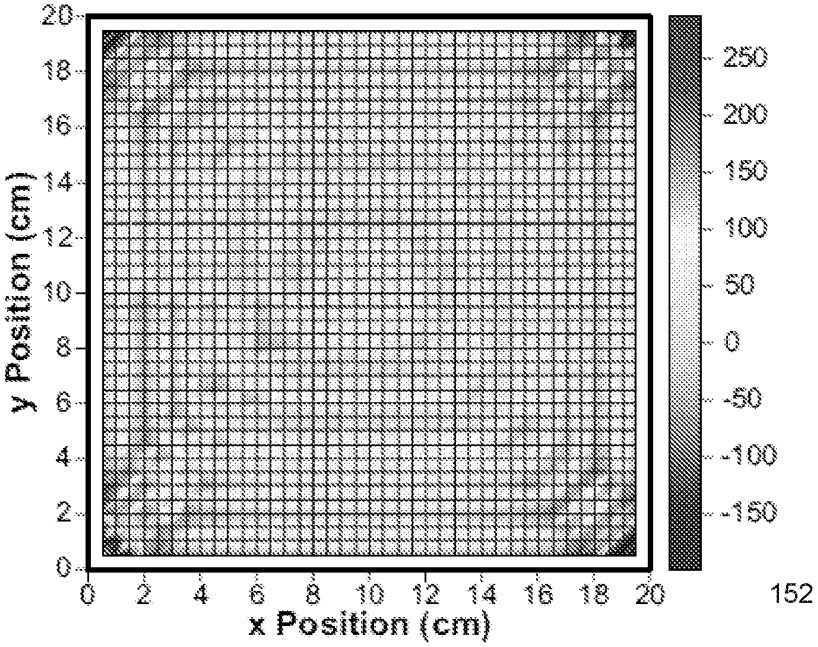


FIGURE 4

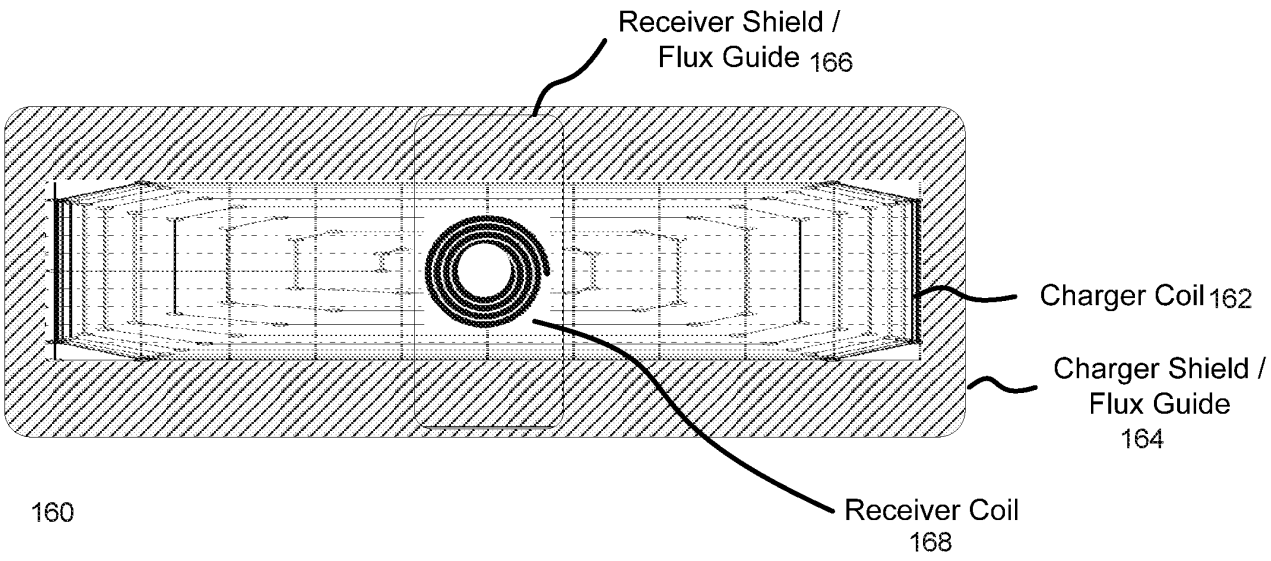


FIGURE 5

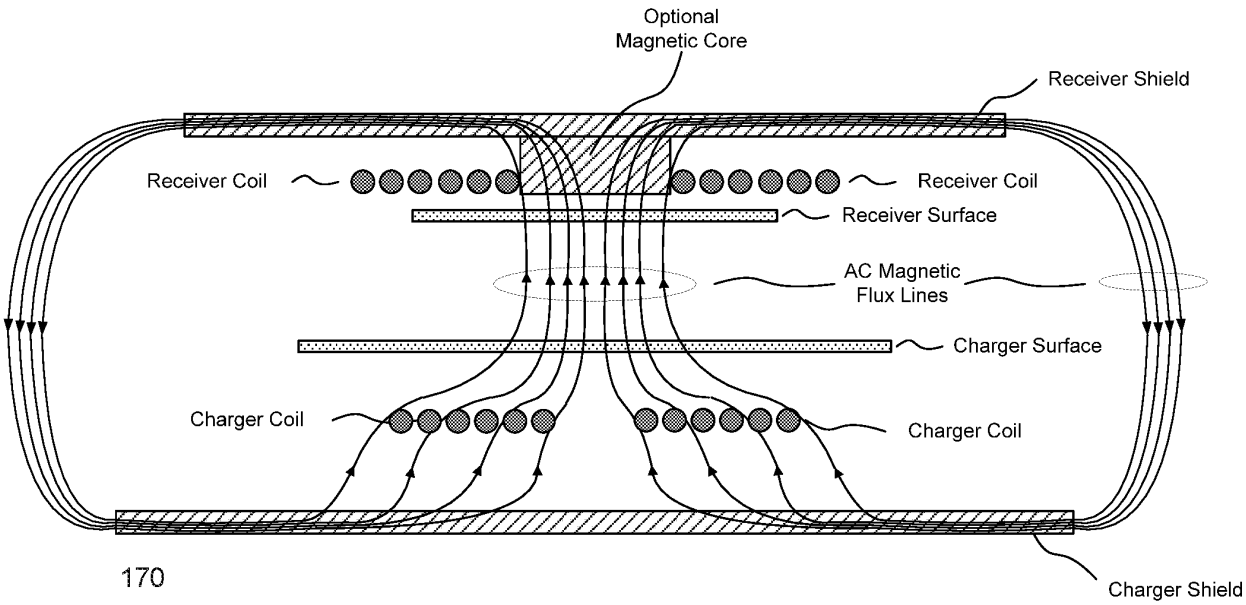


FIGURE 6

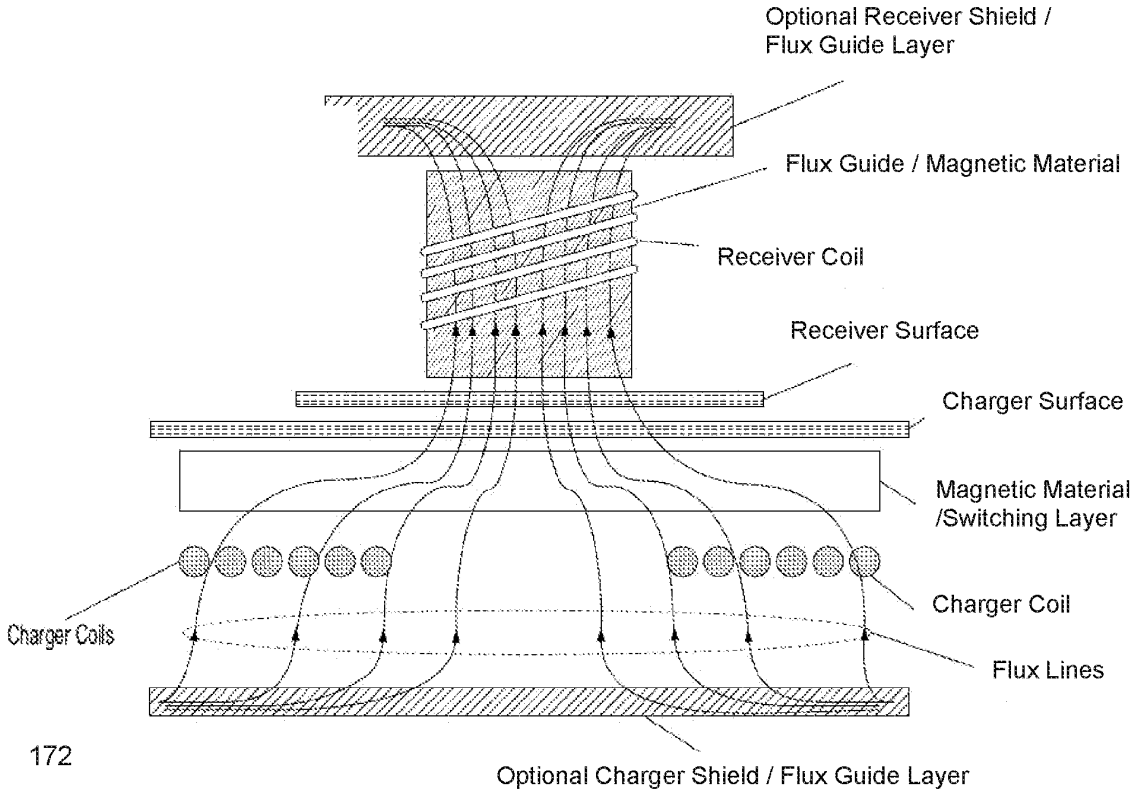


FIGURE 7

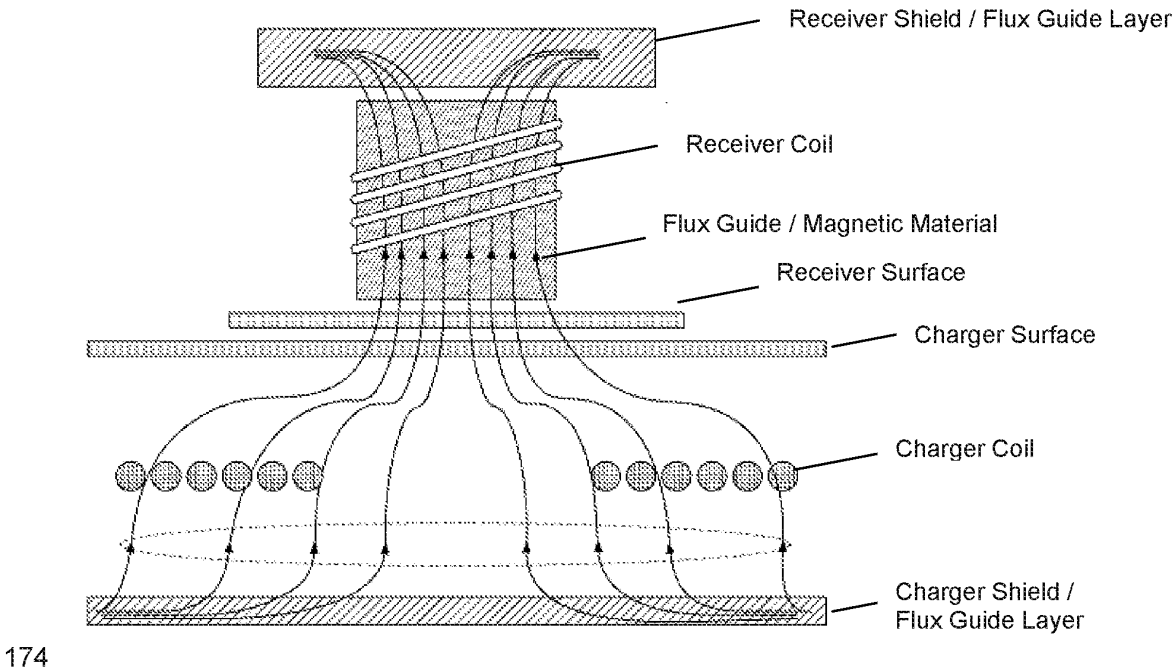


FIGURE 8

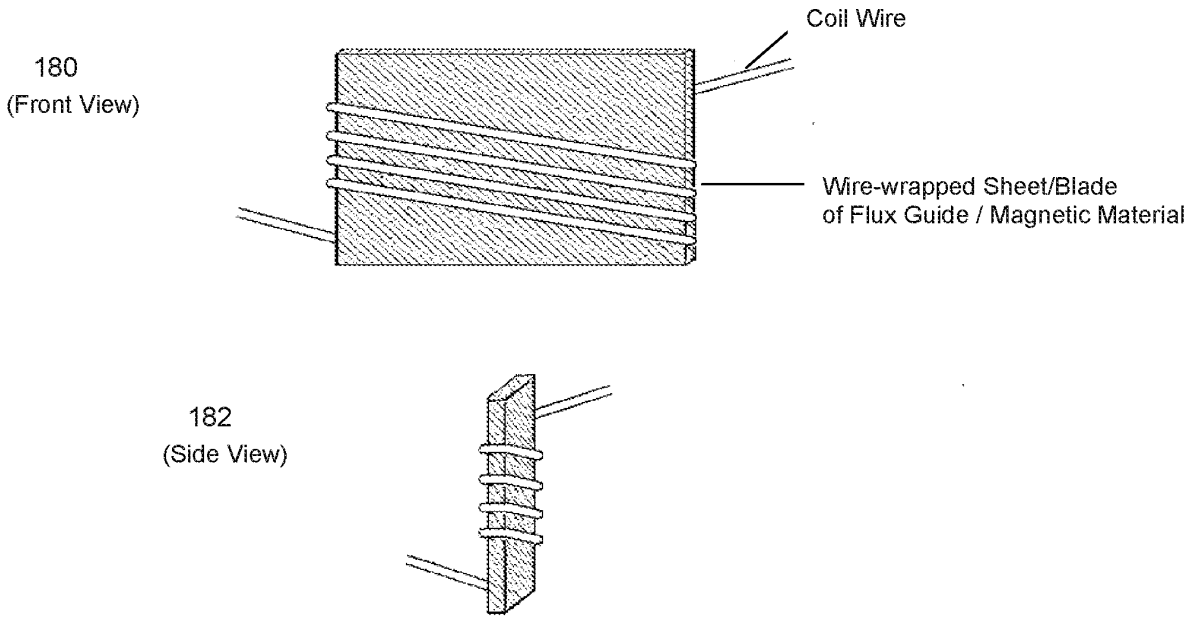


FIGURE 9

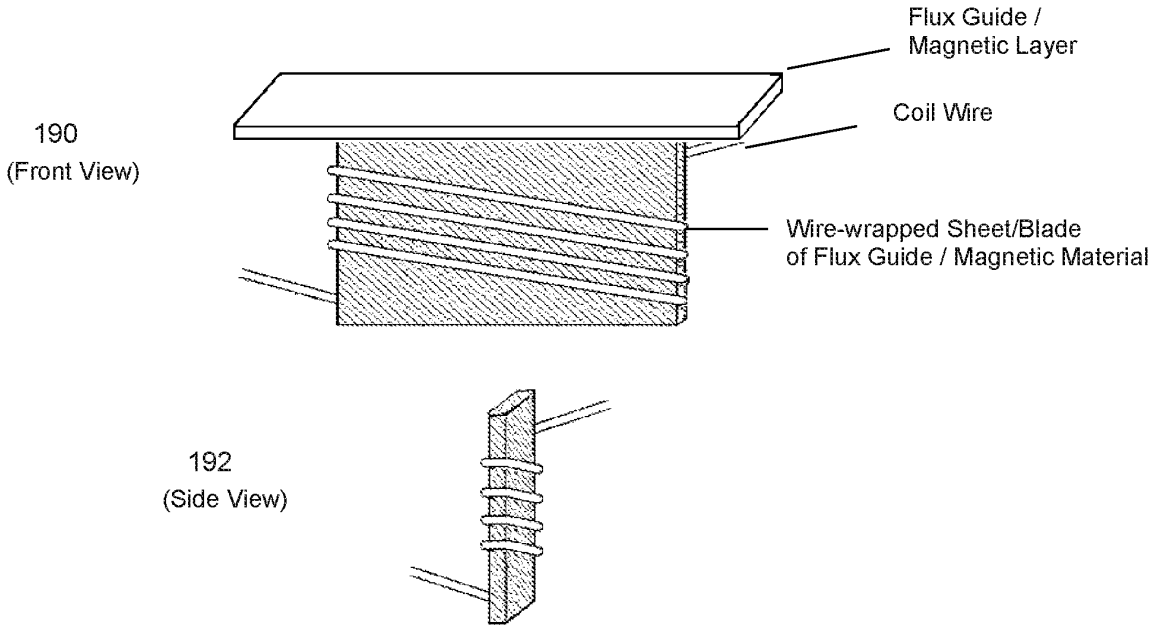


FIGURE 10

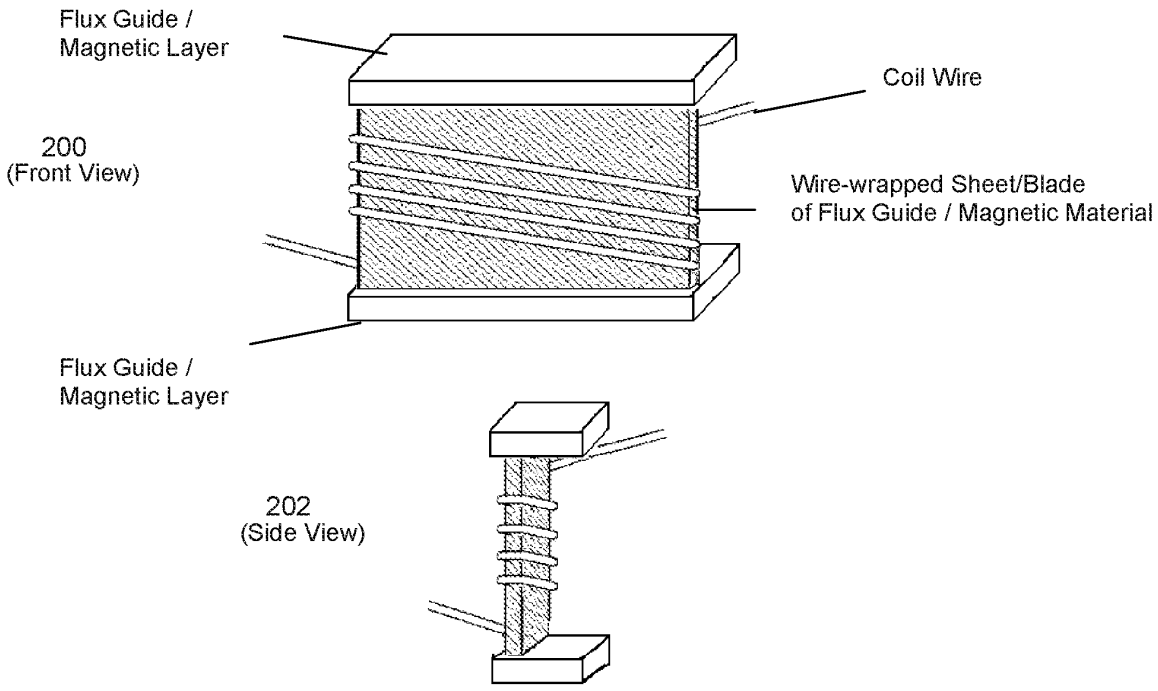

Flux Guide /
Magnetic Layer
Coil Wire
200
(Front View)
Wire-wrapped Sheet/Blade
of Flux Guide / Magnetic Material
Flux Guide /
Magnetic Layer
202
(Side View)

FIGURE 11

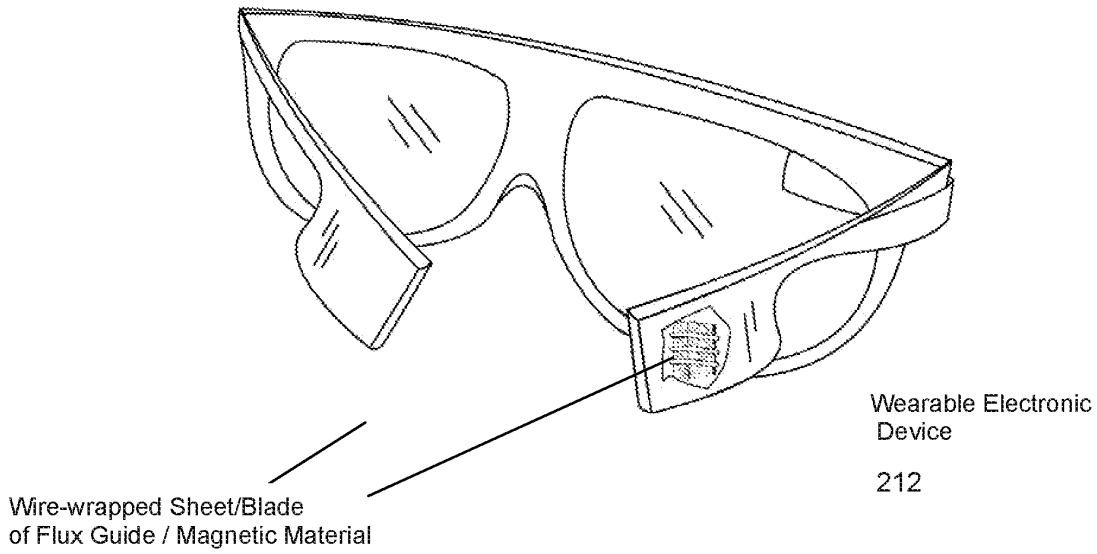


FIGURE 12

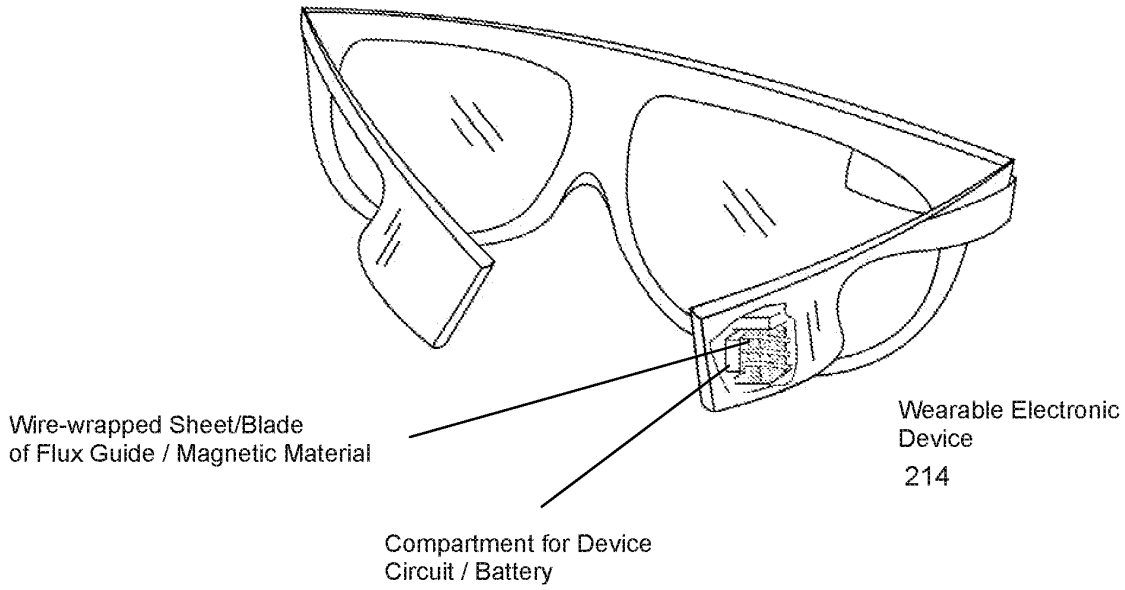


FIGURE 13

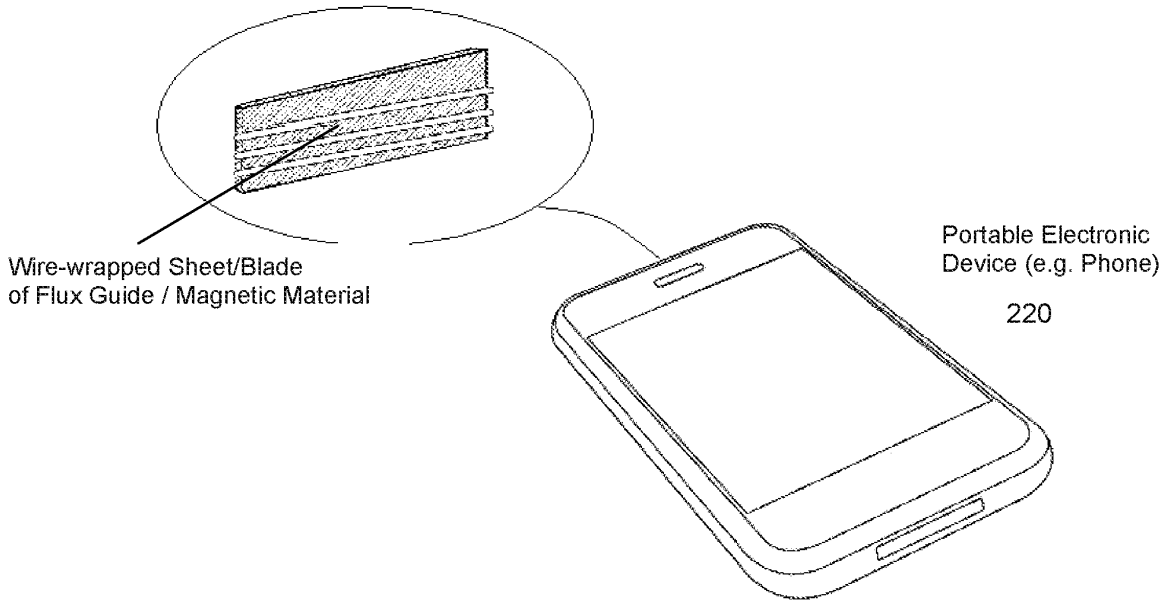


FIGURE 14

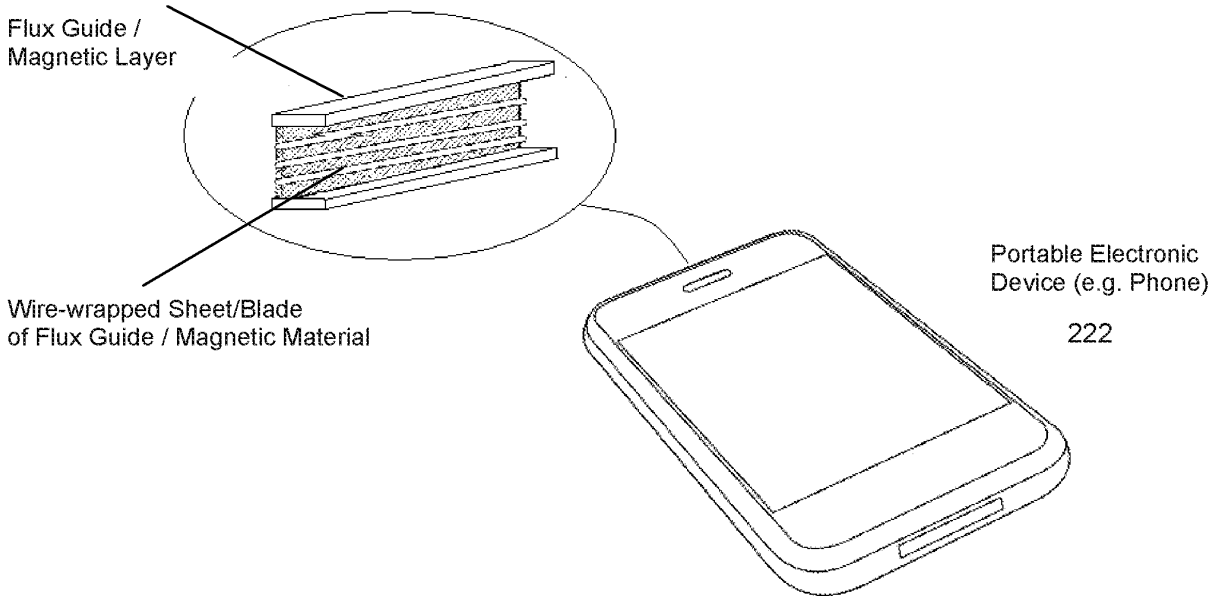


FIGURE 15

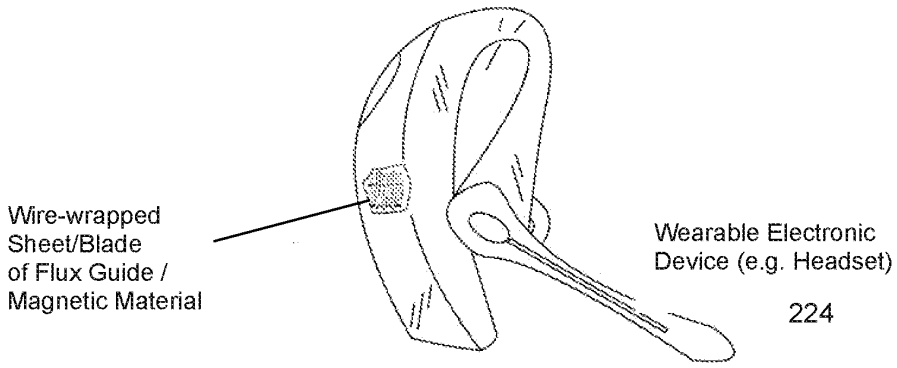


FIGURE 16

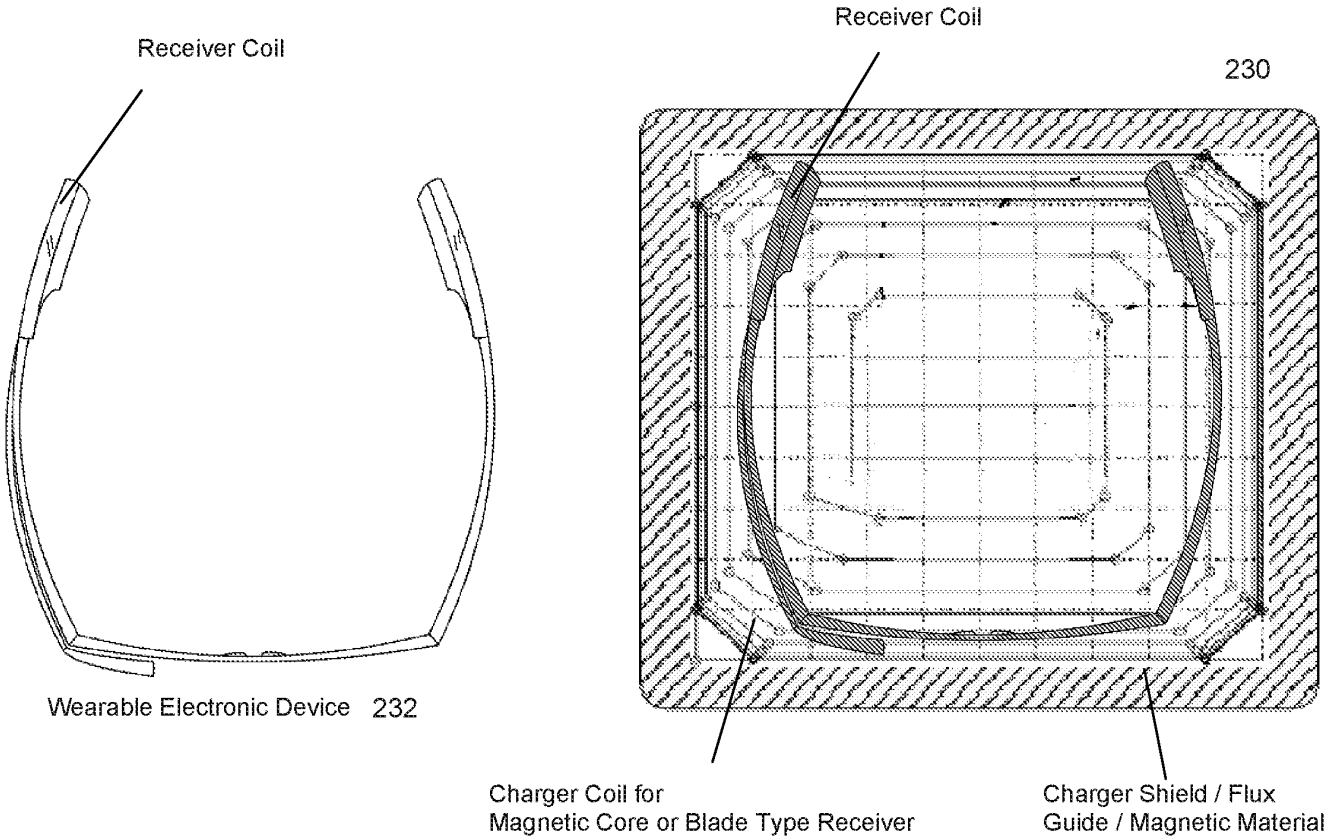


FIGURE 17

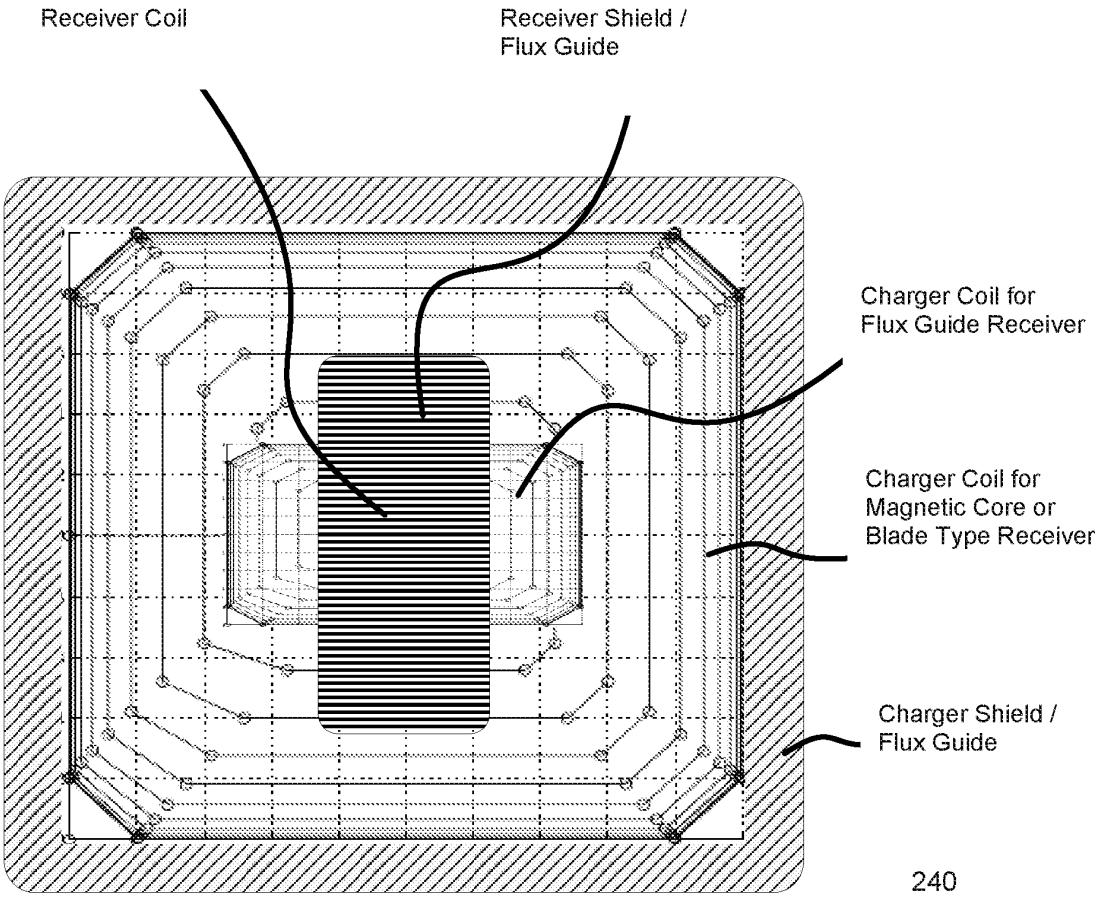

Receiver Coil
Receiver Shield / Flux Guide
Charger Coil for Flux Guide Receiver
Charger Coil for Magnetic Core or Blade Type Receiver
Charger Shield / Flux Guide
240

FIGURE 18

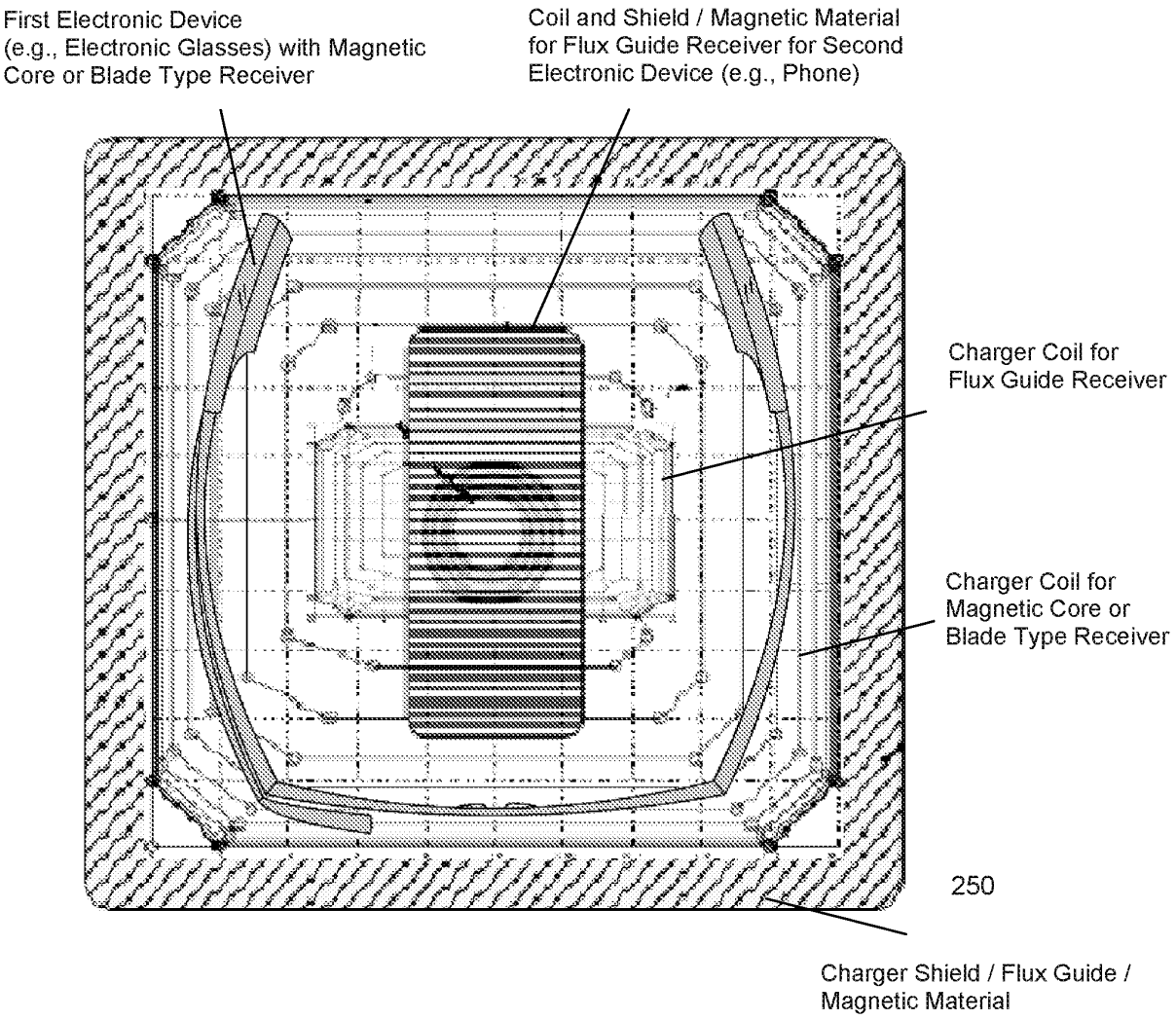

First Electronic Device
(e.g., Electronic Glasses) with Magnetic
Core or Blade Type Receiver
Coil and Shield / Magnetic Material
for Flux Guide Receiver for Second
Electronic Device (e.g., Phone)
Charger Coil for
Flux Guide Receiver
Charger Coil for
Magnetic Core or
Blade Type Receiver
250
Charger Shield / Flux Guide /
Magnetic Material

FIGURE 19

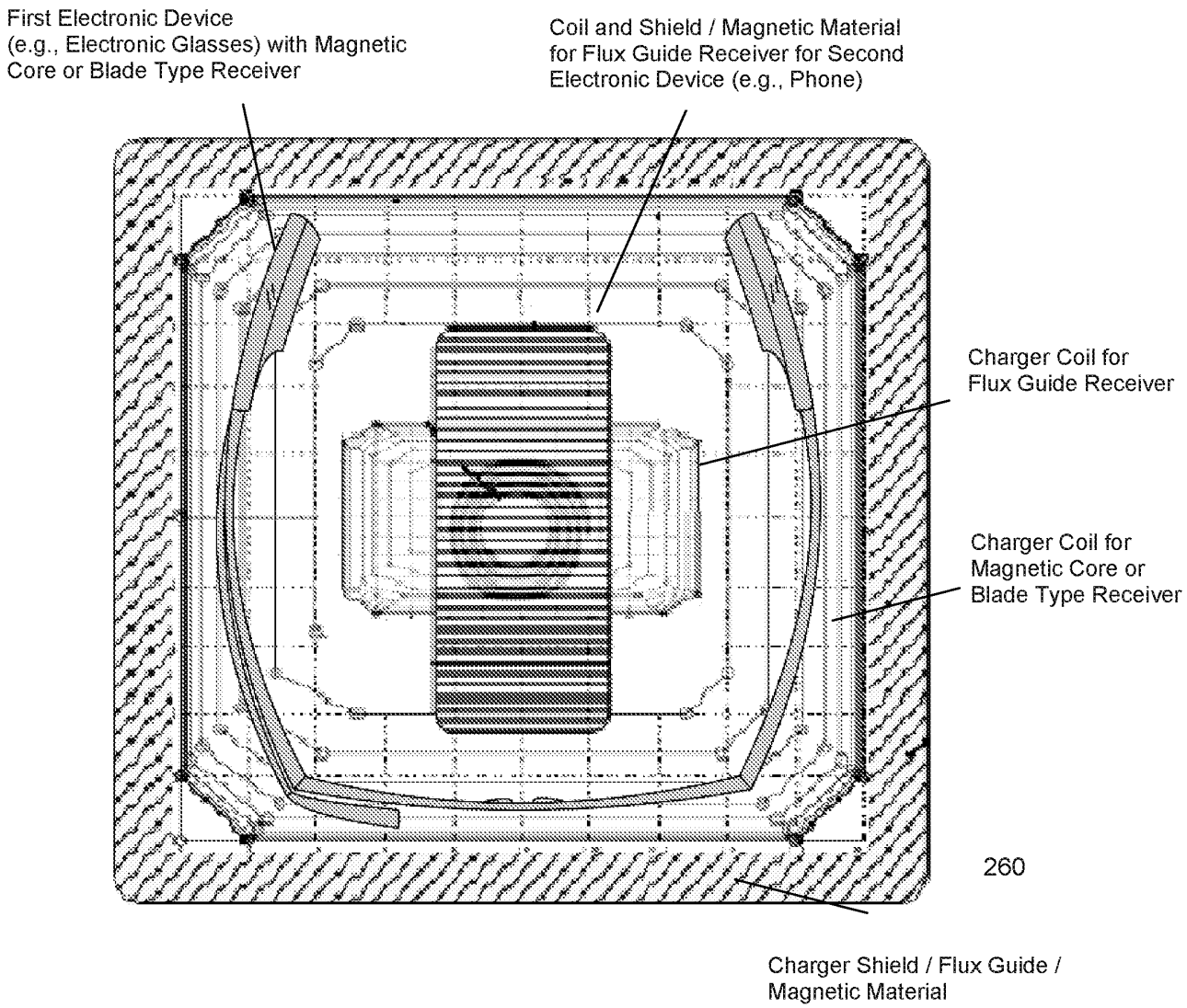

First Electronic Device
(e.g., Electronic Glasses) with Magnetic Core or Blade Type Receiver
Coil and Shield / Magnetic Material for Flux Guide Receiver for Second Electronic Device (e.g., Phone)
Charger Coil for Flux Guide Receiver
Charger Coil for Magnetic Core or Blade Type Receiver
260
Charger Shield / Flux Guide / Magnetic Material

FIGURE 20

Electronic Patent Application Fee Transmittal

Application Number:	17467032
Filing Date:	03-Sep-2021
Title of Invention:	System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes
First Named Inventor/Applicant Name:	Afshin Partovi
Filer:	Kent Bryan Chambers/Celeste Scarborough
Attorney Docket Number:	AFPA-01039US4

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
CLAIMS IN EXCESS OF 20	1202	10	100	1000
INDEPENDENT CLAIMS IN EXCESS OF 3	1201	1	480	480
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**1480**

Electronic Acknowledgement Receipt	
EFS ID:	44346521
Application Number:	17467032
International Application Number:	
Confirmation Number:	1075
Title of Invention:	System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes
First Named Inventor/Applicant Name:	Afshin Partovi
Customer Number:	33438
Filer:	Kent Bryan Chambers/Celeste Scarborough
Filer Authorized By:	Kent Bryan Chambers
Attorney Docket Number:	AFPA-01039US4
Receipt Date:	22-NOV-2021
Filing Date:	03-SEP-2021
Time Stamp:	19:40:06
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$1480
RAM confirmation Number	E2021ALJ41081815
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Preliminary Amendment	AFPA-01039US4_Preliminary_Amendment_2021-11-22.pdf	100926 41ab31366bb63603e27b58533efe8d2278b93a66	no	14
Warnings:					
Information:					
2	Drawings-only black and white line drawings	AFPA-01039US4_Figures_REPLACEMENT_SHEETS-1.pdf	2989787 188421317d04f09300ce8e41923cb5fc8f0d3dfd	no	12
Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	40651 f11489d2f1a20922fb3db10391fc14e80b17a4b7	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	3131364		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventors:	Afshin Partovi		
Applicant:	Mojo Mobility Inc.		
Title:	System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes		
Application No.:	17/467,032	Filing Date:	November 22, 2021
Examiner:	Unassigned	Group Art Unit:	Unassigned
Docket No.:	AFPA-01039US4	Customer No.:	33438

ELECTRONICALLY FILED

Austin, Texas
November 22, 2021

PRELIMINARY AMENDMENT

The following Amendment and Remarks are submitted for entry into the above referenced patent application.

AMENDMENT TO THE FIGURES

Please replace Figures 1-20 with the Replacement Sheets filed herewith.

AMENDMENTS TO THE CLAIMS

Claims 1-20 are canceled.

21. (New) A system for inductive power transfer comprising:

a charger, wherein the charger is an inductive charger, and the charger includes:

a printed circuit board having a charger coil, wherein the charger coil has a substantially planar charger surface;

a substantially planar magnetic layer under the charger coil opposite the charger surface; and

a charger drive circuit, wherein the charger drive circuit includes a resonant capacitor and a FET switch to apply an alternating voltage to the charger coil;

a first mobile device that includes a receiver to inductively receive power for the first mobile device, wherein:

the receiver includes:

a solenoid, wherein the solenoid includes:

a magnetic core having a relative magnetic permeability exceeding 1 and having first and second ends; and

Litz wire wrapped around a section of the magnetic core forming a wire wound section around the magnetic core, with the magnetic core extending beyond the wire wound section; and

a receiver electronic circuit, wherein the receiver electronic circuit includes a resonant capacitor and a rectifier; and

wherein:

the charger further includes a means for positioning the receiver in a power transfer position, proximate to the charger surface, to inductively transfer power to the receiver of the first mobile device;

the charger drive circuit is configured to drive the charger coil at one or more operating frequencies to inductively transfer power from the charger to the

receiver when the receiver is positioned in the power transfer position, wherein when the receiver is positioned in the power transfer position, a tuned circuit, including the charger coil and the resonant capacitor of the charger drive circuit and the solenoid and the resonant capacitor of the receiver electronic circuit, has a resonant frequency that allows the charger to transfer the power to the receiver at the one or more operating frequencies;

the charger coil includes a conductor patterned to include multiple, substantially concentric turns for generating a magnetic flux through a first end of the solenoid when the receiver is placed in the power transfer position, wherein an outermost of the concentric turns defines a perimeter of a charger coil area;

the multiple concentric turns, when driven by the charger drive circuit, generate a magnetic field that is substantially perpendicular to the charger surface at a geometric center of the charger coil area;

the charger coil area is larger than an area of the first end and larger than an area of the second end of the magnetic core of the solenoid;

the magnetic layer of the charger extends beyond the charger coil area; and

when the receiver is in the power transfer position, the first end of the magnetic core is located proximate to the charger coil area above the charger surface to receive magnetic flux from the charger coil area and guide the magnetic flux in a closed magnetic loop from the charger coil area through the solenoid and return through the charger magnetic layer to the charger coil area to form the closed magnetic loop.

22. (New) The system of claim 21, wherein the charger coil is a single coil.

23. (New) The system of claim 21, wherein when positioned in the power transfer position, a winding axis of the solenoid is positioned perpendicular to the charger surface.

24. (New) The system of claim 21, wherein when the receiver is positioned in the power transfer position and when the charger is operated at an operating frequency near the

resonance frequency of the tuned circuit to inductively transfer power from the charger to the receiver, the transfer of power from the charger to the receiver has a power transfer efficiency that exceeds 50%, wherein the power transfer efficiency is defined by power out of a rectifier in the receiver electronic circuit divided by power into the charger drive circuit.

25. (New) The system of claim 21, wherein the charger coil area is at least ten times larger than the area of each of the ends of the magnetic core of the solenoid.

26. (New) The system of claim 21, wherein the charger coil area is at least fifty times larger than the area of each of the ends of the magnetic core of the solenoid.

27. (New) The system of claim 21, wherein the magnetic core of the solenoid has a cross sectional dimension in at least one end of 1 to 2 mm and has a length along a winding axis of 10 to 20 mm.

28. (New) The system of claim 21, wherein the Litz wire is selected for operation at a frequency of greater than 205 kHz.

29. (New) The system of claim 21, wherein when the receiver is positioned in the power transfer position, a winding axis of the solenoid is positioned at an angle relative to an axis perpendicular to the charger surface, wherein the angle is one of any angles relative to the axis perpendicular to the charger surface.

30. (New) The system of claim 21, wherein the magnetic core of the solenoid comprises Ferrite material and the charger magnetic layer comprises Ferrite material.

31. (New) The system of claim 21, wherein a center of the first end of the solenoid is positioned 1 mm or more away from the charger surface when the receiver is positioned in the power transfer position.

32. (New) The system of claim 21, wherein when the receiver is positioned in the power transfer position, the magnetic core of the solenoid extends beyond the charger coil area in a preferential direction and the charger magnetic layer is also elongated extended in the

preferential direction so that the magnetic flux returned during the provision of power to the mobile device flows from the solenoid back to the charger coil to close the magnetic loop.

33. (New) The system of claim 21, wherein:
the charger is incorporated into a second mobile device;
the second mobile device includes an internal, rechargeable battery;
the second mobile device uses the internal battery to transfer power to and operate the charger for a period of time; and
the first and second mobile devices comprise Bluetooth communication systems to communicate with each other during non-power transfer operations.

34. (New) The system of claim 21, wherein no communication between the charger and the receiver occurs during power transfer.

35. (New) The system of claim 21, wherein the second mobile device further includes:
an additional inductive charger, wherein the additional inductive charger includes an additional charger coil to transfer power to additional mobile devices.

36. (New) The system of claim 21, wherein the receiver of the first mobile device is a first receiver, and the second mobile device includes a second receiver to inductively receive power to charge the internal, rechargeable battery of the second mobile device.

37. (New) The system of claim 21, wherein:
the receiver and the charger include communication and control electronics circuits to communicate, between the receiver and the charger, information associated with the transfer of power to the first mobile device; and
the communication is through a charger antenna that includes the charger coil and a receiver antenna that includes the solenoid.

38. (New) The system of claim 21, wherein the charger is incorporated into an enclosed volume for placement of the receiver in the power transfer position to receive inductive power.

39. (New) The system of claim 21, wherein the charger initiates transferring power to the mobile device when a presence of a receiver in the power transfer position is detected.

40. (New) The system of claim 21, wherein the magnetic field from the system is guided and contained so that residual electromagnetic emissions near the system are within safe compliance values.

41. (New) The system of claim 21 further comprising:

an energy storage device coupled to the receiver, wherein when the transfer of power to the receiver occurs, the transferred power charges the energy storage device.

42. (New) The system of claim 21 wherein the energy storage device includes a battery.

43. (New) The system of claim 21, wherein the first mobile device is a member of a group consisting of: a remote controller, a mouse, a wearable electronic glass, or a head-mounted display device.

44. (New) The system of claim 21, wherein the means for positioning includes one or more magnets to position the receiver in the power transfer position.

45. (New) The system of claim 21, wherein the means for positioning includes one or more members of a group consisting of visual, physical, or magnetic means to assist in positioning the receiver in the power transfer position.

46. (New) A charger for inductive charging, the charger comprising:

a printed circuit board having a charger coil, wherein the charger coil has a substantially planar charger surface;

a substantially planar magnetic layer under the charger coil opposite the charger surface;

a charger drive circuit, wherein the charger drive circuit includes a resonant capacitor and a FET switch to apply an alternating voltage to the charger coil; and

means for positioning a receiver in a power transfer position, which is proximate to the charger surface, to inductively transfer power to the receiver of a mobile device, wherein the receiver is included in a mobile device to inductively receive power for the mobile device, and the receiver includes:

a solenoid, wherein the solenoid includes:

a magnetic core having a relative magnetic permeability exceeding 1 and having first and second ends; and

Litz wire wrapped around a section of the magnetic core forming a wire wound section around the magnetic core, with the magnetic core extending beyond the wire wound section; and

a receiver electronic circuit, wherein the receiver electronic circuit includes a resonant capacitor and a rectifier; and

wherein:

the charger drive circuit is configured to drive the charger coil at one or more operating frequencies to inductively transfer power from the charger to the receiver when the receiver is positioned in the power transfer position, wherein when the receiver is positioned in the power transfer position, a turned circuit, which includes the charger coil and the resonant capacitor of the charger drive circuit and the solenoid and the resonant capacitor of the receiver electronic circuit, has a resonant frequency that allows the charger to transfer the power to the receiver at the one or more operating frequencies;

the charger coil includes a conductor patterned to include multiple, substantially concentric turns for generating a magnetic flux through a first end of the solenoid when the receiver is placed in the power transfer position, wherein an outermost of the concentric turns defines a perimeter of a charger coil area;

the multiple substantially concentric turns, when driven by the charger drive circuit, generate a magnetic field that is substantially perpendicular to the charger surface at a geometric center of the charger coil area;

the charger coil area is larger than an area of the first end and larger than the area of the second end of the magnetic core of the solenoid;

the magnetic layer of the charger extends beyond the charger coil area; and

when the receiver is in the power transfer position, the first end of the magnetic core is located proximate to the charger coil area above the charger surface to receive magnetic flux from the charger coil area and guide the magnetic flux in a closed magnetic loop from the charger coil area through the solenoid and return through the charger magnetic layer to the charger coil area to form the closed magnetic loop.

47. (New) The charger of claim 21, wherein the charger coil is a single coil.

48. (New) The charger of claim 21, wherein when positioned in the power transfer position, a winding axis of the solenoid is positioned at an angle relative to an axis perpendicular to the charger surface, wherein the angle is one of any angle relative to the axis perpendicular to the charger surface.

49. (New) A mobile device that receives power inductively, the mobile device comprising:

a receiver to inductively receive power for the mobile device; wherein:

the receiver includes:

a solenoid, wherein the solenoid includes:

a magnetic core having a relative magnetic permeability exceeding 1 and having first and second ends; and

a Litz wire wrapped around a section of the magnetic core forming a wire wound section around the magnetic core, with the magnetic core extending beyond the wire wound section; and

a receiver electronic circuit, wherein the receiver electronic circuit includes a resonant capacitor and a rectifier; and

when the receiver is positioned proximate to a charger surface of an inductive charger, the receiver receives power from the charger, and the charger includes:

a printed circuit board having a charger coil, wherein the charger surface is a substantially planar surface of the charger coil;

a substantially planar magnetic layer under the charger coil opposite the charger surface;

a charger drive circuit, wherein the charger drive circuit includes a resonant capacitor and a FET switch to apply an alternating voltage to the charger coil; and

means for positioning the receiver in a power transfer position, which is proximate to the charger, to inductively transfer power to the receiver of the first mobile device;

wherein:

the charger drive circuit is configured to drive the charger coil at one or more operating frequencies to inductively transfer power from the charger to the receiver when the receiver is positioned in the power transfer position, wherein when the receiver is positioned in the power transfer position, a tuned circuit, which includes the charger coil and the resonant capacitor of the charger drive circuit and the solenoid and the resonant capacitor of the receiver electronic circuit, has a resonant frequency that allows the charger to transfer the power to the receiver at the one or more operating frequencies;

the charger coil includes a conductor patterned to include multiple, substantially concentric turns for generating a magnetic flux through a first end of the solenoid when the receiver is placed in the power transfer position, wherein an outermost of the concentric turns defines a perimeter of a charger coil area;

the multiple concentric turns, when driven by the charger drive circuit, generate a magnetic field that is substantially perpendicular to the charger surface at the charger surface at a geometric center of the charger coil area;

the charger coil area is larger than an area of the first end and larger than an area of the second end of the magnetic core of the solenoid;

the magnetic layer of the charger extends beyond the charger coil area; and

when the receiver is in the power transfer position, the first end of the magnetic core is located proximate to the charger coil area above the charger surface to receive magnetic flux from the charger coil area and guide the magnetic flux in a closed magnetic loop from the charger coil area through the solenoid and return through the charger magnetic layer to the charger coil area to form the closed magnetic loop.

50. (New) A method for inductive power transfer to a mobile device, wherein the mobile device includes a receiver, the method comprising:

positioning the receiver in a power transfer position to inductively receive power from an inductive charger; and

inductively transferring power from the charger to the receiver of the first mobile device;

wherein:

the charger includes:

a printed circuit board having a charger coil, wherein the charger coil has a substantially planar charger surface, and the charger coil includes a conductor patterned to include multiple, substantially concentric turns and an outermost of the concentric turns defines a perimeter of a charger coil area;

a substantially planar magnetic layer under the charger coil opposite the charger surface, wherein the magnetic layer of the charger extends beyond the charger coil area; and

a charger drive circuit, wherein the charger drive circuit includes a resonant capacitor and a FET switch to apply an alternating voltage to the charger coil;

the receiver includes:

a solenoid, wherein the solenoid includes:

a magnetic core having a relative magnetic permeability exceeding 1 and having first and second ends; and

Litz wire wrapped around a section of the magnetic core forming a wire wound section around the magnetic core, with the magnetic core extending beyond the wire wound section; and

a receiver electronic circuit, wherein the receiver electronic circuit includes a resonant capacitor and a rectifier; and

inductively transferring power from the charger to the receiver comprises:

driving the charger coil with the charger driver circuit at one or more operating frequencies to inductively transfer power from the charger to the receiver when the receiver is positioned in the power transfer position, wherein when the receiver is positioned in the power transfer position, a turned circuit, which includes the charger coil and the resonant capacitor of the charger drive circuit and the solenoid and the resonant capacitor of the receiver electronic circuit, has a resonant frequency that allows the charger to transfer the power to the receiver at the one or more operating frequencies;

generating a magnetic field that is substantially perpendicular to the charger surface at a geometric center of the charger coil area; and

generating magnetic flux through the charger coil and through a first end of the solenoid when the receiver is placed in the power transfer position; and

when the receiver is in the power transfer position, the first end of the magnetic core is located proximate to the charger coil area above the charger surface to receive the magnetic flux from the charger coil area and guide the magnetic flux in a closed magnetic loop from the charger coil area through the solenoid and return through the charger magnetic layer to the charger coil area to form the closed magnetic loop.

REMARKS

Claims 1-20 are pending.

Claims 1-20 have been canceled without prejudice or disclaimer of the subject matter recited therein.

Claims 21-50 have been added.

Amendment to the Figures

Figures 1-20 have been replaced for clarity of viewing

No new matter has been added.

CERTIFICATE OF TRANSMISSION

I hereby certify that on November 22, 2021 this correspondence is being transmitted via the U.S. Patent & Trademark Office's electronic filing system.

/Kent B. Chambers/

Respectfully submitted,

/Kent B. Chambers/

Kent B. Chambers
Attorney for Applicant(s)
Reg. No. 38,839

DocCode – SCORE

SCORE Placeholder Sheet for IFW Content

Application Number: 17467032 Document Date: 11/22/2021

The presence of this form in the IFW record indicates that the following document type was received in electronic format on the date identified above. This content is stored in the SCORE database.

Since this was an electronic submission, there is no physical artifact folder, no artifact folder is recorded in PALM, and no paper documents or physical media exist. The TIFF images in the IFW record were created from the original documents that are stored in SCORE.

- Drawing

At the time of document entry (noted above):

- USPTO employees may access SCORE content via DAV or via the SCORE web page.
- External customers may access SCORE content via PAIR using the Supplemental Content tab.

Form Revision Date: March 1, 2019

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 17/467,032

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	80		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	350		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	400		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	1 minus 20 =	*	x 50 =	0.00	OR		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	1 minus 3 =	*	x 240 =	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	830		TOTAL	

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 (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
Application Size Fee (37 CFR 1.16(s))									
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

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 (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
Application Size Fee (37 CFR 1.16(s))									
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest 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
17/467,032	09/03/2021	2859	830	AFPA-01039US4	1	1

CONFIRMATION NO. 1075

UPDATED FILING RECEIPT

33438
TERRILE, CANNATTI & CHAMBERS, LLP
P.O. BOX 203518
AUSTIN, TX 78720

OC000000129887207

Date Mailed: 11/19/2021

Receipt is acknowledged of this non-provisional utility 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 FIRST INVENTOR, 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 corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction 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 provided that the request is grantable.

Inventor(s)

Afshin Partovi, Palo Alto, CA;

Applicant(s)

Mojo Mobility Inc., Palo Alto, CA

Assignment For Published Patent Application

Mojo Mobility Inc., Palo Alto, CA

Power of Attorney: The patent practitioners associated with Customer Number 33438

Domestic Priority data as claimed by applicant

This application is a CON of 16/819,503 03/16/2020 PAT 11114886
which is a CON of 15/830,411 12/04/2017 PAT 10594155
which is a CON of 14/252,627 04/14/2014 PAT 9837846
which claims benefit of 61/811,638 04/12/2013

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 Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 09/15/2021
The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 17/467,032**
Projected Publication Date: 02/24/2022
Non-Publication Request: No
Early Publication Request: No
**** SMALL ENTITY ****
Title

System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes

Preliminary Class

320

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).

SelectUSA

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop

technology, manufacture products, deliver services, and grow your business, visit http://www.SelectUSA.gov or call +1-202-482-6800.

SYSTEM AND METHOD FOR POWERING OR CHARGING RECEIVERS OR DEVICES HAVING SMALL SURFACE AREAS OR VOLUMES

Copyriqht Notice

A portion of the disclosure of this patent document contains material which is subject to copyright protection. The copyright owner has no objection to the facsimile reproduction by anyone of the patent document or the patent disclosure, as it appears in the Patent and Trademark Office patent file or records, but otherwise reserves all copyright rights whatsoever.

Claim of Priority and Cross-reference to Related Applications:

[0001] This application claims the benefit of priority to U.S. Provisional Patent Application No. 61/811,638, titled "SYSTEM AND METHOD FOR POWERING OR CHARGING ONE OR MULTIPLE RECEIVERS OR DEVICES HAVING SMALL SURFACE AREAS OR VOLUMES" filed April 12, 2013; and is related to U.S. Patent Publication No. 20130285604 (U.S. Patent Application No. 13/828,789), titled "SYSTEMS AND METHODS FOR WIRELESS POWER TRANSFER" filed March 14, 2013; and U.S. Patent Publication No. 20120235636 (U.S. Patent Application No. 13/352,096), titled "SYSTEMS AND METHODS FOR PROVIDING POSITIONING FREEDOM, AND SUPPORT OF DIFFERENT VOLTAGES, PROTOCOLS, AND POWER LEVELS IN A WIRELESS POWER SYSTEM", filed January 17, 2012, which claims the benefit of priority to U.S. Provisional Patent Application No. 61/433,883, titled "SYSTEM AND METHOD FOR MODULATING THE PHASE AND AMPLITUDE OF AN ELECTROMAGNETIC WAVE IN MULTIPLE DIMENSIONS", filed January 18, 2011; U.S. Provisional Patent Application No. 61/478,020, titled "SYSTEM AND METHOD FOR MODULATING THE PHASE AND AMPLITUDE OF AN ELECTROMAGNETIC WAVE IN MULTIPLE DIMENSIONS", filed April 21, 2011; and U.S. Provisional Patent Application No. 61/546,316, titled "SYSTEMS AND METHODS FOR PROVIDING POSITIONING FREEDOM, AND SUPPORT OF DIFFERENT VOLTAGES, PROTOCOLS, AND POWER LEVELS IN A WIRELESS POWER SYSTEM", filed October 12, 2011; each of which above applications are herein incorporated by reference.

Field of Invention:

[0002] Embodiments of the invention are generally related to systems and methods for enabling transfer of power, from a wireless charger or power supply, to one or more receivers placed on or near the wireless charger or power supply, including powering or charging one or multiple receivers or devices having small surface areas or volumes.

Background:

[0003] Wireless technologies for powering and charging mobile and other electronic or electric devices, batteries and vehicles have been developed. Such systems generally use a wireless power charger or transmitter, in combination with a wireless power receiver, to provide a means for transfer of power. In some systems, the charger and receiver coil parts of the system are aligned and of comparable size. However, in some applications, it would be preferable to use receiver coils or antennas that have smaller areas or volumes. These are the general areas that embodiments of the invention are intended to address.

Summary:

[0004] Described herein are systems and methods for enabling transfer of power, from a wireless charger or power supply, to one or more receivers placed on or near the wireless charger or power supply, including powering or charging one or multiple receivers or devices having small surface areas or volumes. In accordance with an embodiment, a receiver coil can be generally shaped as a blade or thin solenoid, which receives power inductively, which is then used to power or charge one or more electronic devices. Applications include inductive or magnetic charging and power, and particularly usage in mobile, electronic, electric, lighting, or other devices, batteries, power tools, kitchen, industrial, medical or dental, or military applications, vehicles, robots, trains, and other usages.

Brief Description of the Figures:

[0005] **Figure 1** illustrates a system for wireless powering or charging of devices, inaccordance with an embodiment.

[0006] **Figure 2** illustrates another view of a wireless charger system, in accordancewith an embodiment.

[0007] **Figures 3** illustrates an example of a charger coil, in accordance with an embodiment.

[0008] **Figure 4** illustrates a resulting magnetic field, in accordance with an embodiment.

[0009] **Figure 5** illustrates a charger geometry, in accordance with an embodiment.

[0010] **Figure 6** illustrates a return magnetic flux from a charger, in accordance with an embodiment.

[0011] **Figure 7** illustrates wire wrapped around a core to create a solenoid type receiver, in accordance with an embodiment.

[0012] **Figure 8** illustrates a ferrite lower magnetic shield or flux guide, in accordance with an embodiment.

[0013] **Figure 9** illustrates a receiver coil wrapped around a very thin magnetic material, in accordance with an embodiment.

[0014] **Figure 10** illustrates the use of additional magnetic or ferrite material or layers added to or otherwise integrated with the top and/or bottom of the receiver coil, in accordance with an embodiment.

[0015] **Figure 11** illustrates the use of additional magnetic or ferrite material or layers added to or otherwise integrated with the top and/or bottom of the receiver coil, in accordance with another embodiment.

[0016] **Figure 12** illustrates integration of a receiver into a wearable headset or electronic display device or glasses, in accordance with an embodiment.

[0017] **Figure 13** illustrates an embodiment that incorporates magnetic or ferrite material sections above and below the main coil section, in accordance with an embodiment.

[0018] **Figure 14** illustrates integration of a receiver into a mobile phone, in accordance with an embodiment.

[0019] **Figure 15** illustrates that incorporates magnetic or ferrite material sections aboveand below the main coil section, in accordance with an embodiment.

[0020] **Figure 16** illustrates integration of a receiver into a headset device, in accordance with an embodiment.

[0021] **Figure 17** illustrates a charger for use in coupling to a blade type receiver in the outer perimeter of the charger surface, in accordance with an embodiment.

[0022] **Figure 18** illustrates a charger that provides different sections with different operating principles or protocols and/or driving and/or communication sections, in accordance with an embodiment.

[0023] **Figure 19** illustrates a charger that provides different sections, in accordance with another embodiment.

[0024] **Figure 20** illustrates a charger that provides different sections, in accordance with another embodiment.

Detailed Description:

[0025] With the proliferation of electrical and electronic devices and vehicles (which are considered examples of devices herein), simple and universal methods of providing power and or charging of these devices is becoming increasingly important.

[0026] In accordance with various embodiments, the term device, product, or battery is used herein to include any electrical, electronic, mobile, lighting, or other product, batteries, power tools, cleaning, industrial, kitchen, lighting, military, medical, dental or specialized products and vehicles, automobiles, personal mobility (e.g., Segway type) devices, buses, or movable machines such as robots or other mobile machines or other devices whereby the product, part, or component is powered by electricity or an internal or external battery and/or can be powered or charged externally or internally by a generator or solar cell, fuel cell, hand or other mechanical crank or alike.

[0027] In accordance with an embodiment, a product or device can also include an attachable or integral skin, case, cover, battery door or attachable or add-on or dongle type of receiver component, to enable the user to power or charge the product, battery, or device.

[0028] Induction generally refers to generation of electromotive force (EMF) or voltage across a closed electrical path in response to a changing magnetic flux through any surface bounded by that path. In literature, sometimes magnetic induction is defined as if it is limited to tightly-coupled cases whereby the charger and receiver coils are of similar sizes or the gap between them is small. Magnetic resonance is a term that has been used recently for inductive power transfer where the charger and receiver may be far apart or the transmitter and receiver coils are of different size. The term loosely-coupled wireless charging has also been used for these systems. Since magnetic resonance or loosely-coupled wireless charging is in general a form of induction, as used herein in accordance with various embodiments the term induction is used for any of these systems (including inductive or tightly-coupled wireless power transfer, magnetic resonant or loosely-coupled wireless power transfer and hybrid systems), and induction and magnetic resonance are sometimes used interchangeably to indicate that the method of power transfer can be in either domain or a combination thereof.

[0029] In accordance with various embodiments, an inductive power transmitter employs a magnetic induction coil(s) transmitting energy to a receiving coil(s) in or on a device or product, case, battery door, or attachable or add-on component including attachments such as a dongle or a battery inside or outside of device or attached to device through a connector and/or a wire, or stand-alone placed near or on the power transmitter platform. The receiver can be an otherwise incomplete device that receives power wirelessly and is intended for installation or attachment in or on the final product, battery or device to be powered or charged, or the receiver can be a complete device intended for connection to a device, product or battery directly by a wire or wirelessly. As used herein, the term wireless power, charger, transmitter or inductive or magnetic resonance power and charger are used interchangeably.

[0030] In accordance with an embodiment, the wireless charger can include a flat or curved surface, or an open or enclosed volume or part that can provide energy wirelessly to a receiver. It can also be constructed of flexible materials and/or coils or even plastic electronics to enable mechanical flexibility and bending or folding to save space or for conformity to non-flat surfaces.

[0031] In accordance with an embodiment, the wireless charger can be directly powered by an AC power input, DC power, or other power source such as a car, motorcycle, truck or other vehicle or airplane or boat or ship power outlet, or vehicle, boat, ship or airplane itself, primary (non-rechargeable) or rechargeable battery, solar cell, fuel cell, mechanical (e.g., hand crank, wind, or water source), nuclear source, or other wireless charger or power supply or a combination thereof. In addition, the wireless charger can be powered by a part such as a rechargeable battery which is itself in turn recharged by another source such as an AC or DC power source, vehicle, boat or ship or airplane outlet or vehicle, boat or ship or airplane itself, solar cell, fuel cell, mechanical (e.g., hand crank, wind, or water source) or nuclear source, or a combination thereof.

[0032] In accordance with various embodiments, in applications where the wireless charger is powered by a rechargeable source such as a battery, the battery can also be itself in turn inductively charged by another wireless charger. The wireless charger can be a stand- alone part, device, or product, or can be incorporated into another electric or electronics device, table, desk chair, armrest, TV stand or mount or furniture or vehicle or airplane or marine vehicle or boat or objects such as a table, desk, chair, counter-top, shelving or check out or cashier counters, kiosk, car seat, armrest, car console, car door, netting, cup holder, dashboard,glove box, etc., airplane tray, computer, laptop, netbook, tablet, phone, display, TV, magnetic, optical or semiconductor storage or playback device such as hard drive, solid state storage drive, optical players, etc., cable or game console, computer pads, toys, clothing, bags, case or backpack, belt or holster, etc., industrial, medical, dental, military equipment or kitchen counter, area, devices and appliances, phones, cameras, radios, stereo systems, speakers, etc. The wireless charger can also have other functions built in, or be constructed such that it is modular and additional capabilities or functions can be added as needed.

[0033] In accordance with various embodiments, some of these capabilities or functions include an ability to provide higher power, charge more devices, exchange the top surface or exterior box or cosmetics, operate by internal power as described above through use of a battery and/or renewable source such as solar cells, communicate and/or store data from a device, provide communication between the device and other devices or the charger and/or a

network, etc. An example is a basic wireless charger that has the ability to be extended to include a rechargeable battery pack to enable operation without external power. Examples of products or devices powered or charged by the induction transmitter and receiver include but are not limited to batteries, cell phones, smart phones, cordless phones, communication devices, heads-up displays, wearable computer with head mounted display, 3-d TV glasses, wearable electronic glasses, wearable computer or communication devices, communication or display watches, pagers, personal data assistants, portable media players, global positioning (GPS) devices, powered headphones or noise cancelling headphones, Bluetooth headsets and other devices, shavers, watches, tooth brushes, calculators, cameras, optical scopes, infrared viewers, computers, laptops, tablets, netbooks, keyboards, computer mice, book readers or email devices, pagers, computer monitors, televisions, music or movie players and recorders, storage devices, radios, clocks, speakers, gaming devices, game controllers, toys, remote controllers, power tools, cash register, delivery or other type of scanners, construction tools, office equipment, robots including vacuum cleaning robots, floor washing robots, pool cleaning robots, gutter cleaning robots or robots used in hospital, clean room, military or industrial environments, industrial tools, mobile vacuum cleaners, medical or dental tools, medical stretcher batteries, military equipment or tools, kitchen appliances, mixers, cookers, can openers, food or beverage heaters or coolers such as electrically powered beverage mugs, massagers, adult toys, lights or light fixtures, signs or displays, or advertising applications, electronic magazines or newspapers or magazines or newspapers containing an electronic and/or display part, printers, fax machines, scanners, electric vehicles, electric golf carts, buses,trains, motorcycles or bicycles, personal mobility (e.g., Segway type) devices, trains or other vehicles or mobile transportation machines, and other battery or electrically powered devices or products or a product that is a combination of the products listed above.

[0034] In accordance with an embodiment, the receiver and/or the charger can be incorporated into a bag, carrier, skin, cover, clothing, case, packaging, product packaging or box, crate, box, display case or rack, table, bottle or device etc. to enable some function inside the bag, carrier, skin, clothing, case, packaging, product packaging or box, crate, box, display case or rack, table, bottle (such as, e.g., causing a display case or packaging to display promotional information or instructions, or to illuminate) and/or to use the bag, carrier, skin, clothing, case, packaging, product packaging or box, crate, box, stand or connector, display case or rack, table, bottle, etc., to power or charge another device or component somewhere onor nearby.

[0035] In accordance with various embodiments, the product or device does not

necessarily have to be portable and/or contain a battery to take advantage of induction or wireless power transfer. For example, a lighting fixture or a computer monitor that is typically powered by an AC outlet or a DC power supply can be placed on a table top and receive power wirelessly. The wireless receiver can be a flat or curved surface or part that can receive energy wirelessly from a charger. The receiver and/or the charger can also be constructed of flexible materials and/or coils or even plastic electronics to enable mechanical flexibility and bending or folding to save space or for conformity to non-flat surfaces.

[0036] In accordance with various embodiments, many of these devices contain internal batteries, and the device may or may not be operating during receipt of power. Depending on the degree of charge status of the battery, or its presence and the system design, the applied power may provide power to the device, charge its battery or a combination of the above. The terms charging and/or power are used interchangeably herein to indicate that the received power can be used for either of these cases or a combination thereof. In accordance with various embodiments, unless specifically described, these terms are therefore used interchangeably. Also, unless specifically described herein, in accordance with various embodiments, the terms charger, power supply, and transmitter are used interchangeably. **[0037]Figure 1** illustrates a system for wireless powering or charging of devices in accordance with an embodiment. As shown in Figure 1, in accordance with an embodiment, a wireless charger or power system 100 comprises a first charger or transmitter part 110, and a receiver 120 connected to a mobile or stationary device, vehicle or battery or its charging or power circuit to provide electric power to power or charge the mobile or stationary device, vehicle or its battery.

[0038] Figure 1 shows an example where one charger or power transmitter is charging or powering one receiver. However, in a more general case, the transmitter may comprise one or more transmitters or chargers operating at different power levels and/or using different protocols to power one or more receivers operating at different power levels, voltages and/or protocols.

[0039] **Figure 2** illustrates a more detailed view of a wireless charger system 128, in accordance with an embodiment, with a resonant converter geometry, wherein a pair of transistors 01 and 02 in the charger 130 (such as FETs, MOSFETs, or other types of switch) are driven by a half-bridge driver IC and the voltage is applied to the coil L1 through one or more capacitors shown as C1. In accordance with an embodiment, the receiver 140 includes a coil and an optional capacitor (for added efficiency) shown as C2 that can be in series or in parallel with the receiver coil L2. The charger and/or receiver coils can also include impedance

matching circuits and/or appropriate magnetic material layers behind (on the side opposite to the coil surfaces facing each other) them to increase their inductance and/or to shield the magnetic field leakage to surrounding area. The charger and/or receiver can also include impedance matching circuits to optimize or improve power transfer between the charger and receiver.

[0040] In several of the embodiments and figures described herein, the resonant capacitor C2 in the receiver is shown in a series embodiment. This is intended only as a representative illustration, and in accordance with various embodiments this capacitor can be used in series or parallel with the receiver coil. Similarly, the charger is generally shown in accordance with an embodiment where the resonant capacitor is in series with the coil. System implementations with the capacitor C1 in parallel with the charger coil are also possible.

[0041] In accordance with an embodiment, the charger can also include a circuit that measures the current through and/or voltage across the charger coil (for example, in Figure 2, a current sensor is shown as an example). Communication between the receiver and the charger can also be provided through the same coils as used for the power transfer, through modulation of a load in the receiver. Various demodulation methods for detection of the communication signal on the charger current or voltage are available. This demodulation mechanism can be, e.g., an AM or FM receiver (depending on whether amplitude or frequency modulation is employed in the receiver modulator) similar to a radio receiver tuned to the frequency of the communication or a heterodyne detector.

[0042] In accordance with an embodiment, the communication and control between the charger and the receiver(s) is conducted over a separate or additional RF or optical or other channels. Optional methods of communication between the charger and receiver can be provided through the same coils as used for transfer of power, through a separate coil, through an RF or optical link, through, e.g., RFID, Bluetooth, WiFi, Wireless USB, NFC, Felica, Zigbee, or Wireless Gigabit (WiGig) or through such protocols as defined by the Wireless Power Consortium (WPC), Alliance for Wireless Power (A4WP) or other protocols or standards, developed for wireless power, or specialized protocols such as Dedicated Short Range Communications (DSRC) for automotive applications, or other communication protocol, or combinations thereof.

[0043] In accordance with an embodiment, the microcontroller unit (MCU) in the charger (shown as MCU1 in Figure 2) is responsible for decoding the communication signal from a detection/demodulation circuit and, depending on the algorithm used, making appropriate adjustments to the charger coil drive circuitry to achieve the desired output voltage, current or

power from the receiver output.

[0044] In accordance with various embodiments, it may be preferable for one or more receivers to receive power when placed at a variety of locations or anywhere on or near a wireless charger area. Such an implementation, in general would benefit from a charger and/or receiver design that allows a uniform power transfer over an area or the entire surface of the charger. To provide more uniform power transfer across a coil, in accordance with an embodiment, methods to provide a more uniform magnetic field across a coil can be used. For example, one method for achieving this uses a hybrid coil comprising a combination of a wire and PCB coils (e.g., X. Liu and S. Y. R. Hui, "Optimal design of a hybrid winding structure for planar contactless battery charging platform," IEEE Transactions on Power Electronics, vol. 23, no. 1, pp. 455-463, 2008). In another method, the transmitter coil can be constructed of Litz wire or patterned printed circuit board (PCB) and has a pattern that is very wide between successive turns at the center and is more tightly wound as one gets closer to the edges (e.g., J. J. Casanova, Z. N. Low, J. Lin, and R. Tseng, "Transmitting coil achieving uniform magneticfield distribution for planar wireless power transfer system," in Proceedings of the IEEE Radioand Wireless Symposium, pp. 530-533, January 2009). **Figure 3** shows an example of a coil 150 in accordance with an embodiment, while **Figure 4** shows a resulting magnetic field 152. **[0045]** In a geometry described in U.S. Patent Publication No. 20080067874, a planar spiral inductor coil is demonstrated, wherein the width of the inductor's trace becomes wider as the trace spirals toward the center of the coil to achieve a more uniform magnetic field allowingmore positioning flexibility for a receiver across a transmitter surface.

[0046] In yet other embodiments (e.g., F. Sato, et al., IEEE Digest of Intermag 1999, PP. GR09, 1999), the coil can be a meandering type of coil, wherein the wire is stretched along X or Y direction and then folds back and makes a back and forth pattern to cover the surface.

[0047] In accordance with an embodiment, the charger can operate continuously, and any appropriate receiver coil placed on or near its surface will bring it to resonance and will begin receiving power. The regulation of power to the output can be performed through a regulation stage and/or tuning of the resonant circuit at the receiver. Advantages of such a system include that multiple receivers with different power needs can be simultaneouslypowered in this way. The receivers can also have different output voltage characteristics. **[0048]** In accordance with embodiments described in U.S. Patent Application No. 13/352,096, published as U.S. Patent Publication No. 20120235636, which application is herein incorporated by reference, two techniques have been described whereby through appropriate design of the system, a position-independent power transfer system with reduced or no

undesirable radiation and high efficiency can be achieved. These geometries use a saturable magnetic layer placed above the charger coil area to shield the charger magnetic layer from the surrounding area.

[0049] For example, in accordance with an embodiment, a Magnetic Aperture (MA) receiver includes an appropriate magnet in the receiver that can saturate the shield layer nearby the receiver and allow coupling of power only in that area of the charger, resulting in efficient power coupling with minimal residual electromagnetic emission from nearby areas. In accordance with an embodiment, a Magnetic Coupling (MC) system employs a similar geometrybut uses the increase in the resonant electromagnetic field between the charger and receiver coils to self-saturate the layer, and does not require a receiver magnet to operate and achieve similar results. These two techniques are further described in the patent applications referenced above.

[0050] **Figure 5** shows an additional geometry 160 whereby a charger coil 162 is placed on a magnetic flux guide / shielding layer 164 that extends beyond the edges of the coil. The receiver similarly has a magnetic flux / shielding layer 166 that extends beyond the size of the coil 168, allowing an overlap area between these flux layers on the top and bottom sides of the receiver. **Figure 6** shows 170 the return magnetic flux from the charger that passes the receiver coil and is guided efficiently to close on itself. Such an efficient flux guide (FG) geometry results in confinement of power transfer to the area of overlap of a receiver and charger coil, and significant increase in power transfer efficiency and reduction of undesirable electromagnetic emission compared to Magnetic Resonance (MR) systems. It is also possible to further decrease any potential emissions from non-covered areas of the charger coil by covering the charger coil with a magnetic shield layer and combining the FG geometry with the earlier described MC or MA modes of operation.

[0051] In accordance with the MC geometry, the reluctance of the flux path in the receiver can be lowered by including high permeability material in the core of the receiver ring coil (similar to a solenoid) or a T-shape core or alike. Many geometries are possible, and these geometries are provided merely as examples. Additionally, while in accordance with an embodiment a Litz wire receiver coil can be used, in accordance with other embodiments, PCB coils and/or a combination of Litz wire and PCB coil can be used.

[0052] In accordance with an embodiment, to reduce the reluctance of the path, the receiver coil can be created by using a flux guide material (such as ferrite with permeability greater than 1), with an axis perpendicular (or an angle sufficient to catch the substantially perpendicular flux from the charger) to the surface of the charger. As shown 172 in **Figure 7**,

Litz wire can be wrapped around the core to create a solenoid type receiver with a relatively small cross section (several mm or smaller by 10 or 20 mm) substantially parallel to the surface of the charger. In one example, the solenoid height (along the direction of axis of wire wrapped around it, and perpendicular to the surface of the charger) can be varied from 10 to 20 mm, but can be shorter. A typical number of turns on the receiver coil can be 7 to 20 turns. Use of a series or parallel capacitor with such a receiver coil provides a resonant circuit whose output can be rectified and smoothed with a capacitor to provide a DC output. To provide regulated power output, as shown in Figures 1 and 2, a communication or feedback system between charger and receiver and/or an output stage regulator can also be added.

[0053] In one example, a charger coil similar to that shown in Figure 3 and with a thin (0.5 mm thick) ferrite lower magnetic shield / flux guide similar to that shown 174 in **Figure 8** was used. Substantial power transfer (over 20 W) and high efficiencies of up to 55% DC to DC (DC power output of receiver rectifier divided by input to DC charger circuit input power) was received over the entire surface of the charger coil when the charger coil and its associated resonant capacitor were tuned to be resonant at similar frequencies to the receiver coil and its associated capacitor. Power was received with the receiver coil having zero up to several cm ofgap from the surface of the charger coil. Such a small solenoid can be provided having very small sizes in one or two dimensions, such that it is shaped as or otherwise resembles a blade, with the contact area being the thin edge of the blade.

[0054] In accordance with an embodiment, rotating the angle of the blade solenoid with respect to the perpendicular direction to the surface to the charger can produce large power transfers, confirming that as long as some component of the charger flux is along the axis of the receiver coil, efficient power transfer can be obtained. Both position-free and multiple receiver operation can be provided. As shown in Figure 7, optionally, an additional magnetic shield / guide layer on the top of the receiver and/or on the bottom of the charger can also be included. In many applications, it is beneficial to utilize receivers that occupy minimal space and are able to fit inside (or inside an optional part of) a small mobile or fixed position device.

[0055] In accordance with an embodiment shown in Figure 8, the charger does not utilize a top magnetic layer, and the flux guiding through the magnetic core and/or magnetic layers at the bottom of charger and/or top of receiver is used to provide a low reluctance path for magnetic flux flow and efficient power transfer.

[0056] Some examples of the types of devices that can include a small blade type receiver include mobile phones, MP3 players, and wearable computers such as displays, communication and display watches, and electronic glasses. In some applications, the device

to be charged has a small surface area that is in contact with the charger surface, for example cylindrical batteries that are placed vertically to be charged, or devices such as wearable electronic glasses or displays whereby the device has a small surface area when placed against a flat or curved charger. In accordance with an embodiment, use of the flux guide and a smaller cross-section parallel to the surface of the charger, as shown in Figure 7 or 8, may be useful for these types of applications.

[0057] In accordance with an embodiment, a receiver coil or solenoid with a magnetic flux guide can also be constructed to have a somewhat larger area parallel to the surface of the charger, approximating the embodiment illustrated in Figure 6, but with a flux guide layer or core in the middle of the coil. In this case, the height of this flux guide or core (along the length perpendicular to the surface of the charger) can be made quite short (e.g., 1-2 mm or less).

[0058] In accordance with an embodiment, shown in **Figure 9**, the receiver coil can bewrapped around a very thin magnetic material. By way of example, in accordance with anembodiment 180, 182 this material can be 1 mm or less in thickness. In one example, coilscomprising 0.6 mm thick Litz wire of bundled wire can be wrapped around 0.3 mm thick sheet of600 permeability ferrite material (20 x 10 x 0.3 mm size) and used for such a receiver. Using such a blade type receiver with a coil surface area of 20 x 0.3 mm on a charger surface of 170mm x 170 mm or larger coil with pattern similar to Figure 3, power transfer levels exceeding 20 W, and DC to DC power transfer efficiencies of up to 55 %, were observed when the receiver coil was placed at any location and orientation (with the axis of the receiver coil having some component perpendicular to the surface of the charger) on or near the surface of the charger.Additionally, significant power transfer was observed when the receiver coil was moved awayfrom the charger coil in a vertical direction (with coil to coil spacing of 20 mm or larger).Considering that the blade type receiver coil surface occupies an area of 0.02% of the area ofthe charger coil, achieving such a high level of power transfer and efficiency demonstrates that the flux generated at the surface of the charger coil is efficiently guided and channeled to thelocation of the receiver coil.

[0059] In accordance with an embodiment, such a coil can be made to be symmetrical along its winding axis, and can receive power when the coil is flipped vertically. Such a feature may provide additional flexibility and usage in some applications.

[0060] In accordance with another embodiment shown 190, 192 in **Figure 10**, and 202, 202 in **Figure 11**, additional magnetic or ferrite material or layers can be added to or otherwise integrated with the top and/or bottom of the receiver coil and its associated magnetic section. Such layers aid in the guidance of the flux generated in the receiver coil and can provide higher

efficiency and/or power.

[0061] In accordance with an embodiment, the receiver can be used to charge or power wearable mobile communication and display devices, such as wearable electronic glasses, watches, headsets, or other devices. An example of an embodiment for integration into wearable headsets or electronic display devices or glasses is shown 212 in **Figure 12**. In accordance with an embodiment, a device such as an electronic glasses can be oriented on a surface as shown, to receive charging. Alternately, the electronic glasses can be flipped vertically so the top flat side is in contact with a charging surface. In either orientation, the surface area of the device in or near contact with the charger surface can be quite small.

[0062] Figure 12 shows an embodiment that incorporates the receiver coil and/or its associated electronics in a section with a small horizontal (in the plane of the charger coil if the device is laid down on a charger surface) surface area. The embodiments of the receiver coil described above are useful for this implementation, and can also be incorporated in another embodiment 214 shown in **Figure 13** that incorporates magnetic or ferrite material sections above and below the main coil section to further guide the magnetic flux. These layers can also be used to guide or route the charger magnetic flux around the inside cavity and shield any PCB, circuit, battery, or metallic part that may be included in this space from the magnetic fieldof the charger.

[0063] Since, in accordance with an embodiment, such a receiver can be symmetrical in the Z axis (perpendicular to surface of charger or along the axis of the receiver coil winding), the electronic glasses can be laid down in any of the several orientations flatly on the surface and power will be received by the receiver. In addition, the X and Y position freedom created by the charger coil allows the user to place the electronic glasses at any location on the charger, and even at a Z distance, to receive power.

[0064] In accordance with an exemplary embodiment, when a receiver with integrated horizontal flux guide sections, such as the embodiment shown in Figure 11, was placed near the outer areas of a 170 mm x 170 mm charger coil such as that shown in Figure 8, with a charger under a layer of ferrite material flux guide, it was observed that the receiver can receive power even when its coil axis is parallel to the charger surface. This is due to the large parallel (to the surface) component of the charger magnetic flux in these outer areas. The smaller horizontal sections in the receiver coil (shown as the end flux guides in Figure 11) also aid in guiding the flux into and out of the receiver coil, and enable operation of the receiver in any orientation. This behavior enables a receiver such as that shown in Figure 11 to be generally rotatable at any angle along an axis perpendicular to the plane of the orientation shown in lower part of

Figure 11, when placed on a charger, and still receive power. This behavior can be useful for those applications where orientation independence is required.

[0065] In accordance with another embodiment, the receiver can be integrated into devices such as mobile phones, MP3 players, tablets, watches, batteries, headsets, or other devices where limited space is available**. Figure 14** shows an embodiment 220 for integration into a mobile phone at an edge of the phone, or somewhere within the body of the phone. Sucha phone with the receiver integrated can be charged when placed at any location on a charger surface. In accordance with another embodiment 222, horizontal magnetic or ferrite layers on top and bottom can be used, as shown in **Figure 15**.

[0066] As described above, in accordance with an embodiment, the receiver coil can be made to be symmetrical along its winding axis, which enables, in either of the embodiments, the phone or other electronic device to be charged with either its back side or its front facing the charger surface. In accordance with an embodiment, the charger and/or the receiver can also be configured to detect the orientation or front-back placement of the device during charging and perform additional functionalities. For example, a phone can be configured so that when the phone is placed face-down on the charger, it can be charged but will enter a "Do Not Disturb" mode so that any incoming calls, messages, texts, emails, etc., will not provide audio, visual or other indications; but, when placed on the charger in its other orientation (display face-up), incoming information can be relayed to the user visually, by audio or even displayed or transmitted to another device (such as transmission to another display when used in cars).

[0067] The above illustration is an example of a contextually-aware operation; in accordance with various embodiments, such activities of tying wireless charging to, e.g., launching or performance of other activities or commands can be considered examples of contextually aware charging, additional examples of which are described in U.S. Patent Publication No. 20110050164, which examples can be combined or used with various embodiments of the charger and receiver technologies described herein.

[0068] **Figure 16** shows another embodiment 224 for integration of a sheet or blade type receiver coil within an electronic device, in this illustration a headset device, e.g., at the edge or back of the headset, or another suitable location within the body of the headset.

Charger and Receiver Interaction

[0069] In accordance with an embodiment, the receiver can be provided as an integral part of a device or battery as described above, or can be provided as an otherwise incomplete device that receives power wirelessly and is intended for installation or attachment in or on the

final product, battery or device to be powered or charged, or the receiver can be a complete device intended for connection to a device, product or battery directly by a wire or wirelessly. Examples include replaceable covers, skins, cases, doors, jackets, surfaces, etc for devices or batteries that would incorporate the receiver or part of the receiver and the received power would be directed to the device through connectors in or on the device or battery or the normal wired connector (or power jack) of the device or battery. The receiver can also be a part or device similar to a dongle or insert etc., that can receive power on or near the vicinity of a charger and direct the power to a device or battery to be charged or powered through a wire and/or appropriate connector. Such a receiver can also have a form factor that would allow it to be attached in an inconspicuous manner to the device, such as a part that is attached to the outer surface at the bottom, front, side, or back side of a laptop, netbook, tablet, phone, game player, camera, headset or other electronic device, and routes the received power to the input power connector, battery connector or jack of the device.

[0070] In accordance with an embodiment, the connector of such a receiver can be configured such that it has a pass-through or a separate connector integrated into it, so that a wire cable for providing wired charging or power or communication can be connected to the connector without removal of the connector, thus allowing the receiver and its connector to be permanently or semi-permanently be attached to the device throughout its operation and use.

[0071] In a more integrated approach, the coil, shield and/or the receiver circuit can be integrated into the construction of the electric or electronic device, and be an integral part of the operation of the device which is powered or charged primarily or as an option (in addition to wired charging) through the wireless power received from the receiver. Many other variations of the receiver implementation are possible, and these examples are not meant to be exhaustive.

[0072] In accordance with an embodiment, the receiver can also be provided as a whole or as a part of the electronics, coil, shield, or other part of the system required for receiving power wirelessly. The electronics can comprise discrete components or microcontrollers that when used together provide the wireless receiver functionality, or comprise an Application Specific Integrated Circuit (ASIC) chip or chipset or MCM that is specifically configured to function as the whole or a substantial part of the electronics for wireless receiver system.

[0073] In accordance with an embodiment, a system with largely mis-matched (i.e. dissimilar in size or shape) charger and receiver coils can potentially have several advantages. For example, power can be transferred to the receiver coils placed anywhere on the transmitter coil. Several receivers can be placed and powered on one transmitter allowing for simpler and lower cost of transmitter. The system with higher resonance Q can be configured so the gap

between the transmitter and receiver coil can be larger than a tightly-coupled system leading to design of systems with more design freedom. In practice, power transfer in distances of several cm or even higher have been demonstrated. Power can be transferred to multiple receivers simultaneously. In addition, the receivers can potentially be of differing power rating or be in different stages of charging or require different power levels and/or voltages.

[0074] In accordance with an embodiment, in order to achieve the above characteristics and to achieve high power transfer efficiency, the lower k value is compensated by using a higher Q through design of lower resistance coils, etc. The power transfer characteristics of these systems may differ from tightly-coupled systems and other power drive geometries such as use of resonant converters. Class E amplifiers or Zero Voltage Switching (ZVS) or Zero Current Switching (ZCS) or other power transfer systems may potentially operate more efficiently in these situations. In addition, impedance matching circuits at the charger transmitter and/or receiver may be required to enable these systems to provide power over a range of load values and output current conditions. General operation of the systems can, however be quite similar to the tightly-coupled systems and one or more capacitors in series or parallel with the transmitter and/or receiver coils is used to create a tuned circuit that may have a resonance for power transfer. Operating near this resonance point, efficient power transfer across from the transmitter to the receiver coil can be achieved. Depending on the size difference between the coils and operating points, efficiencies of over 50% up to near 80% have been reported in such loosely-coupled systems.

[0075] To provide communication and control between the charger and receiver or receivers, in accordance with an embodiment, a hardware Physical Communication and Control Layer (PCCL) and a software or firmware Command and Control Layer (CCL) can be implemented. Optional methods of communication between the charger and receiver(s) can be provided through the same coils as used for transfer of power, through a separate coil, through an RF or optical link, through RFID, Bluetooth, Wi-Fi, Wireless USB, NFC, Felica, Zigbee, Wireless Gigabit (WiGig), 3G, 4G, etc. or through such protocols as defined by the Wireless Power Consortium (WPC), Alliance for Wireless Power (A4WP), or Power Matters Alliance (PMA), or other protocols such as Dedicated Short Range Communication (DSRC) used for automotive applications or other standards, developed for wireless power, or other communication protocol, or combination thereof.

[0076] In simpler architectures, there may be minimal or no communication between the charger and receiver. For example, a charger can be configured to be in a standby power transmitting state, and any receiver in close proximity to it can receive power from the charger.

The voltage, power, or current requirements of the device or battery connected to the receiver circuit can be unregulated, or regulated or controlled completely at the receiver or by the device attached to it. In this instance, no regulation or feedback or communication between the charger and receiver may be necessary. In a variation of this, the charger can be configured to be in a state where a receiver in close proximity would bring it into a state of power transmission. Examples of this would be a resonant system where inductive and/or capacitive components are used, so that when a receiver of appropriate design is in proximity to a charger, power is transmitted from the charger to a receiver; but without the presence of a receiver, minimal or no power is transmitted from the charger.

[0077] In accordance with an embodiment, in those examples in which communication is provided through the power transfer coils, one method for communication from receiver or receivers to the charger is to modulate a load or impedance in the receiver to affect the voltage and/or current in the receiver coils and therefore create a modulation in the charger coil voltage or current parameters that can be detected through monitoring of its voltage or current. Other methods can include frequency modulation, by combining the received frequency with a local oscillator signal or inductive, capacitive, or resistive modulation of the output of the receiver coil. In addition to communication from receivers to a charger transmitter, it is also possible to modulate the charger voltage at a pre-determined frequency and communication protocol and detect at each receiver to provide communication from the charger to the receivers. Such bi- directional communication may be advantageous in cases where the charger is used to power multiple receivers as will be explained later.

[0078] In accordance with an embodiment, the communicated information from a receiver to the charger transmitter can be the output voltage, current, power, device or battery status, validation ID for receiver, end of charge or various charge status information, receiver battery, device, or coil temperature, and/or user data such as music, email, voice, photos or video, or other form of digital or analog data used in a device. It can also be patterns or signals or changes in the circuit conditions that are transmitted or occur to simply notify the presence of the receiver nearby.

[0079] In accordance with an embodiment, the data communicated can be any one or more of the information detailed herein, or the difference between these values and the desired value, or simple commands to increase or decrease power, or simply one or more signals that would confirm presence of a receiver or a combination of the above. The receiver and/or charger and/or their coils can also include elements such as thermistors, magnetic shields or magnetic cores, magnetic sensors, and input voltage filters, etc., for safety and/or emission

compliance reasons. The receiver can also be combined with other communication or storage functions, such as NFC, Wi-Fi, Bluetooth, etc. In addition, the charger and or receiver can include means to provide more precise alignment between the charger and receiver coils or antennas. These can include visual, physical, or magnetic means to assist the user in alignment of parts. To implement more positioning freedom of the receiver on the charger, the size of the coils can also be mismatched. For example, the charger can comprise a larger coil size, and the receiver a smaller one, or vice versa, so that the coils do not have to be precisely aligned for power transfer.

[0080] In accordance with an embodiment, to minimize stand-by power use, the charger can periodically be turned on to be driven with a periodic pattern (a ping process) and if a receiver in proximity begins to draw power from it, the charger can detect power being drawn from it and stay in a transmitting state. If no power is drawn during the ping process, the charger can be turned off or placed in a stand-by or hibernation mode to conserve power, and turned on and off again periodically to continue seeking a receiver.

[0081] In accordance with an embodiment, the charger also includes a circuit that measures the current through and/or voltage across the charger coil (for example, a current sensor is shown in Figure 2 by way of example). As described earlier, various demodulation methods for detection of the communication signal on the charger current or voltage can be used.

[0082] While a system for communication between the charger and receiver through the power transfer coils or antennas is described above, in accordance with an embodiment the communication can also be implemented through separate coil or coils, a radio frequency link (AM, FM or other communication method), an optical communication system, or a combination of the above. The communication in any of these methods can also be bi-directional rather than uni-directional as described above.

[0083] In accordance with another embodiment, a dedicated RF channel for uni-directional or bi-directional communication between the charger and receiver can be implemented for validation and/or regulation purposes. This system can be similar to the system shown in Figure 2, except rather than load modulation being the method of communication, the microcontroller (MCU) in the receiver transmits the required information over an RF communication path. A similar system with LED or laser transceivers or detectors and light sources can be implemented. Advantages of such a system include that the power received is not modulated and therefore not wasted during communication and/or that no noise due to the modulation is added to the system.

[0084] In accordance with an embodiment, the microcontroller unit (MCU) in the charger (MCU1) is responsible for recognizing and understanding the communication signal from the detection/demodulation circuit and, depending on the algorithm used, making appropriate adjustments to the charger coil drive circuitry to achieve the desired output voltage, current or power from the receiver output. In addition, MCU1 is responsible for processes such as periodic start of the charger to seek a receiver at the start of charge, keeping the charger on when a receiver is found and accepted as a valid receiver, continuing to apply power and making appropriate adjustments, and/or monitoring temperature or other environmental factors, providing audio or visual indications to the user on the status of charging or power process, etc., or terminating charging or application of power due to end of charge, or customer preference, orover temperature, over current, over voltage, or some other fault condition or to launch or start another program or process.

[0085] In accordance with an embodiment, once the charger MCU1 has received a signal and decoded it, it can take action to provide more or less power to the charger coil. This can be accomplished through known methods of adjusting the frequency, duty cycle or input voltage to the charger coil or a combination of these approaches. Depending on the system and the circuit used, the MCU1 can directly adjust the bridge driver, or an additional circuit such as a frequency oscillator can be used to drive the bridge driver or the FETs. A typical circuit for the receiver, in accordance with a load modulation communication system embodiment, is shown in Figure 2.

[0086] In accordance with an embodiment, the receiver circuit can include an optional capacitor C2 in parallel or series with the receiver coil to produce a tuned receiver circuit. This circuit is known to increase the efficiency of a wireless power system. The rectified and smoothed (through rectifiers and capacitors) output of the receiver coil and optional capacitor is either directly or through a switch or regulator applied to the output. A microcontroller MCU2 is used to measure various values such as voltage V1, current, temperature, state of charge, battery full status, end of charge, etc. and to report back to the charger to provide a closed loop system with the charger as described above. In the circuit shown in Figure 2, the receiver MCU2 communicates back to the charger by modulating the receiver load by rapidly closing andopening a switch in series with a modulation load or impedance at a pre-determined speed and coding pattern. This rapid load modulation technique at a frequency distinct from the power transfer frequency can be easily detected by the charger. A capacitor and/or inductor can also be used as the modulation load.

[0087] In accordance with other embodiments, other methods of communication through

varying the reactive component of the impedance can also be used. The modulation scheme shown in Figure 2 is shown only as a representative method and is not meant to be exhaustive. As an example, the modulation can be achieved capacitively, by replacing the resistor with a capacitor. In this instance, the modulation by the switch in the receiver provides an advantage that by choosing the modulation frequency appropriately, it is possible to achieve modulation and signal communication with the charger coil and circuitry, with minimal power loss (compared to the resistive load modulation).

[0088] The receiver in Figure 2 also shows an optional DC regulator that is used to provide constant stable voltage to the receiver MCU2. This voltage supply may be necessary to avoid drop out of the receiver MCU2 during startup conditions where the power is varying largely or during changes in output current, and also to enable the MCU2 to have a stable voltage reference source so it can measure the V1 voltage accurately. Alternatively, a switch to connect or disconnect the load can be used or combined with the regulator. To avoid voltage overshoots during placement of a receiver on a charger or rapid changes in load condition, a voltage limiter circuit or elements like Transit Voltage Suppressor (TVS), Zener diodes or regulators or other voltage limiters can also be included in the receiver.

[0089] In the above description, a uni-directional communication (from the receiver to the charger) is described. However, this communication can also be bi-directional, and data can be transferred from the charger to the receiver through modulation of the voltage or current in the charger coil and read back by the microcontroller in the receiver detecting a change in thevoltage or current, etc.

[**0090]** In accordance with an embodiment, the communication between the receiver and charger needs to follow a pre-determined protocol, baud rate, modulation depth, etc. and a pre-determined method for hand-shake, establishment of communication, and signaling, etc., as well as optionally methods for providing closed loop control and regulation of power, voltage, etc., in the receiver.

[0091] In accordance with an embodiment, a typical wireless power system can be as follows: the charger periodically activates the charger coil driver and powers the charger coil with a drive signal of appropriate frequency. During this'ping'process, if a receiver coil is placed on or close to the charger coil, power is received through the receiver coil and the receiver circuit is energized. The receiver microcontroller is activated by the received power and begins to perform an initiation process whereby the receiver ID, its presence, power or voltage requirements, receiver or battery temperature or state of charge, manufacturer or serial number and/or other information is sent back to the charger. If this information is verified and

found to be valid, then the charger proceeds to provide continuous power to the receiver. The receiver can alternately send an end of charge, over-temperature, battery full, or other messages that will be handled appropriately by the charger and actions performed. The length of the ping process should be configured to be of sufficient length for the receiver to power up its microcontroller and to respond back and for the response to be received and understood and acted upon. The length of time between the pings can be determined by the implementation designer. If the ping process is performed often, the stand-by power use of the charger is higher. Alternately, if the ping is performed infrequently, the system will have a delay before thecharger discovers a receiver nearby; so in practice, a balance may be suitable.

[0092] Alternatively, in accordance with an embodiment, the ping operation can be initiated upon discovery of a nearby receiver by other means. This provides a very low stand-by power use by the charger and can be performed by including a magnet in the receiver and a magnet sensor in the charger or through optical, capacitive, weight, NFC or Bluetooth, RFID or other RF communication or other methods for detection.

[0093] Alternatively, in accordance with an embodiment, the system can be configured or implemented to be always ON (i.e., the charger coil is powered at an appropriate drive frequency) or pinged periodically and presence of the receiver coil brings the coil to resonance with the receiver coil and power transfer occurs. The receiver in this instance may not even contain a microcontroller and act autonomously and may simply have a regulator in the receiver to provide regulated output power to a device, its skin, case, or battery. In those embodiments in which periodic pinging is performed, the presence of a receiver can be detected by measuring a higher degree of current flow or power transfer or other means, and the charger can simply be kept on to continue transfer of power until either the power drawn falls below a certain level or an end of charge and/or no device present is detected.

[0094] In another embodiment, the charger can be in an OFF or standby, or low or no power condition, until a receiver is detected by means of its presence through a magnetic, RF, optical, capacitive or other methods. For example, in accordance with an embodiment the receiver can contain an RFID chip and once it is present on or nearby the charger, the charger can turn on or begin pinging to detect a receiver.

[0095] In accordance with an embodiment, the protocol used for communication can be any of, e.g., common RZ, NRZ, Manchester code, etc., used for communication. As described above, the charger can periodically start and apply a ping voltage of pre-determined frequency and length to the charger coil. The receiver is then activated, and can begin to send back communication signals. The communication signal can include an optional preamble that is

used to synchronize the detection circuit in the charger and prepare it for detection of communication. A communication containing a data packet may then follow, optionally followed by checksum and parity bits, etc. Similar processes are used in communication systems and similar techniques can be followed. In accordance with an embodiment, the actual data packet can include information such as an ID code for the receiver, a manufacturer's code, received voltage, power, or current values, status of the battery, amount of power in the battery, battery or circuit temperature, end of charge or battery full signals, presence of external wired charger, or a number of the above. Also this packet may include the actual voltage, power, current, etc. value or the difference between the actual value and the desired value or some encoded value that will be useful for the charger to determine how best to regulate the output.

[0096] Alternatively, in accordance with an embodiment, the communication signal can be a pre-determined pattern that is repetitive and simply lets the charger know that a receiver is present and/or that the receiver is a valid device within the power range of the charger, etc. Any combination of systems can be configured to provide the required performance.

[0097] In accordance with an embodiment, in response to the receiver providing information regarding output power or voltage, etc., the charger can modify voltage, frequency, duty cycle of the charger coil signal or a combination of the above. The charger can also use other techniques to modify the power out of the charger coil and to adjust the received power. Alternatively the charger can simply continue to provide power to the receiver if an approved receiver is detected and continues to be present. The charger can also monitor the current into the charger coil and/or its temperature to ensure that no extra-ordinary fault conditions exist. One example of this type of fault may be if instead of a receiver, a metal object is placed on the charger.

[0098] In accordance with an embodiment, the charger can adjust one or more parameters to increase or decrease the power or voltage in the receiver, and then wait for the receiver to provide further information before changing a parameter again, or it can use more sophisticated Proportional Integral Derivative (PIO) or other control mechanism for closing the loop with the receiver and achieving output power control. Alternatively, as described above, the charger can provide a constant output power, and the receiver can regulate the power through a regulator or a charger IC or a combination of these to provide the required power to a device or battery.

[0099] Various manufacturers may use different encodings, and also bit rates and protocols. The control process used by different manufacturers or protocols may also differ, further causing interoperability problems between various chargers and receivers. A source of interoperability differences may be the size, shape, and number of turns used for the power

transfer coils. Furthermore, depending on the input voltage used, the design of a wireless power system may step up or down the voltage in the receiver depending on the voltage required by a device by having appropriate number of turns in the charger and receiver coils. However, a receiver from one manufacturer may then not be able to operate on another manufacturer charger due to these differences in designs employed.

[00100] In accordance with an embodiment, it is therefore beneficial to provide a system that can operate with different receivers or chargers and can be universal. Recently, there has been some movement to standardize the frequency of operation, the coil and electronics characteristics, the identification and communication method, messaging and protocol and other aspects of the systems to allow interoperability between systems from different manufacturers. Several interoperability Standards and Specifications in this area have been established or under consideration. These include the WPC interoperability specification, the Consumer Electronics Association Standard for wireless power, the Alliance for Wireless Power (A4WP), Power Matters Alliance (PMA), the Consumer Electronics Association (CEA) Wireless Power Standards working group and Wireless Power Standards for Electric Vehicle charging, and other international efforts for Specification and Standards development.

[00101] The resonant frequency, F of any LC circuit is given by:

$$F = \frac{1}{2\pi\sqrt{LC}}$$

[00102] Where L is the Inductance of the circuit or coil in Henry and C is the Capacitance in Farad.

[00103] For example, in the system shown in Figure 3, one may use the values of C1 and L1 in the above calculation for a free running charger and, as a receiver is brought close to this circuit, this value is changed by the mutual coupling of the coils involved. In the example that a ferrite shield layer is used behind a coil in the charger and/or receiver, the inductance of the coil is affected by the permeability of the shield and this modified permeability should be used in the above calculation.

[00104] In accordance with an embodiment, to be able to detect and power or charge various receivers, the charger can be configured such that the initial ping signal is at such a frequency range to initially be able to power and activate the receiver circuitry in any receiver during the ping process. After this initial power up of the receiver, the charger communication circuit should be able to detect and decode the communication signal from the receiver. Many

microcontrollers are able to communicate in multiple formats and/or may have different input N D converter pins that can be configured differently to simultaneously receive the communication signal and synchronize and understand the communication at different baud rates and protocols. In accordance with an embodiment, the charger firmware can then decide on which type of receiver is present and proceed to regulate or implement what is required (end of charge, shut-off, fault condition, etc.). Depending on the message received, the charger can then decide to change the charger driver voltage amplitude, frequency, or duty cycle, or a combination of these or other parameters to provide the appropriate regulated output at the receiver output.

[00105] In accordance with an embodiment, the charger's behavior can also take into account the difference in the coil geometry, turns ratio, etc. For example, a charger and receiver pair from one or more manufacturers may require operation of the charger drive voltageat 150 kHz. However, if the same receiver is placed on a charger from another manufacturer or driven with different coil or input voltage combination, to achieve the same output power, the charger frequency may need to be 200 kHz. The charger program may detect the type of receiver placed on it and shift the frequency appropriately to achieve a baseline output power and continue regulating from there. In accordance with an embodiment, the charger can be implemented so that it is able to decode and implement multiple communication and regulation protocols and respond to them appropriately. This enables the charger to be provided as part of a multi-protocol system, and to operate with different types of receivers, technologies and manufacturers.

[00106] Similar techniques can be used to allow a receiver to be chargeable on chargers utilizing different protocols for communication and control. For example, the receiver may recognize the type of charger being used by deciphering the frequency of the charger operation or its ping (through frequency filtering or other techniques) and communicate using different protocols and communication signals accordingly.

[00107] In accordance with an embodiment, for receivers that contain an onboard output stage regulator before the output power, stability of the input voltage to the regulator is not as critical since the regulator performs a smoothing function and keeps the output voltage at the desired level with any output load changes (such as during battery charging). The output of the regulator is then directed to circuitry such as a power management IC (PMIC), or to a battery for charging, or directly connected to the device for use in instances where the receiver acts as a power supply to a device without internal batteries, or a combination of the above. Where an output regulator stage is used in a receiver it is critical for the wireless receiver not to exceed

the maximum rated input voltage of the output stage regulator or to drop below a level required so that the output voltage from the regulator could no longer be maintained at the required value. Various types of output stage regulator such as buck, boost, buck-boost, linear etc., can be used as this output stage. However, in general, inclusion of a regulator and/or a charger IC or PMIC chip (for batteries) relaxes the power/voltage regulation requirements of the wireless power receiver portion of the circuit at the expense of the additional size and cost of this component. In accordance with some embodiments, simpler voltage limiting output stages such as Zener diodes, TVS or other voltage limiting or clamping ICs or circuits, can be used.

[00108] In accordance with another embodiment, the receiver can also include variable or switchable reactive components (capacitors and/or inductors) that would allow the receiver to change its resonant condition to affect the amount of power delivered to the device, load or battery. The receiver and/or charger and/or their coils can also include elements such as thermistors, magnetic shields or magnetic cores, magnetic sensors, and input voltage filters, for safety and/or emission compliance reasons.

[00109] In accordance with an embodiment, the systems described herein can use discrete electronics components or some or all of the functions described above can be integrated into an Application Specific Integrated Circuit (ASIC) or MCMs to achieve smaller footprint, better performance, noise, etc. and/or cost advantages. Such integration is common in the electronics industry and can provide additional advantages here.

[00110] While the system above describes a system wherein the communication is primarily through the coil, as described earlier, communication can also be implemented through a separate coil, RF, optical system or a combination of the above. In such circumstances, a multi-protocol system can also be used to interoperate between systems with different communication and/or control protocols or even means of communication.

Flexible Systems with Multiple Protocols and Technologies

[00111] In accordance with an embodiment, a receiver or receivers placed on or near a charger can communicate with the charger in a variety of communication protocols according to different wireless charging standards, protocols or different proprietary methods. To distinguish them and provide for efficient operation, the charger can be programmed to recognize different messages received, and operate differently.

[00112] For example, different protocols exist for communication and control for charging a single receiver placed on a charger. Some systems may require the charger to control the voltage output from the receiver coil (that is rectified and sent to an output of the system or to a

regulator) within a tight tolerance, and cannot tolerate a large range. An example of such a protocol or standard is the Wireless Power Consortium (WPC) or Chi, A4WP, PMA or other standard which is designed to provide tight receiver coil output voltage tolerances and also requires charger frequency range of 110 to 205 kHz or higher. In accordance with an embodiment a charger system can be configured so that it recognizes such a receiver and controls the output to within its target range. However, in other instances receivers may be designed as described above that can tolerate a larger V_I range by using an output receiver regulator stage to allow multi-receiver charging.

[00113] In accordance with an embodiment, to address these use cases, the charger hardware, firmware or software can be configured to recognize the presence of such receivers and operate using a different algorithm to keep one or several receiver voltage ranges to within a larger acceptable range, and provide multi-receiver charging capability. This allows one charger to be interoperable with two or more protocols and systems.

[00114] In accordance with an embodiment, the charger systems or protocols can employ different power transfer and/or communication frequencies, or different communication methods (e.g., in-band through coil, and out of band through Wi-Fi or Bluetooth or proprietary systems) to communicate and also transfer power to receivers utilizing different protocols. The approaches described herein can be used to enable interoperability between such systems.

[00115] In accordance with an embodiment, the charger can use one or more driving circuits, communication methods or protocols and/or charger power or communication coils or antennas to simultaneously power different receiver coils utilizing different protocols, standards and/or power levels or voltages.

[00116] In accordance with an embodiment, the charger coil and resonant capacitor are tuned to provide the operating frequency of the charger, and the associated receiver and its resonant capacitor is similarly tuned to the vicinity of the same frequency for optimal power transfer. It is possible to provide and control power to two or more receivers simultaneously with one or more charger coils, by multiplexing the power transfer frequency.

[00117] In accordance with another embodiment, the charger can contain several resonant capacitors, such as C1 illustrated in Figure 2, which can be switched to form resonances with the charger coil L1, and to provide charger resonances at different frequencies. For example, depending on the protocol of the receiver, the charger can be configured to switch to use a different C1 in series with its coil to optimize power transfer at the preferred operating frequency of receivers from different protocols.

[00118] In accordance with an embodiment, the charger can first use one C1 value and

perform a ping operation to discover receivers adhering to a frequency of operation with that capacitor value and with the appropriate communication protocol. If an appropriate receiver is discovered, it can continue to provide power at that frequency and protocol. If no such receiver is found, it can switch to use a different value of C1, and repeat the ping and rotate between different C1 values and ping frequencies until appropriate receiver or receivers are discovered. An advantage of using several capacitors and switching between them for different protocols and/or operating frequencies is that higher power transfer efficiencies and/or communication may be obtained compared to using a fixed C1 value.

Multi-Device Charging

[00119] Figure 17 illustrates a charger 230 for use in coupling to a blade type receiver in the outer perimeter of the charger surface, which can be used to power a device or receiver having a geometry similar to that shown in Figures 7 or 8, in this example an electronic glasses device 232.

[00120] In accordance with an embodiment, the system allows mixing or combining of different technologies on the same charger and/or receiver, or different locations or areas of the same charger. As an illustrative example, it may be desirable to charge two types of device simultaneously with different characteristics. For example, Figure 18 and Figure 19 show embodiments 240, 250 wherein the charger includes a large magnetic / ferrite layer below. A plurality (e.g., two or more) separate coil structures are used on top of the magnetic layer in the charger to provide, in this example, two or more different sections (areas) with different operating principles or protocols and/or driving and/or communication sections.

[00121] In the example shown in Figure 18, the central portion can use one central coil to create a flux guide charge section, as described above in accordance with the embodiment in Figure 5. In conjunction with an appropriate flux guide type of receiver coil, this can provide position-independent charging or power transfer in this central section. In addition, as further shown in Figure18, another larger coil area can be integrated into the charger and used to create a larger charger area to be used with a receiver similar to the solenoid or blade type receiver coils described above.

[00122] In accordance with an embodiment, since the operating frequency of each coil is defined by its inductance and associated resonant capacitor, the embodiments of the system shown in Figures 18 and 19 can be provided so that the two coils operate either in similar, or in completely different, frequency range (frequency multiplexing) to power any associated receivers. In accordance with an embodiment, each coil can be driven by a separate driver

circuit and communicate with the associated receivers using load modulation, RF or optical communication channels or combination thereof as described earlier, and can be completely independent.

[00123] In accordance with another embodiment 260 shown in Figure 20, two charger coils for charging two different types of devices or receivers can be provided as distinct coils that are physically separated from one another in space and location. For example, a charger coil can be used to provide magnetic field and efficient coupling to a blade type receiver in the outer perimeter of a charger surface and used to power a receiver in a geometry similar to shown in Figures 7 or 8, while a charger optimized for flux guide power transfer (using a geometry such as that shown in Figures 5 and 6) can be used in the center of the charger.

[00124] In accordance with an embodiment, the two coils can be distinct or driven by different power drivers and/or use different communication systems and/or protocols. As an example, one of the coils and its associated electronics may use in-band or load modulation for communication and control, and the other one may use out of band or RF communication. The two different sections can also use different or same frequency for power transfer as needed to optimize performance for the associated receivers.

[00125] In accordance with an embodiment, each charger section can also charge or power multiple receivers placed on that section. As can be seen, such an embodiment allows the system designer to optimize the performance of a charger to power or charge multiple device types appropriately. In the example shown in Figure20, an electronic display device with a very narrow and small receiver area can be charged position-free when it is placed on the outer regions of the pad, while another device such as a mobile phone with a receiver that may be larger (e.g., with a flat coil with flux guide as shown on the back of the device) can be charged in the central area of the charger. Such a combined performance charger may be useful in various applications, and for an end-user.

[00126] The above description and embodiments are not intended to be exhaustive, and are instead intended to only show some examples of the rich and varied products and technologies that can be envisioned and realized by various embodiments. It will be evident to persons skilled in the art that these and other embodiments can be combined to produce combinations of above techniques, to provide useful effects and products.

[00127] Some aspects of embodiments of the present invention can be conveniently implemented using a conventional general purpose or a specialized digital computer, microprocessor, or electronic circuitry programmed according to the teachings of the present

disclosure. Appropriate software coding can readily be prepared by skilled programmers and circuit designers based on the teachings of the present disclosure, as will be apparent to those skilled in the art.

[00128] In some embodiments, the present invention includes a computer program product which is a storage medium (media) having instructions stored thereon which can be used to program a computer to perform any of the processes of the present invention. The storage medium can include, but is not limited to, any type of disk including floppy disks, optical discs, DVD, CD-ROMs, microdrive, and magneto-optical disks, ROMs, RAMs, EPROMs, EEPROMs, DRAMs, VRAMs, flash memory devices, magnetic or optical cards, nanosystems (including molecular memory ICs), or any type of media or device suitable for storing instructions and/or data.

[00129] The foregoing description of the present invention has been provided for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Many modifications and variations will be apparent to the practitioner skilled in the art. The embodiments were chosen and described in order to best explain the principles of the invention and its practical application, thereby enabling others skilled in the art to understand the invention for various embodiments and with various modifications that are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the following claims and their equivalents.

SYSTEM AND METHOD FOR POWERING OR CHARGING RECEIVERS OR DEVICES HAVING SMALL SURFACE AREAS OR VOLUMES

Copyriqht Notice

A portion of the disclosure of this patent document contains material which is subject to copyright protection. The copyright owner has no objection to the facsimile reproduction by anyone of the patent document or the patent disclosure, as it appears in the Patent and Trademark Office patent file or records, but otherwise reserves all copyright rights whatsoever.

Claim of Priority and Cross-reference to Related Applications:

[0001] This application claims the benefit of priority to U.S. Provisional Patent Application No. 61/811,638, titled "SYSTEM AND METHOD FOR POWERING OR CHARGING ONE OR MULTIPLE RECEIVERS OR DEVICES HAVING SMALL SURFACE AREAS OR VOLUMES" filed April 12, 2013; and is related to U.S. Patent Publication No. 20130285604 (U.S. Patent Application No. 13/828,789), titled "SYSTEMS AND METHODS FOR WIRELESS POWER TRANSFER" filed March 14, 2013; and U.S. Patent Publication No. 20120235636 (U.S. Patent Application No. 13/352,096), titled "SYSTEMS AND METHODS FOR PROVIDING POSITIONING FREEDOM, AND SUPPORT OF DIFFERENT VOLTAGES, PROTOCOLS, AND POWER LEVELS IN A WIRELESS POWER SYSTEM", filed January 17, 2012, which claims the benefit of priority to U.S. Provisional Patent Application No. 61/433,883, titled "SYSTEM AND METHOD FOR MODULATING THE PHASE AND AMPLITUDE OF AN ELECTROMAGNETIC WAVE IN MULTIPLE DIMENSIONS", filed January 18, 2011; U.S. Provisional Patent Application No. 61/478,020, titled "SYSTEM AND METHOD FOR MODULATING THE PHASE AND AMPLITUDE OF AN ELECTROMAGNETIC WAVE IN MULTIPLE DIMENSIONS", filed April 21, 2011; and U.S. Provisional Patent Application No. 61/546,316, titled "SYSTEMS AND METHODS FOR PROVIDING POSITIONING FREEDOM, AND SUPPORT OF DIFFERENT VOLTAGES, PROTOCOLS, AND POWER LEVELS IN A WIRELESS POWER SYSTEM", filed October 12, 2011; each of which above applications are herein incorporated by reference.

Field of Invention:

[0002] Embodiments of the invention are generally related to systems and methods for enabling transfer of power, from a wireless charger or power supply, to one or more receivers placed on or near the wireless charger or power supply, including powering or charging one or multiple receivers or devices having small surface areas or volumes.

Background:

[0003] Wireless technologies for powering and charging mobile and other electronic or electric devices, batteries and vehicles have been developed. Such systems generally use a wireless power charger or transmitter, in combination with a wireless power receiver, to provide a means for transfer of power. In some systems, the charger and receiver coil parts of the system are aligned and of comparable size. However, in some applications, it would be preferable to use receiver coils or antennas that have smaller areas or volumes. These are the general areas that embodiments of the invention are intended to address.

Summary:

[0004] Described herein are systems and methods for enabling transfer of power, from a wireless charger or power supply, to one or more receivers placed on or near the wireless charger or power supply, including powering or charging one or multiple receivers or devices having small surface areas or volumes. In accordance with an embodiment, a receiver coil can be generally shaped as a blade or thin solenoid, which receives power inductively, which is then used to power or charge one or more electronic devices. Applications include inductive or magnetic charging and power, and particularly usage in mobile, electronic, electric, lighting, or other devices, batteries, power tools, kitchen, industrial, medical or dental, or military applications, vehicles, robots, trains, and other usages.

Brief Description of the Figures:

[0005] **Figure 1** illustrates a system for wireless powering or charging of devices, inaccordance with an embodiment.

[0006] **Figure 2** illustrates another view of a wireless charger system, in accordancewith an embodiment.

[0007] **Figures 3** illustrates an example of a charger coil, in accordance with an embodiment.

[0008] **Figure 4** illustrates a resulting magnetic field, in accordance with an embodiment.

[0009] **Figure 5** illustrates a charger geometry, in accordance with an embodiment.

[0010] **Figure 6** illustrates a return magnetic flux from a charger, in accordance with an embodiment.

[0011] **Figure 7** illustrates wire wrapped around a core to create a solenoid type receiver, in accordance with an embodiment.

[0012] **Figure 8** illustrates a ferrite lower magnetic shield or flux guide, in accordance with an embodiment.

[0013] **Figure 9** illustrates a receiver coil wrapped around a very thin magnetic material, in accordance with an embodiment.

[0014] **Figure 10** illustrates the use of additional magnetic or ferrite material or layers added to or otherwise integrated with the top and/or bottom of the receiver coil, in accordance with an embodiment.

[0015] **Figure 11** illustrates the use of additional magnetic or ferrite material or layers added to or otherwise integrated with the top and/or bottom of the receiver coil, in accordance with another embodiment.

[0016] **Figure 12** illustrates integration of a receiver into a wearable headset or electronic display device or glasses, in accordance with an embodiment.

[0017] **Figure 13** illustrates an embodiment that incorporates magnetic or ferrite material sections above and below the main coil section, in accordance with an embodiment.

[0018] **Figure 14** illustrates integration of a receiver into a mobile phone, in accordance with an embodiment.

[0019] **Figure 15** illustrates that incorporates magnetic or ferrite material sections aboveand below the main coil section, in accordance with an embodiment.

[0020] **Figure 16** illustrates integration of a receiver into a headset device, in accordance with an embodiment.

[0021] **Figure 17** illustrates a charger for use in coupling to a blade type receiver in the outer perimeter of the charger surface, in accordance with an embodiment.

[0022] **Figure 18** illustrates a charger that provides different sections with different operating principles or protocols and/or driving and/or communication sections, in accordance with an embodiment.

[0023] **Figure 19** illustrates a charger that provides different sections, in accordance with another embodiment.

[0024] **Figure 20** illustrates a charger that provides different sections, in accordance with another embodiment.

Detailed Description:

[0025] With the proliferation of electrical and electronic devices and vehicles (which are considered examples of devices herein), simple and universal methods of providing power and or charging of these devices is becoming increasingly important.

[0026] In accordance with various embodiments, the term device, product, or battery is used herein to include any electrical, electronic, mobile, lighting, or other product, batteries, power tools, cleaning, industrial, kitchen, lighting, military, medical, dental or specialized products and vehicles, automobiles, personal mobility (e.g., Segway type) devices, buses, or movable machines such as robots or other mobile machines or other devices whereby the product, part, or component is powered by electricity or an internal or external battery and/or can be powered or charged externally or internally by a generator or solar cell, fuel cell, hand or other mechanical crank or alike.

[0027] In accordance with an embodiment, a product or device can also include an attachable or integral skin, case, cover, battery door or attachable or add-on or dongle type of receiver component, to enable the user to power or charge the product, battery, or device.

[0028] Induction generally refers to generation of electromotive force (EMF) or voltage across a closed electrical path in response to a changing magnetic flux through any surface bounded by that path. In literature, sometimes magnetic induction is defined as if it is limited to tightly-coupled cases whereby the charger and receiver coils are of similar sizes or the gap between them is small. Magnetic resonance is a term that has been used recently for inductive power transfer where the charger and receiver may be far apart or the transmitter and receiver coils are of different size. The term loosely-coupled wireless charging has also been used for these systems. Since magnetic resonance or loosely-coupled wireless charging is in general a form of induction, as used herein in accordance with various embodiments the term induction is used for any of these systems (including inductive or tightly-coupled wireless power transfer, magnetic resonant or loosely-coupled wireless power transfer and hybrid systems), and induction and magnetic resonance are sometimes used interchangeably to indicate that the method of power transfer can be in either domain or a combination thereof.

[0029] In accordance with various embodiments, an inductive power transmitter employs a magnetic induction coil(s) transmitting energy to a receiving coil(s) in or on a device or product, case, battery door, or attachable or add-on component including attachments such as a dongle or a battery inside or outside of device or attached to device through a connector and/or a wire, or stand-alone placed near or on the power transmitter platform. The receiver can be an otherwise incomplete device that receives power wirelessly and is intended for installation or attachment in or on the final product, battery or device to be powered or charged, or the receiver can be a complete device intended for connection to a device, product or battery directly by a wire or wirelessly. As used herein, the term wireless power, charger, transmitter or inductive or magnetic resonance power and charger are used interchangeably.

[0030] In accordance with an embodiment, the wireless charger can include a flat or curved surface, or an open or enclosed volume or part that can provide energy wirelessly to a receiver. It can also be constructed of flexible materials and/or coils or even plastic electronics to enable mechanical flexibility and bending or folding to save space or for conformity to non-flat surfaces.

[0031] In accordance with an embodiment, the wireless charger can be directly powered by an AC power input, DC power, or other power source such as a car, motorcycle, truck or other vehicle or airplane or boat or ship power outlet, or vehicle, boat, ship or airplane itself, primary (non-rechargeable) or rechargeable battery, solar cell, fuel cell, mechanical (e.g., hand crank, wind, or water source), nuclear source, or other wireless charger or power supply or a combination thereof. In addition, the wireless charger can be powered by a part such as a rechargeable battery which is itself in turn recharged by another source such as an AC or DC power source, vehicle, boat or ship or airplane outlet or vehicle, boat or ship or airplane itself, solar cell, fuel cell, mechanical (e.g., hand crank, wind, or water source) or nuclear source, or a combination thereof.

[0032] In accordance with various embodiments, in applications where the wireless charger is powered by a rechargeable source such as a battery, the battery can also be itself in turn inductively charged by another wireless charger. The wireless charger can be a stand- alone part, device, or product, or can be incorporated into another electric or electronics device, table, desk chair, armrest, TV stand or mount or furniture or vehicle or airplane or marine vehicle or boat or objects such as a table, desk, chair, counter-top, shelving or check out or cashier counters, kiosk, car seat, armrest, car console, car door, netting, cup holder, dashboard,glove box, etc., airplane tray, computer, laptop, netbook, tablet, phone, display, TV, magnetic, optical or semiconductor storage or playback device such as hard drive, solid state storage drive, optical players, etc., cable or game console, computer pads, toys, clothing, bags, case or backpack, belt or holster, etc., industrial, medical, dental, military equipment or kitchen counter, area, devices and appliances, phones, cameras, radios, stereo systems, speakers, etc. The wireless charger can also have other functions built in, or be constructed such that it is modular and additional capabilities or functions can be added as needed.

[0033] In accordance with various embodiments, some of these capabilities or functions include an ability to provide higher power, charge more devices, exchange the top surface or exterior box or cosmetics, operate by internal power as described above through use of a battery and/or renewable source such as solar cells, communicate and/or store data from a device, provide communication between the device and other devices or the charger and/or a

network, etc. An example is a basic wireless charger that has the ability to be extended to include a rechargeable battery pack to enable operation without external power. Examples of products or devices powered or charged by the induction transmitter and receiver include but are not limited to batteries, cell phones, smart phones, cordless phones, communication devices, heads-up displays, wearable computer with head mounted display, 3-d TV glasses, wearable electronic glasses, wearable computer or communication devices, communication or display watches, pagers, personal data assistants, portable media players, global positioning (GPS) devices, powered headphones or noise cancelling headphones, Bluetooth headsets and other devices, shavers, watches, tooth brushes, calculators, cameras, optical scopes, infrared viewers, computers, laptops, tablets, netbooks, keyboards, computer mice, book readers or email devices, pagers, computer monitors, televisions, music or movie players and recorders, storage devices, radios, clocks, speakers, gaming devices, game controllers, toys, remote controllers, power tools, cash register, delivery or other type of scanners, construction tools, office equipment, robots including vacuum cleaning robots, floor washing robots, pool cleaning robots, gutter cleaning robots or robots used in hospital, clean room, military or industrial environments, industrial tools, mobile vacuum cleaners, medical or dental tools, medical stretcher batteries, military equipment or tools, kitchen appliances, mixers, cookers, can openers, food or beverage heaters or coolers such as electrically powered beverage mugs, massagers, adult toys, lights or light fixtures, signs or displays, or advertising applications, electronic magazines or newspapers or magazines or newspapers containing an electronic and/or display part, printers, fax machines, scanners, electric vehicles, electric golf carts, buses,trains, motorcycles or bicycles, personal mobility (e.g., Segway type) devices, trains or other vehicles or mobile transportation machines, and other battery or electrically powered devices or products or a product that is a combination of the products listed above.

[0034] In accordance with an embodiment, the receiver and/or the charger can be incorporated into a bag, carrier, skin, cover, clothing, case, packaging, product packaging or box, crate, box, display case or rack, table, bottle or device etc. to enable some function inside the bag, carrier, skin, clothing, case, packaging, product packaging or box, crate, box, display case or rack, table, bottle (such as, e.g., causing a display case or packaging to display promotional information or instructions, or to illuminate) and/or to use the bag, carrier, skin, clothing, case, packaging, product packaging or box, crate, box, stand or connector, display case or rack, table, bottle, etc., to power or charge another device or component somewhere onor nearby.

[0035] In accordance with various embodiments, the product or device does not

necessarily have to be portable and/or contain a battery to take advantage of induction or wireless power transfer. For example, a lighting fixture or a computer monitor that is typically powered by an AC outlet or a DC power supply can be placed on a table top and receive power wirelessly. The wireless receiver can be a flat or curved surface or part that can receive energy wirelessly from a charger. The receiver and/or the charger can also be constructed of flexible materials and/or coils or even plastic electronics to enable mechanical flexibility and bending or folding to save space or for conformity to non-flat surfaces.

[0036] In accordance with various embodiments, many of these devices contain internal batteries, and the device may or may not be operating during receipt of power. Depending on the degree of charge status of the battery, or its presence and the system design, the applied power may provide power to the device, charge its battery or a combination of the above. The terms charging and/or power are used interchangeably herein to indicate that the received power can be used for either of these cases or a combination thereof. In accordance with various embodiments, unless specifically described, these terms are therefore used interchangeably. Also, unless specifically described herein, in accordance with various embodiments, the terms charger, power supply, and transmitter are used interchangeably. **[0037]Figure 1** illustrates a system for wireless powering or charging of devices in accordance with an embodiment. As shown in Figure 1, in accordance with an embodiment, a wireless charger or power system 100 comprises a first charger or transmitter part 110, and a receiver 120 connected to a mobile or stationary device, vehicle or battery or its charging or power circuit to provide electric power to power or charge the mobile or stationary device, vehicle or its battery.

[0038] Figure 1 shows an example where one charger or power transmitter is charging or powering one receiver. However, in a more general case, the transmitter may comprise one or more transmitters or chargers operating at different power levels and/or using different protocols to power one or more receivers operating at different power levels, voltages and/or protocols.

[0039] **Figure 2** illustrates a more detailed view of a wireless charger system 128, in accordance with an embodiment, with a resonant converter geometry, wherein a pair of transistors 01 and 02 in the charger 130 (such as FETs, MOSFETs, or other types of switch) are driven by a half-bridge driver IC and the voltage is applied to the coil L1 through one or more capacitors shown as C1. In accordance with an embodiment, the receiver 140 includes a coil and an optional capacitor (for added efficiency) shown as C2 that can be in series or in parallel with the receiver coil L2. The charger and/or receiver coils can also include impedance

matching circuits and/or appropriate magnetic material layers behind (on the side opposite to the coil surfaces facing each other) them to increase their inductance and/or to shield the magnetic field leakage to surrounding area. The charger and/or receiver can also include impedance matching circuits to optimize or improve power transfer between the charger and receiver.

[0040] In several of the embodiments and figures described herein, the resonant capacitor C2 in the receiver is shown in a series embodiment. This is intended only as a representative illustration, and in accordance with various embodiments this capacitor can be used in series or parallel with the receiver coil. Similarly, the charger is generally shown in accordance with an embodiment where the resonant capacitor is in series with the coil. System implementations with the capacitor C1 in parallel with the charger coil are also possible.

[0041] In accordance with an embodiment, the charger can also include a circuit that measures the current through and/or voltage across the charger coil (for example, in Figure 2, a current sensor is shown as an example). Communication between the receiver and the charger can also be provided through the same coils as used for the power transfer, through modulation of a load in the receiver. Various demodulation methods for detection of the communication signal on the charger current or voltage are available. This demodulation mechanism can be, e.g., an AM or FM receiver (depending on whether amplitude or frequency modulation is employed in the receiver modulator) similar to a radio receiver tuned to the frequency of the communication or a heterodyne detector.

[0042] In accordance with an embodiment, the communication and control between the charger and the receiver(s) is conducted over a separate or additional RF or optical or other channels. Optional methods of communication between the charger and receiver can be provided through the same coils as used for transfer of power, through a separate coil, through an RF or optical link, through, e.g., RFID, Bluetooth, WiFi, Wireless USB, NFC, Felica, Zigbee, or Wireless Gigabit (WiGig) or through such protocols as defined by the Wireless Power Consortium (WPC), Alliance for Wireless Power (A4WP) or other protocols or standards, developed for wireless power, or specialized protocols such as Dedicated Short Range Communications (DSRC) for automotive applications, or other communication protocol, or combinations thereof.

[0043] In accordance with an embodiment, the microcontroller unit (MCU) in the charger (shown as MCU1 in Figure 2) is responsible for decoding the communication signal from a detection/demodulation circuit and, depending on the algorithm used, making appropriate adjustments to the charger coil drive circuitry to achieve the desired output voltage, current or

power from the receiver output.

[0044] In accordance with various embodiments, it may be preferable for one or more receivers to receive power when placed at a variety of locations or anywhere on or near a wireless charger area. Such an implementation, in general would benefit from a charger and/or receiver design that allows a uniform power transfer over an area or the entire surface of the charger. To provide more uniform power transfer across a coil, in accordance with an embodiment, methods to provide a more uniform magnetic field across a coil can be used. For example, one method for achieving this uses a hybrid coil comprising a combination of a wire and PCB coils (e.g., X. Liu and S. Y. R. Hui, "Optimal design of a hybrid winding structure for planar contactless battery charging platform," IEEE Transactions on Power Electronics, vol. 23, no. 1, pp. 455-463, 2008). In another method, the transmitter coil can be constructed of Litz wire or patterned printed circuit board (PCB) and has a pattern that is very wide between successive turns at the center and is more tightly wound as one gets closer to the edges (e.g., J. J. Casanova, Z. N. Low, J. Lin, and R. Tseng, "Transmitting coil achieving uniform magneticfield distribution for planar wireless power transfer system," in Proceedings of the IEEE Radioand Wireless Symposium, pp. 530-533, January 2009). **Figure 3** shows an example of a coil 150 in accordance with an embodiment, while **Figure 4** shows a resulting magnetic field 152. **[0045]** In a geometry described in U.S. Patent Publication No. 20080067874, a planar spiral inductor coil is demonstrated, wherein the width of the inductor's trace becomes wider as the trace spirals toward the center of the coil to achieve a more uniform magnetic field allowingmore positioning flexibility for a receiver across a transmitter surface.

[0046] In yet other embodiments (e.g., F. Sato, et al., IEEE Digest of Intermag 1999, PP. GR09, 1999), the coil can be a meandering type of coil, wherein the wire is stretched along X or Y direction and then folds back and makes a back and forth pattern to cover the surface.

[0047] In accordance with an embodiment, the charger can operate continuously, and any appropriate receiver coil placed on or near its surface will bring it to resonance and will begin receiving power. The regulation of power to the output can be performed through a regulation stage and/or tuning of the resonant circuit at the receiver. Advantages of such a system include that multiple receivers with different power needs can be simultaneouslypowered in this way. The receivers can also have different output voltage characteristics. **[0048]** In accordance with embodiments described in U.S. Patent Application No. 13/352,096, published as U.S. Patent Publication No. 20120235636, which application is herein incorporated by reference, two techniques have been described whereby through appropriate design of the system, a position-independent power transfer system with reduced or no

undesirable radiation and high efficiency can be achieved. These geometries use a saturable magnetic layer placed above the charger coil area to shield the charger magnetic layer from the surrounding area.

[0049] For example, in accordance with an embodiment, a Magnetic Aperture (MA) receiver includes an appropriate magnet in the receiver that can saturate the shield layer nearby the receiver and allow coupling of power only in that area of the charger, resulting in efficient power coupling with minimal residual electromagnetic emission from nearby areas. In accordance with an embodiment, a Magnetic Coupling (MC) system employs a similar geometrybut uses the increase in the resonant electromagnetic field between the charger and receiver coils to self-saturate the layer, and does not require a receiver magnet to operate and achieve similar results. These two techniques are further described in the patent applications referenced above.

[0050] **Figure 5** shows an additional geometry 160 whereby a charger coil 162 is placed on a magnetic flux guide / shielding layer 164 that extends beyond the edges of the coil. The receiver similarly has a magnetic flux / shielding layer 166 that extends beyond the size of the coil 168, allowing an overlap area between these flux layers on the top and bottom sides of the receiver. **Figure 6** shows 170 the return magnetic flux from the charger that passes the receiver coil and is guided efficiently to close on itself. Such an efficient flux guide (FG) geometry results in confinement of power transfer to the area of overlap of a receiver and charger coil, and significant increase in power transfer efficiency and reduction of undesirable electromagnetic emission compared to Magnetic Resonance (MR) systems. It is also possible to further decrease any potential emissions from non-covered areas of the charger coil by covering the charger coil with a magnetic shield layer and combining the FG geometry with the earlier described MC or MA modes of operation.

[0051] In accordance with the MC geometry, the reluctance of the flux path in the receiver can be lowered by including high permeability material in the core of the receiver ring coil (similar to a solenoid) or a T-shape core or alike. Many geometries are possible, and these geometries are provided merely as examples. Additionally, while in accordance with an embodiment a Litz wire receiver coil can be used, in accordance with other embodiments, PCB coils and/or a combination of Litz wire and PCB coil can be used.

[0052] In accordance with an embodiment, to reduce the reluctance of the path, the receiver coil can be created by using a flux guide material (such as ferrite with permeability greater than 1), with an axis perpendicular (or an angle sufficient to catch the substantially perpendicular flux from the charger) to the surface of the charger. As shown 172 in **Figure 7**,

Litz wire can be wrapped around the core to create a solenoid type receiver with a relatively small cross section (several mm or smaller by 10 or 20 mm) substantially parallel to the surface of the charger. In one example, the solenoid height (along the direction of axis of wire wrapped around it, and perpendicular to the surface of the charger) can be varied from 10 to 20 mm, but can be shorter. A typical number of turns on the receiver coil can be 7 to 20 turns. Use of a series or parallel capacitor with such a receiver coil provides a resonant circuit whose output can be rectified and smoothed with a capacitor to provide a DC output. To provide regulated power output, as shown in Figures 1 and 2, a communication or feedback system between charger and receiver and/or an output stage regulator can also be added.

[0053] In one example, a charger coil similar to that shown in Figure 3 and with a thin (0.5 mm thick) ferrite lower magnetic shield / flux guide similar to that shown 174 in **Figure 8** was used. Substantial power transfer (over 20 W) and high efficiencies of up to 55% DC to DC (DC power output of receiver rectifier divided by input to DC charger circuit input power) was received over the entire surface of the charger coil when the charger coil and its associated resonant capacitor were tuned to be resonant at similar frequencies to the receiver coil and its associated capacitor. Power was received with the receiver coil having zero up to several cm ofgap from the surface of the charger coil. Such a small solenoid can be provided having very small sizes in one or two dimensions, such that it is shaped as or otherwise resembles a blade, with the contact area being the thin edge of the blade.

[0054] In accordance with an embodiment, rotating the angle of the blade solenoid with respect to the perpendicular direction to the surface to the charger can produce large power transfers, confirming that as long as some component of the charger flux is along the axis of the receiver coil, efficient power transfer can be obtained. Both position-free and multiple receiver operation can be provided. As shown in Figure 7, optionally, an additional magnetic shield / guide layer on the top of the receiver and/or on the bottom of the charger can also be included. In many applications, it is beneficial to utilize receivers that occupy minimal space and are able to fit inside (or inside an optional part of) a small mobile or fixed position device.

[0055] In accordance with an embodiment shown in Figure 8, the charger does not utilize a top magnetic layer, and the flux guiding through the magnetic core and/or magnetic layers at the bottom of charger and/or top of receiver is used to provide a low reluctance path for magnetic flux flow and efficient power transfer.

[0056] Some examples of the types of devices that can include a small blade type receiver include mobile phones, MP3 players, and wearable computers such as displays, communication and display watches, and electronic glasses. In some applications, the device

to be charged has a small surface area that is in contact with the charger surface, for example cylindrical batteries that are placed vertically to be charged, or devices such as wearable electronic glasses or displays whereby the device has a small surface area when placed against a flat or curved charger. In accordance with an embodiment, use of the flux guide and a smaller cross-section parallel to the surface of the charger, as shown in Figure 7 or 8, may be useful for these types of applications.

[0057] In accordance with an embodiment, a receiver coil or solenoid with a magnetic flux guide can also be constructed to have a somewhat larger area parallel to the surface of the charger, approximating the embodiment illustrated in Figure 6, but with a flux guide layer or core in the middle of the coil. In this case, the height of this flux guide or core (along the length perpendicular to the surface of the charger) can be made quite short (e.g., 1-2 mm or less).

[0058] In accordance with an embodiment, shown in **Figure 9**, the receiver coil can bewrapped around a very thin magnetic material. By way of example, in accordance with anembodiment 180, 182 this material can be 1 mm or less in thickness. In one example, coilscomprising 0.6 mm thick Litz wire of bundled wire can be wrapped around 0.3 mm thick sheet of600 permeability ferrite material (20 x 10 x 0.3 mm size) and used for such a receiver. Using such a blade type receiver with a coil surface area of 20 x 0.3 mm on a charger surface of 170mm x 170 mm or larger coil with pattern similar to Figure 3, power transfer levels exceeding 20 W, and DC to DC power transfer efficiencies of up to 55 %, were observed when the receiver coil was placed at any location and orientation (with the axis of the receiver coil having some component perpendicular to the surface of the charger) on or near the surface of the charger.Additionally, significant power transfer was observed when the receiver coil was moved awayfrom the charger coil in a vertical direction (with coil to coil spacing of 20 mm or larger).Considering that the blade type receiver coil surface occupies an area of 0.02% of the area ofthe charger coil, achieving such a high level of power transfer and efficiency demonstrates that the flux generated at the surface of the charger coil is efficiently guided and channeled to thelocation of the receiver coil.

[0059] In accordance with an embodiment, such a coil can be made to be symmetrical along its winding axis, and can receive power when the coil is flipped vertically. Such a feature may provide additional flexibility and usage in some applications.

[0060] In accordance with another embodiment shown 190, 192 in **Figure 10**, and 202, 202 in **Figure 11**, additional magnetic or ferrite material or layers can be added to or otherwise integrated with the top and/or bottom of the receiver coil and its associated magnetic section. Such layers aid in the guidance of the flux generated in the receiver coil and can provide higher

efficiency and/or power.

[0061] In accordance with an embodiment, the receiver can be used to charge or power wearable mobile communication and display devices, such as wearable electronic glasses, watches, headsets, or other devices. An example of an embodiment for integration into wearable headsets or electronic display devices or glasses is shown 212 in **Figure 12**. In accordance with an embodiment, a device such as an electronic glasses can be oriented on a surface as shown, to receive charging. Alternately, the electronic glasses can be flipped vertically so the top flat side is in contact with a charging surface. In either orientation, the surface area of the device in or near contact with the charger surface can be quite small.

[0062] Figure 12 shows an embodiment that incorporates the receiver coil and/or its associated electronics in a section with a small horizontal (in the plane of the charger coil if the device is laid down on a charger surface) surface area. The embodiments of the receiver coil described above are useful for this implementation, and can also be incorporated in another embodiment 214 shown in **Figure 13** that incorporates magnetic or ferrite material sections above and below the main coil section to further guide the magnetic flux. These layers can also be used to guide or route the charger magnetic flux around the inside cavity and shield any PCB, circuit, battery, or metallic part that may be included in this space from the magnetic fieldof the charger.

[0063] Since, in accordance with an embodiment, such a receiver can be symmetrical in the Z axis (perpendicular to surface of charger or along the axis of the receiver coil winding), the electronic glasses can be laid down in any of the several orientations flatly on the surface and power will be received by the receiver. In addition, the X and Y position freedom created by the charger coil allows the user to place the electronic glasses at any location on the charger, and even at a Z distance, to receive power.

[0064] In accordance with an exemplary embodiment, when a receiver with integrated horizontal flux guide sections, such as the embodiment shown in Figure 11, was placed near the outer areas of a 170 mm x 170 mm charger coil such as that shown in Figure 8, with a charger under a layer of ferrite material flux guide, it was observed that the receiver can receive power even when its coil axis is parallel to the charger surface. This is due to the large parallel (to the surface) component of the charger magnetic flux in these outer areas. The smaller horizontal sections in the receiver coil (shown as the end flux guides in Figure 11) also aid in guiding the flux into and out of the receiver coil, and enable operation of the receiver in any orientation. This behavior enables a receiver such as that shown in Figure 11 to be generally rotatable at any angle along an axis perpendicular to the plane of the orientation shown in lower part of

Figure 11, when placed on a charger, and still receive power. This behavior can be useful for those applications where orientation independence is required.

[0065] In accordance with another embodiment, the receiver can be integrated into devices such as mobile phones, MP3 players, tablets, watches, batteries, headsets, or other devices where limited space is available**. Figure 14** shows an embodiment 220 for integration into a mobile phone at an edge of the phone, or somewhere within the body of the phone. Sucha phone with the receiver integrated can be charged when placed at any location on a charger surface. In accordance with another embodiment 222, horizontal magnetic or ferrite layers on top and bottom can be used, as shown in **Figure 15**.

[0066] As described above, in accordance with an embodiment, the receiver coil can be made to be symmetrical along its winding axis, which enables, in either of the embodiments, the phone or other electronic device to be charged with either its back side or its front facing the charger surface. In accordance with an embodiment, the charger and/or the receiver can also be configured to detect the orientation or front-back placement of the device during charging and perform additional functionalities. For example, a phone can be configured so that when the phone is placed face-down on the charger, it can be charged but will enter a "Do Not Disturb" mode so that any incoming calls, messages, texts, emails, etc., will not provide audio, visual or other indications; but, when placed on the charger in its other orientation (display face-up), incoming information can be relayed to the user visually, by audio or even displayed or transmitted to another device (such as transmission to another display when used in cars).

[0067] The above illustration is an example of a contextually-aware operation; in accordance with various embodiments, such activities of tying wireless charging to, e.g., launching or performance of other activities or commands can be considered examples of contextually aware charging, additional examples of which are described in U.S. Patent Publication No. 20110050164, which examples can be combined or used with various embodiments of the charger and receiver technologies described herein.

[0068] **Figure 16** shows another embodiment 224 for integration of a sheet or blade type receiver coil within an electronic device, in this illustration a headset device, e.g., at the edge or back of the headset, or another suitable location within the body of the headset.

Charger and Receiver Interaction

[0069] In accordance with an embodiment, the receiver can be provided as an integral part of a device or battery as described above, or can be provided as an otherwise incomplete device that receives power wirelessly and is intended for installation or attachment in or on the

final product, battery or device to be powered or charged, or the receiver can be a complete device intended for connection to a device, product or battery directly by a wire or wirelessly. Examples include replaceable covers, skins, cases, doors, jackets, surfaces, etc for devices or batteries that would incorporate the receiver or part of the receiver and the received power would be directed to the device through connectors in or on the device or battery or the normal wired connector (or power jack) of the device or battery. The receiver can also be a part or device similar to a dongle or insert etc., that can receive power on or near the vicinity of a charger and direct the power to a device or battery to be charged or powered through a wire and/or appropriate connector. Such a receiver can also have a form factor that would allow it to be attached in an inconspicuous manner to the device, such as a part that is attached to the outer surface at the bottom, front, side, or back side of a laptop, netbook, tablet, phone, game player, camera, headset or other electronic device, and routes the received power to the input power connector, battery connector or jack of the device.

[0070] In accordance with an embodiment, the connector of such a receiver can be configured such that it has a pass-through or a separate connector integrated into it, so that a wire cable for providing wired charging or power or communication can be connected to the connector without removal of the connector, thus allowing the receiver and its connector to be permanently or semi-permanently be attached to the device throughout its operation and use.

[0071] In a more integrated approach, the coil, shield and/or the receiver circuit can be integrated into the construction of the electric or electronic device, and be an integral part of the operation of the device which is powered or charged primarily or as an option (in addition to wired charging) through the wireless power received from the receiver. Many other variations of the receiver implementation are possible, and these examples are not meant to be exhaustive.

[0072] In accordance with an embodiment, the receiver can also be provided as a whole or as a part of the electronics, coil, shield, or other part of the system required for receiving power wirelessly. The electronics can comprise discrete components or microcontrollers that when used together provide the wireless receiver functionality, or comprise an Application Specific Integrated Circuit (ASIC) chip or chipset or MCM that is specifically configured to function as the whole or a substantial part of the electronics for wireless receiver system.

[0073] In accordance with an embodiment, a system with largely mis-matched (i.e. dissimilar in size or shape) charger and receiver coils can potentially have several advantages. For example, power can be transferred to the receiver coils placed anywhere on the transmitter coil. Several receivers can be placed and powered on one transmitter allowing for simpler and lower cost of transmitter. The system with higher resonance Q can be configured so the gap

between the transmitter and receiver coil can be larger than a tightly-coupled system leading to design of systems with more design freedom. In practice, power transfer in distances of several cm or even higher have been demonstrated. Power can be transferred to multiple receivers simultaneously. In addition, the receivers can potentially be of differing power rating or be in different stages of charging or require different power levels and/or voltages.

[0074] In accordance with an embodiment, in order to achieve the above characteristics and to achieve high power transfer efficiency, the lower k value is compensated by using a higher Q through design of lower resistance coils, etc. The power transfer characteristics of these systems may differ from tightly-coupled systems and other power drive geometries such as use of resonant converters. Class E amplifiers or Zero Voltage Switching (ZVS) or Zero Current Switching (ZCS) or other power transfer systems may potentially operate more efficiently in these situations. In addition, impedance matching circuits at the charger transmitter and/or receiver may be required to enable these systems to provide power over a range of load values and output current conditions. General operation of the systems can, however be quite similar to the tightly-coupled systems and one or more capacitors in series or parallel with the transmitter and/or receiver coils is used to create a tuned circuit that may have a resonance for power transfer. Operating near this resonance point, efficient power transfer across from the transmitter to the receiver coil can be achieved. Depending on the size difference between the coils and operating points, efficiencies of over 50% up to near 80% have been reported in such loosely-coupled systems.

[0075] To provide communication and control between the charger and receiver or receivers, in accordance with an embodiment, a hardware Physical Communication and Control Layer (PCCL) and a software or firmware Command and Control Layer (CCL) can be implemented. Optional methods of communication between the charger and receiver(s) can be provided through the same coils as used for transfer of power, through a separate coil, through an RF or optical link, through RFID, Bluetooth, Wi-Fi, Wireless USB, NFC, Felica, Zigbee, Wireless Gigabit (WiGig), 3G, 4G, etc. or through such protocols as defined by the Wireless Power Consortium (WPC), Alliance for Wireless Power (A4WP), or Power Matters Alliance (PMA), or other protocols such as Dedicated Short Range Communication (DSRC) used for automotive applications or other standards, developed for wireless power, or other communication protocol, or combination thereof.

[0076] In simpler architectures, there may be minimal or no communication between the charger and receiver. For example, a charger can be configured to be in a standby power transmitting state, and any receiver in close proximity to it can receive power from the charger.

The voltage, power, or current requirements of the device or battery connected to the receiver circuit can be unregulated, or regulated or controlled completely at the receiver or by the device attached to it. In this instance, no regulation or feedback or communication between the charger and receiver may be necessary. In a variation of this, the charger can be configured to be in a state where a receiver in close proximity would bring it into a state of power transmission. Examples of this would be a resonant system where inductive and/or capacitive components are used, so that when a receiver of appropriate design is in proximity to a charger, power is transmitted from the charger to a receiver; but without the presence of a receiver, minimal or no power is transmitted from the charger.

[0077] In accordance with an embodiment, in those examples in which communication is provided through the power transfer coils, one method for communication from receiver or receivers to the charger is to modulate a load or impedance in the receiver to affect the voltage and/or current in the receiver coils and therefore create a modulation in the charger coil voltage or current parameters that can be detected through monitoring of its voltage or current. Other methods can include frequency modulation, by combining the received frequency with a local oscillator signal or inductive, capacitive, or resistive modulation of the output of the receiver coil. In addition to communication from receivers to a charger transmitter, it is also possible to modulate the charger voltage at a pre-determined frequency and communication protocol and detect at each receiver to provide communication from the charger to the receivers. Such bi- directional communication may be advantageous in cases where the charger is used to power multiple receivers as will be explained later.

[0078] In accordance with an embodiment, the communicated information from a receiver to the charger transmitter can be the output voltage, current, power, device or battery status, validation ID for receiver, end of charge or various charge status information, receiver battery, device, or coil temperature, and/or user data such as music, email, voice, photos or video, or other form of digital or analog data used in a device. It can also be patterns or signals or changes in the circuit conditions that are transmitted or occur to simply notify the presence of the receiver nearby.

[0079] In accordance with an embodiment, the data communicated can be any one or more of the information detailed herein, or the difference between these values and the desired value, or simple commands to increase or decrease power, or simply one or more signals that would confirm presence of a receiver or a combination of the above. The receiver and/or charger and/or their coils can also include elements such as thermistors, magnetic shields or magnetic cores, magnetic sensors, and input voltage filters, etc., for safety and/or emission

compliance reasons. The receiver can also be combined with other communication or storage functions, such as NFC, Wi-Fi, Bluetooth, etc. In addition, the charger and or receiver can include means to provide more precise alignment between the charger and receiver coils or antennas. These can include visual, physical, or magnetic means to assist the user in alignment of parts. To implement more positioning freedom of the receiver on the charger, the size of the coils can also be mismatched. For example, the charger can comprise a larger coil size, and the receiver a smaller one, or vice versa, so that the coils do not have to be precisely aligned for power transfer.

[0080] In accordance with an embodiment, to minimize stand-by power use, the charger can periodically be turned on to be driven with a periodic pattern (a ping process) and if a receiver in proximity begins to draw power from it, the charger can detect power being drawn from it and stay in a transmitting state. If no power is drawn during the ping process, the charger can be turned off or placed in a stand-by or hibernation mode to conserve power, and turned on and off again periodically to continue seeking a receiver.

[0081] In accordance with an embodiment, the charger also includes a circuit that measures the current through and/or voltage across the charger coil (for example, a current sensor is shown in Figure 2 by way of example). As described earlier, various demodulation methods for detection of the communication signal on the charger current or voltage can be used.

[0082] While a system for communication between the charger and receiver through the power transfer coils or antennas is described above, in accordance with an embodiment the communication can also be implemented through separate coil or coils, a radio frequency link (AM, FM or other communication method), an optical communication system, or a combination of the above. The communication in any of these methods can also be bi-directional rather than uni-directional as described above.

[0083] In accordance with another embodiment, a dedicated RF channel for uni-directional or bi-directional communication between the charger and receiver can be implemented for validation and/or regulation purposes. This system can be similar to the system shown in Figure 2, except rather than load modulation being the method of communication, the microcontroller (MCU) in the receiver transmits the required information over an RF communication path. A similar system with LED or laser transceivers or detectors and light sources can be implemented. Advantages of such a system include that the power received is not modulated and therefore not wasted during communication and/or that no noise due to the modulation is added to the system.

[0084] In accordance with an embodiment, the microcontroller unit (MCU) in the charger (MCU1) is responsible for recognizing and understanding the communication signal from the detection/demodulation circuit and, depending on the algorithm used, making appropriate adjustments to the charger coil drive circuitry to achieve the desired output voltage, current or power from the receiver output. In addition, MCU1 is responsible for processes such as periodic start of the charger to seek a receiver at the start of charge, keeping the charger on when a receiver is found and accepted as a valid receiver, continuing to apply power and making appropriate adjustments, and/or monitoring temperature or other environmental factors, providing audio or visual indications to the user on the status of charging or power process, etc., or terminating charging or application of power due to end of charge, or customer preference, orover temperature, over current, over voltage, or some other fault condition or to launch or start another program or process.

[0085] In accordance with an embodiment, once the charger MCU1 has received a signal and decoded it, it can take action to provide more or less power to the charger coil. This can be accomplished through known methods of adjusting the frequency, duty cycle or input voltage to the charger coil or a combination of these approaches. Depending on the system and the circuit used, the MCU1 can directly adjust the bridge driver, or an additional circuit such as a frequency oscillator can be used to drive the bridge driver or the FETs. A typical circuit for the receiver, in accordance with a load modulation communication system embodiment, is shown in Figure 2.

[0086] In accordance with an embodiment, the receiver circuit can include an optional capacitor C2 in parallel or series with the receiver coil to produce a tuned receiver circuit. This circuit is known to increase the efficiency of a wireless power system. The rectified and smoothed (through rectifiers and capacitors) output of the receiver coil and optional capacitor is either directly or through a switch or regulator applied to the output. A microcontroller MCU2 is used to measure various values such as voltage V1, current, temperature, state of charge, battery full status, end of charge, etc. and to report back to the charger to provide a closed loop system with the charger as described above. In the circuit shown in Figure 2, the receiver MCU2 communicates back to the charger by modulating the receiver load by rapidly closing andopening a switch in series with a modulation load or impedance at a pre-determined speed and coding pattern. This rapid load modulation technique at a frequency distinct from the power transfer frequency can be easily detected by the charger. A capacitor and/or inductor can also be used as the modulation load.

[0087] In accordance with other embodiments, other methods of communication through

varying the reactive component of the impedance can also be used. The modulation scheme shown in Figure 2 is shown only as a representative method and is not meant to be exhaustive. As an example, the modulation can be achieved capacitively, by replacing the resistor with a capacitor. In this instance, the modulation by the switch in the receiver provides an advantage that by choosing the modulation frequency appropriately, it is possible to achieve modulation and signal communication with the charger coil and circuitry, with minimal power loss (compared to the resistive load modulation).

[0088] The receiver in Figure 2 also shows an optional DC regulator that is used to provide constant stable voltage to the receiver MCU2. This voltage supply may be necessary to avoid drop out of the receiver MCU2 during startup conditions where the power is varying largely or during changes in output current, and also to enable the MCU2 to have a stable voltage reference source so it can measure the V1 voltage accurately. Alternatively, a switch to connect or disconnect the load can be used or combined with the regulator. To avoid voltage overshoots during placement of a receiver on a charger or rapid changes in load condition, a voltage limiter circuit or elements like Transit Voltage Suppressor (TVS), Zener diodes or regulators or other voltage limiters can also be included in the receiver.

[0089] In the above description, a uni-directional communication (from the receiver to the charger) is described. However, this communication can also be bi-directional, and data can be transferred from the charger to the receiver through modulation of the voltage or current in the charger coil and read back by the microcontroller in the receiver detecting a change in thevoltage or current, etc.

[**0090]** In accordance with an embodiment, the communication between the receiver and charger needs to follow a pre-determined protocol, baud rate, modulation depth, etc. and a pre-determined method for hand-shake, establishment of communication, and signaling, etc., as well as optionally methods for providing closed loop control and regulation of power, voltage, etc., in the receiver.

[0091] In accordance with an embodiment, a typical wireless power system can be as follows: the charger periodically activates the charger coil driver and powers the charger coil with a drive signal of appropriate frequency. During this'ping'process, if a receiver coil is placed on or close to the charger coil, power is received through the receiver coil and the receiver circuit is energized. The receiver microcontroller is activated by the received power and begins to perform an initiation process whereby the receiver ID, its presence, power or voltage requirements, receiver or battery temperature or state of charge, manufacturer or serial number and/or other information is sent back to the charger. If this information is verified and

found to be valid, then the charger proceeds to provide continuous power to the receiver. The receiver can alternately send an end of charge, over-temperature, battery full, or other messages that will be handled appropriately by the charger and actions performed. The length of the ping process should be configured to be of sufficient length for the receiver to power up its microcontroller and to respond back and for the response to be received and understood and acted upon. The length of time between the pings can be determined by the implementation designer. If the ping process is performed often, the stand-by power use of the charger is higher. Alternately, if the ping is performed infrequently, the system will have a delay before thecharger discovers a receiver nearby; so in practice, a balance may be suitable.

[0092] Alternatively, in accordance with an embodiment, the ping operation can be initiated upon discovery of a nearby receiver by other means. This provides a very low stand-by power use by the charger and can be performed by including a magnet in the receiver and a magnet sensor in the charger or through optical, capacitive, weight, NFC or Bluetooth, RFID or other RF communication or other methods for detection.

[0093] Alternatively, in accordance with an embodiment, the system can be configured or implemented to be always ON (i.e., the charger coil is powered at an appropriate drive frequency) or pinged periodically and presence of the receiver coil brings the coil to resonance with the receiver coil and power transfer occurs. The receiver in this instance may not even contain a microcontroller and act autonomously and may simply have a regulator in the receiver to provide regulated output power to a device, its skin, case, or battery. In those embodiments in which periodic pinging is performed, the presence of a receiver can be detected by measuring a higher degree of current flow or power transfer or other means, and the charger can simply be kept on to continue transfer of power until either the power drawn falls below a certain level or an end of charge and/or no device present is detected.

[0094] In another embodiment, the charger can be in an OFF or standby, or low or no power condition, until a receiver is detected by means of its presence through a magnetic, RF, optical, capacitive or other methods. For example, in accordance with an embodiment the receiver can contain an RFID chip and once it is present on or nearby the charger, the charger can turn on or begin pinging to detect a receiver.

[0095] In accordance with an embodiment, the protocol used for communication can be any of, e.g., common RZ, NRZ, Manchester code, etc., used for communication. As described above, the charger can periodically start and apply a ping voltage of pre-determined frequency and length to the charger coil. The receiver is then activated, and can begin to send back communication signals. The communication signal can include an optional preamble that is

used to synchronize the detection circuit in the charger and prepare it for detection of communication. A communication containing a data packet may then follow, optionally followed by checksum and parity bits, etc. Similar processes are used in communication systems and similar techniques can be followed. In accordance with an embodiment, the actual data packet can include information such as an ID code for the receiver, a manufacturer's code, received voltage, power, or current values, status of the battery, amount of power in the battery, battery or circuit temperature, end of charge or battery full signals, presence of external wired charger, or a number of the above. Also this packet may include the actual voltage, power, current, etc. value or the difference between the actual value and the desired value or some encoded value that will be useful for the charger to determine how best to regulate the output.

[0096] Alternatively, in accordance with an embodiment, the communication signal can be a pre-determined pattern that is repetitive and simply lets the charger know that a receiver is present and/or that the receiver is a valid device within the power range of the charger, etc. Any combination of systems can be configured to provide the required performance.

[0097] In accordance with an embodiment, in response to the receiver providing information regarding output power or voltage, etc., the charger can modify voltage, frequency, duty cycle of the charger coil signal or a combination of the above. The charger can also use other techniques to modify the power out of the charger coil and to adjust the received power. Alternatively the charger can simply continue to provide power to the receiver if an approved receiver is detected and continues to be present. The charger can also monitor the current into the charger coil and/or its temperature to ensure that no extra-ordinary fault conditions exist. One example of this type of fault may be if instead of a receiver, a metal object is placed on the charger.

[0098] In accordance with an embodiment, the charger can adjust one or more parameters to increase or decrease the power or voltage in the receiver, and then wait for the receiver to provide further information before changing a parameter again, or it can use more sophisticated Proportional Integral Derivative (PIO) or other control mechanism for closing the loop with the receiver and achieving output power control. Alternatively, as described above, the charger can provide a constant output power, and the receiver can regulate the power through a regulator or a charger IC or a combination of these to provide the required power to a device or battery.

[0099] Various manufacturers may use different encodings, and also bit rates and protocols. The control process used by different manufacturers or protocols may also differ, further causing interoperability problems between various chargers and receivers. A source of interoperability differences may be the size, shape, and number of turns used for the power

transfer coils. Furthermore, depending on the input voltage used, the design of a wireless power system may step up or down the voltage in the receiver depending on the voltage required by a device by having appropriate number of turns in the charger and receiver coils. However, a receiver from one manufacturer may then not be able to operate on another manufacturer charger due to these differences in designs employed.

[00100] In accordance with an embodiment, it is therefore beneficial to provide a system that can operate with different receivers or chargers and can be universal. Recently, there has been some movement to standardize the frequency of operation, the coil and electronics characteristics, the identification and communication method, messaging and protocol and other aspects of the systems to allow interoperability between systems from different manufacturers. Several interoperability Standards and Specifications in this area have been established or under consideration. These include the WPC interoperability specification, the Consumer Electronics Association Standard for wireless power, the Alliance for Wireless Power (A4WP), Power Matters Alliance (PMA), the Consumer Electronics Association (CEA) Wireless Power Standards working group and Wireless Power Standards for Electric Vehicle charging, and other international efforts for Specification and Standards development.

[00101] The resonant frequency, F of any LC circuit is given by:

~~F 1 / 2TT√LC~~ $F = \frac{1}{2\pi\sqrt{LC}}$

[00102] Where L is the Inductance of the circuit or coil in Henry and C is the Capacitance in Farad.

[00103] For example, in the system shown in Figure 3, one may use the values of C1 and L1 in the above calculation for a free running charger and, as a receiver is brought close to this circuit, this value is changed by the mutual coupling of the coils involved. In the example that a ferrite shield layer is used behind a coil in the charger and/or receiver, the inductance of the coil is affected by the permeability of the shield and this modified permeability should be used in the above calculation.

[00104] In accordance with an embodiment, to be able to detect and power or charge various receivers, the charger can be configured such that the initial ping signal is at such a frequency range to initially be able to power and activate the receiver circuitry in any receiver during the ping process. After this initial power up of the receiver, the charger communication circuit should be able to detect and decode the communication signal from the receiver. Many

microcontrollers are able to communicate in multiple formats and/or may have different input N D converter pins that can be configured differently to simultaneously receive the communication signal and synchronize and understand the communication at different baud rates and protocols. In accordance with an embodiment, the charger firmware can then decide on which type of receiver is present and proceed to regulate or implement what is required (end of charge, shut-off, fault condition, etc.). Depending on the message received, the charger can then decide to change the charger driver voltage amplitude, frequency, or duty cycle, or a combination of these or other parameters to provide the appropriate regulated output at the receiver output.

[00105] In accordance with an embodiment, the charger's behavior can also take into account the difference in the coil geometry, turns ratio, etc. For example, a charger and receiver pair from one or more manufacturers may require operation of the charger drive voltageat 150 kHz. However, if the same receiver is placed on a charger from another manufacturer or driven with different coil or input voltage combination, to achieve the same output power, the charger frequency may need to be 200 kHz. The charger program may detect the type of receiver placed on it and shift the frequency appropriately to achieve a baseline output power and continue regulating from there. In accordance with an embodiment, the charger can be implemented so that it is able to decode and implement multiple communication and regulation protocols and respond to them appropriately. This enables the charger to be provided as part of a multi-protocol system, and to operate with different types of receivers, technologies and manufacturers.

[00106] Similar techniques can be used to allow a receiver to be chargeable on chargers utilizing different protocols for communication and control. For example, the receiver may recognize the type of charger being used by deciphering the frequency of the charger operation or its ping (through frequency filtering or other techniques) and communicate using different protocols and communication signals accordingly.

[00107] In accordance with an embodiment, for receivers that contain an onboard output stage regulator before the output power, stability of the input voltage to the regulator is not as critical since the regulator performs a smoothing function and keeps the output voltage at the desired level with any output load changes (such as during battery charging). The output of the regulator is then directed to circuitry such as a power management IC (PMIC), or to a battery for charging, or directly connected to the device for use in instances where the receiver acts as a power supply to a device without internal batteries, or a combination of the above. Where an output regulator stage is used in a receiver it is critical for the wireless receiver not to exceed

the maximum rated input voltage of the output stage regulator or to drop below a level required so that the output voltage from the regulator could no longer be maintained at the required value. Various types of output stage regulator such as buck, boost, buck-boost, linear etc., can be used as this output stage. However, in general, inclusion of a regulator and/or a charger IC or PMIC chip (for batteries) relaxes the power/voltage regulation requirements of the wireless power receiver portion of the circuit at the expense of the additional size and cost of this component. In accordance with some embodiments, simpler voltage limiting output stages such as Zener diodes, TVS or other voltage limiting or clamping ICs or circuits, can be used.

[00108] In accordance with another embodiment, the receiver can also include variable or switchable reactive components (capacitors and/or inductors) that would allow the receiver to change its resonant condition to affect the amount of power delivered to the device, load or battery. The receiver and/or charger and/or their coils can also include elements such as thermistors, magnetic shields or magnetic cores, magnetic sensors, and input voltage filters, for safety and/or emission compliance reasons.

[00109] In accordance with an embodiment, the systems described herein can use discrete electronics components or some or all of the functions described above can be integrated into an Application Specific Integrated Circuit (ASIC) or MCMs to achieve smaller footprint, better performance, noise, etc. and/or cost advantages. Such integration is common in the electronics industry and can provide additional advantages here.

[00110] While the system above describes a system wherein the communication is primarily through the coil, as described earlier, communication can also be implemented through a separate coil, RF, optical system or a combination of the above. In such circumstances, a multi-protocol system can also be used to interoperate between systems with different communication and/or control protocols or even means of communication.

Flexible Systems with Multiple Protocols and Technologies

[00111] In accordance with an embodiment, a receiver or receivers placed on or near a charger can communicate with the charger in a variety of communication protocols according to different wireless charging standards, protocols or different proprietary methods. To distinguish them and provide for efficient operation, the charger can be programmed to recognize different messages received, and operate differently.

[00112] For example, different protocols exist for communication and control for charging a single receiver placed on a charger. Some systems may require the charger to control the voltage output from the receiver coil (that is rectified and sent to an output of the system or to a

regulator) within a tight tolerance, and cannot tolerate a large range. An example of such a protocol or standard is the Wireless Power Consortium (WPC) or Chi, A4WP, PMA or other standard which is designed to provide tight receiver coil output voltage tolerances and also requires charger frequency range of 110 to 205 kHz or higher. In accordance with an embodiment a charger system can be configured so that it recognizes such a receiver and controls the output to within its target range. However, in other instances receivers may be designed as described above that can tolerate a larger V_1 range by using an output receiver regulator stage to allow multi-receiver charging.

[00113] In accordance with an embodiment, to address these use cases, the charger hardware, firmware or software can be configured to recognize the presence of such receivers and operate using a different algorithm to keep one or several receiver voltage ranges to within a larger acceptable range, and provide multi-receiver charging capability. This allows one charger to be interoperable with two or more protocols and systems.

[00114] In accordance with an embodiment, the charger systems or protocols can employ different power transfer and/or communication frequencies, or different communication methods (e.g., in-band through coil, and out of band through Wi-Fi or Bluetooth or proprietary systems) to communicate and also transfer power to receivers utilizing different protocols. The approaches described herein can be used to enable interoperability between such systems.

[00115] In accordance with an embodiment, the charger can use one or more driving circuits, communication methods or protocols and/or charger power or communication coils or antennas to simultaneously power different receiver coils utilizing different protocols, standards and/or power levels or voltages.

[00116] In accordance with an embodiment, the charger coil and resonant capacitor are tuned to provide the operating frequency of the charger, and the associated receiver and its resonant capacitor is similarly tuned to the vicinity of the same frequency for optimal power transfer. It is possible to provide and control power to two or more receivers simultaneously with one or more charger coils, by multiplexing the power transfer frequency.

[00117] In accordance with another embodiment, the charger can contain several resonant capacitors, such as C1 illustrated in Figure 2, which can be switched to form resonances with the charger coil L1, and to provide charger resonances at different frequencies. For example, depending on the protocol of the receiver, the charger can be configured to switch to use a different C1 in series with its coil to optimize power transfer at the preferred operating frequency of receivers from different protocols.

[00118] In accordance with an embodiment, the charger can first use one C1 value and

perform a ping operation to discover receivers adhering to a frequency of operation with that capacitor value and with the appropriate communication protocol. If an appropriate receiver is discovered, it can continue to provide power at that frequency and protocol. If no such receiver is found, it can switch to use a different value of C1, and repeat the ping and rotate between different C1 values and ping frequencies until appropriate receiver or receivers are discovered. An advantage of using several capacitors and switching between them for different protocols and/or operating frequencies is that higher power transfer efficiencies and/or communication may be obtained compared to using a fixed C1 value.

Multi-Device Charging

[00119] Figure 17 illustrates a charger 230 for use in coupling to a blade type receiver in the outer perimeter of the charger surface, which can be used to power a device or receiver having a geometry similar to that shown in Figures 7 or 8, in this example an electronic glasses device 232.

[00120] In accordance with an embodiment, the system allows mixing or combining of different technologies on the same charger and/or receiver, or different locations or areas of the same charger. As an illustrative example, it may be desirable to charge two types of device simultaneously with different characteristics. For example, Figure 18 and Figure 19 show embodiments 240, 250 wherein the charger includes a large magnetic / ferrite layer below. A plurality (e.g., two or more) separate coil structures are used on top of the magnetic layer in the charger to provide, in this example, two or more different sections (areas) with different operating principles or protocols and/or driving and/or communication sections.

[00121] In the example shown in Figure 18, the central portion can use one central coil to create a flux guide charge section, as described above in accordance with the embodiment in Figure 5. In conjunction with an appropriate flux guide type of receiver coil, this can provide position-independent charging or power transfer in this central section. In addition, as further shown in Figure18, another larger coil area can be integrated into the charger and used to create a larger charger area to be used with a receiver similar to the solenoid or blade type receiver coils described above.

[00122] In accordance with an embodiment, since the operating frequency of each coil is defined by its inductance and associated resonant capacitor, the embodiments of the system shown in Figures 18 and 19 can be provided so that the two coils operate either in similar, or in completely different, frequency range (frequency multiplexing) to power any associated receivers. In accordance with an embodiment, each coil can be driven by a separate driver

circuit and communicate with the associated receivers using load modulation, RF or optical communication channels or combination thereof as described earlier, and can be completely independent.

[00123] In accordance with another embodiment 260 shown in Figure 20, two charger coils for charging two different types of devices or receivers can be provided as distinct coils that are physically separated from one another in space and location. For example, a charger coil can be used to provide magnetic field and efficient coupling to a blade type receiver in the outer perimeter of a charger surface and used to power a receiver in a geometry similar to shown in Figures 7 or 8, while a charger optimized for flux guide power transfer (using a geometry such as that shown in Figures 5 and 6) can be used in the center of the charger.

[00124] In accordance with an embodiment, the two coils can be distinct or driven by different power drivers and/or use different communication systems and/or protocols. As an example, one of the coils and its associated electronics may use in-band or load modulation for communication and control, and the other one may use out of band or RF communication. The two different sections can also use different or same frequency for power transfer as needed to optimize performance for the associated receivers.

[00125] In accordance with an embodiment, each charger section can also charge or power multiple receivers placed on that section. As can be seen, such an embodiment allows the system designer to optimize the performance of a charger to power or charge multiple device types appropriately. In the example shown in Figure20, an electronic display device with a very narrow and small receiver area can be charged position-free when it is placed on the outer regions of the pad, while another device such as a mobile phone with a receiver that may be larger (e.g., with a flat coil with flux guide as shown on the back of the device) can be charged in the central area of the charger. Such a combined performance charger may be useful in various applications, and for an end-user.

[00126] The above description and embodiments are not intended to be exhaustive, and are instead intended to only show some examples of the rich and varied products and technologies that can be envisioned and realized by various embodiments. It will be evident to persons skilled in the art that these and other embodiments can be combined to produce combinations of above techniques, to provide useful effects and products.

[00127] Some aspects of embodiments of the present invention can be conveniently implemented using a conventional general purpose or a specialized digital computer, microprocessor, or electronic circuitry programmed according to the teachings of the present

disclosure. Appropriate software coding can readily be prepared by skilled programmers and circuit designers based on the teachings of the present disclosure, as will be apparent to those skilled in the art.

[00128] In some embodiments, the present invention includes a computer program product which is a storage medium (media) having instructions stored thereon which can be used to program a computer to perform any of the processes of the present invention. The storage medium can include, but is not limited to, any type of disk including floppy disks, optical discs, DVD, CD-ROMs, microdrive, and magneto-optical disks, ROMs, RAMs, EPROMs, EEPROMs, DRAMs, VRAMs, flash memory devices, magnetic or optical cards, nanosystems (including molecular memory ICs), or any type of media or device suitable for storing instructions and/or data.

[00129] The foregoing description of the present invention has been provided for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Many modifications and variations will be apparent to the practitioner skilled in the art. The embodiments were chosen and described in order to best explain the principles of the invention and its practical application, thereby enabling others skilled in the art to understand the invention for various embodiments and with various modifications that are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the following claims and their equivalents.

Electronic Acknowledgement Receipt	
EFS ID:	44299268
Application Number:	17467032
International Application Number:	
Confirmation Number:	1075
Title of Invention:	System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes
First Named Inventor/Applicant Name:	Afshin Partovi
Customer Number:	33438
Filer:	Kent Bryan Chambers
Filer Authorized By:	
Attorney Docket Number:	AFPA-01039US4
Receipt Date:	16-NOV-2021
Filing Date:	03-SEP-2021
Time Stamp:	19:59:32
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Miscellaneous Incoming Letter	AFPA-01039US4_RNtFCAP_2021-09-16.pdf	93931 76d317d9dfa3ee505bd48b67bd1b8d7d4653194d	no	3

Warnings:

Information:					
2	Specification	AFPA-01039US4_Clean_Specification.pdf	224858 36217a9d5a8aea281b85fca1be6b43f1925c3877	no	29
Warnings:					
Information:					
3	Specification	AFPA-01039US4_Markedup_Specification.pdf	227549 c717438d0a034001ad81759fc5359052bf223e32	no	29
Warnings:					
Information:					
			Total Files Size (in bytes):	546338	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventors:	Afshin Partovi		
Applicant:	Mojo Mobility Inc.		
Title:	System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes		
Application No.:	17/467,032	Filing Date:	November 16, 2021
Examiner:	Unassigned	Group Art Unit:	2859
Docket No.:	AFPA-01039US4	Customer No.:	33438

ELECTRONICALLY FILED

Austin, Texas
November 16, 2021

RESPONSE TO NOTICE TO FILE CORRECTED APPLICATION PAPERS

Filing Date Granted

This paper responds to the Notice to File Corrected Application Papers – Filing Date Granted ("*Notice*"), dated September 16, 2021, having a shortened statutory period expiring November 16, 2021. The *Notice* requires a clean and marked-up, substitute Specification that includes the amendments to the Specification that were filed in the Preliminary Amendment.

The Commissioner is hereby authorized to charge any required, additional fees and credit any overpayments to Deposit Account No. 502264.

AMENDMENT TO THE SPECIFICATION

Please amend the Specification in accordance with the clean and marked-up copies of the Specification submitted herewith. The Specification amends paragraph 00101 as follows:

[00101] The resonant frequency, F of any LC circuit is given by:

~~F=l/2.pi. LC~~ $$\underline{F = \frac{1}{2\pi\sqrt{LC}}}$$

REMARKS

Claim 1 is pending.

Claims 2-20 have been canceled without prejudice or disclaimer of the subject matter recited therein.

In response to the *Notice*, Applicant has amended the Specification in accordance with the clean and marked-up copies of the Specification filed herewith. The clean and marked up versions of the Specification comply with 37 CFR 1.52, 1.121(b)(3), and 1.125.

Please note, the Specification was amended in a September 3, 2021 Preliminary Amendment. The Preliminary Amendment inadvertently identified paragraph 0118 as the amended paragraph. However, the actual paragraph amended is paragraph 00101 as reflected in the amended Specification filed herewith. The amendment corrects an inadvertent error in the well-known resonant frequency formula. Further support for the amendment is found in ¶0051 of US Provisional Patent Application No. 61/546,316, which is incorporated by reference in paragraph 0001 of the *Present Application*.

No new matter has been added.

CONCLUSION

Applicant has amended the specification and filed clean and marked-up copies of the Specification in accordance with the requirements of the Notice to File Corrected Application Papers. Accordingly, Applicant respectfully submits that Applicant has complied with the requirements of the Notice.

CERTIFICATE OF TRANSMISSION

I hereby certify that on November 16, 2021 this correspondence is being transmitted via the U.S. Patent & Trademark Office's electronic filing system.

/Kent B. Chambers/

Respectfully submitted,

/Kent B. Chambers/

Kent B. Chambers
Attorney for Applicant(s)
Reg. No. 38,839

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	17467032
Filing Date	2021-09-03
First Named Inventor	Afshin Partovi
Art Unit	2859
Examiner Name	Undetermined
Attorney Docket Number	AFPA-01039US4

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	8234189	B2	2012-01-31	Taylor et al.	
	2	8069100	B2	2011-11-29	Taylor et al.	
	3	6040680		2000-03-21	Shoichi Toya et al.	
	4	5311973		1994-05-17	Tseng	
	5	7804054		2010-09-28	Shalom	
	6	5925814		1999-07-20	Tsuzuki	
	7	5744933		1998-04-28	Inoue	
	8	5434493		1995-07-18	Woody	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	9	5963012		1999-10-05	Garcia	
	10	6870089		2005-03-02	Gray	
	11	3938018		1976-02-10	Dahl	
	12	5991170		1999-11-23	Nagai	
	13	5550452		1996-08-27	Shirai	
	14	6310465		2001-10-30	Najima	
	15	7026789		2006-04-11	Bozzone	
	16	7399202		2008-07-15	Dayan	
	17	6184654		2001-02-06	Bachner	
	18	7355150		2008-04-08	Baarman	
	19	7855529		2010-12-21	Xun Liu	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	20	7872445		2011-01-18	Shu-Yuen Ron Hui	
	21	6888438		2005-05-03	Shu-Yuen Ron Hui	
	22	6501364		2002-12-31	Shu-Yuen Ron Hui	
	23	6913477		2005-07-05	Dayan	
	24	4415959		1983-11-15	Vinciarelli	
	25	7311526		2007-12-25	Rohrbach	
	26	7645143		2010-01-12	Rohrbach	
	27	7554316		2009-06-30	Stevens	
	28	7605496		2009-10-20	Stevens	
	29	7164245		2007-01-16	Chen	
	30	8035255		2011-10-11	Kurs	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	31	7825543		2010-11-02	Karalis	
	32	7741734		2010-06-22	Joannopoulos	
	33	8049370		2011-11-01	Azancot	
	34	7906936		2011-03-15	Azancot	
	35	8040103		2011-10-18	Hui	
	36	7495414		2009-02-24	Hui	
	37	5642087		1997-06-24	Crow	
	38	4731585		1988-03-15	Fox	
	39	7781916		2010-08-24	Boys	
	40	8050068		2011-11-01	Hussmann	
	41	D639734		2011-06-14	Ferber	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	42	D625721		2010-10-19	Ferber	
	43	D624316		2010-09-28	Ferber	
	44	D611408		2010-03-09	Ferber	
	45	D611407		2010-03-09	Webb	
	46	D607879		2010-01-12	Ferber	
	47	D603603		2009-11-10	Laine	
	48	D636333		2011-04-19	Kulikowski	
	49	6906495		2005-06-14	Cheng	
	50	5959433		1999-09-28	Rohde	
	51	6208115		2001-03-27	Binder	
	52	5952814		1999-09-14	Van Lerbergne	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	53	6489745		2002-12-03	Koreis	
	54	6331744		2001-12-18	Chen	
	55	7336054		2005-03-09	Crisp	
	56	5803744	B1	2014-10-12	Anthony Sabo	
	57	6636017		2003-10-21	Zink et al	
	58	6586909		2003-07-01	Trepka	
	59	6462509		2002-10-08	Abe	
	60	6844702		2005-01-28	Giannopoulos	
	61	4311953		1982-01-19	Fukuda	
	62	6016046		2000-01-18	Kaile et al.	
	63	7164255	B2	2007-01-16	Shu-Yuen Ron Hui	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	64	6756765		2004-06-29	Bruning	
	65	6917182		2005-07-12	Burton	
	66	6741064		2004-05-25	Liu	
	67	6650088		2003-11-18	Webb	
	68	6697272		2004-02-24	Nanbu	
	69	6008622		1999-12-28	Nakawatase	
	70	6625477		2003-09-23	Wakefield	
	71	6436299		2002-08-20	Baarman	
	72	6673250		2004-01-06	Kuennen	
	73	6731071		2004-05-04	Baarman	
	74	6806649		2004-10-19	Mollema	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	75	6812645		2004-11-02	Baarman	
	76	6825620		2004-11-30	Kuennen	
	77	6831417		2004-12-14	Baarman	
	78	6917163		2005-07-12	Baarman	
	79	6943733		2005-09-13	Vance	
	80	6975198		2005-12-13	Baarman	
	81	7031662		2006-04-18	Suzuki	
	82	7116200		2006-10-03	Baarman	
	83	7118240		2006-10-10	Baarman	
	84	7126450		2006-10-24	Baarman	
	85	7132918		2006-11-07	Baarman	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	86	7162264		2007-01-09	Vance	
	87	7183870		2007-02-27	Takagi	
	88	7184706		2007-02-27	Someya	
	89	7209084		2007-04-24	Lindell	
	90	7221919		2007-05-22	Takagi	
	91	7305258		2007-12-04	Rydgren	
	92	7324051		2008-01-29	Hayes	
	93	7342539		2008-03-11	Rosenberg	
	94	7952322		2011-05-31	Partovi	
	95	7376408		2008-05-20	Hayes	
	96	7382636		2008-06-03	Baarman	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	97	7385357		2008-06-10	Kuennen	
	98	7388543		2008-06-17	Vance	
	99	7415248		2008-08-19	Andersson et al.	
	100	7462951		2008-12-09	Baarman	
	101	7477195		2009-01-13	Vance	
	102	7487921		2009-02-10	Takahashi	
	103	7498871		2009-03-03	Ruuswik	
	104	7948208		2011-05-24	Partovi	
	105	6803774		2004-10-12	Park	
	106	7378817		2008-05-27	Calhoon	
	107	4311853		1982-01-19	Cree	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	108	6798716		2004-09-28	Charych	
	109	5543702		1996-08-06	Pfeiffer	
	110	5991665		1999-11-23	Wang	
	111	6498455		2002-12-24	Zink	
	112	7443135		2008-10-28	Cho	
	113	6906495		2005-06-14	Cheng	
	114	6972543		2005-12-06	Wells	
	115	7042196		2006-05-09	Ka-Lai	
	116	7239110		2007-07-07	Cheng	
	117	5889384		1999-05-30	Hayes	
	118	7525283		2009-04-28	Cheng	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	119	7576514		2009-08-18	Hui	
	120	5237257		1993-08-17	Johnson	
	121	5656917		1997-08-12	Theobald	
	122	5696433		1997-12-09	Palino	
	123	6094119		2000-07-25	Reznik	
	124	6573817		2003-06-03	Gottschalk	
	125	7915858		2011-03-29	Liu	
	126	8169185		2012-05-01	Partovi	
	127	4800328		1989-01-24	Bolger	
	128	5367242		1994-11-22	Hulman	
	129	7151357		2006-12-19	Xian	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20140339916	A1	2014-11-14	Fells et al.	
	2	20120259735	A1	2012-10-11	Taylor et al.	
	3	20120150670	A1	2012-06-14	Taylor et al.	
	4	20120119588	A1	2112-05-17	Baarman et al.	
	5	20120112552	A1	2012-05-10	Baarman et al.	
	6	20120041843	A1	2012-02-16	Taylor et al.	
	7	20100171369	A1	2010-07-08	Taylor et al.	
	8	20090212637	A1	2009-08-27	Baarman et al.	
	9	20090174263	A1	2009-07-09	Baarman et al.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	10	20110221387		2011-09-15	Steigerwald	
	11	20040145343	A1	2004-07-29	Naskali	
	12	20070236174	A1	2007-10-11	Kaye	
	13	20090212639	A1	2009-08-27	Johnson	
	14	20100235006		2010-09-16	Brown	
	15	20100314946		2010-12-16	Budde	
	16	20110115430		2011-05-19	Saunamaki	
	17	20120049991		2012-03-01	Baarman	
	18	20120126745		2012-05-24	Partovi	
	19	20110222493		2011-09-15	Mangold	
	20	20120146576		2012-06-14	Partovi	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	21	20060105718		2006-05-18	Ozluturk	
	22	20120235636		2012-09-20	Partovi	
	23	20110193520		2011-08-11	Yamazaki	
	24	20100117596		2010-05-13	Cook	
	25	20100259401		2010-10-14	Azancot	
	26	20100257382		2010-10-07	Azancot	
	27	20100253282		2010-10-07	Azancot	
	28	20100244584		2010-09-30	Azancot	
	29	20100219698		2010-09-02	Azancot	
	30	20100219697		2010-09-02	Azancot et al.	
	31	20100219693		2010-09-02	Azancot	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	32	20100219183		2010-09-02	Azancot	
	33	20100194336		2010-08-05	Azancot	
	34	20100181841		2010-07-22	Azancot	
	35	20100073177		2010-03-25	Azancot	
	36	20100072825		2010-03-25	Azancot	
	37	20100070219		2010-03-18	Azancot	
	38	20100066176		2010-03-18	Azancot	
	39	20090257259		2009-10-15	Leibovitz	
	40	20060021926		2006-02-02	Woodard	
	41	20080067874		2008-03-20	Tseng	
	42	20080164839		2008-07-10	Kato	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	43	20090015075		2009-01-15	Cook	
	44	20090033564		2009-02-05	Cook	
	45	20110217927		2011-09-08	Ben-Shalom	
	46	20110157137		2011-06-30	Ben-Shalom	
	47	20110121660		2011-05-26	Azancot	
	48	20110062793		2011-03-17	Azancot	
	49	20100181845		2010-07-22	Fiorello	
	50	20100181843		2010-07-22	Schatz	
	51	20100187911		2010-07-29	Joannopoulos	
	52	20100171368		2010-07-08	Schatz	
	53	20100164298		2010-07-01	Karalis	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	54	20100164297		2010-07-01	Kurs	
	55	20100164296		2010-07-01	Kurs	
	56	20100148589		2010-06-17	Hamam	
	57	20100141042		2010-06-10	Kesler	
	58	20100133920		2010-06-03	Joannopoulos	
	59	20100133919		2010-06-03	Joannopoulos	
	60	20100133918		2010-06-03	Joannopoulos	
	61	20100127575		2010-05-27	Joannopoulos	
	62	20100127574		2010-05-27	Joannopoulos	
	63	20100127573		2010-05-27	Joannopoulos	
	64	20100123355		2010-05-20	Joannopoulos et al.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	65	20100123354		2010-05-20	Joannopoulos	
	66	20100123353		2010-05-20	Joannopoulos	
	67	20100117456		2010-05-13	Karalis	
	68	20100117455		2010-05-13	Joannopoulos	
	69	20100109445		2010-05-06	Kurs	
	70	20100102641		2010-04-29	Joannopoulos	
	71	20100102640		2010-04-29	Joannopoulos	
	72	20100102639		2010-04-29	Joannopoulos	
	73	20100096934		2010-04-22	Joannopoulos	
	74	20090284083		2009-11-19	Karalis	
	75	20090267710		2009-10-29	Joannopoulos	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	76	20090267709		2009-10-29	Joannopoulos	
	77	20090224856		2009-09-10	Karalis	
	78	20090195333		2009-08-06	Joannopoulos	
	79	20090195332		2009-08-06	Joannopoulos	
	80	20080278264		2008-11-13	Karalis	
	81	20110266878		2008-11-13	Cook	
	82	20100038970		2010-02-18	Cook	
	83	20090243397		2009-10-01	Cook	
	84	20090224609		2009-09-10	Cook	
	85	20090224608		2009-09-10	Cook	
	86	20090213028		2009-08-27	Cook	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	87	20090212636		2009-08-27	Cook	
	88	20090167449		2009-07-02	Cook	
	89	20090134712		2009-05-28	Cook	
	90	20090102292		2009-04-23	Cook	
	91	20090079268		2009-03-26	Cook	
	92	20090072629		2009-03-19	Cook	
	93	20090072628		2009-03-19	Cook	
	94	20070109708		2007-05-17	Hussman	
	95	20070296393		2007-12-27	Malpas	
	96	20080247210		2008-10-09	Hu	
	97	20090284227		2009-11-19	Mohammadian	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	98	20100109443		2010-05-06	Cook	
	99	20100190435		2010-07-29	Cook	
	100	20100184371		2010-07-22	Cook	
	101	20100207572		2010-08-19	Kirby	
	102	20100253281		2010-10-07	Li	
	103	20060106965		2006-05-18	Falcon	
	104	20080014897		2008-01-17	Cook	
	105	20090127937		2009-05-21	Widmer	
	106	20090058189		2009-03-05	Cook	
	107	20090072627		2009-03-19	Cook	
	108	20020093309		2002-07-18	Peele	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	109	20100201313		2010-08-12	Vorenkamp	
	110	20090043727		2009-02-12	Cohen. Jr.	
	111	20100213895		2010-08-26	Keating	
	112	20100327804		2010-12-30	Takahashi	
	113	20110057606		2011-03-10	Saunamaki	
	114	20070139000		2007-06-21	Kozuma	
	115	20110050164		2011-03-03	Partovi	
	116	20110095617		2011-04-28	Cook	
	117	20100117454		2010-05-13	Cook	
	118	20060202665		2006-09-14	Hsu	
	119	20100127660		2010-05-27	Cook	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	120	20100190436		2010-07-29	Cook	
	121	20100277120		2010-11-04	Cook	
	122	20110090723		2011-04-21	Hu	
	123	20030210106		2003-11-13	Cheng	
	124	20050116683		2005-06-02	Cheng	
	125	20050162125		2005-07-28	Yu	
	126	20050140482		2005-06-30	Cheng	
	127	20050017677		2005-01-27	Burton	
	128	20060238930		2006-10-26	Baarman	
	129	20050135122		2005-06-23	Cheng	
	130	20060038794		2006-02-23	Schneidman	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	131	20070069687		2007-03-29	Suzuki	
	132	20060284593		2006-12-21	Nagy	
	133	20020004167		2002-01-10	Jenson	
	134	20020067238		2002-06-06	Leu	
	135	20050127869		2005-06-16	Calhoon	
	136	20050075696		2005-04-07	Forsberg	
	137	20050063488		2005-03-24	Troyk	
	138	20030214255		2003-11-20	Baarman	
	139	20040130915		2004-07-08	Baarman	
	140	20040130916		2004-07-08	Baarman	
	141	20020089305		2002-07-11	Park	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	142	20040222751		2004-11-11	Mollema	
	143	20040232845		2004-11-25	Baarman	
	144	20050007067		2005-01-13	Baarman	
	145	20050093475		2005-05-05	Kuennen	
	146	20050116650		2005-06-02	Baarman	
	147	20050122058		2005-06-09	Baarman	
	148	20050122059		2005-06-09	Baarman	
	149	20050127849		2005-06-16	Baarman	
	150	20050127850		2005-06-16	Baarman	
	151	20060132045		2006-06-22	Baarman	
	152	20040113589		2004-06-17	Crisp	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	153	20030094921		2003-05-22	Lau	
	154	20030103039		2003-06-05	Burr	
	155	20050127867		2005-06-16	Calhoon	
	156	20110221391		2011-09-15	Won	
	157	20060146517		2006-07-06	Park	
	158	20060205381		2006-09-14	Beart	
	159	20080258679		2008-10-23	Manico	
	160	20070178945		2007-08-02	Cook et al	
	161	20060108977		2006-05-25	Kagermeier	
	162	20100007307		2010-01-14	Baarman	
	163	20070279002		2007-12-07	Partovi	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	164	20100277121		2010-11-04	Hall	
	165	20090096413		2009-04-16	Partovi	
	166	20110012556		2011-01-20	Lai	
	167	20100081473		2010-04-01	Chatterjee	
	168	20110187318		2011-08-04	Hui	
	169	20090049554		2009-02-19	Vuong	

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	201200116054	WO		2012-08-30	Steele		
	2	2003045731	JP	A1	2003-02-14	NEC Tokin Corp.		
	3	2000341885	JP		2000-12-08	Matsushita Electric Works Ltd.		

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	4	100836634	KR		2008-04-29	Hanrim Postech Co., Ltd.		
	5	2009200174	JP		2009-09-03	Panasonic Electric Works Co., Ltd.		
	6	2005109597	WO		2005-11-17	Splashpower Limited		
	7	2005024865	WO		2005-03-17	Splashpower Limited		
	8	2004055654	WO		2004-07-01	Splashpower Limited		
	9	2004038887	WO		2004-05-06	Splashpower Limited		
	10	2004038888	WO		2004-05-06	Splashpower Limited		
	11	20030105311	WO		2003-12-18	Splashpower Limited		
	12	408000838	JP		1996-08-01	Sudo		
	13	2003096361	WO		2003-11-20	Splashpower Limited		
	14	2004030176	WO		2004-04-08	Splashpower Limited		

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	15	2008137996	WO		2008-11-13	Mojo Mobility. Inc.			
	16	20110156768	WO		2011-12-15	Partovi			
	17	2006500894	JP		2006-01-05	Beart			
	18	2006246633	JP		2006-09-14	Kamitsuma Yosuke			
	19	2003096512	WO		2003-11-20	Splashpower Limited			
	20	2003105308	WO		2003-12-18	City University of Hong Kong			
	21	2005109598	WO		2005-11-17	Splashpower Limited			

If you wish to add additional Foreign Patent Document citation information please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T5
	1	JAPANESE PATENT OFFICE, Office Action for Japanese Patent Application No. 2010-507666, March 9, 2015, 8 pages.	
	2	JAPANESE PATENT OFFICE, Office Action for Japanese Patent Application No. 2014-104181, March 23, 2015, 14 pages.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	3	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U.S. Patent Application No. 13/830,161, April 16, 2015, 24 pages.	
	4	JAPANESE PATENT OFFICE, Examiner's Reconsideration Report for Japanese Patent Application No. 2010-507666, July 17, 2014, 1 page.	
	5	THE PATENT OFFICE OF THE PEOPLE'S REPUBLIC OF CHINA, 2nd Office Action for Chinese Patent Application No. 200880023854.4, April 15, 2013, 4 pages.	
	6	UNKNOWN AUTHOR, System Description Wireless Power Transfer, Volume 1: Low Power Part 1: Interface Definition, Version 1.0, July 2010, 83 pages.	
	7	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U.S. Patent Application No. 13/829,346, February 12, 2015, 10 pages.	
	8	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U.S. Patent Application No. 13/829,186, January 23, 2015, 12 pages.	
	9	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U.S. Patent Application No. 13/828,933, February 5, 2015, 11 pages.	
	10	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U.S. Patent Application No. 13/352,096, August 18, 2014, 14 pages.	
	11	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U.S. Patent Application No. 13/708,584, January 23, 2015, 25 pages.	
	12	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U.S. Patent Application No. 12/769,586, June 2, 2014, 23 pages.	
	13	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U.S. Patent Application No. 13/708,520, August 14, 2014, 9 pages.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	14	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U.S. Patent Application No. 13/115,811, August 20, 2014, 20 pages.	
	15	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U.S. Patent Application No. 14/135,082, December 5, 2014, 14 pages.	
	16	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U.S. Patent Application No. 13/708,520, March 11, 2015, 10 pages.	
	17	INTERNATIONAL SEARCHING AUTHORITY AT THE U.S. PATENT AND TRADEMARK OFFICE, International Search Report and Written Opinion for PCT International Patent Application No. PCT/US2013/078534, May 13, 2014, 11 pages.	
	18	INTERNATIONAL SEARCHING AUTHORITY AND WRITTEN OPINION FROM THE U.S. PATENT AND TRADEMARK OFFICE, International Search Report and Written Opinion for PCT International Application No. PCT/US2013/069270, April 4, 2014, 9 pages.	
	19	HUI, "A New Generation of Universal Contactless Battery Charging Platform for Portable Consumer Electronic Equipment", IEEE Transactions on Power Electronics, Vol. 20, No. 3, May 2005, pp. 620-627, 8 pages	
	20	TANG, et al., "Evaluation of the Shielding Effects on Printed-Circuit-Board Transformers Using Ferrite Plates and Copper Sheets", IEEE Transactions on Power Electronics, Vol. 17, No. 6, November 2002, pp. 1080-1088, 9 pages.	
	21	LIU, et al., "An Analysis of a Double-Layer Electromagnetic Shield for a Universal Contactless Battery Charging Platform", Department of Electronic Engineering City University of Hong Kong, IEEE, 2005, pp. 1767-1772, 6 pages.	
	22	LIU, et al., "Equivalent Circuit Modeling of a Multilayer Planar Winding Array Structure for Use in a Universal Contactless Battery Charging Platform, IEEE Transactions on Power Electronics, Vol. 22, No. 1, January 2007, pp. 21-29, 9 pages	
	23	LIU, et al., "Simulation Study and Experimental Verification of a Universal Contactless Battery Charging Platform with Localized Charging Features", IEEE Transactions on Power Electronics, Vol. 22, No. 6, November 2007, pp. 2202-2210, 9 pages	
	24	LIU, et al., "Optimal Design of a Hybrid Winding Structure for Planar Contactless Battery Charging Platform", IEEE Transactions on Power Electronics, Vol. 23, No. 1, January 2008, pp. 455-463, 9 pages.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	25	KARALIS, et al., "Efficient Wirelss Non-Radiative Mid-Range Energy Transfer", ScienceDirect, Annals of Physics 323, 2008, pp. 34-48, 15 pages.	
	26	SU, et al., "Mutual Inductance Calculation of Movable Planar Coils on Parallel Surfaces", IEEE Transactions on Power Electronics, Vol. 24, No. 4, April 2009, pp. 1115-1124, 10 pages.	
	27	HUI, et al., "Careless Printed Circuit Board (PCB) Transformers -- Fundamental Characteristics and Application Potential", IEEE Circuits and Systems, Vo. 11, No. 3, Third Quarter 2000, pp. 1-48, 48 pages.	
	28	SEKITANI, et al., "A Large-Area Flexible Wireless Power Transmission Sheet Using Printed Plastic MEMS Switches and Organic Field-Effect Transistors", IEEE, Quantum-Phase Electronics Center, School of Engineering, The University of Tokyo, 2006, 4 pages.	
	29	CHOI, et al., "A New Contactless Battery Charger for Portable Telecommunication/Compuing Electronics", IEEE, School of Electronic and Electrical Engineering, Kyungpook National University, Taegu, Korea, 2011, pp. 58-59 2 pages.	
	30	HUI, et al., "Careless Printed Circuit Board (PCB) Transformers for Power MOSFET/IGBT Gate Drive Circuits", IEEE Transactions on Power Electronics, Vol. 14, No. 3, May 1999, pp. 422-430, 9 pages.	
	31	TANG, et al., "Careless Planar Printed-Circuit-Board (PCB) Transformers --A Fundamental Concept for Signal and Energy Transfer", IEEE Transactions on Power Electronics, Vol.15, No. 5, September 2000, pp. 931-941, 11 pages.	
	32	HATANAKA. et al.. "Power Transmission of a Desk with Cord-Free Power Supply". IEEE Transactions on Magnetics. Vol. 38. No. 5, September 2002, pp. 3329-3331, 3 pages.	
	33	FERNANDEZ, et al., "Design Issues of a Core-less Transformer for a Contact-less Application", IEEE, Universidad Politecnica de Madrid, 2002, pp. 339-345, 7 pages.	
	34	Office Action in connection with Application No. 113/155,811 dated March 8, 2013, 13 pages.	
	35	LIU, et al., "Optimal Design of a Hybrid Winding Structure for Planar Contactless Battery Charging Platform", IEEE, Department of Electronic Engineering, City University of Hong Kong, 2006, pp. 2568-2575, 8 pages.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	36	TOPFER, et al., "Multi-Pole Magnetization of NdFeB Sintered Magnets and Thick Films for Magnetic Micro-Actuators", ScienceDirect, Sensor and Actuators, 2004, pp. 257-263, 7 pages.	
	37	TOPFER, et al., "Multi-Pole Magnetization of NdFeB Magnets for Magnetic Micro-Actuators and Its Characterization with a Magnetic Field Mapping Device", ScienceDirect, Journal of Magnetism and Magnetic Materials, 2004, 124-129, 6 pages.	
	38	SAKAMOTO, et al., "A Novel High Power Converter for Non-Contact Charging with Magnetic Coupling", IEEE Transactions on Magnetics, Vol. 30, No. 6, November 1994, pp. 4755-4757, 3 pages.	
	39	HUI, et al., "Some Electromagnetic Aspects of Careless PCB Transformers", IEEE Transactions on Power Electronics, Vol. 15, No. 4, July 2000, pp. 805-810, 6 pages.	
	40	WAFFENSCHMIDT, et al., "Limitation of Inductive Power Transfer for Consumer Applications", 13th European Conference on Power Electronics and Applications, Barcelona, 2009. EPE '09. pp. 1 - 10, 10 pages.	
	41	STOKES, "Palm Strikes Back with new OS, Pre Handset at CES, http://arstechnica.com/news.ars/post/20090101-palm-laundhes -new-handset-pre-operating", January 8, 2009, 6 pages.	
	42	SULLIVAN, Visteon to Sell Wireless Gadget Charger, "Wire-Free Technology will Lets Consumers Dump Cords and Chargers", Red Herring, December 29, 2006, 2 pages.	
	43	KIM, "Wireless Charger for New Palm Phone", San Francisco Chronicle and SFGate.com, May 11, 2009, 2 pages.	
	44	COMPEAU, Red Zen Marketing, "Could This be the Mojo Behind the Palm Pre's Touchstone Charger?", http:// redzenmarketing.posterous.com/could-this-be-the-mojo-behind-the-palm-pres-t, June 5, 2009, 3 pages.	
	45	Fulton Innovation LLC, "The Big Story for CES 2007: The Public Debut of eCoupled Intelligent Wireless Power", ecoupled, December 27, 2006, 2 pages.	
	46	MILLER, "Palm May Make Pre Scarce", The San Jose Mercury News, April 29, 2009, 1 page.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	47	MURAKAMI et al., "Consideration on Cordless Power Station Contactless Power Transmission System", IEEE Transactions on Magnets, Vol. 32, No. 5, September 1996, 3 pages.
	48	Epson Air Trans "Wireless Power Transfer", http://www.2k1.co.uk/components/epson_airtrans.asp, 12/8/2008, 2 pages.
	49	CHOI, et al., "A New Contactless Battery Charger for Portable Telecommunication/Compuing Electronics", IEEE, School of Electronic and Electrical Engineering, Kyungpook National University, Taegu, Korea, 2001, pp. 58-59 2 pages.
	50	PCT International Preliminary Report on Patentability dated 10 November 2011 in re International Application No. PCT, US2010/032845, 7 pages.

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature		Date Considered	

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

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Kent B. Chambers/	Date (YYYY-MM-DD)	2021-11-05
Name/Print	Kent B. Chambers	Registration Number	38839

This collection of information is required by 37 CFR 1.97 and 1.98. 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 1 hour to complete, including gathering, preparing and submitting the completed application 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.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt	
EFS ID:	44213209
Application Number:	17467032
International Application Number:	
Confirmation Number:	1075
Title of Invention:	System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes
First Named Inventor/Applicant Name:	Afshin Partovi
Customer Number:	33438
Filer:	Kent Bryan Chambers/Anita Chambers
Filer Authorized By:	Kent Bryan Chambers
Attorney Docket Number:	AFPA-01039US4
Receipt Date:	05-NOV-2021
Filing Date:	03-SEP-2021
Time Stamp:	11:37:24
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	AFPA-01039US4_IDS5_2021-11-05.pdf	1044863 00270d1d24cf6ac54d997f21005c0bad219f83ee	no	37

Warnings:

Information:	
Total Files Size (in bytes):	1044863

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetremined
	Attorney Docket Number	AFPA-01039US4

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20070029965		2007-02-08	Hui	
	2	20100207771		2010-08-19	Trigiani	
	3	20070182367		2007-08-09	Partovi	

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							

EFS Web 2.1.18

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetremined
	Attorney Docket Number	AFPA-01039US4

If you wish to add additional Foreign Patent Document citation information please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T5
	1	WiPower, Wikipedia, the free encyclopedia, http://en.wikipedia.org/wiki/WiPower, 11/18/2011, 2 pages	
	2	PowerbyProxi, Wireless Power Solutions, http://www.powerbyproxi.com/, 11/18/2011, 2 pages	
	3	Now charge your iPhone 4 and 4S with Powermat!, Wireless charging mats and receivers for your iPhone, iPod, Blackberry ... http://www.powermat.com/, 11/18/2011, 1 page	
	4	Witricity. Wireless Electricity Delivered Over Distance, http://www.witricity.com, 11/18/2011, 1 page	
	5	ConvenientPower, ConvenientPower HK Limited, http://www.convenientpower.com/1/about.php, 11/18/2011, 1 page	
	6	Nigel Power LLC: Private Company Information - Business Week, http://investing.businessweek.com/research/stocks/private/snapshot.asp? p ... , 11/18/2011, 2 pages	
	7	SAKAMOTO, et al., "A Novel Circuit for Non-Contact Charging Through Electro-Magnetic Coupling", 1992, IEEE, pp. 165-17 4.	
	8	ABE, et al., "A Non-Contact Charger Using a Resonant Converter with Parallel Capacitor of the Secondary Coil", April 2000, IEEE, Vo.l. 36, No. 2, pp. 444-451.	
	9	SAKAMOTO, et al. "Large Air-Gap Coupler for Inductive Charger", September 1999, IEEE, Vol. 35, No. 5, pp. 3526-3528.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetremined
	Attorney Docket Number	AFPA-01039US4

	10	SAKAMOTO, et al. "A Novel Converter for Non-Contact Charging with Electromagnetic Coupling", November 1993, IEEE, Vol. 29, No. 6, pp. 3228-3230	
	11	KIM, et al. "Design of a Contactless Battery Charger for Cellular Phone", December 2001, IEEE, Vol. 48, No. 6, pp. 1238-1247.	
	12	HUI, et al." Careless Printed-Circuit Board Transformers for Signal and Energy Transfer", Electronics Letters, May 1998, Vol. 34, No. 11, pp. 1052-1054	
	13	HUI, et al. "Optimal Operation of Careless PCB Transformer-Isolated Gate Drive Circuits with Wide Switching Frequency Range", May 1999, IEEE Transactions of Power Electronics, Vol. 14, No. 3, pp. 506-514	
	14	TANG, et al. "Characterization of Careless Printed Circuit Board (PCB) Transformers", November 2000, IEEE Transactions of Power Electronics, Vol. 15, No. 6, pp. 1275-1282	
	15	TANG, et al. "Careless Printed Circuit Board (PCB) Transformers with Multiple Secondary Windings for Complementary Gate Drive Circuits", May 1999, IEEE Transactions of Power Electronics, Vol. 14, No. 3, pp. 431-437	
	16	TANG, et al." Careless Printed Circuit Board (PCB) Transformers with High Power Density and High Efficiency", May 2000, Electronics Letters, Vol. 36, No. 11, pp. 943-944	
	17	BORENSTEIN, "Man Tries Wirelessly Boosting Batteries"', November 2006, USA Today, http://www.usatoday.com/tech/wireless/data/2006-11-16-wireless-recharging_x.htm, 5 pages.	
	18	MURPH, "WildCharger Charges Your Gadgetry Sans Wires", December 2006, Misc. Gadgets, 2 pages	
	19	Gizmo Watch, "Pitstop: A Table Top Recharging Solution by Belkin", http://www.gizmowatch.com/entry/pitstop-a-table-top-recharging-solution-by-belkin, December 2006, 5 pages.	
	20	UNKNOWN AUTHOR, "Cutting the Cord", April 2007, The Economist, 1 page.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetremined
	Attorney Docket Number	AFPA-01039US4

	21	BISHOP, "Microsoft Surface Brings Computing to the Table", May 2007, http://seattlepi.nwsource.com/ business/317737 msftdevic30.html, 7 pages.	
	22	WILDCHARGE, "The Wire-Free Power Revolution is Only Days Away, and WildCharge, Inc. Is Leading the Charge", September 2007, 3 pages.	
	23	Economist.com Science Technology Quarterly, "Wireless Charging", http://www.economist.com/science/tq/ PrinterFriendly.cfm?story_id=13174387, 4/15/2009, 4 pages.	
	24	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U. S. Patent Application No. 13/708,548, November 20, 2013, 5 pages	
	25	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U. S. Patent Application No. 13/115,811, September 23, 2013, 17 pages.	
	26	UNITED STATES PATENT AND TRADEMARK OFFICE. Office Action for U. S. Patent Application No. 13/708,584, September 13, 2013, 16 pages.	
	27	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U. S. Patent Application No. 13/158,134 January 22, 2014, 43 pages.	
	28	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U. S. Patent Application No. 13/708,827 February 5, 2014, 28 pages.	
	29	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U. S. Patent Application No. 13/708,520, February 5, 2014, 8 pages.	
	30	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U. S. Patent Application No. 13/115,811, March 4, 2014, 15 pages.	
	31	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U. S. Patent Application No. 13/709,983, February 27, 2014, 10 pages.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetremined
	Attorney Docket Number	AFPA-01039US4

	32	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U. S. Patent Application No. 13/710,062, February 27, 2014, 9 pages.	
	33	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U. S. Patent Application No. 13/710,017, February 27, 2014, 11 pages.	
	34	Office Action in connection with Application No. 13/708,520 dated May 24, 2013, 7 pages.	
	35	Office Action in connection with Application No. 13/158,134 dated June 12, 2013, 15 pages.	
	36	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for U. S. Patent Application No. 13/708,838, March 14, 2014, 30 pages.	
	37	Office Action in connection with Application No. 13/709,983 dated June 7, 2013, 7 pages.	
	38	International Search Report dated June 14, 2013, International Application No. PCT/US2013/033352 filed March 21, 2013, 3 pages	
	39	INTERNATIONAL SEARCHING AUTHORITY, International Search Report and Written Opinion for PCT/ US2012/021729, August 31, 2012, 9 pages.	
	40	Office Action in connection with Application No. 13/710,017 dated June 11, 2013, 7 pages.	
	41	European Search Report and Search Opinion in connection with Europe Application 08747863.2 (European National Stage application of PCT/US2008/063084) dated April 2, 2013, 7 pages.	
	42	Office Action in connection with Chinese Application 200880023854.4 (Chinese National Stage application of PCT/ US2008/063084) dated August 28, 2012, 18 pages.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetremined
	Attorney Docket Number	AFPA-01039US4

	43	Office Action in connection with Japanese Application JP/2010-50766 (Japanese National Stage application of PCT/US2008/063084) dated December 3, 2012, 4 pages.
	44	Office Action in connection with Application No. 13/709,937 dated September 12, 2013, 7 pages.
	45	Office Action in connection with Application No. 12/769,586 dated December 13, 2012, 19 pages.
	46	Office Action in connection with Application No. 13/708,827 dated June 26, 2013, 22 pages.
	47	Office Action in connection with Application No. 13/708,838 dated June 24, 2013, 27 pages.
	48	PCT International Search Report in connection with PCT Application No. PCT/US2011/040062 dated February 17, 2012, 9 pages.
	49	Office Action in connection with Application No. 13/708,548 dated June 7, 2013, 5 pages.
	50	Office Action in connection with Application No. 13/115,811 dated March 28, 2013, 13 pages.

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature		Date Considered	

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

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetremined
	Attorney Docket Number	AFPA-01039US4

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Kent B. Chambers/	Date (YYYY-MM-DD)	2021-11-05
Name/Print	Kent B. Chambers	Registration Number	38839

This collection of information is required by 37 CFR 1.97 and 1.98. 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 1 hour to complete, including gathering, preparing and submitting the completed application 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.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt	
EFS ID:	44213184
Application Number:	17467032
International Application Number:	
Confirmation Number:	1075
Title of Invention:	System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes
First Named Inventor/Applicant Name:	Afshin Partovi
Customer Number:	33438
Filer:	Kent Bryan Chambers/Anita Chambers
Filer Authorized By:	Kent Bryan Chambers
Attorney Docket Number:	AFPA-01039US4
Receipt Date:	05-NOV-2021
Filing Date:	03-SEP-2021
Time Stamp:	11:35:52
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	AFPA-01039US4_IDS4_2021-11-05.pdf	1037253 3bd2e55fc6108eeca4c9aec17fd73f78b1e47c3e	no	8

Warnings:

Information:	
Total Files Size (in bytes):	1037253

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	17467032
Filing Date	2021-09-03
First Named Inventor	Afshin Partovi
Art Unit	2859
Examiner Name	Undetermined
Attorney Docket Number	AFPA-01039US4

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							

If you wish to add additional Foreign Patent Document citation information please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	1	PCT International Search Report in connection with PCT application No. PCT/US2007/61406, 8 pages, dated February 14, 2008.	
	2	PCT International Search Report in connection with PCT application No. PCT/US2008/63084, 8 pages, dated August 8, 2008.	
	3	Office Action in connection with Application No. 13/442,698 dated September 13, 2012, 6 pages.	
	4	Office Action in connection with Application No. 12/116,876 dated May 2, 2011, 5 pages.	
	5	Office Action in connection with Application No. 11/669,113 dated May 13, 2010, 20 pages.	
	6	Office Action in connection with Application No. 11/669,113 dated August 25, 2009, 17 pages.	
	7	Office Action in connection with Application No. 11/669,113 dated October 29, 2008, 11 pages.	
	8	Office Action in connection with Application No. 13/113,977 dated November 9, 2012, 9 pages.	
	9	International Search Report and Written Opinion of the International Searching Authority, Korean Intellectual Property Office, in re International Application No. PCT/US2010/032845 dated December 13, 2010, 10 pages.	
	10	WildCharge Life unplugged!. http://www.wildcharg.com/4/17/2009, 2 pages	
	11	Powermat "the Future of Wireless Power has Arrived", http://www.pwrmal.com,4/15/2009, 2 pages	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	12	eCoupled Wireless Power Technology Fulton Innovation, http://www.ecoupled.com, 4/15/2009, 5 pages	
	13	Qualcomm Products and Services -Wirelss Airlink Technologies, http://www.qualcomm.com/products_services/airlinks, 4/15/2009, 4 pages	
	14	Office Action in connection with Application No. 11/757,067 dated January 26, 2009, 14 pages.	
	15	Office Action in connection with Application No. 11/757,067 dated October 19, 2009, 14 pages.	
	16	Office Action in connection with Application No. 11/757,067 dated May 10, 2010, 15 pages.	

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature		Date Considered	

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

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Kent B. Chambers/	Date (YYYY-MM-DD)	2021-11-05
Name/Print	Kent B. Chambers	Registration Number	38839

This collection of information is required by 37 CFR 1.97 and 1.98. 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 1 hour to complete, including gathering, preparing and submitting the completed application 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.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt	
EFS ID:	44213161
Application Number:	17467032
International Application Number:	
Confirmation Number:	1075
Title of Invention:	System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes
First Named Inventor/Applicant Name:	Afshin Partovi
Customer Number:	33438
Filer:	Kent Bryan Chambers/Anita Chambers
Filer Authorized By:	Kent Bryan Chambers
Attorney Docket Number:	AFPA-01039US4
Receipt Date:	05-NOV-2021
Filing Date:	03-SEP-2021
Time Stamp:	11:34:16
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	AFPA-01039US4_IDS3_2021-11-05.pdf	1035206 84d2daf8b05465127dadbc6366b599970a3e8cdb	no	5

Warnings:

Information:	
A U.S. Patent Number Citation or a U.S. Publication Number Citation is required in the Information Disclosure Statement (IDS) form for autoloading of data into USPTO systems. You may remove the form to add the required data in order to correct the Informational Message if you are citing U.S. References. If you chose not to include U.S. References, the image of the form will be processed and be made available within the Image File Wrapper (IFW) system. However, no data will be extracted from this form. Any additional data such as Foreign Patent Documents or Non Patent Literature will be manually reviewed and keyed into USPTO systems.	
Total Files Size (in bytes):	1035206

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	17467032
Filing Date	2021-09-03
First Named Inventor	Afshin Partovi
Art Unit	2859
Examiner Name	Undetermined
Attorney Docket Number	AFPA-01039US4

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	4873677		1989-10-10	Sakamoto et al	
	2	5455466		1995-10-03	Parks et al	
	3	5600225		1997-02-04	Goto, Masataka	
	4	5734254		1998-03-31	Stephens, Charles S.	
	5	6118249		2000-09-12	Brockman, et al	
	6	6184651	B1	2001-02-06	Fernandez et al	
	7	6301128	B1	2001-10-19	Jang et al	
	8	6803744	B1	2014-10-12	Sabo, Anthony	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	9	6831544	B2	2004-12-14	Patel et al	
	10	7211986	B1	2007-05-01	Flowerdew et al	
	11	7248017	B2	2007-07-24	Cheng et al	
	12	7352567	B2	2008-04-01	Hotelling et al	
	13	7375493	B2	2008-05-20	Calhoon et al	
	14	7733215	B2	2010-06-08	Kozuma et al	
	15	8115448	B2	2012-02-14	John, Michael Sasha	
	16	8234509	B2	2012-07-31	Gioscia et al	
	17	8290463	B2	2012-10-16	Liu et al	
	18	8554165	B2	2013-10-08	Liu et al	
	19	9407327	B2	2016-08-02	Kirby et al	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	20	9793738	B2	2017-10-17	Jacobs et al	

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20040145342	A1	2004-07-29	Hewlett-Packard Company	
	2	20040150934	A1	2004-08-05	Baarman et al	
	3	20050068019	A1	2005-03-31	Nakamura et al	
	4	20050189910	A1	2005-09-01	Shu-yuen, Ron Hui	
	5	20080272889	A1	2008-11-06	Symons, Peter Robert	

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	2396901	EP	B1	2019-12-25	Kirby et al		

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

	2	200601557	WO	A1	2006-01-05	Hanrim Postech Co., Ltd.			

If you wish to add additional Foreign Patent Document citation information please click the Add button [Add]

NON-PATENT LITERATURE DOCUMENTS [Remove]

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1		

If you wish to add additional non-patent literature document citation information please click the Add button [Add]

EXAMINER SIGNATURE

Examiner Signature		Date Considered	

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

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17467032
	Filing Date	2021-09-03
	First Named Inventor	Afshin Partovi
	Art Unit	2859
	Examiner Name	Undetermined
	Attorney Docket Number	AFPA-01039US4

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Kent B. Chambers/	Date (YYYY-MM-DD)	2021-11-05
Name/Print	Kent B. Chambers	Registration Number	38839

This collection of information is required by 37 CFR 1.97 and 1.98. 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 1 hour to complete, including gathering, preparing and submitting the completed application 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.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 396 901 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
25.12.2019 Bulletin 2019/52

(21) Application number: **10707151.6**

(22) Date of filing: **12.02.2010**

(51) Int Cl.:
H04B 5/00 *(2006.01)*

(86) International application number:
PCT/US2010/024161

(87) International publication number:
WO 2010/093973 (19.08.2010 Gazette 2010/33)

(54) **WIRELESS POWER FOR CHARGEABLE AND CHARGING DEVICES**

DRAHTLOSE STROMVERSORGUNG FÜR AUFLADBARE UND LADEEINRICHTUNGEN

ALIMENTATION SANS FIL POUR DISPOSITIFS RECHARGEABLES ET DE CHARGEMENT

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR

(30) Priority: **28.01.2010 US 695911**
13.02.2009 US 152359 P

(43) Date of publication of application:
21.12.2011 Bulletin 2011/51

(73) Proprietor: **QUALCOMM Incorporated**
San Diego, CA 92121 (US)

(72) Inventors:
- **KIRBY, Miles, A.**
San Diego
CA 92121 (US)
- **GROB, Matthew, S.**
San Diego
CA 92121 (US)

(74) Representative: **Tomkins & Co**
5 Dartmouth Road
Dublin 6 (IE)

(56) References cited:
WO-A1-2008/125072
US-A1- 2005 181 823
US-A1- 2007 222 609
US-A1- 2007 274 373
US-A1- 2008 162 029
US-A1- 2008 238 621
US-A1- 2008 238 679
US-A1- 2009 033 280
US-A1- 2009 039 828

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

Printed by Jouve, 75001 PARIS (FR)

EP 2 396 901 B1

Description

BACKGROUND

Field

[0001] The present invention relates generally to wireless electronic devices, and more specifically to electronic devices configured for wireless communication, wireless charging, and enabling for an optimal charging scenario.

Background

[0002] Typically, each battery powered device requires its own charger and power source, which is usually an AC power outlet. This becomes unwieldy when many devices need charging.

[0003] Approaches are being developed that use over the air power transmission between a transmitter and the device to be charged. These generally fall into two categories. One is based on the coupling of plane wave radiation (also called far-field radiation) between a transmit antenna and receive antenna on the device to be charged which collects the radiated power and rectifies it for charging the battery. Antennas may be of resonant length in order to improve the coupling efficiency. This approach suffers from the fact that the power coupling falls off quickly with distance between the antennas. So charging over reasonable distances (e.g., >1-2m) becomes difficult. Additionally, since the system radiates plane waves, unintentional radiation can interfere with other systems if not properly controlled through filtering.

[0004] Other approaches are based on inductive coupling between a transmit antenna embedded, for example, in a "charging" mat or surface and a receive antenna plus rectifying circuit embedded in the host device to be charged. This approach has the disadvantage that the spacing between transmit and receive antennas must be very close (e.g. mms). Though this approach may have the capability to simultaneously charge multiple devices in the same area, this area is typically small, hence the user must locate the devices to a specific area.

[0005] WO2008125072 (A1) discloses a data transmission system comprises a plurality of noncontacting mobile radio participants, the mobile radio participants each comprising an electromagnetic radio wave-based (FW) HF transmitter/receiver unit at least for transmitting an individual identification code (IDT). The data transmission system comprises a plurality of inductive charging stations, each having a magnetic charging station antenna for emitting an alternating magnetic field (MAG). The mobile radio participants are each provided with a magnetic radio participant antenna for decoupling electrical energy from the alternating magnetic field (MAG) of each charging station at least for supplying the HF transmitter/receiver unit of the mobile radio participant,

[0006] US 2009/0039828 A1 discloses a wireless charger wherein a user can select different charging protocols.

[0007] A need exists for wireless power devices configured for detecting other wireless power devices and determining optimal charging solutions. More specifically, a need exists for a chargeable device configured to detect one or more wireless chargers and, thereafter, determine an optimal charging solution for receiving a charge. Further, a need exists for a wireless charger configured to detect one or more chargeable devices and, thereafter, determine an optimal charging solution for charging at least one of the one or more detected chargeable devices.

Summary of the invention

[0008] The invention is defined by the independent claims. Preferred embodiments of the invention are described in the dependent claims. While several embodiments and/or examples have been disclosed in this description, the subject matter for which protection is sought is strictly and solely limited to those embodiments and/or examples encompassed by the scope of the appended claims. Embodiments and/ or examples mentioned in the description that do not fall under the scope of the claims are useful for understanding the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

FIG. 1 shows a simplified block diagram of a wireless power transfer system.

FIG. 2 shows a simplified schematic diagram of a wireless power transfer system.

FIG. 3 shows a schematic diagram of a loop antenna for use in exemplary embodiments of the present invention.

FIG. 4 is a simplified block diagram of a transmitter, in accordance with an exemplary embodiment of the present invention.

FIG. 5 is a simplified block diagram of a receiver, in accordance with an exemplary embodiment of the present invention.

FIG. 6 shows a simplified schematic of a portion of transmit circuitry for carrying out messaging between a transmitter and a receiver.

FIG. 7 illustrates a chargeable device, in accordance with an exemplary embodiment of the present invention.

FIG. 8 illustrates another chargeable device, according to an exemplary embodiment of the present invention.

FIG. 9 illustrates a system including a wireless charger and a chargeable device, according to an exemplary embodiment of the present invention.

FIG. 10 illustrates a system including a plurality of wireless chargers and a chargeable device, in ac-

cordance with an exemplary embodiment of the present invention.

FIG. 11 illustrates a chargeable device having a plurality of receive antennas, according to an exemplary embodiment of the present invention.

FIG. 12 illustrates a system including a plurality of wireless chargers and a chargeable device having a plurality of receive antennas, according to an exemplary embodiment of the present invention.

FIG. 13 is a flowchart illustrating a method, according to an exemplary embodiment of the present invention.

FIG. 14 illustrates a wireless charger, according to an exemplary embodiment of the present invention.

FIG. 15 illustrates a system including a wireless charger and a plurality of chargeable devices, according to an exemplary embodiment of the present invention.

FIG. 16 illustrates another system including a wireless charger and a plurality of chargeable devices, in accordance with an exemplary embodiment of the present invention.

FIG. 17 is a flowchart illustrating another method, according to an exemplary embodiment of the present invention.

DETAILED DESCRIPTION

[0010] The word "exemplary" is used herein to mean "serving as an example, instance, or illustration." Any embodiment described herein as "exemplary" is not necessarily to be construed as preferred or advantageous over other embodiments.

[0011] The detailed description set forth below in connection with the appended drawings is intended as a description of exemplary embodiments of the present invention and is not intended to represent the only embodiments in which the present invention can be practiced. The term "exemplary" used throughout this description means "serving as an example, instance, or illustration," and should not necessarily be construed as preferred or advantageous over other exemplary embodiments. The detailed description includes specific details for the purpose of providing a thorough understanding of the exemplary embodiments of the invention. It will be apparent to those skilled in the art that the exemplary embodiments of the invention may be practiced without these specific details. In some instances, well-known structures and devices are shown in block diagram form in order to avoid obscuring the novelty of the exemplary embodiments presented herein.

[0012] The words "wireless power" is used herein to mean any form of energy associated with electric fields, magnetic fields, electromagnetic fields, or otherwise that is transmitted between from a transmitter to a receiver without the use of physical electromagnetic conductors.

[0013] FIG. 1 illustrates a wireless transmission or charging system 100, in accordance with various exemplary embodiments of the present invention. Input power 102 is provided to a transmitter 104 for generating a radiated field 106 for providing energy transfer. A receiver 108 couples to the radiated field 106 and generates an output power 110 for storing or consumption by a device (not shown) coupled to the output power 110. Both the transmitter 104 and the receiver 108 are separated by a distance 112. In one exemplary embodiment, transmitter 104 and receiver 108 are configured according to a mutual resonant relationship and when the resonant frequency of receiver 108 and the resonant frequency of transmitter 104 are very close, transmission losses between the transmitter 104 and the receiver 108 are minimal when the receiver 108 is located in the "near-field" of the radiated field 106.

[0014] Transmitter 104 further includes a transmit antenna 114 for providing a means for energy transmission and receiver 108 further includes a receive antenna 118 for providing a means for energy reception. The transmit and receive antennas are sized according to applications and devices to be associated therewith. As stated, an efficient energy transfer occurs by coupling a large portion of the energy in the near-field of the transmitting antenna to a receiving antenna rather than propagating most of the energy in an electromagnetic wave to the far field. When in this near-field a coupling mode may be developed between the transmit antenna 114 and the receive antenna 118. The area around the antennas 114 and 118 where this near-field coupling may occur is referred to herein as a coupling-mode region.

[0015] FIG. 2 shows a simplified schematic diagram of a wireless power transfer system. The transmitter 104 includes an oscillator 122, a power amplifier 124 and a filter and matching circuit 126. The oscillator is configured to generate a signal at a desired frequency, which may be adjusted in response to adjustment signal 123. The oscillator signal may be amplified by the power amplifier 124 with an amplification amount responsive to control signal 125. The filter and matching circuit 126 may be included to filter out harmonics or other unwanted frequencies and match the impedance of the transmitter 104 to the transmit antenna 114.

[0016] The receiver 108 may include a matching circuit 132 and a rectifier and switching circuit 134 to generate a DC power output to charge a battery 136 as shown in FIG. 2 or power a device coupled to the receiver (not shown). The matching circuit 132 may be included to match the impedance of the receiver 108 to the receive antenna 118. The receiver 108 and transmitter 104 may communicate on a separate communication channel 119 *(e.g.,* Bluetooth, zigbee, cellular, *etc*).

[0017] As illustrated in FIG. 3, antennas used in exemplary embodiments may be configured as a "loop" antenna 150, which may also be referred to herein as a "magnetic" antenna. Loop antennas may be configured to include an air core or a physical core such as a ferrite core. Air core loop antennas may be more tolerable to extraneous physical devices placed in the vicinity of the core.

Furthermore, an air core loop antenna allows the placement of other components within the core area. In addition, an air core loop may more readily enable placement of the receive antenna 118 (FIG. 2) within a plane of the transmit antenna 114 (FIG. 2) where the coupled-mode region of the transmit antenna 114 (FIG. 2) may be more powerful.

[0018] As stated, efficient transfer of energy between the transmitter 104 and receiver 108 occurs during matched or nearly matched resonance between the transmitter 104 and the receiver 108. However, even when resonance between the transmitter 104 and receiver 108 are not matched, energy may be transferred at a lower efficiency. Transfer of energy occurs by coupling energy from the near-field of the transmitting antenna to the receiving antenna residing in the neighborhood where this near-field is established rather than propagating the energy from the transmitting antenna into free space.

[0019] The resonant frequency of the loop or magnetic antennas is based on the inductance and capacitance. Inductance in a loop antenna is generally simply the inductance created by the loop, whereas, capacitance is generally added to the loop antenna's inductance to create a resonant structure at a desired resonant frequency. As a non-limiting example, capacitor 152 and capacitor 154 may be added to the antenna to create a resonant circuit that generates resonant signal 156. Accordingly, for larger diameter loop antennas, the size of capacitance needed to induce resonance decreases as the diameter or inductance of the loop increases. Furthermore, as the diameter of the loop or magnetic antenna increases, the efficient energy transfer area of the near-field increases. Of course, other resonant circuits are possible. As another non-limiting example, a capacitor may be placed in parallel between the two terminals of the loop antenna. In addition, those of ordinary skill in the art will recognize that for transmit antennas the resonant signal 156 may be an input to the loop antenna 150.

[0020] Exemplary embodiments of the invention include coupling power between two antennas that are in the near-fields of each other. As stated, the near-field is an area around the antenna in which electromagnetic fields exist but may not propagate or radiate away from the antenna. They are typically confined to a volume that is near the physical volume of the antenna. In the exemplary embodiments of the invention, magnetic type antennas such as single and multi-turn loop antennas are used for both transmit (Tx) and receive (Rx) antenna systems since magnetic near-field amplitudes tend to be higher for magnetic type antennas in comparison to the electric near-fields of an electric-type antenna (*e.g.*, a small dipole). This allows for potentially higher coupling between the pair. Furthermore, "electric" antennas (*e.g.*, dipoles and monopoles) or a combination of magnetic and electric antennas is also contemplated.

[0021] The Tx antenna can be operated at a frequency that is low enough and with an antenna size that is large enough to achieve good coupling (*e.g.*, >-4 dB) to a small Rx antenna at significantly larger distances than allowed by far field and inductive approaches mentioned earlier. If the Tx antenna is sized correctly, high coupling levels *(e.g.,* -2 to -4 dB) can be achieved when the Rx antenna on a host device is placed within a coupling-mode region *(i.e.,* in the near-field) of the driven Tx loop antenna.

[0022] FIG. 4 is a simplified block diagram of a transmitter 200, in accordance with an exemplary embodiment of the present invention. The transmitter 200 includes transmit circuitry 202 and a transmit antenna 204. Generally, transmit circuitry 202 provides RF power to the transmit antenna 204 by providing an oscillating signal resulting in generation of near-field energy about the transmit antenna 204. By way of example, transmitter 200 may operate at the 13.56 MHz ISM band.

[0023] Exemplary transmit circuitry 202 includes a fixed impedance matching circuit 206 for matching the impedance of the transmit circuitry 202 *(e.g.,* 50 ohms) to the transmit antenna 204 and a low pass filter (LPF) 208 configured to reduce harmonic emissions to levels to prevent self-jamming of devices coupled to receivers 108 (FIG. 1). Other exemplary embodiments may include different filter topologies, including but not limited to, notch filters that attenuate specific frequencies while passing others and may include an adaptive impedance match, that can be varied based on measurable transmit metrics, such as output power to the antenna or DC current draw by the power amplifier. Transmit circuitry 202 further includes a power amplifier 210 configured to drive an RF signal as determined by an oscillator 212. The transmit circuitry may be comprised of discrete devices or circuits, or alternately, may be comprised of an integrated assembly. An exemplary RF power output from transmit antenna 204 may be on the order of 2.5 Watts.

[0024] Transmit circuitry 202 further includes a controller 214 for enabling the oscillator 212 during transmit phases (or duty cycles) for specific receivers, for adjusting the frequency of the oscillator, and for adjusting the output power level for implementing a communication protocol for interacting with neighboring devices through their attached receivers.

[0025] The transmit circuitry 202 may further include a load sensing circuit 216 for detecting the presence or absence of active receivers in the vicinity of the near-field generated by transmit antenna 204. By way of example, a load sensing circuit 216 monitors the current flowing to the power amplifier 210, which is affected by the presence or absence of active receivers in the vicinity of the near-field generated by transmit antenna 204. Detection of changes to the loading on the power amplifier 210 are monitored by controller 214 for use in determining whether to enable the oscillator 212 for transmitting energy to communicate with an active receiver.

[0026] Transmit antenna 204 may be implemented as an antenna strip with the thickness, width and metal type selected to keep resistive losses low. In a conventional implementation, the transmit antenna 204 can generally

be configured for association with a larger structure such as a table, mat, lamp or other less portable configuration. Accordingly, the transmit antenna 204 generally will not need "turns" in order to be of a practical dimension. An exemplary implementation of a transmit antenna 204 may be "electrically small" *(i.e.,* fraction of the wavelength) and tuned to resonate at lower usable frequencies by using capacitors to define the resonant frequency. In an exemplary application where the transmit antenna 204 may be larger in diameter, or length of side if a square loop, *(e.g.,* 0.50 meters) relative to the receive antenna, the transmit antenna 204 will not necessarily need a large number of turns to obtain a reasonable capacitance.

[0027] The transmitter 200 may gather and track information about the whereabouts and status of receiver devices that may be associated with the transmitter 200. Thus, the transmitter circuitry 202 may include a presence detector 280, an enclosed detector 290, or a combination thereof, connected to the controller 214 (also referred to as a processor herein). The controller 214 may adjust an amount of power delivered by the amplifier 210 in response to presence signals from the presence detector 280 and the enclosed detector 290. The transmitter may receive power through a number of power sources, such as, for example, an AC-DC converter (not shown) to convert conventional AC power present in a building, a DC-DC converter (not shown) to convert a conventional DC power source to a voltage suitable for the transmitter 200, or directly from a conventional DC power source (not shown).

[0028] As a non-limiting example, the presence detector 280 may be a motion detector utilized to sense the initial presence of a device to be charged that is inserted into the coverage area of the transmitter. After detection, the transmitter may be turned on and the RF power received by the device may be used to toggle a switch on the Rx device in a pre-determined manner, which in turn results in changes to the driving point impedance of the transmitter.

[0029] As another non-limiting example, the presence detector 280 may be a detector capable of detecting a human, for example, by infrared detection, motion detection, or other suitable means. In some exemplary embodiments, there may be regulations limiting the amount of power that a transmit antenna may transmit at a specific frequency. In some cases, these regulations are meant to protect humans from electromagnetic radiation. However, there may be environments where transmit antennas are placed in areas not occupied by humans, or occupied infrequently by humans, such as, for example, garages, factory floors, shops, and the like. If these environments are free from humans, it may be permissible to increase the power output of the transmit antennas above the normal power restrictions regulations. In other words, the controller 214 may adjust the power output of the transmit antenna 204 to a regulatory level or lower in response to human presence and adjust the power output of the transmit antenna 204 to a level above the regulatory level when a human is outside a regulatory distance from the electromagnetic field of the transmit antenna 204.

[0030] As a non-limiting example, the enclosed detector 290 (may also be referred to herein as an enclosed compartment detector or an enclosed space detector) may be a device such as a sense switch for determining when an enclosure is in a closed or open state. When a transmitter is in an enclosure that is in an enclosed state, a power level of the transmitter may be increased.

[0031] In exemplary embodiments, a method by which the transmitter 200 does not remain on indefinitely may be used. In this case, the transmitter 200 may be programmed to shut off after a user-determined amount of time. This feature prevents the transmitter 200, notably the power amplifier 210, from running long after the wireless devices in its perimeter are fully charged. This event may be due to the failure of the circuit to detect the signal sent from either the repeater or the receive coil that a device is fully charged. To prevent the transmitter 200 from automatically shutting down if another device is placed in its perimeter, the transmitter 200 automatic shut off feature may be activated only after a set period of lack of motion detected in its perimeter. The user may be able to determine the inactivity time interval, and change it as desired. As a non-limiting example, the time interval may be longer than that needed to fully charge a specific type of wireless device under the assumption of the device being initially fully discharged.

[0032] FIG. 5 is a simplified block diagram of a receiver 300, in accordance with an exemplary embodiment of the present invention. The receiver 300 includes receive circuitry 302 and a receive antenna 304. Receiver 300 further couples to device 350 for providing received power thereto. It should be noted that receiver 300 is illustrated as being external to device 350 but may be integrated into device 350. Generally, energy is propagated wirelessly to receive antenna 304 and then coupled through receive circuitry 302 to device 350.

[0033] Receive antenna 304 is tuned to resonate at the same frequency, or near the same frequency, as transmit antenna 204 (FIG. 4). Receive antenna 304 may be similarly dimensioned with transmit antenna 204 or may be differently sized based upon the dimensions of the associated device 350. By way of example, device 350 may be a portable electronic device having diametric or length dimension smaller that the diameter of length of transmit antenna 204. In such an example, receive antenna 304 may be implemented as a multi-turn antenna in order to reduce the capacitance value of a tuning capacitor (not shown) and increase the receive antenna's impedance. By way of example, receive antenna 304 may be placed around the substantial circumference of device 350 in order to maximize the antenna diameter and reduce the number of loop turns (*i.e.*, windings) of the receive antenna and the inter-winding capacitance.

[0034] Receive circuitry 302 provides an impedance match to the receive antenna 304. Receive circuitry 302

includes power conversion circuitry 306 for converting a received RF energy source into charging power for use by device 350. Power conversion circuitry 306 includes an RF-to-DC converter 308 and may also in include a DC-to-DC converter 310. RF-to-DC converter 308 rectifies the RF energy signal received at receive antenna 304 into a non-alternating power while DC-to-DC converter 310 converts the rectified RF energy signal into an energy potential (*e.g.*, voltage) that is compatible with device 350. Various RF-to-DC converters are contemplated, including partial and full rectifiers, regulators, bridges, doublers, as well as linear and switching converters.

[0035] Receive circuitry 302 may further include switching circuitry 312 for connecting receive antenna 304 to the power conversion circuitry 306 or alternatively for disconnecting the power conversion circuitry 306. Disconnecting receive antenna 304 from power conversion circuitry 306 not only suspends charging of device 350, but also changes the "load" as "seen" by the transmitter 200 (FIG. 2).

[0036] As disclosed above, transmitter 200 includes load sensing circuit 216 which detects fluctuations in the bias current provided to transmitter power amplifier 210. Accordingly, transmitter 200 has a mechanism for determining when receivers are present in the transmitter's near-field.

[0037] When multiple receivers 300 are present in a transmitter's near-field, it may be desirable to time-multiplex the loading and unloading of one or more receivers to enable other receivers to more efficiently couple to the transmitter. This "unloading" of a receiver is also known herein as a "cloaking." A receiver may also be cloaked in order to eliminate coupling to other nearby receivers or to reduce loading on nearby transmitters. Furthermore, this switching between unloading and loading as controlled by receiver 300 and detected by transmitter 200 provides a communication mechanism from receiver 300 to transmitter 200 as is explained more fully below. Additionally, a protocol can be associated with the switching which enables the sending of a message from receiver 300 to transmitter 200. By way of example, a switching speed may be on the order of 100 μsec.

[0038] In an exemplary embodiment, communication between the transmitter and the receiver refers to a device sensing and charging control mechanism, rather than conventional two-way communication. In other words, the transmitter uses, for example, on/off keying of the transmitted signal to adjust whether energy is available in the near-filed. The receivers interpret these changes in energy as a message from the transmitter. From the receiver side, the receiver uses tuning and detuning of the receive antenna to adjust how much power is being accepted from the near-field. The transmitter can detect this difference in power used from the near-field and interpret these changes as signal forming a message from the receiver.

[0039] Receive circuitry 302 may further include signaling detector and beacon circuitry 314 used to identify received energy fluctuations, which may correspond to informational signaling from the transmitter to the receiver. Furthermore, signaling and beacon circuitry 314 may also be used to detect the transmission of a reduced RF signal energy (*i.e.,* a beacon signal) and to rectify the reduced RF signal energy into a nominal power for awakening either un-powered or power-depleted circuits within receive circuitry 302 in order to configure receive circuitry 302 for wireless charging.

[0040] Receive circuitry 302 further includes processor 316 for coordinating the processes of receiver 300 described herein including the control of switching circuitry 312 described herein. Cloaking of receiver 300 may also occur upon the occurrence of other events including detection of an external wired charging source (*e.g.*, wall/USB power) providing charging power to device 350. Processor 316, in addition to controlling the cloaking of the receiver, may also monitor beacon circuitry 314 to determine a beacon state and extract messages sent from the transmitter. Processor 316 may also adjust DC-to-DC converter 310 for improved performance.

[0041] FIG. 6 shows a simplified schematic of a portion of transmit circuitry for carrying out messaging between a transmitter and a receiver. In some exemplary embodiments of the present invention, a means for communication may be enabled between the transmitter and the receiver. In FIG. 6 a power amplifier 210 drives the transmit antenna 204 to generate the radiated field. The power amplifier is driven by a carrier signal 220 that is oscillating at a desired frequency for the transmit antenna 204. A transmit modulation signal 224 is used to control the output of the power amplifier 210.

[0042] The transmit circuitry can send signals to receivers by using an ON/OFF keying process on the power amplifier 210. In other words, when the transmit modulation signal 224 is asserted, the power amplifier 210 will drive the frequency of the carrier signal 220 out on the transmit antenna 204. When the transmit modulation signal 224 is deactivated, the power amplifier will not drive any signal on the transmit antenna 204.

[0043] The transmit circuitry of FIG. 6 also includes a load sensing circuit 216 that supplies power to the power amplifier 210 and generates a receive signal 235. In the load sensing circuit 216, a voltage drop across resistor R_s develops between the power in signal 226 and the power supply 228 to the power amplifier 210. Any change in the power consumed by the power amplifier 210 will cause a change in the voltage drop that will be amplified by differential amplifier 230. When the transmit antenna is in coupled mode with a receive antenna in a receiver (not shown in FIG. 6) the amount of current drawn by the power amplifier 210 will change. In other words, if no coupled mode resonance exist for the transmit antenna 204, the power required to drive the radiated field will be a first amount. If a coupled mode resonance exists, the amount of power consumed by the power amplifier 210 will go up because much of the power is being coupled

into the receive antenna. Thus, the receive signal 235 can indicate the presence of a receive antenna coupled to the transmit antenna 235 and can also detect signals sent from the receive antenna. Additionally, a change in receiver current draw will be observable in the transmitter's power amplifier current draw, and this change can be used to detect signals from the receive antennas.

[0044] Details of some exemplary embodiments for cloaking signals, beacon signals, and circuits for generating these signals can be seen in U.S. Utility Patent Application 12/249,873, entitled "REVERSE LINK SIGNALING VIA RECEIVE ANTENNA IMPEDANCE MODULATION" filed on October 10, 2008; and in U.S. Utility Patent Application 12/249,861, entitled "TRANSMIT POWER CONTROL FOR A WIRELESS CHARGING SYSTEM" filed on October 10, 2008.

[0045] Details of exemplary communication mechanisms and protocols can be seen in U.S. Utility Patent Application 12/249,866 entitled "SIGNALING CHARGING IN WIRELESS POWER ENVIRONMENT" filed on October 10, 2008.

[0046] FIG. 7 depicts a chargeable device 700 that may comprise any known and suitable chargeable device. As non-limiting examples, chargeable device 700 may comprise a cellular telephone, a portable media player, a camera, a gaming device, a navigation device, a headset (*e.g.*, a Bluetooth headset), a tool, a toy, or any combination thereof. Chargeable device 700 may include at least one receive antenna 702, at least one coil 705, or any combination thereof. Each of receive antenna 702 and coil 705 may be configured to receive power wirelessly transmitted from a suitable wireless power source. More specifically, according to one exemplary embodiment, antenna 702 and an associated receiver, such as receiver 108 of FIG. 2, may be configured to receive wireless power transmitted from a wireless power source within an associated near-field region. Further, according to another exemplary embodiment, coil 705 and an associated receiver, such as receiver 108 of FIG. 2, may be configured to receive wireless power transmitted from a wireless power source via inductive coupling. Additionally, chargeable device 700 may be configured to store received power within a battery (*e.g.*, battery 136 of FIG. 2) of chargeable device 700. It is noted that the terms "receive antenna" and "coil" may each be referred to herein as a "receive element."

[0047] Furthermore, in accordance with various exemplary embodiments, chargeable device 700 may be configured to detect one or more wireless chargers, which are positioned within a charging region of chargeable device 700 and include one or more wireless transmit elements (*e.g.*, a wireless transmit antenna or a coil). More specifically, chargeable device 700 may be configured to detect one or more wireless chargers according to one or more specific protocols and/or one or more specific frequencies. For example only, chargeable device 700 may be configured to detect one or more wireless chargers by sampling for wireless chargers operating with one or more specific wireless charging protocols, sampling for wireless chargers resonating at one more specific frequencies, or both. As described more fully below, upon detection of a wireless charger, chargeable device 700 may be configured to determine an amount of power received from the detected wireless charger, including at each frequency and with each protocol that the detected wireless charger is configured to transmit.

[0048] According to one exemplary embodiment, chargeable device 700 may be configured to detect a wireless charger, which is positioned within a near-field region of chargeable device 700 and is configured to wirelessly transmit power at one or more suitable frequencies (*e.g.*, unlicensed ISM bands) via a near-field resonance protocol. It is noted that various frequencies may be suitable for wireless power transmission in one location (*e.g.*, a first country) but not suitable in another location (*e.g.*, a second country). As such, according to one exemplary embodiment, chargeable device 700 may be configured to determine its location via a location device 701, and, thereafter, determine which one or more frequencies are suitable for wireless power transmission. For example only, location device 701 may comprise a Global Positioning System (GPS) device. By way of example only, chargeable device 700 may be configured to detect a wireless charger positioned within an associated near-field region and configured to transmit wireless power, via near-field resonance, at one or more of 6.78 MHz, 13.56 MHz, 27.12, and 40.68 MHz. Further, according to one exemplary embodiment, chargeable device 700 may be configured to detect a wireless charger positioned within an associated charging region and configured to convey wireless power via an inductive coupling protocol.

[0049] Moreover, chargeable device 700 may be configured to establish a communication link with a detected wireless charger and, upon establishing the communication link, may wirelessly receive data (*e.g.*, audio files, data files, or video files) from the detected wireless charger, wirelessly transmit data to the detected wireless charger, or both. It is noted that chargeable device 700 may be configured to detect and receive wireless power from multiple versions of wireless chargers. It is noted further that chargeable device 700 may be configured to identify a version of a detected wireless charger and, as a result, may receive wireless power from and communicate with the detected wireless charger accordingly. Additionally, upon establishing the communication link, chargeable device 700 may be configured to control an operation of a detected wireless charger (*e.g.*, transmission of power, synchronization of data, displaying media, or any user-interface functionality).

[0050] Upon detection of one or more wireless chargers, chargeable device 700 may be further configured to select at least one of the detected one or more wireless charging to receive power therefrom for optimizing an amount of power received by chargeable device 700. A method of optimizing an amount of power received by

chargeable device 700 may be based on at least one of one or more charging protocols of each detected wireless charger, one or more charging frequencies of each detected wireless charger, a position of each detected wireless charger relative to chargeable device 700, and a version of each detected wireless charger. It is noted that relatively small chargeable devices *(e.g.,* a Bluetooth headset) may charge more efficiently at a higher frequency *(e.g.,* 40.68 MHz) in comparison to a lower frequency (6.78 MHz). On the other hand, relatively large chargeable devices (*e.g.*, a camera) may charge more efficiently at a lower frequency (*e.g.*, 6.78 MHz) in comparison to a higher frequency (40.68 MHz).

[0051] FIG. 8 illustrates a chargeable device 700A, which is similar to chargeable device 700 of FIG. 7 and, therefore, will not be explained again. However, in FIG. 8, chargeable device 700A does not include a coil and only includes one receive antenna 702. It is noted that in an embodiment wherein chargeable device 700A includes a single receive element *(i.e.,* receive antenna 702), chargeable device 700A may be configured to receive wireless power from only one wireless transmit element at any one time. Accordingly, in this exemplary embodiment, chargeable device 700A may be configured to determine which detected wireless charger may enable for optimal charging. Stated another way, chargeable device 700A may be configured to determine which detected wireless charger and, more specifically, which transmit element of the one or more detected wireless chargers may enable for maximum efficiency, maximum charging rate, minimum interference, or any combination thereof. Further, according to another exemplary embodiment, chargeable device 700A may be configured to determine which plurality of transmit elements of the one or more detected wireless chargers, utilizing a time domain multiplexing method based upon allocated activation time slots for each selected transmit element, may enable for maximum efficiency, maximum charging rate, minimum interference, or any combination thereof.

[0052] FIG. 9 illustrates a system 730 including chargeable device 700A and a wireless charger 732. Wireless charger 732 includes a first transmit antenna 734 configured to transmit wireless power at a frequency of, for example only, 13.56 MHz. Further, wireless charger 732 includes a second transmit antenna 736 configured to transmit wireless power at a frequency of, for example only, 6.78 MHz. According to one contemplated operation of system 730, chargeable device 700 may detect wireless charger 732, which is positioned within an associated charging region and operating with one or more specific protocols (*e.g.*, near-field resonance) and/or resonating at one or more specific frequencies (*e.g.*, 6.78 MHz and 13.56 MHz). Further, upon detection of wireless charger 732, a communication link 733 between chargeable device 700A and wireless charger 732 may be established. Moreover, after wireless charger 732 has been detected, an optimal scenario for charging chargeable device 700A with wireless charger 732 may be determined.

[0053] According to one exemplary embodiment, determining an optimal charging scenario may include determining which single protocol *(i.e.,* either near-field resonance via transmit antenna 734 or near-field resonance via transmit antenna 736) enables for optimal charging (*e.g.*, maximum efficiency, maximum charging rate, minimum interference, or any combination thereof) of chargeable device 700A. As an example, chargeable device 700A, wireless charger 732, or a combination thereof, may determine that transmit antenna 736 enables for optimal charging of chargeable device 700A. As a more specific example, chargeable device 700A may receive wireless power from transmit antenna 734 at a first frequency (*e.g.*, 13.56 MHz.), determine an amount of power received from transmit antenna 734 and, thereafter, provide this information to wireless charger 732. Further, chargeable device 700A may receive wireless power from transmit antenna 736 at a second frequency (*e.g.*, 6.78 MHz.), determine an amount of power received from transmit antenna 736 and, thereafter, provide this information to wireless charger 732. Wireless charger 732 may then inform chargeable device 700A, via communication link 733, which protocol *(i.e.,* either near-field resonance via transmit antenna 734 or near-field resonance via transmit antenna 736) facilitates optimal charging by wireless charger 732. After determining which transmit element facilitates optimal charging, chargeable device 700A, wireless charger 732, or a combination thereof, may select the transmit element, and wireless power may be transmitted to chargeable device 700A.

[0054] It is noted that upon receiving information from chargeable device 700A relating to an amount of power received from a specific transmit element (*e.g.*, transmit antenna 734 or transmit antenna 736), wireless charger 732 may be configured to increase or decrease an amount of power transmitted from the specific transmit element. It is further noted that depending on the type of device *(i.e.,* whether chargeable device 700A is, for example only, a mobile telephone, a media player, or a Bluetooth headset) and/or a type of battery within chargeable device 700A, wireless charger 732 may be configured to increase or decrease an amount of power transmitted from a specific transmit element.

[0055] According to another exemplary embodiment, determining an optimal charging scenario may include determining which plurality of transmit elements, utilizing a time domain multiplexing method, may provide for optimal charging. As an example, chargeable device 700A, wireless charger 732, or a combination thereof, may determine that transmit antenna 734 may be time multiplexed with transmit antenna 736 to enable for optimized charging of chargeable device 700A.

[0056] FIG. 10 illustrates another system 750 including chargeable device 700. System 750 further includes a first wireless charger 752, a second wireless charger 754, and a third wireless charger 756, each of which is positioned within an associated charging region of chargea-

ble device 700. As illustrated in FIG. 10, first wireless charger 752 includes a transmit antenna 760 and may be configured to transmit wireless power at a frequency of, for example only, 40.68 MHz. Further, second wireless charger 754 includes a first transmit antenna 762 configured to transmit wireless power at a frequency of, for example only, 27.12 MHz., and a second transmit antenna 764 configured to transmit wireless power at a frequency of, for example only, 6.78 MHz. Moreover, third wireless charger 756 includes a transmit antenna 766 configured to transmit wireless power at a frequency of, for example only, 13.56 MHz. Third wireless charger 756 further includes a coil 768 configured to transmit power, via inductive coupling, to a coil *(e.g.,* coil 705) adequately aligned therewith.

[0057] According to one contemplated operation of system 750, chargeable device 700 may detect one or more wireless chargers positioned within an associated charging region and operating with one or more specific protocols (*e.g.*, near-field resonance and/or inductive coupling) and/or resonating at one or more specific frequencies (*e.g.*, unlicensed ISM bands). Accordingly, chargeable device 700 may detect each of first wireless charger 752, second wireless charger 754, and third wireless charger 756. Moreover, upon detection, respective communication links 735, 737, and 739 may be established between chargeable device 700 and first wireless charger 752, second wireless charger 754, and third wireless charger 756.

[0058] Furthermore, upon detection of first wireless charger 752, second wireless charger 754, and third wireless charger 756, an optimal charging scenario for charging chargeable device 700 may be determined. Determining an optimal charging scenario may include, as noted above, determining an optimal charging scenario for one or more detected wireless chargers that may include one or more protocols and/or are configured to transmit wireless power at one or more frequencies. Furthermore, determining an optimal charging scenario may include determining which plurality of transmit elements within one or more detected wireless chargers, utilizing a time domain multiplexing method, may provide for optimal charging. For example, according to one exemplary embodiment, chargeable device 700 may be configured to sequentially receive wireless power from each individual transmit element within system 750. Further, after receiving wireless power from each individual transmit element within system 750, chargeable device 700 may be configured to determine which one or more transmit elements enable for optimal charging.

[0059] More specifically, for example, receive antenna 702 may be configured to receive wireless power from transmit antenna 760, via near-field resonance, at a frequency (*e.g.*, 40.68 MHz.), and an amount of power received from transmit antenna 760 may be determined by chargeable device 700. In addition, receive antenna 702 may be configured to receive wireless power from transmit antenna 762, via near-field resonance, at a frequency (*e.g.*, 27.12 MHz.), and chargeable device 700 may determine an amount of power received from transmit antenna 762. Further, receive antenna 702 may be configured to receive wireless from power transmit antenna 764, via near-field resonance, at a frequency (*e.g.*, 6.78 MHz.), and an amount of power received from transmit antenna 764 may be determined by chargeable device 700. Moreover, transmit antenna 700 may be configured to receive wireless power from transmit antenna 766, via near-field resonance, at a frequency (*e.g.*, 6.78 MHz.), and an amount of power received from transmit antenna 766 may be determined by chargeable device 700. Furthermore, coil 705 may be configured to receive wireless power, via inductive coupling, from coil 768 of wireless charger 756 and chargeable device 700 may determine an amount of received from coil 768. Thereafter, chargeable device 700 may determine which one or more transmit elements enable for maximum efficiency, maximum charging rate, minimum interference, or any combination thereof. Accordingly, as an example, chargeable device 700 may determine that wireless charger transmit antenna 762 of wireless charger 754 and coil 768 of wireless charger 756 enable for optimal charging. After determining which one or more transmit elements enable for an optimal charging scenario, chargeable device 700 may select the one or more transmit elements and wireless power may be transmitted to chargeable device 700A accordingly.

[0060] Furthermore, as noted above, a time domain multiplexing method may be utilized to provide for optimal charging. As such, chargeable device 700 may be configured to determine an optimal charging scenario by utilizing a time domain multiplexing method based upon allocated activation time slots for two or more transmit elements. Accordingly, as an example, chargeable device 700 may determine that, in addition to receiving wireless power from coil 768, transmit antenna 760 of wireless charger 752 may be time multiplexed with transmit antenna 766 of wireless charger 756 to enable for optimized charging.

[0061] FIG. 11 depicts a chargeable device 700B, which is similar to chargeable device 700 of FIG. 7 and, therefore, will not be explained again. However, in FIG. 11, chargeable device 700B includes a plurality of receive antennas 702. Although chargeable device 700B is depicted as having only two receive antennas 702, chargeable device 700B may include any number of receive antennas 702. Similarly to chargeable device 700, chargeable device 700B may be configured to detect one or more wireless chargers positioned within an associated charging region and including one or more transmit elements. Furthermore, upon detection of one or more wireless chargers, chargeable device 700B may be configured to optimize an amount of power received from the one or more wireless chargers and, more specifically, the one or more transmit elements. It is noted that in an embodiment wherein chargeable device 700B includes multiple receive antennas, chargeable device 700B may

be configured to receive wireless power from multiple transmit antennas associated with one or more wireless chargers at any one time.

[0062] Determining an optimal charging scenario may include determining an optimal charging scenario for one or more detected wireless chargers that may include one or more protocols and/or may be configured to transmit wireless power at one or more frequencies. More specifically, determining an optimal charging scenario may include determining which plurality of transmit elements associated with one or more detected wireless chargers enables for optimal charging of chargeable device 700B. It is noted that in an embodiment wherein chargeable device 700B includes multiple antennas, a time domain multiplexing method, as mentioned above, may still be used.

[0063] FIG. 12 illustrates a system 780 including chargeable device 700B. System 780 further includes first wireless charger 752, second wireless charger 754, and third wireless charger 756, each of which is positioned within an associated charging region of chargeable device 700B. First wireless charger 752, second wireless charger 754, and third wireless charger 756 have been described above and, therefore, will not be explained again. However, it is noted that first wireless charger 752 includes a coil 763. According to one contemplated operation of system 780, chargeable device 700B may detect one or more wireless chargers within an associated charging region and operating with one or more specific protocols (*e.g.*, near-field resonance and/or inductive coupling) and/or resonating at one or more specific frequencies *(i.e.,* unlicensed ISM bands). Accordingly, chargeable device 700B may detect each of first wireless charger 752, second wireless charger 754, and third wireless charger 756.

[0064] Moreover, upon detection thereof, respective communication links 765, 767, and 769 may be established between chargeable device 700B and first wireless charger 752, second wireless charger 754, and third wireless charger 756. As noted above with respect to chargeable device 700, upon establishing a communication link with a detected wireless charger, chargeable device 700B may be configured to control an operation of a detected wireless charger (*e.g.*, transmission of power, synchronization of data, displaying media, or any user-interface functionality). Further, upon detection of first wireless charger 752, second wireless charger 754, and third wireless charger 756, chargeable device 700B may be configured to determine an optimal charging scenario.

[0065] For example, with reference to FIG. 12, chargeable device 700B may be configured to sequentially receive wireless power from each individual transmit element *(i.e.,* transmit antenna 760, transmit antenna 762, transmit antenna 764, transmit antenna 766, coil 763, and coil 768). Furthermore, chargeable device 700B may be configured to sequentially receive wireless power from every possible and suitable combination of two or more transmit elements. It is noted that chargeable device 700B may only simultaneously receive power from a number of transmit antennas equal to a number of receive antennas 702. For example, if chargeable device 700B comprises two receive antennas 702, chargeable device 700B may be configured to simultaneously receive wireless power from every possible combination of two transmit antennas. However, it is noted that coil 705 may simultaneously receive wireless power from both coil 763 and 768, so long as coil 763 and 768 are each in phase with coil 705.

[0066] After determining an amount of power received from each suitable combination of transmit elements, and optionally each transmit element individually, chargeable device 700B may be configured to identify one or more transmit elements for optimal charging. By way of example, in an embodiment wherein chargeable device 700B includes two antennas 702, charging device 700B may identify transmit antenna 764, transmit antenna 766, and coil 763 as transmit elements for enabling an optimal charging scenario. As another example, charging device 700B may identify transmit antenna 766, transmit antenna 762, and coil 768 as transmit elements for enabling an optimal charging scenario. Further, chargeable device 700B may be configured to determine an optimal charging scenario by utilizing a time domain multiplexing method based upon allocated activation time slots for two or more transmit antennas.

[0067] FIG. 13 is a flowchart illustrating a method 680, in accordance with one or more exemplary embodiments. Method 680 may include detecting one or more transmit elements positioned within an associated charging region (depicted by numeral 682). Method 680 may further include selecting at least one transmit element of the detected one or more transmit elements to receive wireless power therefrom to enable optimal charging of the chargeable device (depicted by numeral 684).

[0068] FIG. 14 depicts a charger 900 that may comprise any known and suitable charger configured to transmit wireless power. Charger 900 may include at least one transmit antenna 704 configured to wirelessly transmit power to at least one chargeable device (*e.g.*, chargeable device 700). More specifically, transmit antenna 704 and an associated transmitter, such as transmitter 104 of FIG. 2, may be configured to transmit wireless power at a frequency (*e.g.*, an unlicensed ISM band) to a receiver within an associated near-field region. Further, charger 900 may include at least one coil 902 configured to transmit wireless power to a chargeable device (*e.g.*, chargeable device 700) via inductive coupling.

[0069] Furthermore, in accordance with various exemplary embodiments of the present invention, charger 900 may be configured to detect one or more chargeable devices, which are positioned within a charging region of charger 900 and are configured to receive wireless power via a suitable protocol. More specifically, charger 900 may be configured to detect one or more chargeable devices according to one or more specific protocols, one or more specific frequencies, or both. For example only,

charger 900 may be configured to detect chargeable devices within a charging region by sampling for chargeable devices operating with specific wireless charging protocols, sampling for chargeable devices resonating at specific wireless charging frequencies, or both.

[0070] According to one exemplary embodiment, charger 900 may be configured to detect one or more chargeable devices positioned within an associated near-field region and configured to receive wireless power at one or more frequencies via near-field resonance. For example only, charger 900 may be configured to detect one or more chargeable devices positioned within an associated near-field region and configured to receive wireless power, via near-field resonance, at a suitable frequency, such as an unlicensed ISM band *(e.g.,* 13.56 MHz). It is noted that various frequencies may be suitable for wireless power transmission in one location (*e.g.*, a first country) but not suitable in another location (*e.g.,* a second country). As such, according to one exemplary embodiment, charger 900 may be configured to determine its location via a location device 901 and, thereafter, determine which one or more frequencies are suitable for wireless power transmission. For example only, location device 901 may comprise a Global Positioning System (GPS) device. Further, according to one exemplary embodiment, charger 900 may be configured to detect one or more chargeable devices positioned within an associated charging region and configured to receive wireless power via an inductive coupling protocol.

[0071] Moreover, charger 900 may be configured to establish a communication link with a detected chargeable device and, upon establishing the communication link, may wirelessly receive data (*e.g.*, audio files, data files, or video files) from the chargeable device, wirelessly transmit data to the chargeable device, or both. Additionally, it is noted that charger 900 may be configured to perform various operations (*e.g.*, synchronizing data and/or displaying media) while transmitting power to one or more chargeable devices. Furthermore, charger 900 may be configured to detect and transmit wireless to multiple versions of chargeable devices. Accordingly, charger 900 may be configured to identify a version of a detected chargeable device and transmit power to and communicate with the detected chargeable device in a suitable manner. It is further noted that charger 900 may attempt to communicate with each detected chargeable device according to a common version protocol. However, in the event that a detected chargeable device is not compatible with the common version protocol, charger 900 may be configured to communicate with the chargeable device in a suitable manner using a suitable version protocol.

[0072] Additionally, upon detection of one or more chargeable devices, charger 900 may be configured to determine an optimal charging solution which may maximize efficiency, maximize charging rates, minimize interference, or any combination thereof, for charging the one or more detected chargeable devices. More specifically, for example, charger 900 may be configured to determine an optimal solution for providing wireless power to one or more of the detected chargeable devices for a given set of conditions (*e.g.*, the number of available transmit elements within charger 900 compared to the number of detected chargeable devices, the charging levels of each of the detected chargeable devices, or the amount of power received by each detected chargeable devices (*i.e.,* the charging efficiency between charger 900 and each of the detected chargeable devices)).

[0073] FIG. 15 illustrates a system 910 including a charger 900A, a first chargeable device 902, and a second chargeable device 903. As illustrated, each of first chargeable device 902 and second chargeable device 903 include a receive antenna 702 and each are configured to receive wireless power transmitted at a specific frequency via near-filed resonance. It is noted that charger 900A is similar to charger 900 of FIG. 13 and, therefore, will not be described in detail. However, it is noted that charger 900A does not include a coil and only includes a single transmit antenna 704.

[0074] According to one contemplated operation of system 910, charger 900A may detect each of first chargeable device 902 and second chargeable device 903 via any suitable manner. According to one contemplated operation of system 910, charger 900A may detect each of first chargeable device 902 and second chargeable device 903, each of which being positioned within an associated charging region and operating with one or more wireless power protocols (*e.g.*, near-field resonance) and/or resonating at one or more wireless power frequencies (*e.g.*, unlicensed ISM bands). Moreover, upon detection thereof, respective communication links 905 and 907 may be established between charger 900A and each of first chargeable device 902 and second chargeable device 903. Furthermore, upon detection of first chargeable device 902 and second chargeable device 903, charger 900A may determine an optimal charging solution for system 910. It is noted that in an embodiment wherein charger 900A includes a single transmit element *(i.e.,* transmit antenna 704), charger 900A may be configured to transmit wireless power to only one chargeable device at any one time.

[0075] As such, according to one exemplary embodiment, charger 900A may be configured to determine which single detected chargeable device *(i.e.,* either first chargeable device 902 or second chargeable device 903) should be charged to enable for an optimal charging solution. As one example, charger 900A may be configured to determine charging efficiencies between charger 900A and each of first chargeable device 902 and second chargeable device 903. Thereafter, to reduce power loss, charger 900A may be configured to convey wireless power to the device that has the highest charging efficiency. More specifically, for example, charger 900A may be configured to sequentially transmit wireless power to each of first chargeable device 902 and second chargeable device 903. Further, charger 900A may be configured to

request and receive a signal from each of first chargeable device 902 and second chargeable device 903 identifying an amount of power received by each of first chargeable device 902 and second chargeable device 903. Thereafter, charger 900A may determine which chargeable device has a higher charging efficiency and, thereafter, convey power thereto. By way of example, charger 900A may determine that a charging efficiency with first chargeable device 902 is greater than a charging efficiency with second chargeable device 903 and, therefore, charger 900A may select first chargeable device 902 and convey power thereto.

[0076] As another example, charger 900A may be configured to charge a device having the greatest need for a charge. More specifically, for example, charger 900A may be configured to determine, via communication means, a charging level of each of first chargeable device 902 and second chargeable device 903 and, thereafter, select and convey wireless power to the device that has the least charged battery. By way of example, charger 900A may determine that a battery of second chargeable device 903 has a lower charging level than a battery of first chargeable device 902 and, as a result, charger 900A may select and convey wireless power to second chargeable device 903. Furthermore, after a charging level of the battery of second chargeable device 903 has reached an acceptable status, charger 900A may convey wireless power to first chargeable device 902. Further, according to another exemplary embodiment, charger 900A may be configured to determine whether a time domain multiplexing method, based upon allocated activation time slots for each of first chargeable device 902 and second chargeable device 903, may enable for an optimal charging solution.

[0077] FIG. 16 illustrates a system 950 including charger 900B, a first chargeable device 911, a second chargeable device 912, a third chargeable device 913, and a forth chargeable device 914. As illustrated, each of first chargeable device 911, second chargeable device 912, third chargeable device 913, and forth chargeable device 914 include an antenna 702 configured to receive wireless power transmitted at a specific frequency via near-filed resonance. Furthermore, each of first chargeable device 911, second chargeable device 912, third chargeable device 913, and forth chargeable device 914 include a coil 909 configured to receive wireless power via inductive coupling. It is noted that charger 900B is similar to charger 900 of FIG. 13 and, therefore, will not be described in detail. However, it is noted that charger 900B includes two transmit antennas 704. According to one contemplated operation of system 950, charger 900B may detect each of first chargeable device 911, second chargeable device 912, third chargeable device 913, and forth chargeable device 914 via any suitable means. According to one contemplated operation of system 950, charger 900B may detect each of first chargeable device 911, second chargeable device 912, third chargeable device 913, and forth chargeable device 914, each of which being positioned within an associated charging region and operating with one or more wireless power protocols (e.g., near-field resonance) and/or resonating at one or more wireless power frequencies (*e.g.*, unlicensed ISM bands).

[0078] Moreover, upon detection thereof, respective communication links 970, 971, 972, and 973 may be established between charger 900 and each of first chargeable device 911, second chargeable device 912, third chargeable device 913, and a forth chargeable device 914. Furthermore, upon detection of first chargeable device 911, second chargeable device 912, third chargeable device 913, and forth chargeable device 914, charger 900B may determine an optimal charging solution for system 950.

[0079] It is noted that charger 900B may simultaneously transmit power to a number of receive antennas *(i.e.,* receive antenna 702) equal to a number of transmit antennas (*i.e.*, transmit antennas 704). For example, in the embodiment illustrated in FIG. 15, charger 900B may be configured to simultaneously transmit wireless power to two transmit antennas 704. Furthermore, it is noted that coil 902 may simultaneously transmit wireless power to multiple coils 909, so long as the coils 909 are in phase with coil 902

[0080] According to one exemplary embodiment, charger 900B may be configured to determine which one or more detected chargeable devices should be charged to enable for an optimal charging solution. As one example, charger 900B may be configured to determine a charging efficiency between charger 900B and each of first chargeable device 911, second chargeable device 912, third chargeable device 913, and forth chargeable device 914. Thereafter, to reduce power loss, charger 900B may be configured to convey wireless power to one or more chargeable devices that have the highest charging efficiency. More specifically, for example, charger 900B may be configured to sequentially transmit wireless power to each of first chargeable device 911, second chargeable device 912, third chargeable device 913, and forth chargeable device 914 according to various protocols and frequencies. Further, charger 900B may be configured to request and receive a signal from each of first chargeable device 911, second chargeable device 912, third chargeable device 913, and forth chargeable device 914 identifying an amount of power received by each of first chargeable device 911, second chargeable device 912, third chargeable device 913, and forth chargeable device 914 according to each suitable protocol and frequency. Thereafter, charger 900B may determine which one or more chargeable devices should be charged with which protocols and frequencies to enable for an optimal charging scenario of system 950.

[0081] As another example, charger 900B may be configured to convey power to one or more chargeable devices that have the greatest need for a charge. More specifically, for example, charger 900B may be configured to determine, via communication means, a charging level

of each of first chargeable device 911, second chargeable device 912, third chargeable device 913, and forth chargeable device 914 and, thereafter, convey wireless power to the one or more chargeable devices having the least charged batteries. Further, according to another exemplary embodiment, charger 900B may be configured to determine whether a time domain multiplexing method, based upon allocated activation time slots for two or more of first chargeable device 911, second chargeable device 912, third chargeable device 913, and forth chargeable device 914, may enable for an optimal charging solution.

[0082] It is noted that charger 900 and, more specifically, at least one antenna 704 of charger 900 may include additional functionality. As one example, antenna 704 may be configured to transmit radio frequencies. Furthermore, for example, antenna 704 may be configured to operate as a RF repeater, a femtocell, a WiFi access point (AP), or any combination thereof. Additionally, antenna 704 may positioned remotely from and connected to charger 900 via a coax, an RF conductor, an IP connection, or any other suitable connector. In this example, antenna704 may configured to operate as a remote antenna for an RF repeater, a femtocell, a WiFi access point (AP), or any combination thereof.

[0083] FIG. 17 is a flowchart illustrating a method 690, in accordance with one or more exemplary embodiments. Method 690 may include detecting one or more receive elements positioned within an associated charging region (depicted by numeral 692). Method 690 may further include selecting at least one receive element of the detected one or more receive elements to transmit wireless power thereto to enable for an optimal charging solution of one or more chargeable devices associated with the one or more receive elements (depicted by numeral 694).

[0084] Those of skill in the art would understand that information and signals may be represented using any of a variety of different technologies and techniques. For example, data, instructions, commands, information, signals, bits, symbols, and chips that may be referenced throughout the above description may be represented by voltages, currents, electromagnetic waves, magnetic fields or particles, optical fields or particles, or any combination thereof.

[0085] Those of skill would further appreciate that the various illustrative logical blocks, modules, circuits, and algorithm steps described in connection with the exemplary embodiments disclosed herein may be implemented as electronic hardware, computer software, or combinations of both. To clearly illustrate this interchangeability of hardware and software, various illustrative components, blocks, modules, circuits, and steps have been described above generally in terms of their functionality. Whether such functionality is implemented as hardware or software depends upon the particular application and design constraints imposed on the overall system. Skilled artisans may implement the described functionality in varying ways for each particular application, but such implementation decisions should not be interpreted as causing a departure from the scope of the exemplary embodiments of the invention.

[0086] The various illustrative logical blocks, modules, and circuits described in connection with the exemplary embodiments disclosed herein may be implemented or performed with a general purpose processor, a Digital Signal Processor (DSP), an Application Specific Integrated Circuit (ASIC), a Field Programmable Gate Array (FPGA) or other programmable logic device, discrete gate or transistor logic, discrete hardware components, or any combination thereof designed to perform the functions described herein. A general purpose processor may be a microprocessor, but in the alternative, the processor may be any conventional processor, controller, microcontroller, or state machine. A processor may also be implemented as a combination of computing devices, *e.g.*, a combination of a DSP and a microprocessor, a plurality of microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration.

[0087] The steps of a method or algorithm described in connection with the exemplary embodiments disclosed herein may be embodied directly in hardware, in a software module executed by a processor, or in a combination of the two. A software module may reside in Random Access Memory (RAM), flash memory, Read Only Memory (ROM), Electrically Programmable ROM (EPROM), Electrically Erasable Programmable ROM (EEPROM), registers, hard disk, a removable disk, a CD-ROM, or any other form of storage medium known in the art. An exemplary storage medium is coupled to the processor such that the processor can read information from, and write information to, the storage medium. In the alternative, the storage medium may be integral to the processor. The processor and the storage medium may reside in an ASIC. The ASIC may reside in a user terminal. In the alternative, the processor and the storage medium may reside as discrete components in a user terminal.

[0088] In one or more exemplary embodiments, the functions described may be implemented in hardware, software, firmware, or any combination thereof. If implemented in software, the functions may be stored on or transmitted over as one or more instructions or code on a computer-readable medium. Computer-readable media includes both computer storage media and communication media including any medium that facilitates transfer of a computer program from one place to another. A storage media may be any available media that can be accessed by a computer. By way of example, and not limitation, such computer-readable media can comprise RAM, ROM, EEPROM, CD-ROM or other optical disk storage, magnetic disk storage or other magnetic storage devices, or any other medium that can be used to carry or store desired program code in the form of instructions or data structures and that can be accessed by a computer. Also, any connection is properly termed a computer-readable medium. For example, if the software is transmitted from a website, server, or other remote

source using a coaxial cable, fiber optic cable, twisted pair, digital subscriber line (DSL), or wireless technologies such as infrared, radio, and microwave, then the coaxial cable, fiber optic cable, twisted pair, DSL, or wireless technologies such as infrared, radio, and microwave are included in the definition of medium. Disk and disc, as used herein, includes compact disc (CD), laser disc, optical disc, digital versatile disc (DVD), floppy disk and blu-ray disc where *disks* usually reproduce data magnetically, while *discs* reproduce data optically with lasers. Combinations of the above should also be included within the scope of computer-readable media.

[0089] The previous description of the disclosed exemplary embodiments is provided to enable any person skilled in the art to make or use the present invention. Various modifications to these exemplary embodiments will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other embodiments without departing from the scope of the invention as defined by the appended claims.

Claims

1. A wireless charger for transmitting power, via a wireless field, to a chargeable device (118, 302, 700, 700A, 700B, 902, 903, 911, 912, 913, 914), the wireless charger comprising:

   means for detecting one or more chargeable devices positioned within an associated charging region;
   means for transmitting power to the one or more chargeable devices, via the wireless field, in accordance with a plurality of charging protocols, the means configured to transmit power to one of said chargeable devices in accordance with a first protocol of the plurality of charging protocols and to transmit power to the one of said chargeable devices in accordance with a second protocol of the plurality of charging protocols;
   means (214) for determining an optimal charging protocol from the first and second charging protocols for the one of said chargeable devices, and for selecting the determined optimal charging protocol for transmitting power to the one of said chargeable devices.

2. The wireless charger of claim 1, further comprising:

   means for detecting (280) a plurality of receive elements of a chargeable device positioned within an associated charging region; and
   means for selecting (214) at least one receive element of the detected plurality of receive elements to transmit power thereto.

3. The wireless charger of claim 1, wherein the means for transmitting power via the wireless field comprises an antenna (204, 704, 714, 734, 736, 760, 762, 764, 766) or a coil (768, 763, 902).

4. The wireless charger of claim 1, further comprising means for detecting the one or more chargeable devices according to at least one of a plurality charging protocols and a plurality of charging frequencies.

5. The wireless charger of claim 4, wherein the means for detecting is configured to detect the one or more chargeable devices by sampling for chargeable devices operating with at least one of the plurality of charging protocols, and wherein the plurality of charging protocols include a near-field resonance protocol and an inductive coupling protocol.

6. The wireless charger of claim 4, wherein the means for detecting is configured to detect the one or more chargeable devices by sampling for chargeable devices resonating at one of the plurality of charging frequencies.

7. A method of transmitting power, via a wireless field, to a chargeable device (118, 302, 700, 700A, 700B, 902, 903, 911, 912, 913, 914) from a transmitter adapted to transmit power in accordance with a plurality of charging protocols, the method comprising:

   detecting one or more chargeable devices positioned within an associated charging region;
   transmitting power to one of said chargeable devices in accordance with a first protocol of the plurality of charging protocols and transmitting power to the one of said chargeable devices in a accordance with a second protocol of the plurality of charging protocols;
   determining an optimal charging protocol from the first and second protocols for the one of said chargeable devices; and
   selecting the determined optimal charging protocol; and
   transmitting power to the one of said chargeable devices, via the wireless field, in accordance with the selected optimal charging protocol.

8. The method of claim 7, wherein the protocol comprises at least one of a near-field resonance protocol and an inductive coupling protocol.

9. The method of claim 7, wherein the chargeable device includes a plurality of receive elements, the method further comprising selecting the plurality of receive elements to transmit power thereto in a time-domain multiplexing method.

10. The method of claim 7, wherein the chargeable de-

vice includes a plurality of receive elements, the method further comprising receiving a signal from the chargeable device indicative of an amount of power received at each of the plurality of receive elements; and selecting a receive element of the plurality of receive elements having the highest charging efficiency with the transmitter.

11. The method of claim 7, wherein the transmitter includes a plurality of transmit elements and the chargeable device includes a plurality of receive elements, the method further comprising:

detecting at least one of a plurality of receive elements positioned within an associated charging region; and
selecting at least one transmit element to transmit power to one of the detected plurality of receive elements.

12. A device for receiving power according to a plurality of charging protocols, via a wireless field, from a transmitter (114, 202, 732, 752, 754, 756, 900, 900A, 900B), the device comprising:

means for receiving power in accordance with a first protocol of the plurality of charging protocols and for receiving power in accordance with a second protocol of the plurality of charging protocols;
means for selecting (316) an optimal charging protocol from the first and second charging protocols; and
means for receiving power (118, 302, 700, 700A, 700B, 902, 903, 911, 912, 913, 914), from the transmitter (114, 202, 732, 752, 754, 756, 900, 900A, 900B), in accordance with the selected optimal charging protocol.

13. A method of receiving power with a receiver (118, 302, 700, 700A, 700B, 902, 903, 911, 912, 913, 914) configured to receive power, via a wireless field, according to a plurality of charging protocols from a transmitter (114, 202, 732, 752, 754, 756, 900, 900A, 900B), the method comprising:

receiving power in accordance with a first protocol of the plurality of charging protocols;
receiving power in accordance with a second protocol of the plurality of charging protocols;
selecting an optimal charging protocol from the first and second charging protocols; and
receiving power, via the wireless field, from the transmitter in accordance with the selected optimal charging protocol.

14. A computer program product for processing data for a program configured to operate a receiver (118, 302, 700, 700A, 700B, 902, 903, 911, 912, 913, 914) to receive power, via wireless field, from a transmitter(114, 202, 732, 752, 754, 756, 900, 900A, 900B), the computer program product comprising:
a non-transitory computer-readable medium having stored thereon code for causing processing circuitry to perform the method of claim 13.

Patentansprüche

1. Ein drahtloses Ladegerät zum Übertragen von Leistung über ein drahtloses Feld zu einem aufladbaren Gerät (118, 302, 700, 700A, 700B, 902, 903, 911, 912, 913, 914), wobei das drahtlose Ladegerät aufweist:

Mittel zum Erfassen eines oder mehrerer aufladbarer Geräte, die in einem assoziierten Ladebereich positioniert sind,
Mittel zum Übertragen von Leistung zu dem einen oder den mehreren aufladbaren Geräten über das drahtlose Feld gemäß einer Vielzahl von Ladeprotokollen, wobei die Mittel konfiguriert sind zum Übertragen von Leistung zu einem der aufladbaren Geräte gemäß einem ersten Protokoll aus der Vielzahl von Ladeprotokollen und zum Übertragen von Leistung zu dem einen der aufladbaren Geräte gemäß einem zweiten Protokoll aus der Vielzahl von Ladeprotokollen,
Mittel (214) zum Bestimmen eines optimalen Ladeprotokolls aus den ersten und zweiten Ladeprotokollen für das eine der aufladbaren Geräte und zum Auswählen des bestimmten optimalen Ladeprotokolls für das Übertragen von Leistung zu dem einen der aufladbaren Geräte.

2. Drahtloses Ladegerät nach Anspruch 1, das weiterhin aufweist:

Mittel zum Erfassen (280) einer Vielzahl von Empfangselementen eines aufladbaren Geräts, das in einem assoziierten Ladebereich positioniert ist, und
Mittel zum Auswählen (214) wenigstens eines Empfangselements aus der erfassten Vielzahl von Empfangselementen für das Übertragen von Leistung zu diesem.

3. Drahtloses Ladegerät nach Anspruch 1, wobei die Mittel zum Übertragen von Leistung über das drahtlose Feld eine Antenne (204, 704, 714, 734, 736, 760, 762, 764, 766) oder eine Spule (768, 763, 902) umfassen.

4. Drahtloses Ladegerät nach Anspruch 1, das weiterhin Mittel zum Erfassen des einen oder der mehreren aufladbaren Geräte gemäß einer Vielzahl von Lade-

protokollen und/oder einer Vielzahl von Ladefrequenzen aufweist.

5. Drahtloses Ladegerät nach Anspruch 4, wobei die Mittel zum Erfassen konfiguriert sind zum Erfassen des einen oder der mehreren aufladbaren Geräte durch das Suchen nach aufladbaren Geräten, die mit dem wenigstens einen aus der Vielzahl von Ladeprotokollen betrieben werden, und wobei die Vielzahl von Ladeprotokollen ein Nahfeldresonanzprotokoll und ein Induktivkopplungsprotokoll umfassen.

6. Drahtloses Ladegerät nach Anspruch 4, wobei die Mittel zum Erfassen konfiguriert sind zum Erfassen des einen oder der mehreren aufladbaren Geräte durch das Suchen nach aufladbaren Geräten, die bei einer aus der Vielzahl von Ladefrequenzen resonieren.

7. Ein Verfahren zum Übertragen von Leistung über ein drahtloses Feld zu einem aufladbaren Gerät (118, 302, 700, 700A, 700B, 902, 903, 911, 912, 913, 914) von einem Sender, der ausgebildet ist zum Übertragen von Leistung gemäß einem aus einer Vielzahl von Ladeprotokollen, wobei das Verfahren aufweist:

Erfassen eines oder mehrerer aufladbarer Geräte, die in einem assoziierten Ladebereich positioniert sind,
Übertragen von Leistung zu einem der aufladbaren Geräte gemäß einem ersten Protokoll aus der Vielzahl von Ladeprotokollen, und Übertragen von Leistung zu dem einen der aufladbaren Geräte gemäß einem zweiten Protokoll aus der Vielzahl von Ladeprotokollen,
Bestimmen eines optimalen Ladeprotokolls aus den ersten und zweiten Ladeprotokollen für das eine der aufladbaren Geräte, und Auswählen des bestimmten optimalen Ladeprotokolls, und Übertragen von Leistung zu dem einen der aufladbaren Geräte über das drahtlose Feld gemäß dem ausgewählten optimalen Ladeprotokoll.

8. Verfahren nach Anspruch 7, wobei das Protokoll ein NahfeldResonanzprotokoll und/oder ein Induktionskopplungsprotokoll ist.

9. Verfahren nach Anspruch 7, wobei das aufladbare Gerät eine Vielzahl von Empfangselementen enthält, wobei das Verfahren weiterhin das Auswählen der Vielzahl von Empfangselementen für das Übertragen von Leistung zu diesen in einem Zeitmultiplexverfahren aufweist.

10. Verfahren nach Anspruch 7, wobei das aufladbare Gerät eine Vielzahl von Empfangselementen enthält, wobei das Verfahren weiterhin das Empfangen eines Signals von dem aufladbaren Gerät, das eine an jedem aus der Vielzahl von Empfangselementen empfangene Leistungsmenge angibt, und das Auswählen eines Empfangselements aus der Vielzahl von Empfangselementen mit der höchsten Ladeeffizienz mit dem Sender aufweist.

11. Verfahren nach Anspruch 7, wobei der Sender eine Vielzahl von Sendeelementen enthält und das aufladbare Gerät eine Vielzahl von Empfangselementen enthält, wobei das Verfahren weiterhin aufweist:

Erfassen wenigstens eines aus einer Vielzahl von Empfangselementen, die in einem assoziierten Ladebereich positioniert sind, und
Auswählen wenigstens eines Sendeelements für das Übertragen von Leistung zu einem aus der erfassten Vielzahl von Empfangselementen.

12. Ein Gerät zum Empfangen von Leistung gemäß einem aus einer Vielzahl von Ladeprotokollen über ein drahtloses Feld von einem Sender (114, 202, 732, 752, 754, 756, 900, 900A, 900B), wobei das Gerät aufweist:

Mittel zum Empfangen von Leistung gemäß einem ersten Protokoll aus der Vielzahl von Ladeprotokollen und zum Empfangen von Leistung gemäß einem zweiten Protokoll aus der Vielzahl von Ladeprotokollen,
Mittel zum Auswählen (316) eines optimalen Ladeprotokolls aus den ersten und zweiten Ladeprotokollen, und
Mittel zum Empfangen von Leistung (118, 302, 700, 700a, 700B, 902, 903, 911, 912, 913, 914) von dem Sender (114, 202, 732, 752, 754, 756, 900, 900A, 900B) gemäß dem ausgewählten optimalen Ladeprotokoll.

13. Ein Verfahren zum Empfangen von Leistung mit einem Empfänger (118, 302, 700, 700A, 700B, 902, 903, 911, 912, 913, 914), der konfiguriert ist zum Empfangen von Leistung über ein drahtloses Feld gemäß einer Vielzahl von Ladeprotokollen von einem Sender (114, 202, 732, 752, 754, 756, 900, 900A, 900B), wobei das Verfahren aufweist:

Empfangen von Leistung gemäß einem ersten Protokoll aus der Vielzahl von Ladeprotokollen,
Empfangen von Leistung gemäß einem zweiten Protokoll aus der Vielzahl von Ladeprotokollen,
Auswählen eines optimalen Ladeprotokolls aus den ersten und zweiten Ladeprotokollen, und
Empfangen von Leistung über das drahtlose Feld von dem Sender gemäß dem ausgewählten optimalen Ladeprotokoll.

14. Ein Computerprogrammprodukt für das Verarbeiten von Daten für ein Programm, das konfiguriert ist zum Betreiben eines Empfängers (118, 302, 700, 700A, 700B, 902, 903, 911, 912, 913, 914) für das Empfangen von Leistung über ein drahtloses Feld von einem Sender (114, 202, 732, 752, 754, 756, 900, 900A, 900B), wobei das Computerprogrammprodukt aufweist:
ein nicht-transitorisches, computerlesbares Medium mit einem darauf gespeicherten Code, der einen Verarbeitungsschaltungsaufbau veranlasst zum Durchführen des Verfahrens von Anspruch 13.

Revendications

1. Chargeur sans fil destiné à transmettre de l'énergie, par l'intermédiaire d'un champ sans fil, à un dispositif rechargeable (118, 302, 700, 700A, 700B, 902, 903, 911, 912, 913, 914), le chargeur sans fil comprenant :

   un moyen pour détecter un ou plusieurs dispositifs rechargeables positionnés dans une zone de charge associée ;
   un moyen pour transmettre de l'énergie audit un ou auxdits plusieurs dispositifs rechargeables, par l'intermédiaire du champ sans fil, conformément à une pluralité de protocoles de charge, le moyen étant configuré de manière à transmettre de l'énergie à l'un desdits dispositifs rechargeables conformément à un premier protocole de la pluralité de protocoles de charge, et à transmettre de l'énergie audit un desdits dispositifs rechargeables conformément à un second protocole de la pluralité de protocoles de charge ;
   un moyen (214) pour déterminer un protocole de charge optimal parmi les premier et second protocoles de charge pour ledit un desdits dispositifs rechargeables ; et
   un moyen pour sélectionner le protocole de charge optimal déterminé en vue de transmettre de l'énergie audit un desdits dispositifs rechargeables.

2. Chargeur sans fil selon la revendication 1, comprenant en outre :

   un moyen pour détecter (280) une pluralité d'éléments de réception d'un dispositif rechargeable positionné dans une zone de charge associée ; et
   un moyen pour sélectionner (214) au moins un élément de réception parmi la pluralité détectée d'éléments de réception, en vue de lui transmettre de l'énergie.

3. Chargeur sans fil selon la revendication 1, dans lequel le moyen de transmission d'énergie par l'intermédiaire du champ sans fil comprend une antenne (204, 704, 714, 734, 736, 760, 762, 764, 766) ou une bobine (768, 763, 902).

4. Chargeur sans fil selon la revendication 1, comprenant en outre un moyen pour détecter ledit un ou lesdits plusieurs dispositifs rechargeables selon au moins l'un parmi une pluralité de protocoles de charge et une pluralité de fréquences de charge.

5. Chargeur sans fil selon la revendication 4, dans lequel le moyen de détection est configuré de manière à détecter ledit un ou lesdits plusieurs dispositifs rechargeables, par le biais d'un échantillonnage, pour des dispositifs rechargeables fonctionnant avec au moins un protocole de la pluralité de protocoles de charge, et dans lequel la pluralité de protocoles de charge inclut un protocole de résonance en champ proche et un protocole de couplage inductif.

6. Chargeur sans fil selon la revendication 4, dans lequel le moyen de détection est configuré de manière à détecter ledit un ou lesdits plusieurs dispositifs rechargeables, par le biais d'un échantillonnage, pour des dispositifs rechargeables résonnant à l'une de la pluralité de fréquences de charge.

7. Procédé de transmission d'énergie, par l'intermédiaire d'un champ sans fil, à un dispositif rechargeable (118, 302, 700, 700A, 700B, 902, 903, 911, 912, 913, 914), à partir d'un émetteur apte à transmettre de l'énergie selon une pluralité de protocoles de charge, le procédé comprenant les étapes ci-dessous consistant à :

   détecter un ou plusieurs dispositifs rechargeables positionnés dans une zone de charge associée ;
   transmettre de l'énergie à l'un desdits dispositifs rechargeables conformément à un premier protocole de la pluralité de protocoles de charge, et transmettre de l'énergie audit un desdits dispositifs rechargeables conformément à un second protocole de la pluralité de protocoles de charge ;
   déterminer un protocole de charge optimal parmi les premier et second protocoles de charge pour ledit un desdits dispositifs rechargeables ; et
   sélectionner le protocole de charge optimal déterminé ; et
   transmettre de l'énergie audit un desdits dispositifs rechargeables, par l'intermédiaire du champ sans fil, conformément au protocole de charge optimal sélectionné.

8. Procédé selon la revendication 7, dans lequel le pro-

tocole comprend au moins un protocole parmi un protocole de résonance en champ proche et un protocole de couplage inductif.

9. Procédé selon la revendication 7, dans lequel le dispositif rechargeable inclut une pluralité d'éléments de réception, le procédé comprenant en outre l'étape consistant à sélectionner la pluralité d'éléments de réception en vue de leur transmettre de l'énergie dans le cadre d'un procédé de multiplexage de domaine temporel.

10. Procédé selon la revendication 7, dans lequel le dispositif rechargeable inclut une pluralité d'éléments de réception, le procédé comprenant en outre l'étape consistant à recevoir un signal en provenance du dispositif rechargeable, indicatif d'une quantité d'énergie reçue au niveau de chaque élément de la pluralité d'éléments de réception ; et l'étape consistant à sélectionner un élément de réception, parmi la pluralité d'éléments de réception, présentant l'efficacité de charge le plus élevée avec l'émetteur.

11. Procédé selon la revendication 7, dans lequel l'émetteur inclut une pluralité d'éléments de transmission et le dispositif rechargeable inclut une pluralité d'éléments de réception, le procédé comprenant en outre les étapes ci-dessous consistant à :

détecter au moins un élément parmi une pluralité d'éléments de réception positionnés dans une zone de charge associée ; et
sélectionner au moins un élément de transmission en vue de transmettre de l'énergie à un élément de la pluralité sélectionnée d'éléments de réception.

12. Dispositif destiné à recevoir de l'énergie selon une pluralité de protocoles de charge, par l'intermédiaire d'un champ sans fil, en provenance d'un émetteur (114, 202, 732, 752, 754, 756, 900, 900A, 900B), le dispositif comprenant :

un moyen pour recevoir de l'énergie conformément à un premier protocole de la pluralité de protocoles de charge, et pour recevoir de l'énergie conformément à un second protocole de la pluralité de protocoles de charge ;
un moyen pour sélectionner (316) un protocole de charge optimal parmi les premier et second protocoles de charge ; et
un moyen pour recevoir de l'énergie (118, 302, 700, 700A, 700B, 902, 903, 911, 912, 913, 914), en provenance de l'émetteur (114, 202, 732, 752, 754, 756, 900, 900A, 900B), conformément au protocole de charge optimal sélectionné.

13. Procédé de réception d'énergie au moyen d'un récepteur (118, 302, 700, 700A, 700B, 902, 903, 911, 912, 913, 914) configuré de manière à recevoir de l'énergie, par l'intermédiaire d'un champ sans fil, selon une pluralité de protocoles de charge, en provenance d'un émetteur (114, 202, 732, 752, 754, 756, 900, 900A, 900B), le procédé comprenant les étapes ci-dessous consistant à :

recevoir de l'énergie conformément à un premier protocole de la pluralité de protocoles de charge ;
recevoir de l'énergie conformément à un second protocole de la pluralité de protocoles de charge ;
sélectionner un protocole de charge optimal parmi les premier et second protocoles de charge ; et
recevoir de l'énergie, par l'intermédiaire du champ sans fil, en provenance de l'émetteur, conformément au protocole de charge optimal sélectionné.

14. Produit formant un programme informatique destiné à traiter des données pour un programme configuré de manière à faire fonctionner un récepteur (118, 302, 700, 700A, 700B, 902, 903, 911, 912, 913, 914) destiné à recevoir de l'énergie, par l'intermédiaire d'un champ sans fil, en provenance d'un émetteur (114, 202, 732, 752, 754, 756, 900, 900A, 900B), le produit formant un programme informatique comprenant :
un support non transitoire lisible par ordinateur sur lequel est stocké un code pour amener un montage de circuits de traitement à mettre en œuvre le procédé selon la revendication 13.

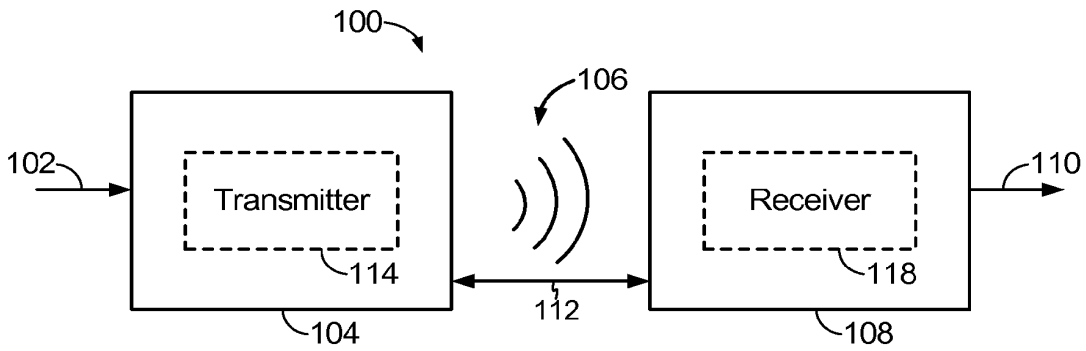


FIG. 1

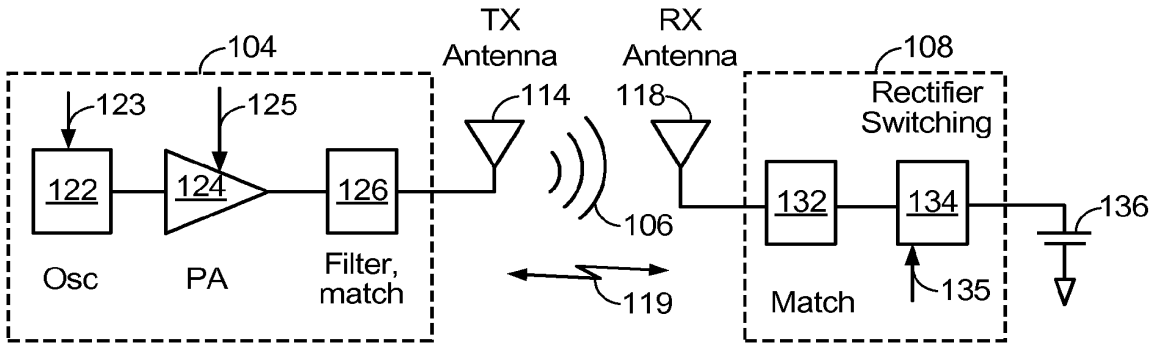


FIG. 2

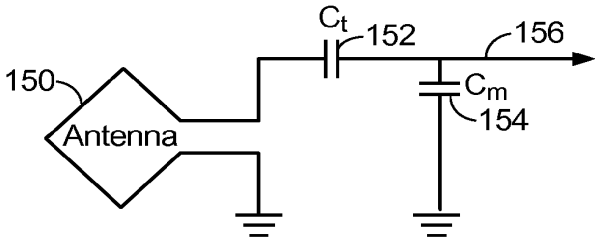


FIG. 3

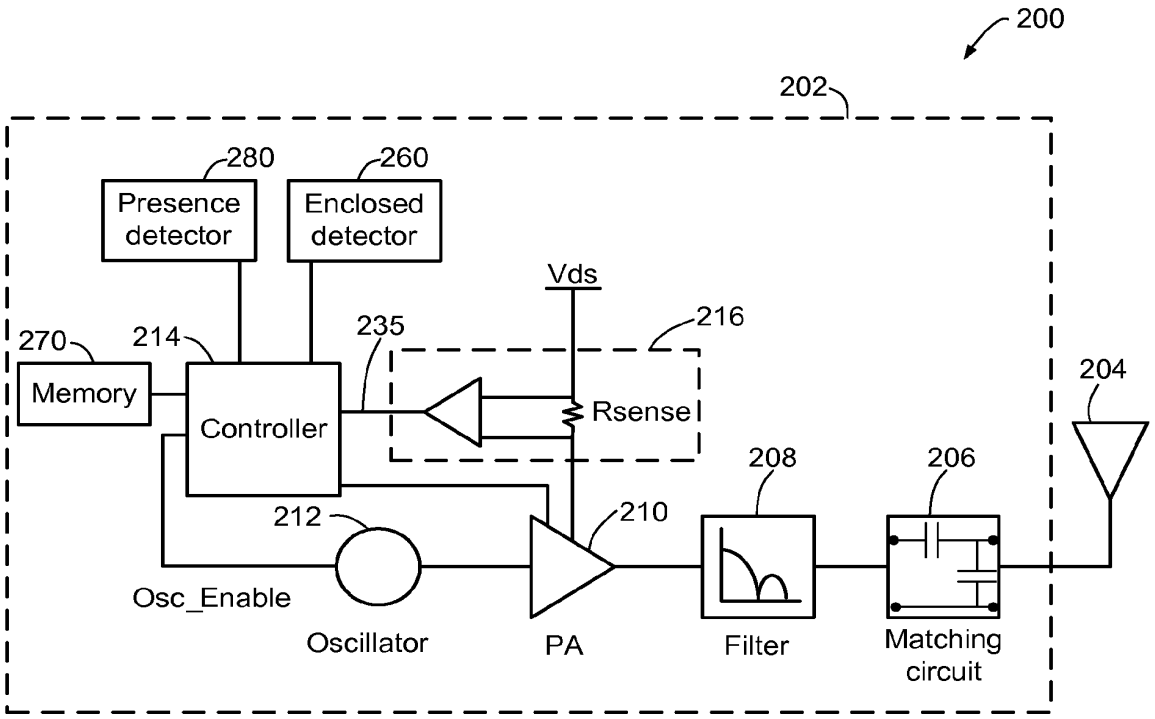

200
202
280
260
Presence detector
Enclosed detector
Vds
216
270
214
235
Memory
Controller
Rsense
204
208
206
212
210
Osc_Enable
Oscillator
PA
Filter
Matching circuit

FIG. 4

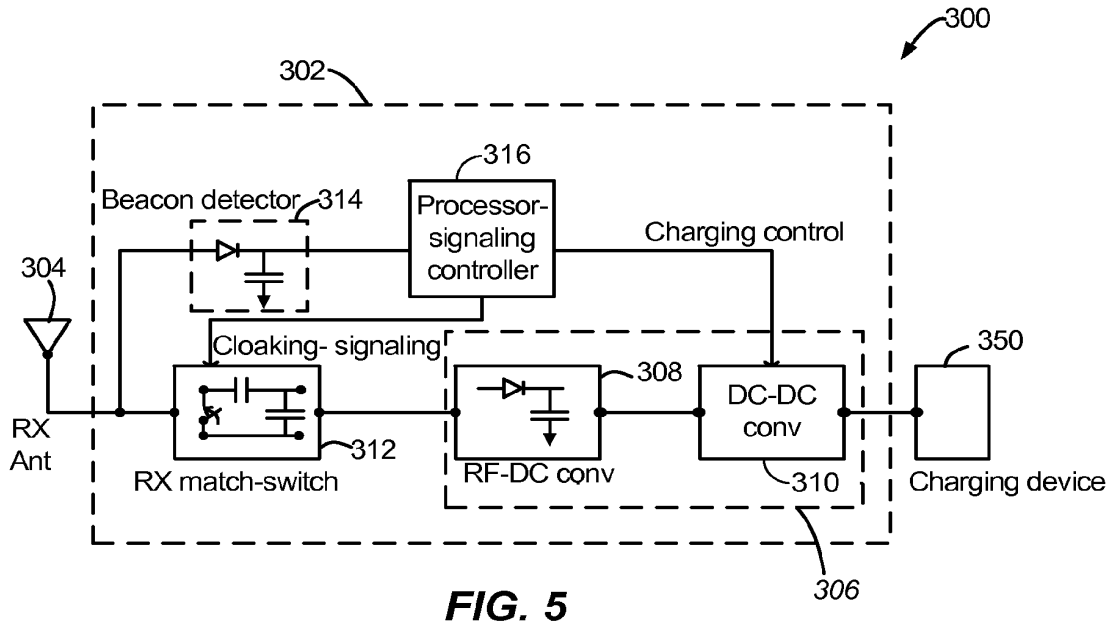

300
302
316
Beacon detector
314
Processor-signaling controller
Charging control
304
Cloaking- signaling
350
308
RX Ant
312
DC-DC conv
RX match-switch
RF-DC conv
310
Charging device
306

FIG. 5

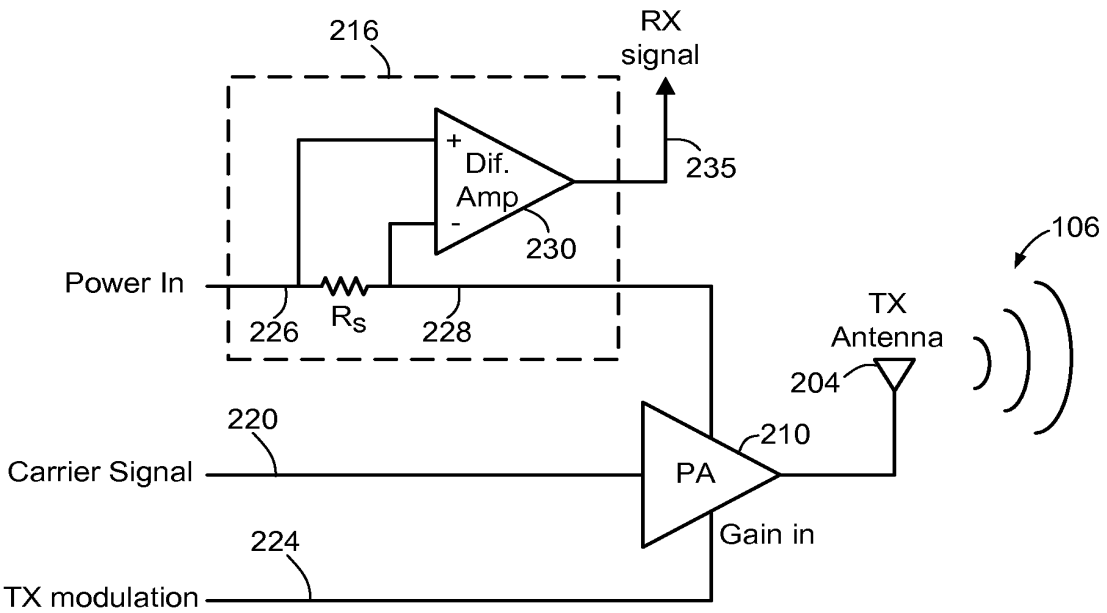

216
RX
signal
+
Dif.
Amp
-
235
230
106
Power In
226
Rs
228
TX
Antenna
204
220
210
Carrier Signal
PA
Gain in
224
TX modulation

FIG. 6

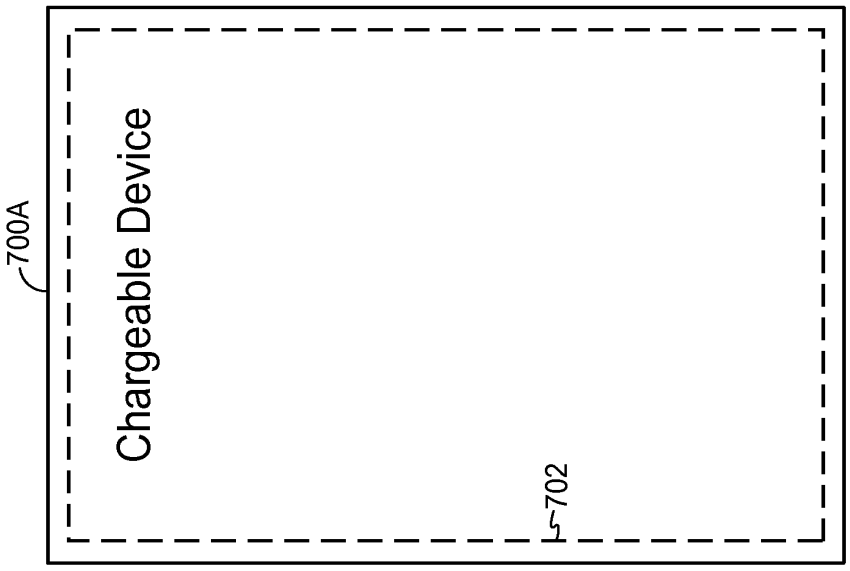

700A
Chargeable Device
702

FIG. 8

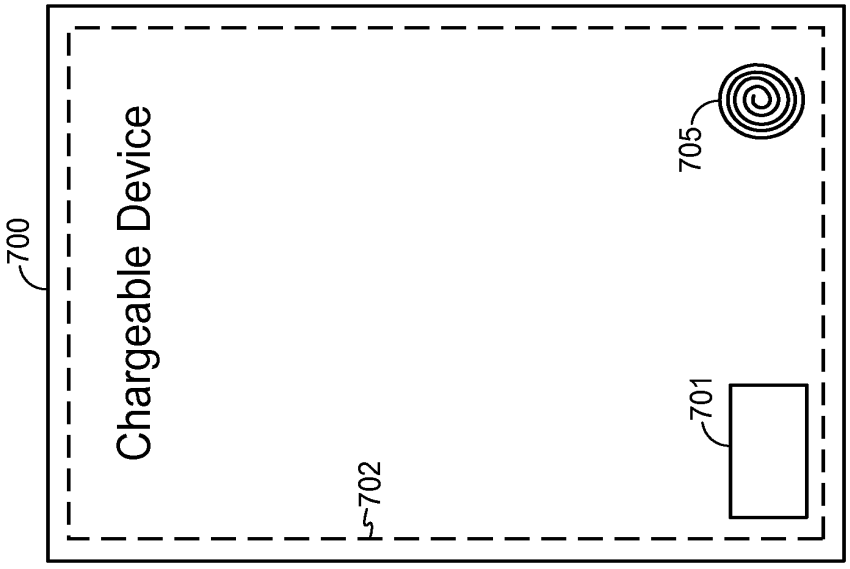

700
Chargeable Device
705
701
702

FIG. 7

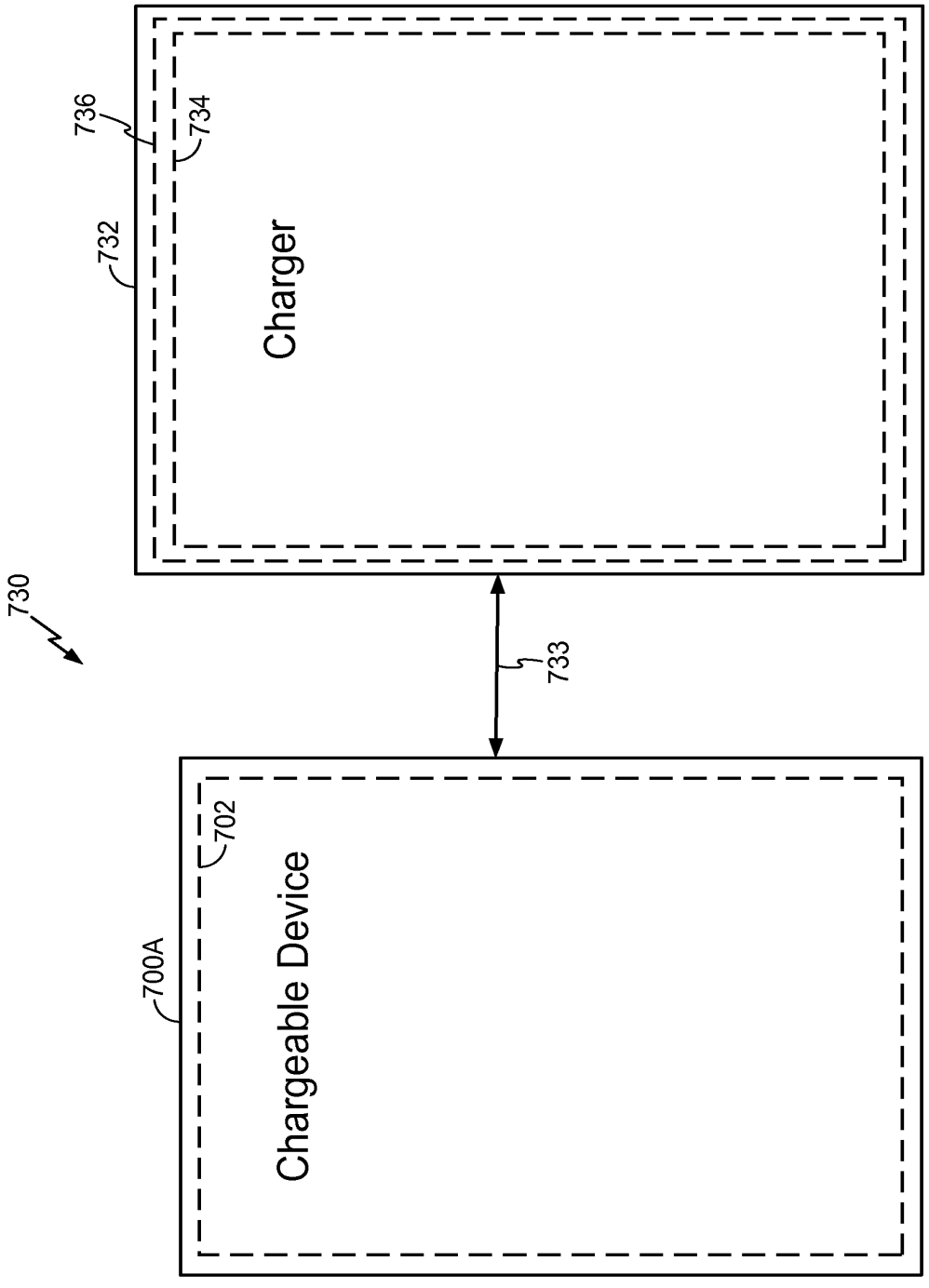


FIG. 9

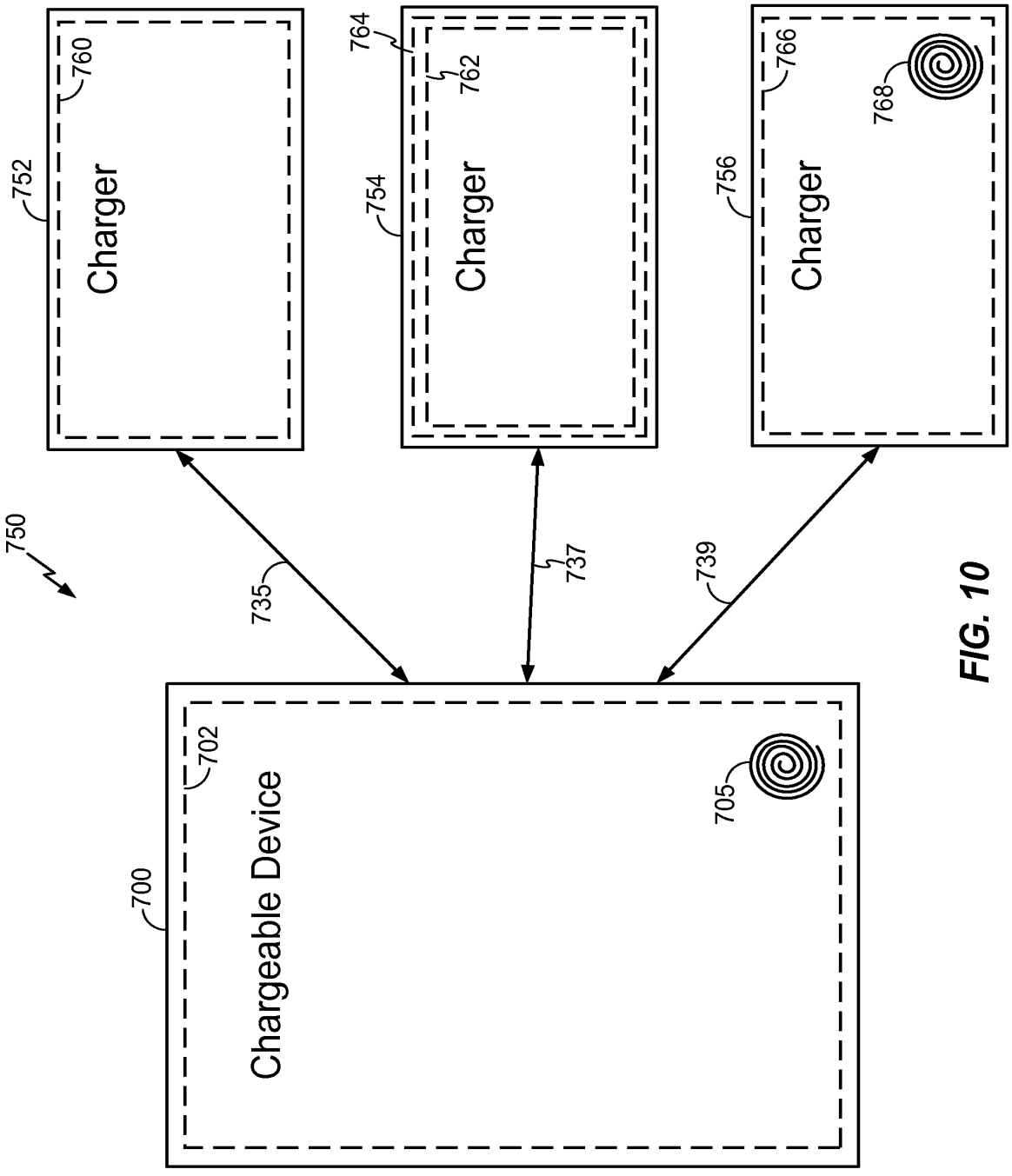

750
752
Charger
760
754
Charger
762
764
756
Charger
766
768
735
737
739
700
Chargeable Device
702
705

FIG. 10

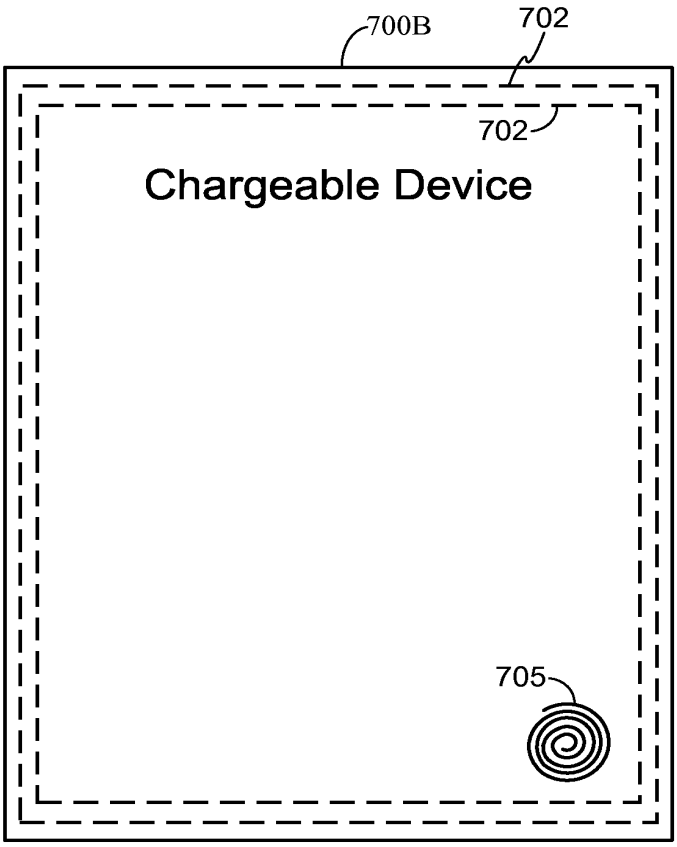


FIG. 11

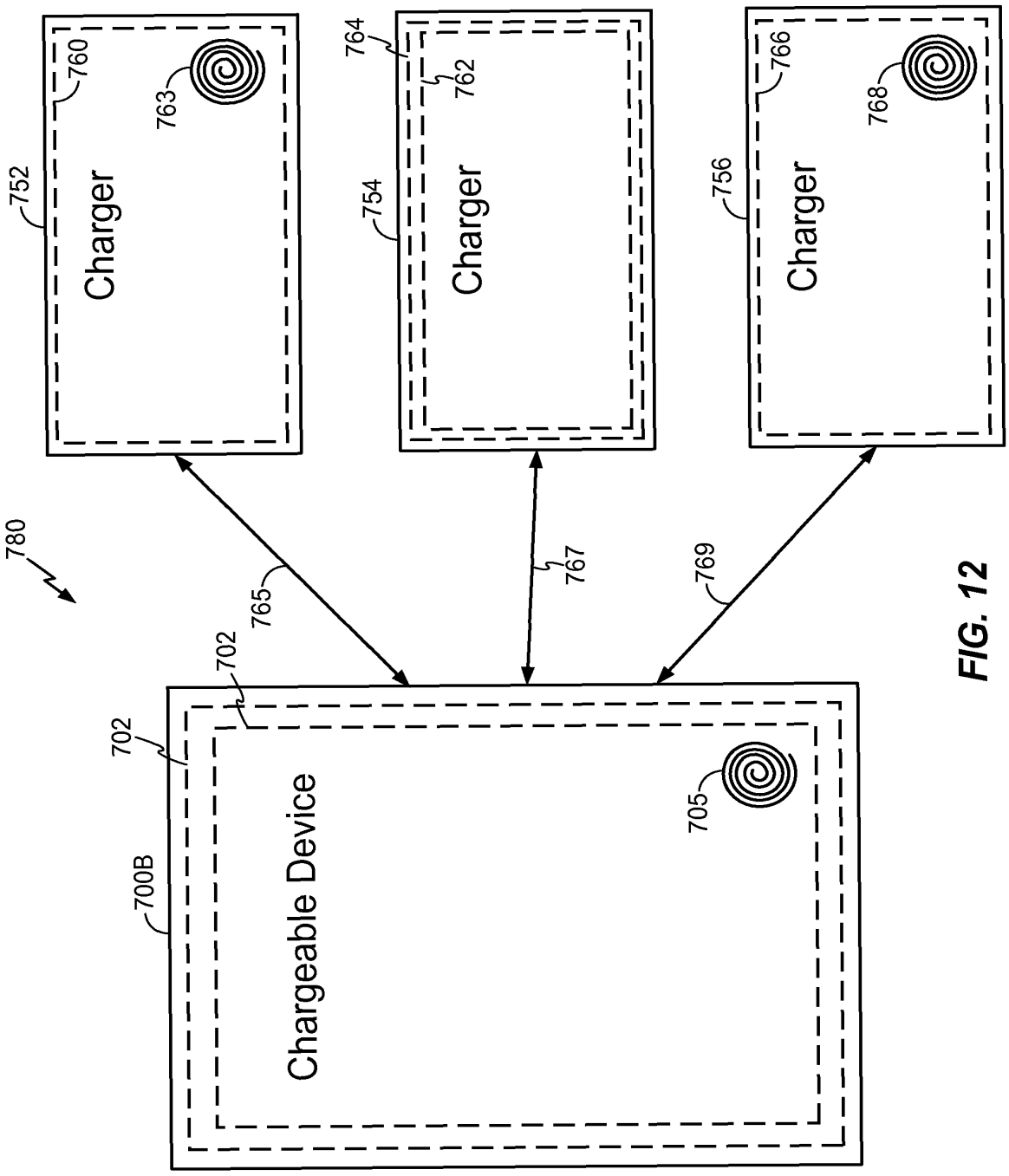

Charger
760
763
752
Charger
764
762
754
Charger
766
768
756
780
765
767
769
702
702
Chargeable Device
705
700B

FIG. 12

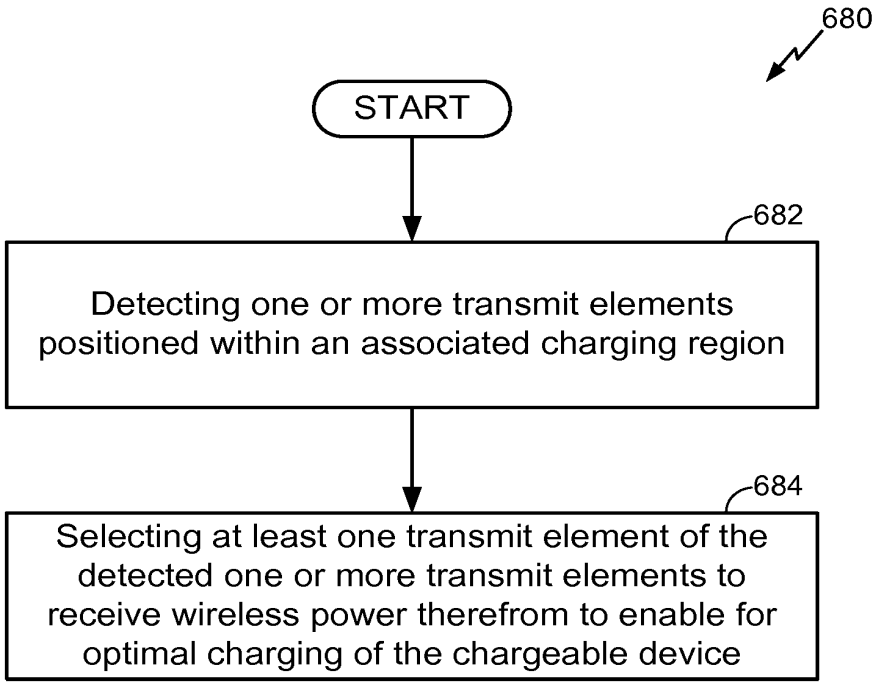

680
START
682
Detecting one or more transmit elements positioned within an associated charging region
684
Selecting at least one transmit element of the detected one or more transmit elements to receive wireless power therefrom to enable for optimal charging of the chargeable device

FIG. 13

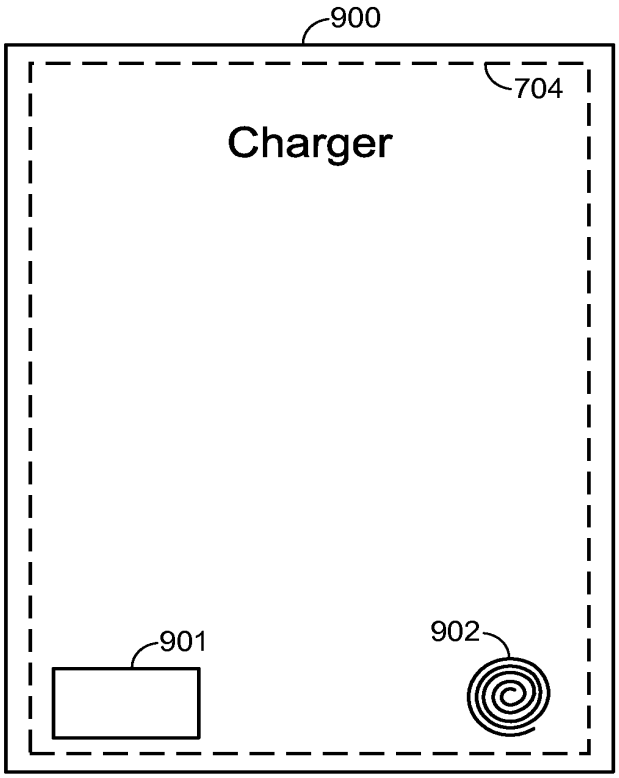


FIG. 14

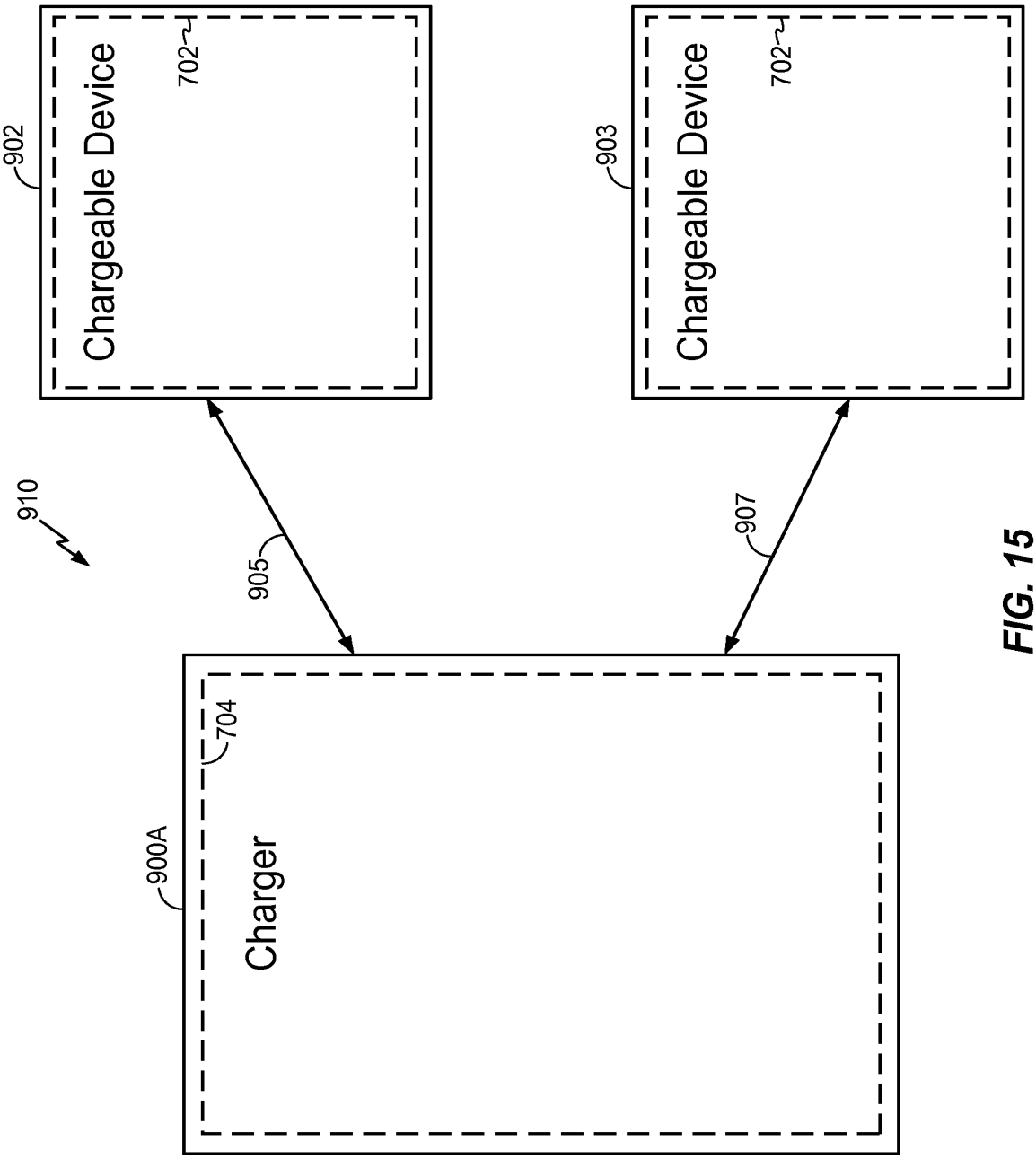

Chargeable Device
702
902
Chargeable Device
702
903
910
905
907
704
900A
Charger

FIG. 15

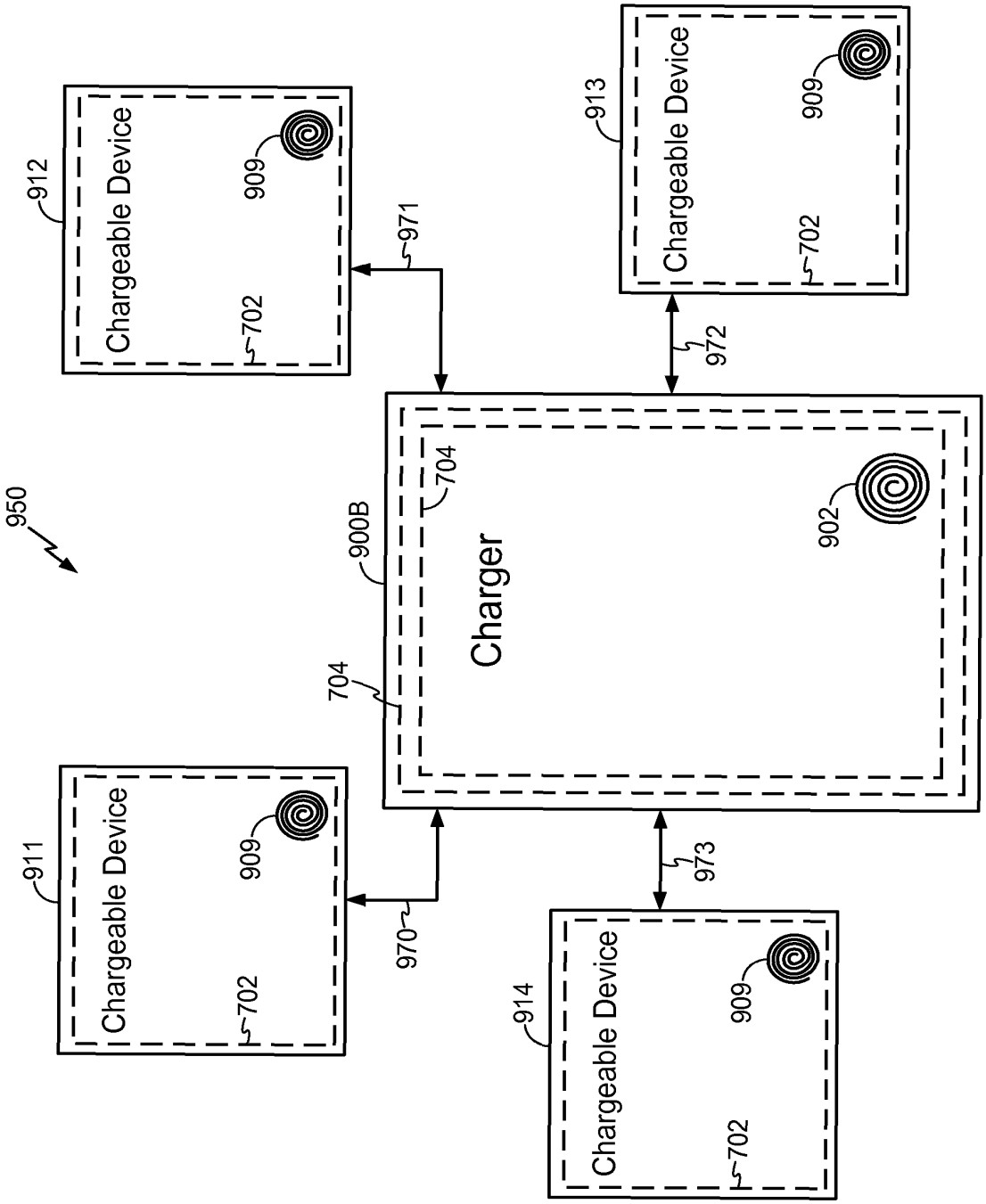

950
900B
Charger
704
902
912
Chargeable Device
909
702
971
913
Chargeable Device
909
702
972
911
Chargeable Device
909
702
970
914
Chargeable Device
909
702
973

FIG. 16

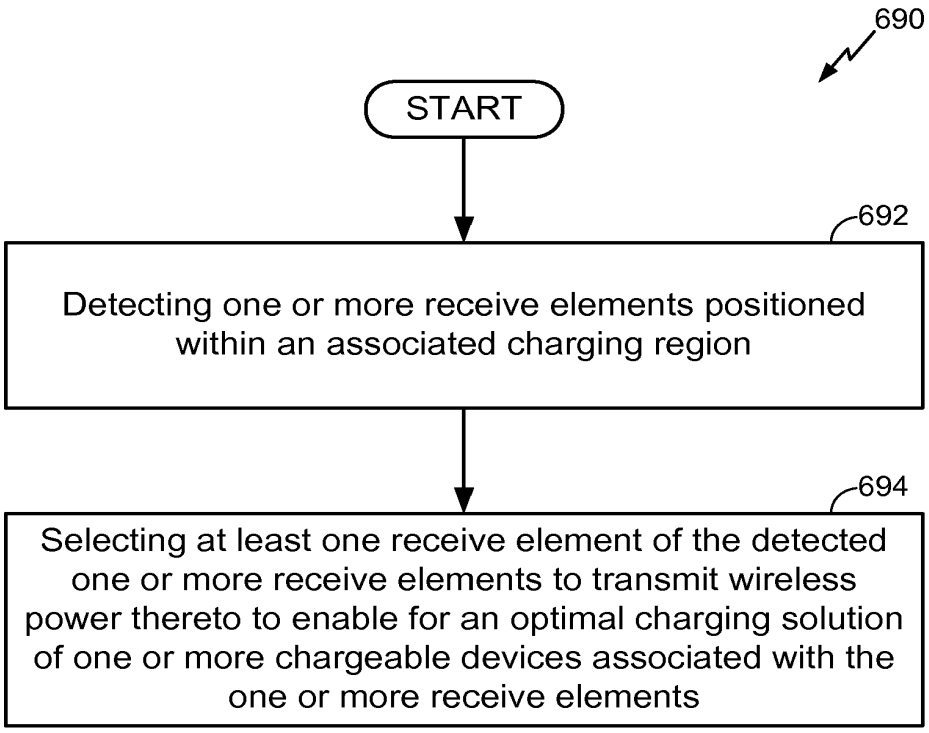

690
START
692
Detecting one or more receive elements positioned within an associated charging region
694
Selecting at least one receive element of the detected one or more receive elements to transmit wireless power thereto to enable for an optimal charging solution of one or more chargeable devices associated with the one or more receive elements

FIG. 17

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- WO 2008125072 A1 **[0005]**
- US 20090039828 A1 **[0006]**
- US 24987308 **[0044]**
- US 24986108 **[0044]**
- US 24986608 **[0045]**

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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
5 January 2006 (05.01.2006)

PCT

(10) International Publication Number
WO 2006/001557 A1

(51) International Patent Classification[7]: H02J 7/02

(21) International Application Number:
PCT/KR2004/002263

(22) International Filing Date:
7 September 2004 (07.09.2004)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10-2004-0048286 25 June 2004 (25.06.2004) KR

(71) Applicant *(for all designated States except US)*: **HANRIM POSTECH CO., LTD.** [KR/KR]; 626-1 Pajang-dong, Jangan-gu, Suwan-si, Gyeonggi-do 440-290 (KR).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **JUNG, Chun-Kil** [KR/KR]; 77-9 Nonhyeong-dong, Gangnam-gu, Seoul 135-010 (KR). **KOOK, Yoon-Sang** [KR/KR]; 123-102 Jugong Apartment, 37 Jungang-dong, Gwacheon-si, Gyeonggi-do 427-010 (KR).

(74) Agent: **KIM, Sung-Gyu**; 4th FL. Jangan Bldg., 827-3 Yoksam-dong, Kangnam-gu, Seoul 135-080 (KR).

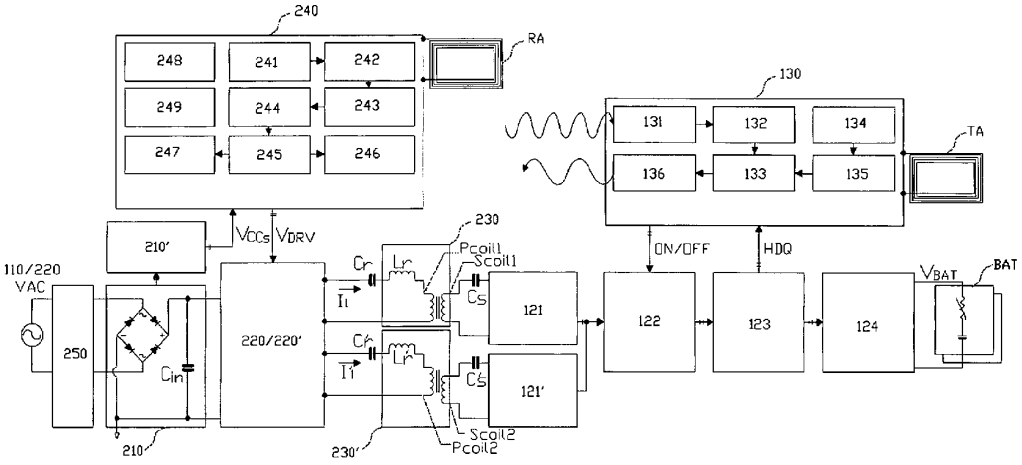
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KZ, LC, LK, LR, LS,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

(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, HU, IE, IT, LU, MC, NL, 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:
— *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.

(54) Title: WIRELESS CHARGING PAD AND BATTERY PACK USING RADIO FREQUENCY IDENTIFICATION TECHNOLOGY



(57) Abstract: The present invention relates to a wireless charging pad and a battery pack, to which a radio frequency identification technology is applied, which can detect the charged status of the battery pack in real time, and which includes a means for detecting devices placed on the wireless charging pad. Thus effectively coping with the case where a plurality of battery packs, or an object that cannot be charged, is placed on the wireless charging pad.

WO 2006/001557 A1

DESCRIPTION

WIRELESS CHARGING PAD AND BATTERY PACK USING RADIO FREQUENCY IDENTIFICATION TECHNOLOGY

Technical Field

The present invention relates, in general, to a wireless charging pad and a battery pack to which a radio frequency identification technology is applied and, more particularly, to a wireless charging pad and a battery pack, to which a radio frequency identification technology is applied, which can detect the charged status of the battery pack in real time, and which includes a means for detecting devices placed on the wireless charging pad, thus effectively coping with the case where a plurality of battery packs, or an object that cannot be charged, is placed on the wireless charging pad.

Background Art

Recently, with the development of communication and information processing technologies, the use of portable devices that are convenient to carry, such as a mobile phone, is increasing, and with the development of technologies, new model terminals having improved efficiency are continuously popularized. To charge such portable devices, a contact type charging method is used,

or a non-contact type charging method in which a battery is charged using magnetic coupling without electrical contact is used so as to overcome the problem of the contact type charging method that is attributable to the exposure of contact terminals to an outside.

As for technology corresponding to a non-contact charger, a method of charging a battery through wireless communication between a battery pack and a charging device using magnetic cores is disclosed in Korean Unexamined Pat. Pub. No. 2002-0035242 entitled "Non-contact Charging Device for Battery of Portable Device using Inductive Coupling," and a method of solving a problem of a magnetic core using a transformer formed in such a way that coils are wound on a Printed Circuit Board (PCB) is disclosed in Korean Unexamined Pat. Pub. No. 2002-0057469 entitled "Thin PCB Transformer without Core and Non-contact Battery Charger using PCB Transformer."

The present applicant proposed the technology in which a wireless charging pad for functioning as a wireless charger was constructed and the battery pack of a portable device was charged in a non-contact manner by placing the battery pack on the wireless charging pad through "Non-contact Battery Charging System capable of Multi-Charging and Method of Designing Core Block" (Korean Pat. application No. 2004-21335).

However, in the prior art, the wireless charging pad

could not detect the charged status of the battery pack in real time and a means for detecting devices placed on the wireless charging pad was not implemented, so that a problem arises in that the prior art is difficult to cope with the case where a plurality of battery packs, or an object that cannot be charged, is placed on a wireless charging pad.

Description of Drawings

FIG. 1 is a view showing the construction of a battery pack charged by a wireless charging pad in a non-contact manner, according to the present invention;

FIG. 2 is a view showing the entire construction of a non-contact battery charging system composed of the wireless charging pad and the battery pack, according to the present invention;

FIGS. 3 to 5 are views illustrating the components of the wireless charging pad or battery pack, according to the present invention;

FIG. 6 is a view showing a method of generating a magnetic field based on the switching patterns of the wireless charging pad, according to the present invention;

FIG. 7 is a view showing the size expansion of the wireless charging pad according to the number of charging devices, according to the present invention;

FIG. 8 is a view showing the detailed construction of

the non-contact battery charging system composed of the wireless charging pad and the battery pack, according to the present invention;

FIG. 9 is a flowchart showing a method of charging a battery using the wireless charging pad of FIG. 8;

FIGS. 10 and 11 are views showing the equivalent circuits of series and parallel resonant converters, respectively, provided to the wireless charging pad of the present invention;

FIGS. 12 to 17 are views showing the operation of a half-bridge series resonant converter provided to the wireless charging pad of the present invention, according to modes;

FIG. 18 is a view showing the voltage and current waveforms of a transformer according to the gate signal of the half-bridge series resonant converter provided to the wireless charging pad of the present invention;

FIG. 19 is a view showing the rotating directions of a magnetic field according to the operation of the half-bridge series resonant converter provided to the wireless charging pad of the present invention, according to modes;

FIGS. 20 to 23 are views showing the rectifying circuits of a charging receiver module according to the present invention;

FIG. 24 is a view showing the construction of a controller provided to the wireless charging pad of the

present invention; and

FIG. 25 is a view showing the flow of an RF signal between the wireless charging pad and the battery pack according to the present invention.

Disclosure

Technical Problem

Accordingly, the present invention has been made keeping in mind the above problems occurring in the prior art, and an object of the present invention is to provide a wireless charging pad and a battery pack, to which a radio frequency identification technology is applied, which can detect the charged status of the battery pack in real time, and which includes a means for detecting devices placed on the wireless charging pad, thus effectively coping with the case where a plurality of battery packs, or an object that cannot be charged, is placed on the wireless charging pad.

Technical Solution

In order to accomplish the above objects, the present invention provides a wireless charging pad (200) for charging a battery pack (100) mounted on a portable device in a non-contact manner, to which a radio frequency identification technology is applied, including a controller (240) for switching to an active mode and

controlling drive circuits (220 and 220') while standing by in an energy saving mode when access of the battery pack (100) is detected, for transmitting a Radio Frequency (RF) carrier signal to the battery pack (100) in the active mode, receiving RF data, which is modulated and includes wireless identification information and charged status information of the battery pack (100), through a reader antenna (RA) in response to the RF carrier signal, and indicating the charged status of the battery pack (100), and for switching to the energy saving mode again when charging of the battery pack (100) is completed; the drive circuits (220 and 220') for switching two primary coils (Pcoil1 and Pcoil2) under control of the controller (240); and a primary-side transformer formed by constructing a pad core, which is adapted to generate induced electromotive force through switching of the drive circuits (220 and 220') and charge the battery pack (100), and which is formed by connecting a plurality of small cobalt-based amorphous metallic or ferrite planar cores in a square or rectangular shape, and winding two primary coils (Pcoil1 and Pcoil2) on the pad core in directions perpendicular to each other.

Preferably, the controller (240) may read wireless identification information and charged status information of each of battery packs (100) in order in which the battery packs (100) are placed, indicate charged status of

each battery pack (100), and switch to the energy saving mode when charging of all the battery packs (100) are completed, and therefore, fully charged status may be established.

Preferably, the controller (240) may include an oscillator (241) for generating an oscillation signal of a certain frequency; an antenna driver (242) for using the oscillation signal of the oscillator (241) as a clock, monitoring the access of the battery pack (100) by transmitting the RF carrier signal to an outside through the reader antenna (RA) and monitoring whether a return signal exists, and wirelessly receiving RF data, which is modulated and includes the wireless identification information and charged status information of the battery pack (100), in response to the RF carrier signal when the battery pack (100) makes access; a demodulator (243) for demodulating the RF data received by the antenna driver (242); a filter and amplification unit (244) for filtering the wireless identification information and charged status information from the demodulated data and amplifying the filtered information; a data decoder (245) for decoding the wireless identification information and the charged status information received by the filter and amplification unit (244); and a display unit (247) for displaying the data decoded by the data decoder (245).

Preferably, the drive circuits (220 and 220') may

include two half-bridge series-parallel resonant converters to control the primary coils (Pcoil1 and Pcoil2) perpendicular to each other, and switch the primary coils (Pcoil1 and Pcoil2) at a frequency higher than a resonant point so that switching patterns of the primary coils (Pcoil1 and Pcoil2) have a phase difference of 90 degrees, thus allowing linkage flux to vary while rotating in a sequence of 180°→ 135°→ 90°→ 45°→ 0°→ -45°→ -90°→ -135°, and thereby, generating a magnetic field that rotates by 360 degrees.

Preferably, the wireless charging pad may further include an electromagnetic wave filter (250) combined with a power input terminal to block electromagnetic waves from Alternating Current (AC) power input; an AC/Direct Current (DC) conversion circuit (210) for receiving the AC power, the electromagnetic waves of which are blocked, from the electromagnetic wave filter (250) and rectifying the AC power into DC power; and a flyback converter (210') connected to the AC/DC conversion circuit (210) and the controller (240) to accumulate power while a transistor is turned on and transmit the accumulated power to the controller (240) when the transistor is turned off so as to drive the drive circuits (220 and 220').

Preferably, the wireless charging pad (200) may include input ports that are combined with at least one of an AC adapter, a Universal Serial Bus (USB) port and a

cigar lighter jack for a vehicle.

The present invention provides a battery pack (B) mounted on a portable device to be charged by a wireless charging pad (A) in a non-contact manner, to which a radio frequency identification technology is applied, including a charging receiver module (110) formed of an amorphous metallic planar core and two secondary coils (Scoil1 and Scoil2), which are wound on the planar core in vertical and horizontal directions, to induce power through magnetic coupling with the wireless charging pad (200); a charging protection circuit module (120) combined with the charging receiver module (110) and the battery (BAT) to record charged status information generated by periodically monitoring charged status of the battery (BAT) in an Radio Frequency Identification (RFID) tag (130), and to control whether to charge or discharge the battery (BAT) by selectively supplying or blocking the power induced to the charging receiver module (110) to the battery (BAT); the RFID tag (130) combined with the charging protection circuit module (120) to store wireless identification information of the battery (BAT), to periodically record the charged status information, and to generate and modulate RF data including the wireless identification information and charged status information of the battery (BAT) and transmit the modulated RF data to the wireless charging pad (200) when an RF carrier signal is transmitted

from the wireless charging pad (200) through a tag antenna (TA); and the battery (BAT) to be charged under control of the protection circuit (124).

Preferably, the wireless charging pad may further include an amorphous metallic electromagnetic protector (140) for minimizing a rise in temperature of the battery (BAT) attributable to frequency interference, which is caused by radio signals or induced electromotive force in a magnetic field, or attributable to inductive heating, by magnetically blocking a gap between the battery (BAT) and the charging receiver module (110).

Preferably, the wireless charging pad may further include a battery casing (150) manufactured using a cool polymer to perform an operation of emitting heat generated due to charging while admitting the induced electromotive force, and to entirely surround a structure that is formed by assembling the components.

Preferably, the charging protection circuit module (120) may include rectifying circuits 121 and 121' for rectifying the power induced to the charging receiver module (110) and supplying the rectified power to a charging control circuit (122); the charging control circuit (122) combined with the rectifying circuits (121 and 121') to supply the power rectified by the rectifying circuits (121 and 121') to a fuel gauge (123) under On/Off control of the RFID tag (130); the fuel gauge (123) for

supplying the power supplied from the charging control circuit (122) to the battery (BAT) through a protection circuit (124), and generating the charged status information while monitoring the charged status of the battery (BAT), and periodically recording the charged status information in the RFID tag (130); and the protection circuit (124) combined with the fuel gauge (123) and the battery (BAT) to protect the battery (BAT) by controlling whether to charge or discharge according to the charged status of the battery (BAT).

Preferably, the rectifying circuits (121 and 121') may be series-parallel resonant center tap half-bridge rectifying circuits using an output of a single center tap rectifying diode and an output filter capacitor, or series-parallel resonant full-bridge rectifying circuits using an output of a full-bridge rectifying diode and an output filter capacitor.

Preferably, the RFID tag (130) may include a clock extraction unit (131) for extracting a clock from the RF carrier signal wirelessly received from the wireless charging pad (200); a sequencer (132) for inspecting an sequence of arranged data extracted from the clock extraction unit (131) and transmitting a control signal to a data encoder (133); the data encoder (133) for receiving the wireless identification information and charged status information of the battery (BAT) from a tag (135) when the

control signal is transmitted from the sequencer (132), and transmitting the wireless identification information and charged status information to a data modulator (136) after coding the wireless identification information and charged status information; the data modulator (136) for generating RF data generated by modulating the data received from the data encoder (133), and wirelessly transmitting the RF data to the wireless charging pad (200); Read Only Memory (ROM) (134) for recording the wireless identification information and charged status information therein; and the tag (135) for reading the wireless identification information and charged status information of the battery (BAT) stored in the ROM (134), and transmitting the wireless identification information and charged status information to the data encoder (133).

Preferably, the wireless identification information may correspond to one of a product name of the battery (BAT), a serial number of the battery (BAT) and a user identification number that is stored in the RFID tag (130) through communication between a body of a portable device, on which the battery pack (100) is mounted, and the battery pack (100).

Preferably, the RF carrier signal may be a signal that accesses an RFID signal stored in the battery pack (100) using a carrier signal in High Frequency (HF) (3 to 30 MHz) or Ultra High Frequency (UHF) (300 to 3000 MHz)

bands.

Advantageous Effects

As described above, the present invention is advantageous in that there is provided a wireless charging pad and a battery pack, to which a radio frequency identification technology is applied, which can detect the charged status of the battery pack in real time, and which includes a means for detecting devices placed on the wireless charging pad, thus effectively coping with the case where a plurality of battery packs, or an object that cannot be charged, is placed on the wireless charging pad.

Best Mode

Preferred embodiments of the present invention are described in detail with reference to the attached drawings below, but detailed descriptions of related well-known functions and construction may be omitted if the detailed descriptions are determined to make the gist of the present invention unclear.

FIG. 1 is a view showing the entire construction of a battery pack charged by a wireless charging pad in a non-contact manner, according to the present invention.

Referring to FIG. 1, a battery pack 100 includes a charging receiver module 110 provided with secondary coils Scoil1 and Scoil2 to receive induced electromotive force

from a primary-side wireless charging pad 200 (refer to FIG. 2), a charging protection circuit module 120 and a battery BAT having fuel gauge and charging functions, an RFID tag 130 (refer to FIG. 2) and a tag antenna TA adapted to transmit and receive radio signals, and an electromagnetic protector 140 that is an amorphous metal-based electromagnetic interference shield for magnetically isolating the battery BAT and the charging receiver module 110 so that the battery BAT does not affect the inductive coupling between the receiver module 110 and the wireless charging pad 200 (refer to FIG. 2).

The electromagnetic protector 140 is made of an amorphous metal-based magnetic material to remove frequency interference in a magnetic field attributable to radio signals and induced electromotive force, and generally functions to minimize a rise in temperature of the battery BAT in a magnetic field attributable to inductive heating caused by a metallic battery casing, so that the electromagnetic protector 140 must be inserted.

The battery pack 100 may further include the battery casing 150 for surrounding all the components, such as the charging receiver module 110, the charging protection circuit module 120, the battery BAT and the electromagnetic protector 140, combined into a single structure. In this case, the battery casing 150 is manufactured using a cool polymer material, such as cobalt or nickel, so that the

battery casing 150 functions to pass the induced electromotive force or electromagnetic waves, and emit heat generated inside the battery casing 150 due to charging.

FIG. 2 is a view showing the construction of a non-contact battery charging system composed of the wireless charging pad and the battery pack, according to the present invention.

Referring to FIG. 2, the non-contact battery charging system composed of the wireless charging pad and the battery pack separately comprises the wireless charging pad 200 adapted to function as a non-contact charger and the battery pack 100 charged with power provided by the wireless charging pad 200. A separative transformer is provided between the wireless charging pad 200 and the battery pack 100 so that a primary side of the transformer is provided in the wireless charging pad 200 and a secondary side of the transformer is provided in the battery pack 100.

The battery pack 100 includes the charging receiver module 110, the charging protection circuit module 120, the RFID tag 130, the tag antenna TA and the battery BAT that constitute the secondary side of the transformer.

The charging receiver module 110 receives the power induced from the wireless charging pad 200 and supplies the power to the charging protection circuit module 120.

The charging protection circuit module 120 having

fuel gauge and charging functions includes rectifying circuits 121 and 121' for rectifying the power supplied from the charging receiver module 110 by performing AC/DC conversion, a switch mode charging control circuit 122 for charging the battery BAT made of lithium ion or lithium polymer at Constant Voltage (CV) and Constant Current (CC), and a protection circuit 124 for detecting the charged status of the battery BAT and determining whether to supply or block the power supplied to the battery BAT from the charging control circuit 122 so as to protect the battery BAT. The charging protection circuit module 120 is constructed in such a way that the output of the charging receiver module 110 is the input of the rectifying circuits 121 and 121' and the output of the rectifying circuits 121 and 121' is connected to the input of the switch mode charging control circuit 122. Furthermore, the output of the charging control circuit 122 is connected to a fuel gauge 123, and the fuel gauge 123 is connected to the protection circuit 124 that protects the battery BAT from excessive charging and excessive current. Such components are mounted in the battery pack 100 of a portable device, and can be applied to a hard pack or an inner pack according to the type of the battery pack 100.

The wireless charging pad 200 functioning as a non-contact charger has various input ports having DC inputs, so that the wireless charging pad 200 can be used in

connection with various types of external power sources (e.g., the output of an AC adapter, a USB port of a computer, cigar lighter jack of a vehicle, etc.). In the wireless charging pad 200, the primary side of the transformer is provided, switching loss is reduced through zero voltage and zero current soft switching by switching at a frequency higher than a resonant point using a half-bridge resonant converter, and linkage flux is induced to the battery pack 100 of a portable device that constitutes a secondary side. Furthermore, the wireless charging pad 200 has a function of detecting the wireless identification information of the battery BAT and indicating charged status information on the wireless charging pad 200 through radio communication when the battery pack 100 equipped with the charging receiver module 110 is placed on the wireless charging pad 200, and a function of entering a shutdown mode and an energy saving mode when an object other than a battery pack 100 is placed on the wireless charging pad 200. Furthermore, when a plurality of portable devices is placed on the wireless charging pad 200, the wireless charging pad 200 reads the wireless identification information (e.g., personal phone numbers, etc.) stored in the RFID tag 130, indicates the wireless identification information on the wireless charging pad 200, indicates charged status, and indicates charging completion status on the wireless charging pad 200 after receiving information

on the completion of charging from the battery pack 100.

The RFID tag 130 and the tag antenna TA function to interface with the fuel gauge 123 that controls the charged status information of the battery BAT and transmit the charged status information of the battery BAT to the wireless charging pad 200 in a radio data form using a radio frequency in HF (13.56MHz) or UHF (900MHz) bands. The RFID tag 130 includes a memory block and a logic block, and stores the wireless identification information, such as a product name, a serial number and a user identification number (e.g., personal telephone number), therein. In this case, the user identification number is stored in the memory block of the RFID tag 130 through the communication between the terminal body of the portable device and the battery pack 100.

FIGS. 3 and 4 are views illustrating the components of the wireless charging pad and the battery pack according to the present invention, respectively.

Referring to FIG. 3, the wireless charging pad 200 according to the present invention includes a controller 240 for reading the RFID tag and controlling charging, drive circuits 220 and 220', and primary coils Pcoil1 and Pcoil2.

The wireless charging pad 200 may include various input ports having DC inputs, and generates the switching patterns of the primary coils Pcoil1 and Pcoil2 through the

drive circuits 220 and 220', respectively, and performs a control function of detecting portable devices placed on the wireless charging pad 200 and indicating the energy saving mode and the charged status of each of the portable devices. The drive circuits 220 and 220' are On/Off switching devices for switching the primary coils Pcoil1 and Pcoil2, respectively, each of which is composed of an upper switch and a lower switch. The drive circuits 220 and 220' are each constructed using a half-bridge or full-bridge resonant converter (serial, parallel or serial-parallel resonant converter).

Referring to FIG. 4, in the wireless charging pad 200 according to the present invention, the primary side of the transformer is constructed in such way that the two primary coils Pcoil1 and Pcoil2 are wound on a planar core, which is formed by combining small cobalt-based amorphous metallic cores, such as Co, Fe, Ni, B and Si, or ferrite cores in various shapes, in directions perpendicular to each other as shown in FIG. 4. In this case, the switching patterns perform switching so that a phase difference of 90 degrees occurs between the two primary coils Pcoil1 and Pcoil2. Accordingly, induced energy can be received regardless of the location of the portable device that is placed on the wireless charging pad 200 and has the battery pack 100 equipped with the charging receiver module 100.

The input form of the wireless charging pad 200 is

described below.

A control power source supplies the driving power of the controller 240 and the drive circuits 220 and 220' using a flyback converter in a 110/220 V direct drive fashion. In the resonant converter, DC power obtained by rectifying AC power in a 110/220 V switching fashion is always set to a 110 V input condition. DC power (12, 24, 48 V) is generated using the flyback converter for free voltages ranging from 86 to 265 V and is used as the input power of the resonant converter, and forms the driving power of the controller 240 and the drive circuits 220 and 220' using a regulator.

The controller 240 performs both a function of reading an RFID tag and a function of controlling charging. The construction of the controller 240 is described below.

First, a controller 240 is provided to detect the battery pack 100 equipped with the charging receiver module 110 and control charging. Wireless identification information, such as the product code and serial number of the battery BAT, and charged status information are read from the RFID tag 130 of the battery pack 100 through the controller 240. Furthermore, when the battery pack 100 equipped with the charging receiver module 110 is placed on the wireless charging pad 200 while the controller 240 in a sleep mode is maintained in a standby mode (energy saving mode: below 1 W) and monitors the battery pack 100, the

controller 240 wakes up and switches to an active mode to generate induced electromotive force by controlling the drive circuits 220 and 220', starts to charge the battery pack 100, and indicates the charged status of the battery pack 100. When the charging of the battery pack 100 is completed, the wireless charging pad 200 switches from the active mode to the energy saving mode again to save energy.

Second, when a plurality of battery packs 100 each equipped with a charging receiver modules 110 is placed on the wireless charging pad 200, wireless identification information stored in the RFID tags 130 of the battery packs 100 is read in order in which the battery packs 100 are placed. Furthermore, a fully charged battery pack 100 is indicated by a green Light Emitting Diode (LED) and a discharged battery pack 100 is indicated by a red LED. When the battery pack 100 is fully charged, the LED switches from red to green by receiving the wireless identification information of the RFID tag 130 so that the charged status is indicated by the wireless charging pad 200.

The construction of the drive circuits 220 and 220' is described below.

Two resonant converters control perpendicularly arranged primary coils Pcoil1 and Pcoil2, respectively, and the primary coils Pcoil1 and Pcoil2 are switched at a frequency higher than a resonant point so that the switching patterns of the primary coils have a phase

difference of 90 degrees. Accordingly, linkage flux rotates by 360 degrees in eight steps, thus enabling the battery pack 100 to be charged regardless of the location of the battery pack 100.

The construction of the primary side of the transformer is described below.

A single square or rectangular pad core is formed by connecting a plurality of small planar cores, is surrounded by an insulation tape, is provided with a coil wound thereon in a vertical direction, and is insulated by an insulation tape. Furthermore, the pad core is provided with a coil wound thereon in a horizontal direction and is insulated by an insulation tape, thus manufacturing the primary side of a planar transformer. In this case, the coil may be formed into a bobbinless type and be inserted into the pad core in vertical and horizontal directions. The charging receiver module 110 is operated as the secondary side of the transformer.

FIG. 5 is a view showing the charging receiver module 110. The charging receiver module 110 is manufactured in such a way that a plurality of cobalt-based amorphous metallic cores is stacked to form a single planar core, and secondary coils Scoil1 and Scoil2 are wound on the single planar core in vertical and horizontal directions, respectively. In this case, the planar core is made of an amorphous metal-based material that has high magnetic

permeability (>80,000) and a non-breakable characteristic. In the charging receiver module 110, the magnitude of induced electromotive force varies according to a function of the number of stacked cores forming the planar core, the sectional area of the planar core and the number of windings of the coils. The charging receiver module 110 has a load curve in which voltage is inversely proportional to current.

FIG. 6 is a view showing a method of generating a magnetic field depending on the switching patterns of the wireless charging pad according to the present invention.

In the wireless charging pad 200, a magnetic field rotates by 360 degrees in the case where current is applied by successively switching regions in the sequence of a first region→ a second region→ a third region→ a fourth region→ a fifth region→ a sixth region→ a seventh region→ an eighth region at a predetermined frequency, thus enabling a portable device equipped with the charging receiver module 110 to be charged regardless of the location and direction of the portable device when the portable device is placed on the wireless charging pad 200 (the magnetic field is rotated by 180°→ 135°→ 90°→ 45°→ 0°→ -45°→ -90°→ -135°). In this case, the drive circuits 220 and 220' include two half-bridge series-parallel resonant converters to control the perpendicularly arranged primary coils Pcoil1 and Pcoil2, respectively, and switch

the primary coils Pcoil1 and Pcoil2 at a frequency higher than a resonant point so that the switching patterns of the primary coils Pcoil1 and Pcoil2 have a phase difference of 90 degrees, thus allowing linkage flux to vary while rotating by 360 degrees in the sequence of 180°→ 135°→ 90°→ 45°→ 0°→ -45°→ -90°→ -135°, and thereby, generating a magnetic field that rotates by 360 degrees.

FIG. 7 is a view showing the size expansion of the wireless charging pad according to the number of charging devices, according to the present invention.

In a process of forming a pad core constituting the wireless charging pad 200, a wireless charging pad 200 having a desired size and shape can be formed by combining a plurality of small cobalt-based metallic or ferrite planar cores. For example, a pad core is formed by combining m cores in a longitudinal direction and n cores in a transverse direction according to the number of portable devices desired to be charged.

FIG. 8 is a view showing the detailed construction of a non-contact battery charging system composed of the wireless charging pad and the battery pack according to the present invention.

As shown in FIG. 8, a primary-side wireless charging pad 200 and a secondary-side battery pack 100 equipped with the charging receiver module 110 are magnetically combined with each other.

The primary-side wireless charging pad 200 includes a power input terminal, an AC/DC conversion circuit 210, a controller 240 for detecting wireless identification information transmitted from the secondary side, two half-bridge serial-parallel resonant converters, drive circuits 220 and 220′ for generating a magnetic field by generating control signals for controlling the two primary coils Pcoil1 and Pcoil2, respectively, a primary-side transformer constructed by winding the two primary coils Pcoil1 and Pcoil2 on the pad core in vertical and horizontal directions, respectively, and inductive couplers 230 and 230′ formed by providing L_r and L_r' to the corresponding primary-side transformer.

Furthermore, the primary-side wireless charging pad 200 may further include an electromagnetic wave filter 250 connected to the power input terminal for the purpose of blocking the electromagnetic waves of input AC power, and a flyback converter 210′ connected to the AC/DC conversion circuit 210 for receiving the AC power, the electromagnetic waves of which are blocked, from the electromagnetic wave filter 250 and rectifying the AC power into DC power and the controller 240 for the purpose of accumulating power while an equipped transistor is turned on and transmitting the accumulated power to the controller 240 when the equipped transistor is turned off so as to enable the drive circuits 220 and 220′ to be driven.

The secondary-side battery pack 100 includes a receiver module 110 composed of an amorphous metallic planar core and two secondary coils Scoil1 and Scoil2 that are wound on the planar core in vertical and horizontal directions, respectively, to be magnetically combined with the wireless charging pad 100, thus inducing induced electromotive force; a charging protection circuit module 120 for generating charged status information by periodically monitoring the charged status of a battery BAT, recording the generated charged status information in an RFID tag 130 and controlling whether to charge or discharge the battery BAT by selectively supplying or blocking the power, which is induced to the charging receiver module 110, to the battery BAT under the On/Off control of the RFID tag 130; the RFID tag 130 combined with the charging protection circuit module 120 to store the wireless identification information of the battery BAT and periodically record the charged status information therein, generate and modulate RFID data including the wireless identification information and charged status information of the battery BAT and transmit the modulated RFID data to the wireless charging pad 200 in response to an RFID carrier signal transmitted from the wireless charging pad 200 through a tag antenna TA; and the battery BAT to be charged under the control of the protection circuit 124.

The charging protection circuit module 120 may

include rectifying circuits 121 and 121' adapted to rectify the power induced to the charging receiver module 110 and supply the rectified power to a charging control circuit 122, the charging control circuit 122 combined with the rectifying circuits 121 and 121' to supply the power, rectified by the rectifying circuits 121 and 121' under the On/Off control of the RFID tag 130, to a fuel gauge 123, the fuel gauge 123 adapted to supply the power supplied from the charging control circuit 122 to the battery BAT through the protection circuit 124, and generate the charged status information by monitoring the charged status of the battery BAT and periodically record the charged status information in the RFID tag 130, and the protection circuit 124 combined with the fuel gauge 123 and the battery BAT to protect the battery BAT by controlling whether to charge or discharge in accordance with the charged status of the battery BAT.

When the RFID carrier signal is transmitted from the wireless charging pad 200 through the tag antenna TA, the RFID tag 130 generates and modulates RFID data that includes previously stored wireless identification information of the battery BAT and charged status information, which is periodically recorded through the fuel gauge 123, in response to the RFID carrier signal, and transmits the modulated RFID data to the wireless charging pad 200. In this case, the RFID tag 130 is composed of a

memory block and a logic block. The memory block can be implemented using ROM 134 in which the wireless identification information and the charged status information are recorded. It is preferable to use Electrically Erasable and Programmable Read Only Memory (EEPROM) as the ROM 134. The logic block can be implemented using a clock extraction unit 131 for extracting a clock from the RFID carrier signal that is wirelessly received from the wireless charging pad 200, a sequencer 132 for inspecting the sequence of arranged data extracted from the clock extraction unit 131 and transmitting a control signal to a data encoder 133, the data encoder 133 for receiving the wireless identification information and charged status information of the battery BAT from a tag 135 when the control signal is transmitted from the sequencer 132, encoding the received information and transmitting the encoded information to a data modulator 136, the data modulator 136 for generating the modulated RFID data by modulating the data received from the data encoder 133 and wirelessly transmitting the modulated RFID data to the wireless charging pad 200, and the tag 135 for reading the wireless identification information and charged status information of the battery BAT stored in the ROM 134 and transmitting the wireless identification information and charged status information to the data encoder 133.

FIG. 9 is a flowchart showing a method of charging a

battery through the wireless charging pad of FIG. 8. The method of charging a battery using the wireless charging pad 200 according to the present invention is described with reference to FIG. 9 below.

Step S100) First, when the secondary-side battery pack 100 is placed on the primary-side wireless charging pad 200, the primary-side wireless charging pad 200 generates an RFID carrier signal and inspects an object placed on the wireless charging pad 200.

Step S110) If, as a result of the inspection, the object does not contain information indicating that the object is a battery pack 100 equipped with a charging receiver module 110, the primary-side wireless charging pad 200 always enters an energy saving mode.

Step S120) If, as a result of the inspection, the object contains information indicating that the object is a battery pack 100 equipped with a charging receiver module 110, the wireless charging pad 200 wakes up to detect wireless identification information and starts charging control.

Step S130) Wireless identification information about the battery pack 100 of each of various portable devices is displayed, and whether the battery pack 100 is in charging status or fully charged status is indicated after receiving charged status information. The battery 100 in fully charged status that indicates charging is completed is

indicated by a green LED, and the battery 100 being charged is indicated by a red LED.

Step S140) When the fully charged status in which the charging of all the battery packs 100 are completed is established, the wireless charging pad 200 collects the wireless identification information and enters a standby mode, that is, the energy saving mode.

FIGS. 10 and 11 are views showing the equivalent circuits of series and parallel resonant converters provided to the wireless charging pad according to the present invention.

FIGS. 10 and 11 are views showing the equivalent circuits of a separative transformer that has a gap between the wireless charging pad 200 and the battery pack 100. In a non-contact type charging method in which energy is transmitted using the magnetic coupling of the transformer, the primary side of the transformer is included in the wireless charging pad 200 functioning as a non-contact charger and the secondary side of the transformer is included in the battery pack 100, so that a gap exists between the primary and secondary sides, thus causing inefficiency in energy transmission because a coupling coefficient and magnetizing inductance are reduced and leakage inductance is increased. Besides, it is problematic in that it is difficult to electrically transmit output information to a primary-side controller at the time of

controlling feedback. In the present invention, in order to overcome the disadvantages of the separative transformer and effectively transmit energy, a half-bridge serial resonant converter is applied to the primary side of the transformer. The serial resonant converter applied to the primary side of the transformer reduces the influence of leakage inductance on the primary side of the separative transformer, thus enabling effective energy transmission.

The self-inductance L_1 and L_2 are measured in such a way that a secondary-side module is opened and primary-side inductance is measured, and the leakage inductance L_{l1} and L_{l2} are measured in such a way that a secondary-side module is shorted and primary-side inductance is measured.

Mutual inductance L_M is calculated in such a way that impedance L_P is measured by connecting the primary and secondary sides in parallel, impedance L_S is measured by connecting the primary and secondary sides in series, and the measured impedance L_P and L_S are substituted for L_P and L_s of Equation 1,

$$L_M = \frac{L_P - L_S}{4} \quad (1)$$

The magnetizing inductance L_m is measured using Equations 2 to 4,

$$L_m = L_M(\frac{N_1}{N_2}), \quad N = \frac{N_2}{N_1} \tag{2}$$

(N_1: number of primary windings, N_2: number of secondary windings)

$$k = \frac{L_M}{\sqrt{L_1 L_2}} \tag{3}$$

$$L_{l1} = L_1 - L_m, \quad L_{l2} = L_2 - NL_M \tag{4}$$

Voltage imposed in the primary side of the transformer is applied to the primary side of the transformer through the voltage distribution of L_{l1} and L_{l2}, and is transmitted to the secondary side based on a winding ratio. The secondary-side voltage is transmitted to the actual secondary side of the transformer through the voltage distribution of L_{l2} and secondary-side load, so that the voltage gain is lower than that of an ideal transformer.

Furthermore, if the coupling coefficient is low, the magnetizing inductance L_m of the transformer is low, so that current flowing to the primary side of the transformer is not transmitted to the secondary side of the transformer through L_{l2}, but is circulated and transmitted to the first side of the transformer again through the magnetizing inductance L_m that has lower impedance. That is, in order to supply current required by the load, input current must be large. If the primary-side current increases, continuity loss in a switch increases, thus causing the efficiency of

a system to decrease. Accordingly, in order to increase the efficiency of the system by reducing the primary-side current, the coupling coefficient of the transformer must be increased. In the non-contact charger, the primary- and secondary-side cores are separated by a gap, and winding areas are also separated. Furthermore, the gap is located in a path through which magnetic flux passes, so that magnetic resistance is increased, thus lowering the magnetic flux density inside the cores.

When a large gap exists between the primary- and secondary-side cores, magnetic flux density is expressed by Equation 5,

$$B_f = \frac{NI}{\frac{l_f}{\mu_f} + \frac{l_g}{\mu_o}} \approx \frac{\mu_o NI}{l_g} (\mu_f >> \mu_o) \quad (5)$$

(B: magnetic flux density, N: number of windings, I: current flowing through transformer, l_f: length of magnetic path of core, l_g: length of magnetic path in gap, μ_f: magnetic permeability of core, μ_o: magnetic permeability of gap)

The magnetic flux density, when the gap does not exist, is expressed by Equation 6,

$$B_f = \frac{\mu_f NI}{l_f} >> B_f \quad (6)$$

The magnetic permeability of the core is considerably larger than that of air, and the size of the gap is relatively larger than that of the core, so that the magnetic flux density in the case where the gap does not exist has a value considerably higher than that in the case where the gap is large. As a result, in the case of a transformer having a large gap, it is difficult for saturation status to occur inside the core, and also local saturation status is not generated easily. Accordingly, with respect to the shape of a core, a narrow section or protrusion is allowed. Furthermore, the magnetic flux density in the core is low, so that core loss due to hysteresis is also low.

Since the gap is large, the magnetic resistance is increased, so that the inductance of the core is decreased. Accordingly, in order to obtain required magnetizing inductance, the number of windings is increased and a wider winding area is required as a result.

The magnetizing inductance L_m may be expressed by Equation 7,

$$L_m = L_M(\frac{N_1}{N_2}) = \frac{N_1}{N_2}(\frac{N_1 N_2}{R_m}) = \frac{N_1^2}{R_m} \quad (7)$$

(R_m: magnetic resistance, N_1: number of primary windings, N_2: number of secondary windings, L_M: mutual inductance)

That is, since the magnetic resistance R_m is large, the number of windings is increased to obtain the required magnetizing inductance L_M. Generally, the difference between the primary- and secondary-side voltages of a non-contact charger is large, so that a difference in the winding ratio is also large. As a result, since the winding areas of the primary and secondary sides are different and the difference between the winding ratios is large, the shapes of the primary- and secondary-side cores are generally asymmetric.

Most leakage magnetic flux is generated in the gap existing between the primary- and secondary-side cores, so that a section area of the cores opposite to each other must be large to increase the coupling coefficient in the transformer. However, in the case of a transformer used in the non-contact charger, the volume and weight of the secondary-side core are limited because the secondary-side core is located inside the battery pack, so that the section area of the cores opposite to each other is also limited. However, in the present invention, a planar pad core, the section area of which is large in considerations of limited volume and weight, is used.

FIGS. 12 to 17 are views showing the operation of the half-bridge serial resonant converter provided to the wireless charging pad of the present invention, according

to modes.

FIGS. 12 to 17 are views showing the operation of the half-bridge serial resonant converter (upper converter), according to modes.

In FIG. 12, when Q_1 is turned on, current i_1 flows to a transformer through the switch Q_1. In FIG. 13, when the switch Q_1 is turned off, the current i_1 flows while discharging the parallel capacitor of a switch Q_2 and charging the parallel capacitor of the switch Q_1. In FIG. 14, when the voltage of the switch Q_2 is zero (the voltage of the switch Q_1 is input voltage), the current i_1 flows through the parallel diode of the switch Q_2, and the voltage of the switch Q_2 remains at zero. Furthermore, if the switch Q^2 is turned on before the direction of the current i_1 is reversed, Zero Voltage Switching (ZVS) is achieved in the switch Q_2. In FIG. 15, when the direction of the current i_1 is reversed, the current i_1 flows through the switch Q^2. In FIG. 16, when the switch Q^2 is turned off, the current i_1 flows while discharging the parallel capacitor of the switch Q^1 and charging the parallel capacitor of the switch Q^2. In FIG. 17, when the voltage of the switch Q^2 is zero (the voltage of the switch Q^2 is the input voltage), the current i_1 flows through the parallel diode of the switch Q^1, and the voltage of the switch Q^1 remains at zero. Furthermore, when the switch Q^1 is turned on before the direction of the current is restored, the ZVS is achieved

in the switch Q^1.

In order to achieve the ZVS of the switch Q^2, the magnitude of the current i_1 at the time of being changed from FIG. 12 to FIG. 13 must be large enough so that the energy of a magnetic circuit depending on the current i_1 can charge or discharge the parallel capacitor, and the gate signal of the switch Q^2 must be provided before the direction of the current i_1 is reversed. The switch Q^1 can achieve the ZVS using the same principle.

In this case, a resonant frequency considerably affects efficiency. The switching frequency is operated at a frequency close to the resonant frequency, so that the core loss and gap loss of the transformer are reduced if the resonant frequency is low. However, the loss may be increased because magnetic current, that is, the primary-side current of the transformer, is increased. Accordingly, the switching loss attributable to the ZVS is reduced by selecting a switching frequency higher than the resonant frequency.

FIG. 18 is a view showing the voltage and current waveforms of the transformer according to the gate signal of the half-bridge series resonant converter provided in the wireless charging pad of the present invention.

Referring to FIG. 18, square wave voltage identical to the input voltage is applied to the transformer by the gate signals of the switches Q^1 and Q^2, and sine wave current

identical to the current i_1 flows to the transformer through the resonant circuit.

FIG. 19 is a view showing the rotating directions of the magnetic field according to the operation of the half-bridge series resonant converter provided in the wireless charging pad of the present invention, according to modes.

FIG. 20 is a view showing the rotating directions of the magnetic field generated according to the operation of the half-bridge series resonant converter according to modes. Accordingly, since the magnetic field rotates by 360 degrees, induced electromotive force can be transmitted to the secondary side regardless of the location and direction of the battery pack 100 when the battery pack 100 equipped with the charging receiver module 110 is placed on the wireless charging pad 200.

FIGS. 20 to 23 are views showing the rectifying circuits of the charging receiver module according to the present invention.

Referring to FIGS. 20 to 23, the secondary-side charging receiver module 110 transmits power through a series-parallel resonant center tap half-bridge rectifying circuit that uses the output of a single center tap rectifying diode and an output filter capacitor, or through a series-parallel resonant full-bridge rectifying circuit that uses the output of a full-bridge rectifying diode and an output filter capacitor.

FIG. 24 is a view showing the construction of a controller provided in the wireless charging pad of the present invention.

The controller 240 provided in the wireless charging pad 200 of the present invention determines whether a battery pack 100 is placed on the wireless charging pad 200, reads wireless identification information, which is stored in the RFID tag 130, from the battery pack 100 if the battery pack 100 is placed, determines whether the battery pack 100 needs to be charged or how many battery packs 100 are placed, and generates a drive control signal and indicates the charged status of each of the battery packs at the same time.

Referring to FIG. 24, the controller 240 provided in the wireless charging pad 200 of the present invention may include an oscillator 241 for generating an oscillation signal of a certain frequency, an antenna driver 242, a demodulator 243 for demodulating RF data received by the antenna driver 242, a filter and amplification unit 244 for filtering wireless identification information and charged status information from the demodulated data and amplifying the filtered information, a data decoder 245 for decoding the wireless identification information and charged status information received by the filter and amplification unit 244, a driver control unit 246 for performing mode conversion according to the charged status based on the

decoded data, a display unit 247 for displaying the data decoded by the data decoder 245, a timer 248, and a reset unit 249.

The antenna driver 242 uses the oscillation signal of the oscillator 241 as a clock, monitors the access of the battery pack 100, and wirelessly receives RF data, which is modulated and includes the wireless identification information and charged status information of the battery pack 100, in response to an RF carrier signal through the reader antenna RA when the battery pack 100 makes access. In this case, a polling method of periodically transmitting the RF carrier signal to the outside through the reader antenna RA and monitoring whether a return signal exists can be applied as a method of the antenna driver 242 monitoring the access of the battery pack 100.

Furthermore, in the case where a plurality of battery packs 100 is placed, the controller 240 reads the wireless identification information and charged status information of each of the battery packs 100 in order in which the battery packs 100 are placed, indicates the charged status of each of the battery packs 100, and switches from an active mode to an energy saving mode when all the battery packs 100 are completely charged, and thereby, the fully charged status is established.

FIG. 25 is a view showing the flow of the RF signal between the wireless charging pad and the battery pack

according to the present invention.

Referring to FIG. 25, when the controller 240 accesses the RFID tag 130 in the battery pack 100 equipped with the charging receiver module 110 to access information on the battery BAT using a carrier frequency in HF (3 to 30 MHz) or UHF (300 to 3000 MHz) bands, the battery information stored in the memory block of the RFID tag 130 is transmitted to the wireless charging pad 200 in a modulated RF signal form.

The present invention may be modified in various forms without departing from the basic concept of the invention according to the demands of those skilled in the art.

CLAIMS

1. A wireless charging pad (200) for charging a battery pack (100) mounted on a portable device in a non-contact manner, to which a radio frequency identification technology is applied, comprising:

a controller (240) for switching to an active mode and controlling drive circuits (220 and 220') while standing by in an energy saving mode when access of the battery pack (100) is detected, for transmitting a Radio Frequency (RF) carrier signal to the battery pack (100) in the active mode, receiving RF data, which is modulated and includes wireless identification information and charged status information of the battery pack (100), through a reader antenna (RA) in response to the RF carrier signal, and indicating the charged status of the battery pack (100), and for switching to the energy saving mode again when charging of the battery pack (100) is completed;

the drive circuits (220 and 220') for switching two primary coils (Pcoil1 and Pcoil2) under control of the controller (240); and

a primary-side transformer formed by constructing a pad core, which is adapted to generate induced electromotive force through switching of the drive circuits (220 and 220') and charge the battery pack (100), and which is formed by connecting a plurality of small cobalt-based

amorphous metallic or ferrite planar cores in a square or rectangular shape, and winding two primary coils (Pcoil1 and Pcoil2) on the pad core in directions perpendicular to each other.

2. The wireless charging pad according to claim 1, wherein the controller (240) reads wireless identification information and charged status information of each of battery packs (100) in order in which battery packs (100) are placed, indicates charged status of each battery pack (100), and switches to the energy saving mode when charging of all the battery packs (100) are completed, and therefore, fully charged status is established.

3. The wireless charging pad according to claim 1 or 2, wherein the controller (240) comprises an oscillator (241) for generating an oscillation signal of a certain frequency; an antenna driver (242) for using the oscillation signal of the oscillator (241) as a clock, monitoring the access of the battery pack (100) by transmitting the RF carrier signal to an outside through the reader antenna (RA) and monitoring whether a return signal exists, and wirelessly receiving RF data, which is modulated and includes the wireless identification information and charged status information of the battery pack (100), in response to the RF carrier signal when the

battery pack (100) makes access; a demodulator (243) for demodulating the RF data received by the antenna driver (242); a filter and amplification unit (244) for filtering the wireless identification information and charged status information from the demodulated data and amplifying the filtered information; a data decoder (245) for decoding the wireless identification information and the charged status information received by the filter and amplification unit (244); and a display unit (247) for displaying the data decoded by the data decoder (245).

4. The wireless charging pad according to claim 1, wherein the drive circuits (220 and 220') include two half-bridge series-parallel resonant converters to control the primary coils (Pcoil1 and Pcoil2) perpendicular to each other, and switch the primary coils (Pcoil1 and Pcoil2) at a frequency higher than a resonant point so that switching patterns of the primary coils (Pcoil1 and Pcoil2) have a phase difference of 90 degrees, thus allowing linkage flux to vary while rotating in a sequence of 180°→ 135°→ 90°→ 45°→ 0°→ -45°→ -90°→ -135°, and thereby, generating a magnetic field that rotates by 360 degrees.

5. The wireless charging pad according to claim 1, further comprising:

an electromagnetic wave filter (250) combined with a

power input terminal to block electromagnetic waves from Alternating Current (AC) power input; an AC/Direct Current (DC) conversion circuit (210) for receiving the AC power, the electromagnetic waves of which are blocked, from the electromagnetic wave filter (250) and rectifying the AC power into DC power; and a flyback converter (210') connected to the AC/DC conversion circuit (210) and the controller (240) to accumulate power while a transistor is turned on and transmit the accumulated power to the controller (240) when the transistor is turned off so as to drive the drive circuits (220 and 220').

6. The wireless charging pad according to claim 1, wherein the wireless charging pad (200) includes input ports that are combined with at least one of an AC adapter, a Universal Serial Bus (USB) port and a cigar lighter jack for a vehicle.

7. The wireless charging pad according to claim 1, wherein the wireless identification information corresponds to one of a product name of the battery (BAT), a serial number of the battery (BAT) and a user identification number that is stored in an Radio Frequency Identification (RFID) tag (130) through communication between a body of a portable device, on which the battery pack (100) is mounted, and the battery pack (100).

8. The wireless charging pad according to claim 1, wherein the RF carrier signal is a signal that accesses an RFID signal stored in the battery pack (100) using a carrier signal in High Frequency (HF) (3 to 30 MHz) or Ultra High Frequency (UHF) (300 to 3000 MHz) bands.

9. A battery pack (B) mounted on a portable device to be charged by a wireless charging pad (A) in a non-contact manner, to which a radio frequency identification technology is applied, comprising:

a charging receiver module (110) formed of an amorphous metallic planar core and two secondary coils (Scoil1 and Scoil2), which are wound on the planar core in vertical and horizontal directions, to induce power through magnetic coupling with the wireless charging pad (200);

a charging protection circuit module (120) combined with the charging receiver module (110) and the battery (BAT) to record charged status information generated by periodically monitoring charged status of the battery (BAT) in an RFID tag (130), and to control whether to charge or discharge the battery (BAT) by selectively supplying or blocking the power induced to the charging receiver module (110) to the battery (BAT);

the RFID tag (130) combined with the charging protection circuit module (120) to store wireless

identification information of the battery (BAT), to periodically record the charged status information, and to generate and modulate RF data including the wireless identification information and charged status information of the battery (BAT) and transmit the modulated RF data to the wireless charging pad (200) when an RF carrier signal is transmitted from the wireless charging pad (200) through a tag antenna (TA); and

the battery (BAT) to be charged under control of the protection circuit (124).

10. The wireless charging pad according to claim 9, further comprising an amorphous metallic electromagnetic protector (140) for minimizing a rise in temperature of the battery (BAT) attributable to frequency interference, which is caused by radio signals or induced electromotive force in a magnetic field, or attributable to inductive heating, by magnetically blocking a gap between the battery (BAT) and the charging receiver module (110).

11. The wireless charging pad according to claim 9 or 10, further comprising a battery casing (150) manufactured using a cool polymer to perform an operation of emitting heat generated due to charging while admitting the induced electromotive force, and to entirely surround a structure that is formed by assembling the components.

12. The wireless charging pad according to claim 9, wherein the charging protection circuit module (120) comprises:

rectifying circuits 121 and 121' for rectifying the power induced to the charging receiver module (110) and supplying the rectified power to a charging control circuit (122); the charging control circuit (122) combined with the rectifying circuits (121 and 121') to supply the power rectified by the rectifying circuits (121 and 121') to a fuel gauge (123) under On/Off control of the RFID tag (130); the fuel gauge (123) for supplying the power supplied from the charging control circuit (122) to the battery (BAT) through a protection circuit (124), and generating the charged status information while monitoring the charged status of the battery (BAT), and periodically recording the charged status information in the RFID tag (130); and the protection circuit (124) combined with the fuel gauge (123) and the battery (BAT) to protect the battery (BAT) by controlling whether to charge or discharge according to the charged status of the battery (BAT).

13. The wireless charging pad according to claim 12, wherein the rectifying circuits (121 and 121') are series-parallel resonant center tap half-bridge rectifying circuits using an output of a single center tap rectifying

diode and an output filter capacitor, or series-parallel resonant full-bridge rectifying circuits using an output of a full-bridge rectifying diode and an output filter capacitor.

14. The wireless charging pad according to claim 9, wherein the RFID tag (130) comprises:

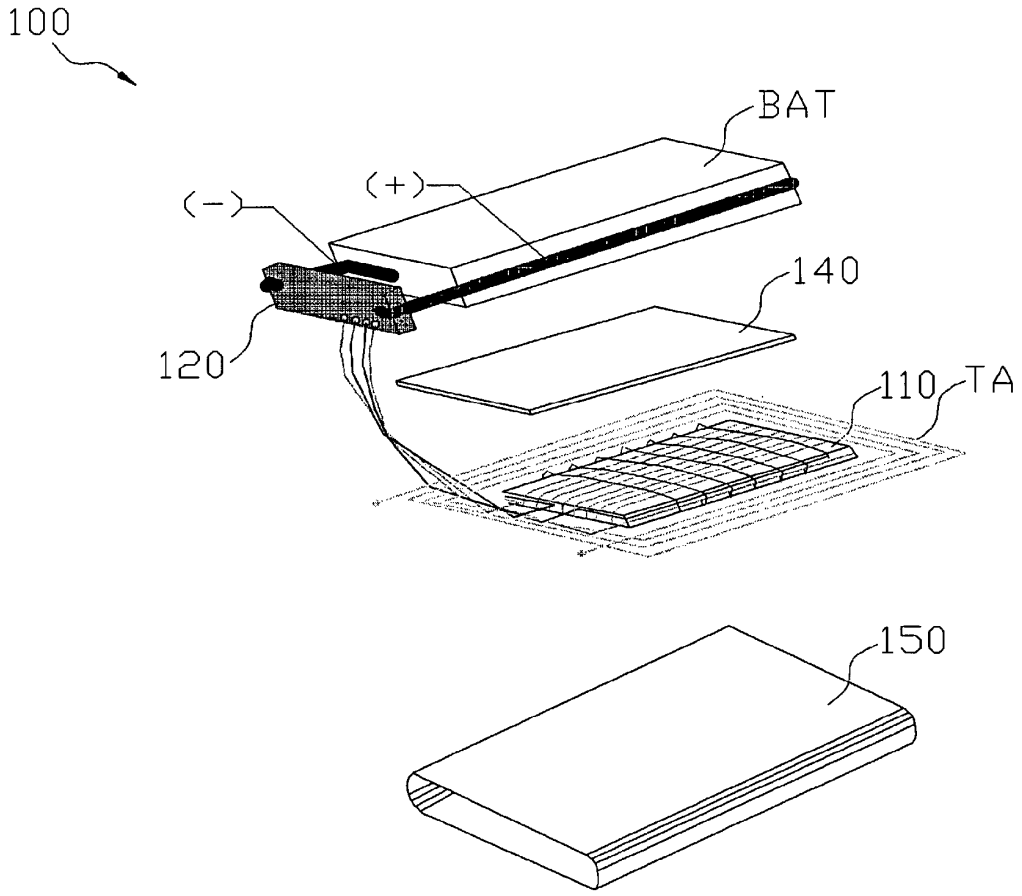
a clock extraction unit (131) for extracting a clock from the RF carrier signal wirelessly received from the wireless charging pad (200); a sequencer (132) for inspecting an sequence of arranged data extracted from the clock extraction unit (131) and transmitting a control signal to a data encoder (133); the data encoder (133) for receiving the wireless identification information and charged status information of the battery (BAT) from a tag (135) when the control signal is transmitted from the sequencer (132), and transmitting the wireless identification information and charged status information to a data modulator (136) after coding the wireless identification information and charged status information; the data modulator (136) for generating RF data generated by modulating the data received from the data encoder (133), and wirelessly transmitting the RF data to the wireless charging pad (200); Read Only Memory (ROM) (134) for recording the wireless identification information and charged status information therein; and the tag (135) for

reading the wireless identification information and charged status information of the battery (BAT) stored in the ROM (134), and transmitting the wireless identification information and charged status information to the data encoder (133).

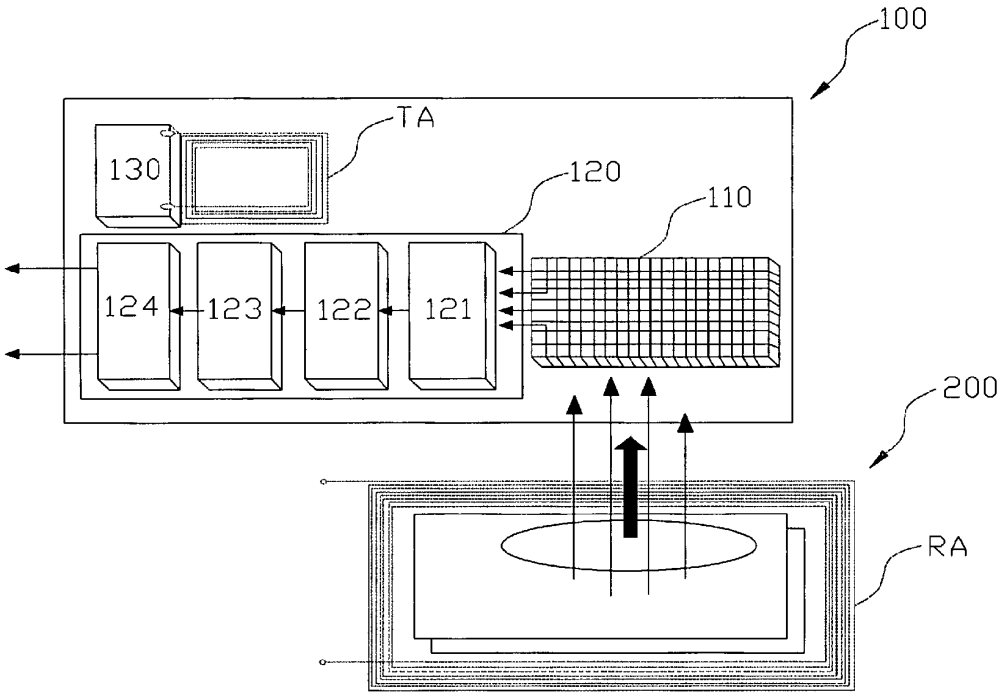
15. The wireless charging pad according to claim 9, wherein the wireless identification information corresponds to one of a product name of the battery (BAT), a serial number of the battery (BAT) and a user identification number that is stored in the RFID tag (130) through communication between a body of a portable device, on which the battery pack (100) is mounted, and the battery pack (100).

16. The wireless charging pad according to claim 9, wherein the RF carrier signal is a signal that accesses an RFID signal stored in the battery pack (100) using a carrier signal in HF (3 to 30 MHz) or UHF (300 to 3000 MHz) bands.

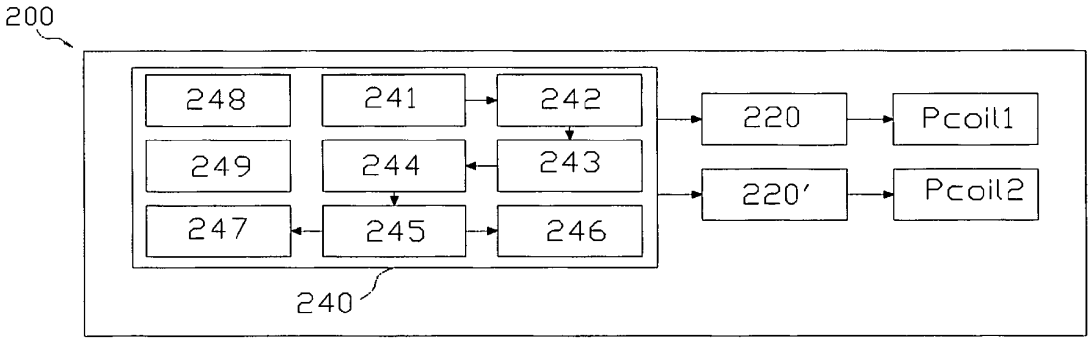
【FIG. 1】



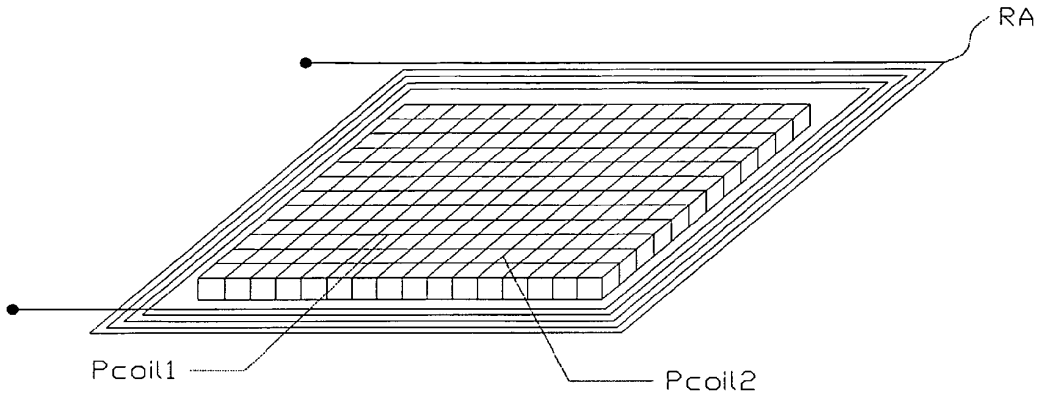
【FIG. 2】


100
TA
130
120
110
124
123
122
121
200
RA

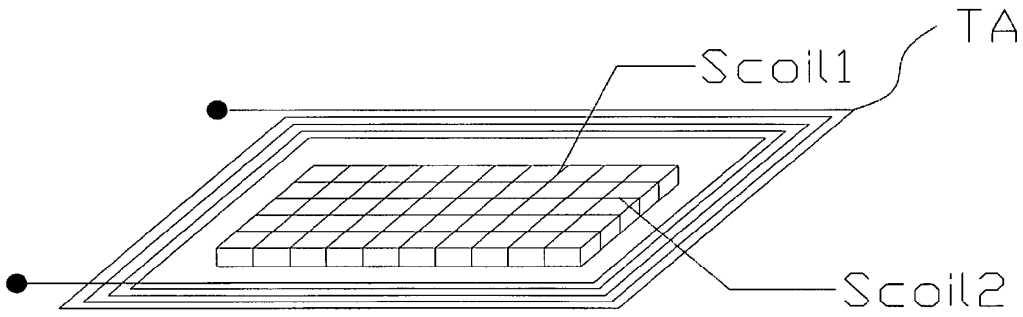
【FIG. 3】


200
248
241
242
220
Pcoil1
249
244
243
220'
Pcoil2
247
245
246
240

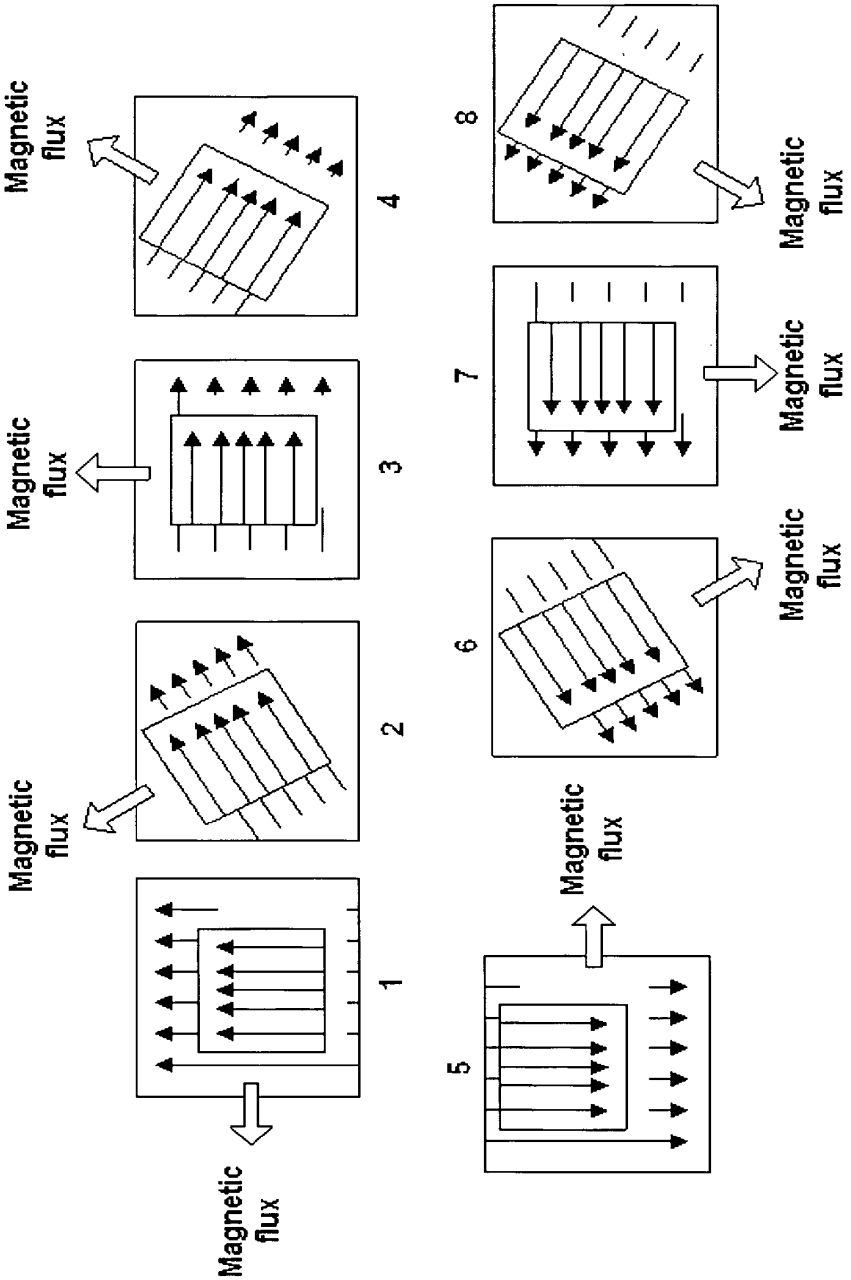
【FIG. 4】



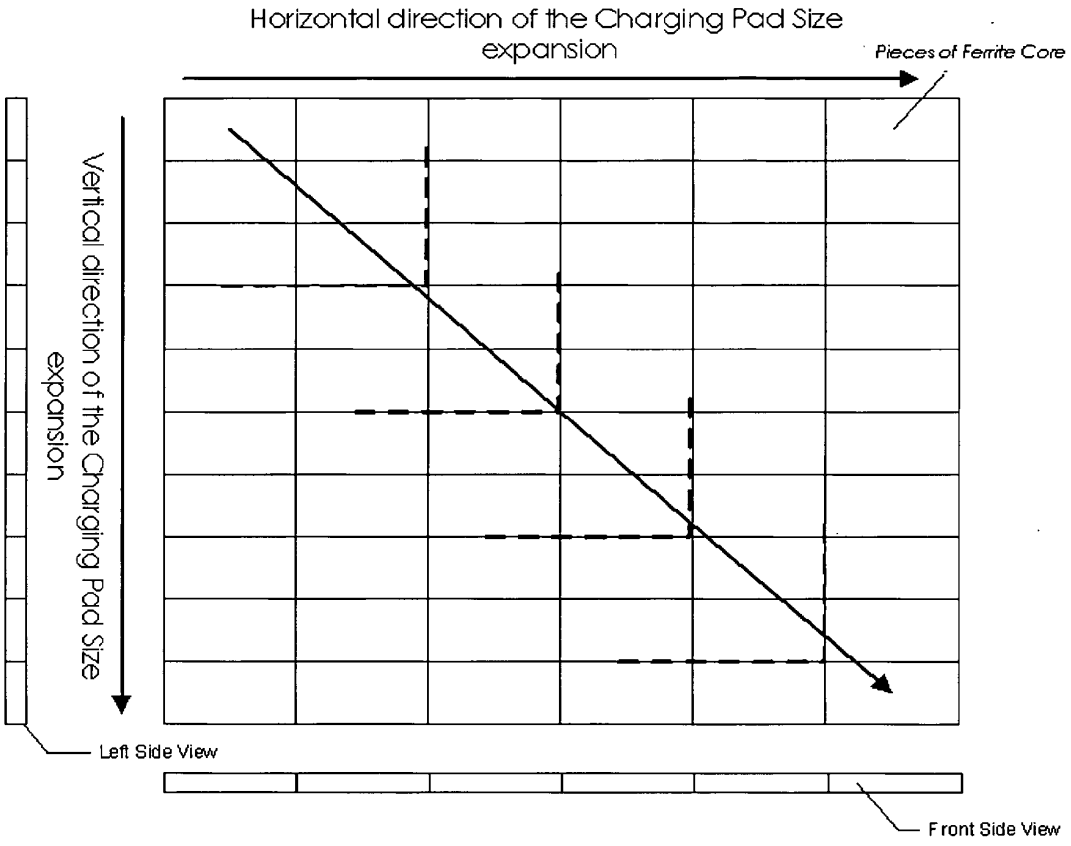
【FIG. 5】



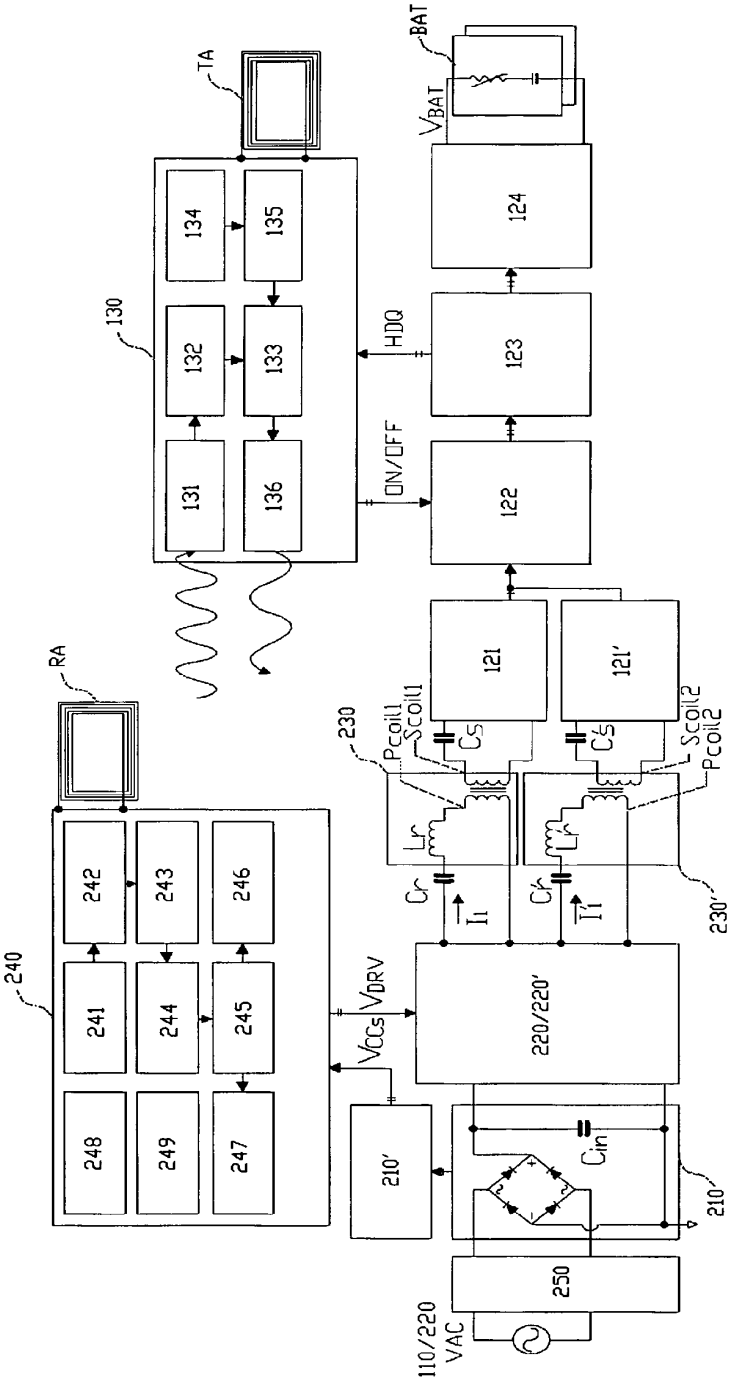
【FIG. 6】


Magnetic flux
1
Magnetic flux
2
Magnetic flux
3
Magnetic flux
4
Magnetic flux
5
Magnetic flux
6
Magnetic flux
7
Magnetic flux
8

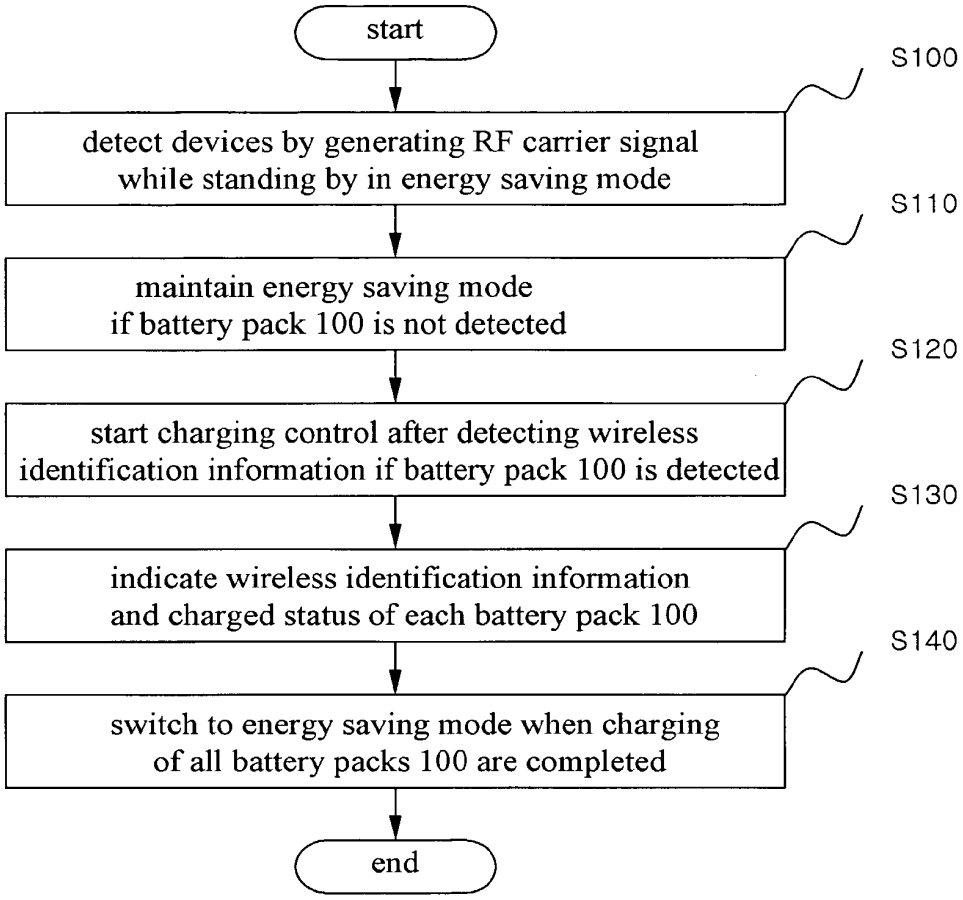
【FIG. 7】


Horizontal direction of the Charging Pad Size expansion
Pieces of Ferrite Core
Vertical direction of the Charging Pad Size expansion
Left Side View
Front Side View

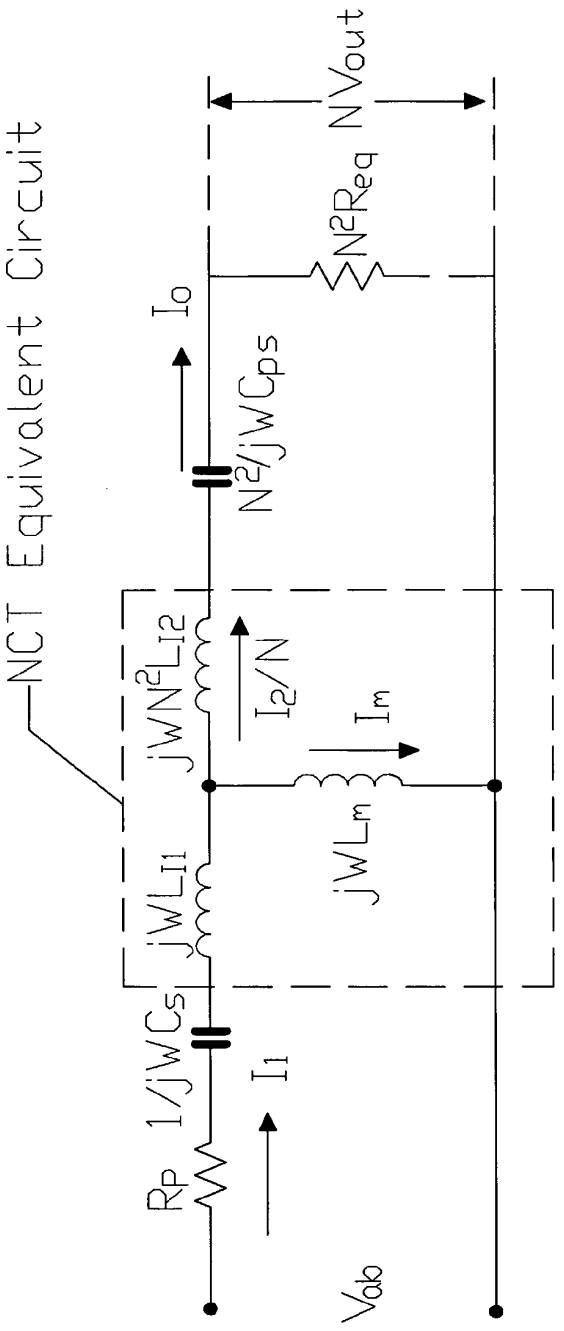
【FIG. 8】


TA
BAT
VBAT
124
123
122
HDQ
ON/OFF
130
134
135
132
133
131
136
RA
121
121'
230
Pcoil1
Scoil1
Cs
Scoil2
Pcoil2
Lr
Lr'
Cr
Cr'
I1
I1'
230'
240
242
243
246
241
244
245
248
249
247
VDRV
VCCS
220/220'
210'
Cin
210
250
110/220
VAC

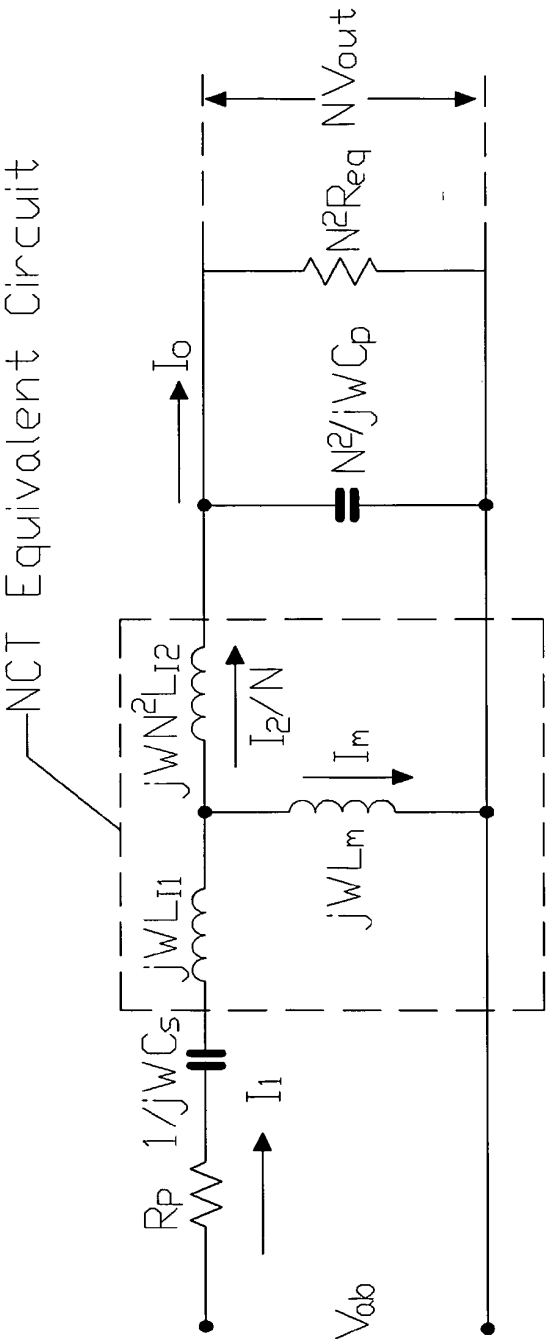
【FIG. 9】


start
S100
detect devices by generating RF carrier signal while standing by in energy saving mode
S110
maintain energy saving mode if battery pack 100 is not detected
S120
start charging control after detecting wireless identification information if battery pack 100 is detected
S130
indicate wireless identification information and charged status of each battery pack 100
S140
switch to energy saving mode when charging of all battery packs 100 are completed
end

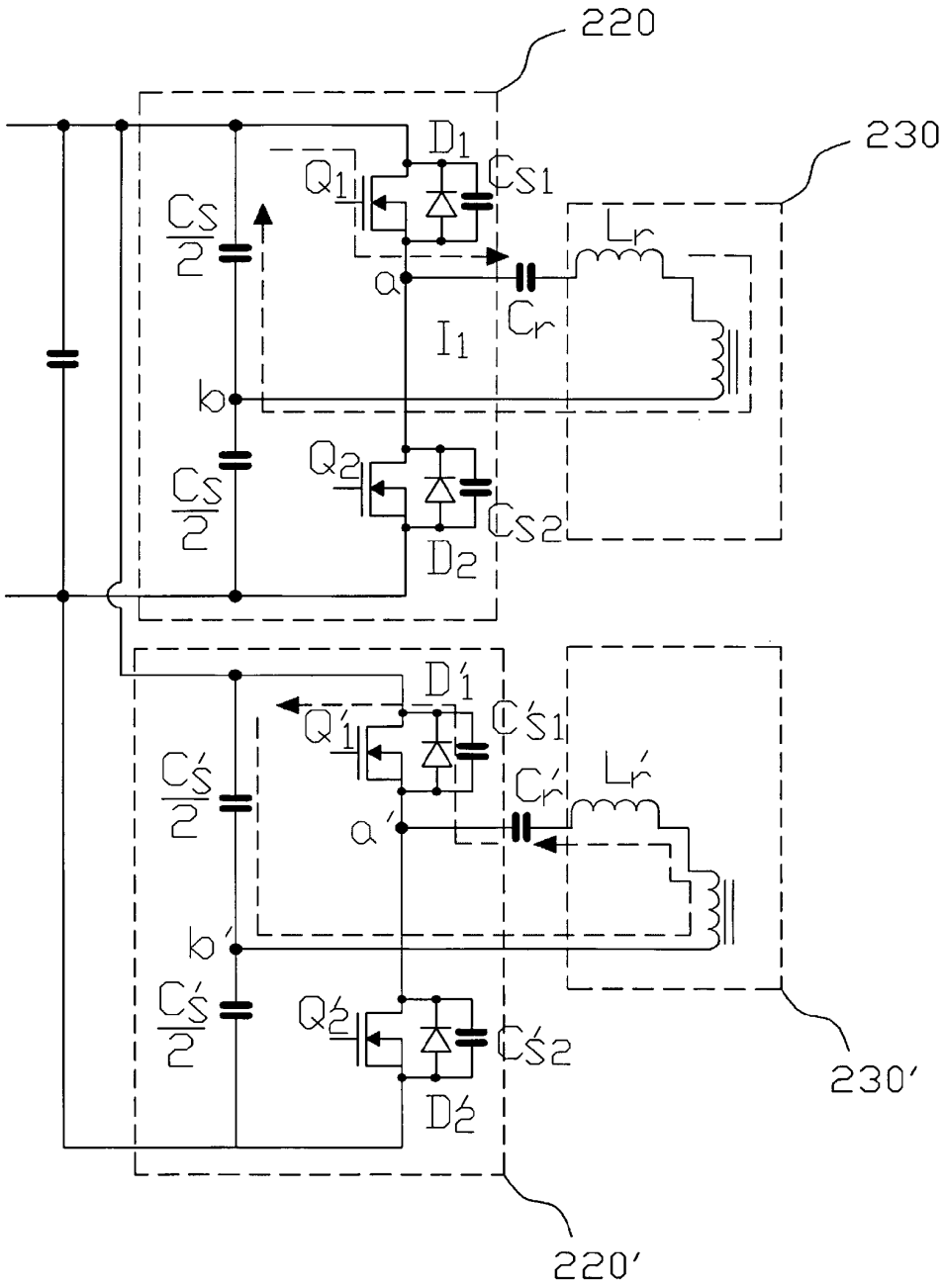
【FIG. 10】


NCT Equivalent Circuit
NVout
N²Req
Io
N²/jwCps
jwN²LI2
I2/N
Im
jwLm
jwLI1
1/jwCs
RP
I1
Vab

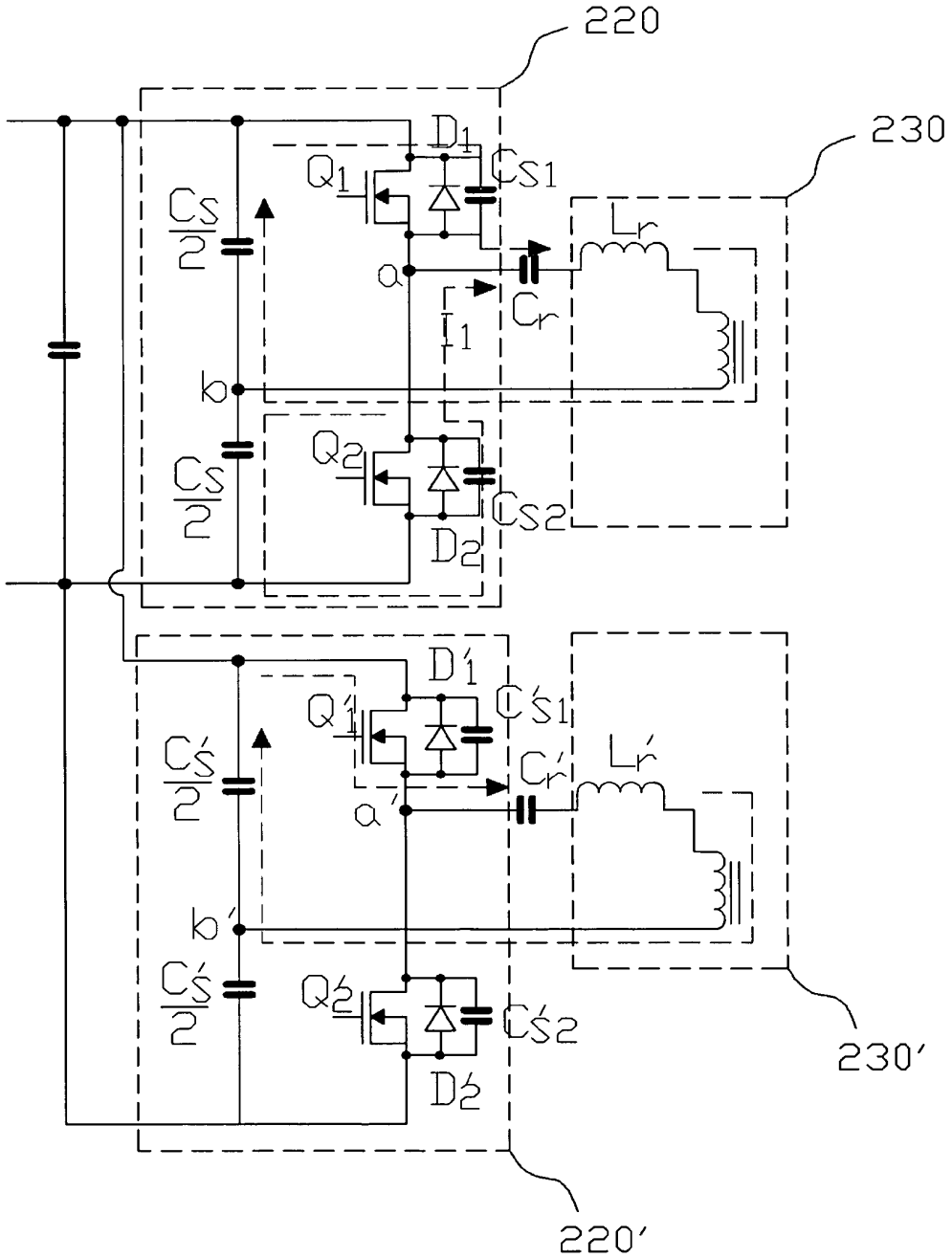
【FIG. 11】


NCT Equivalent Circuit
NVout
N²Req
Io
N²/jwCp
I2/N
Im
jwN²LI2
jwLm
jwLI1
1/jwCs
RP
I1
Vab

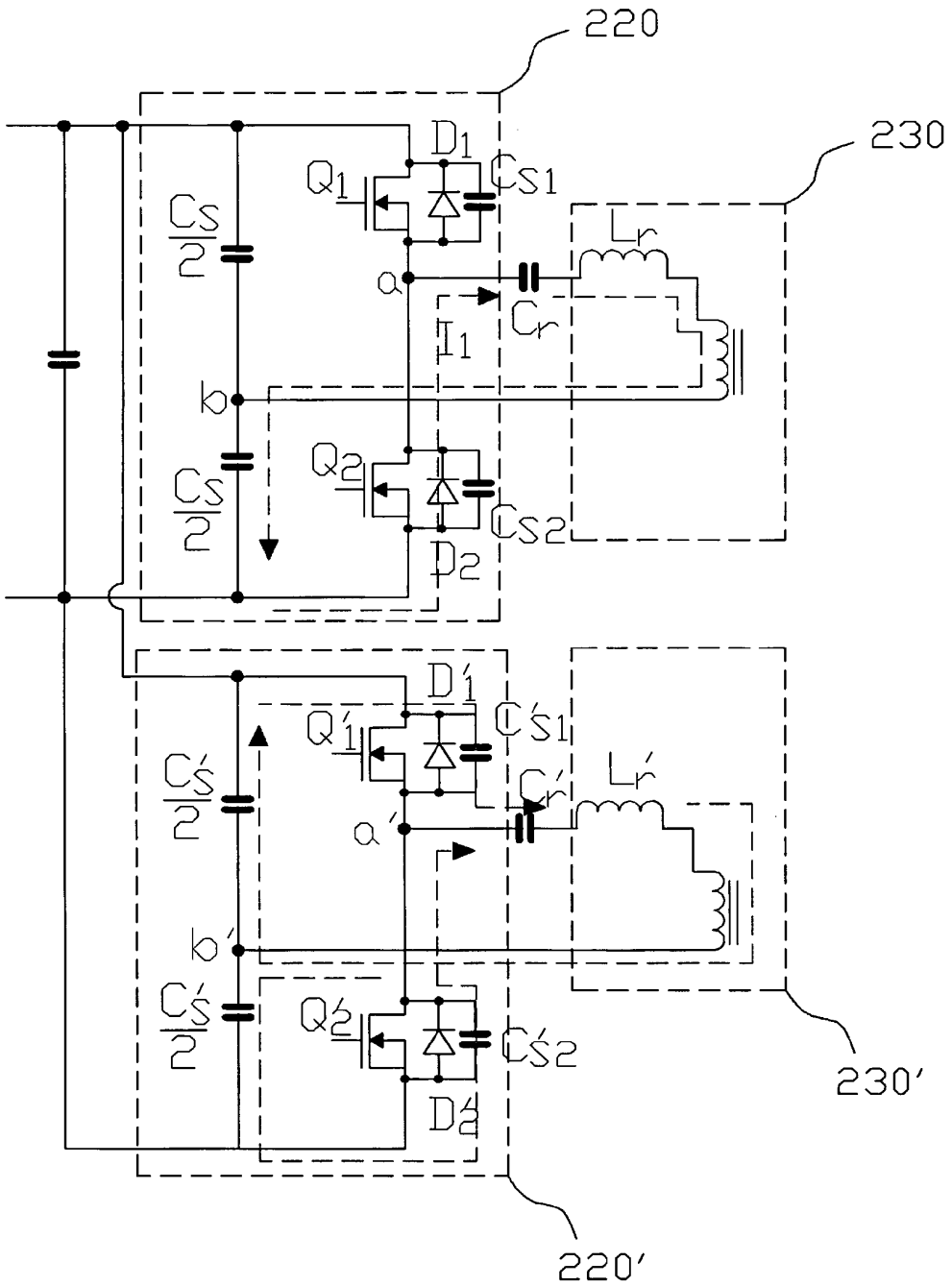
【FIG. 12】


220
230
D1
Q1
Cs1
Cs/2
Lr
a
Cr
I1
b
Q2
Cs/2
Cs2
D2
D'1
Q'1
C's1
C's/2
Cr'
Lr'
a'
b'
C's/2
Q'2
C's2
D'2
230'
220'

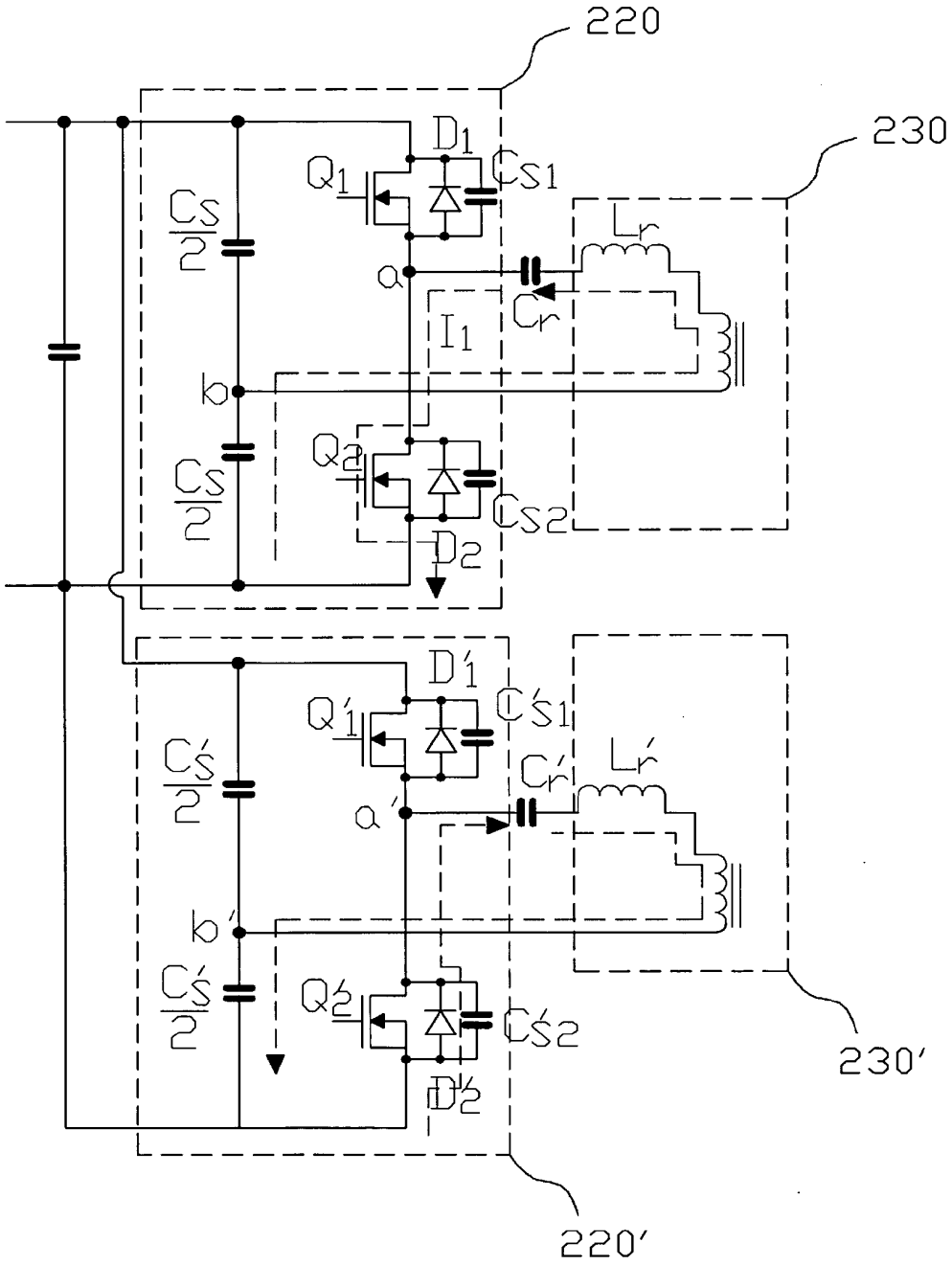
【FIG. 13】


220
230
D1
Q1
Cs1
Cs/2
a
Lr
Cr
I1
b
Q2
Cs/2
Cs2
D2
D'1
Q'1
C's1
C's/2
C'r
L'r
a'
b'
C's/2
Q'2
C's2
D'2
230'
220'

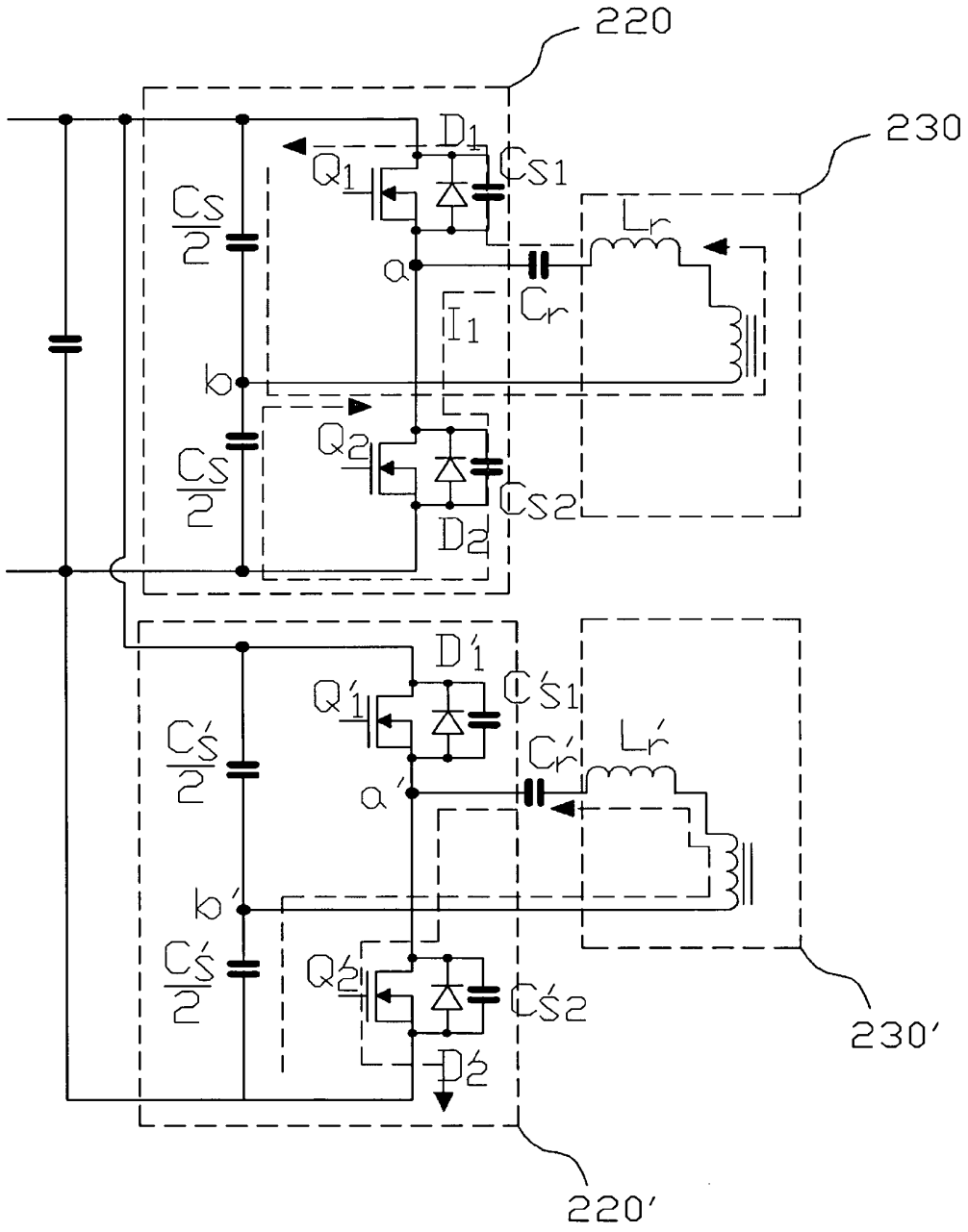
【FIG. 14】


220
230
D1
Q1
CS1
CS/2
Lr
a
Cr
I1
b
Q2
CS/2
CS2
D2
D'1
Q'1
C'S1
C'S/2
C'r
L'r
a'
b'
C'S/2
Q'2
C'S2
D'2
230'
220'

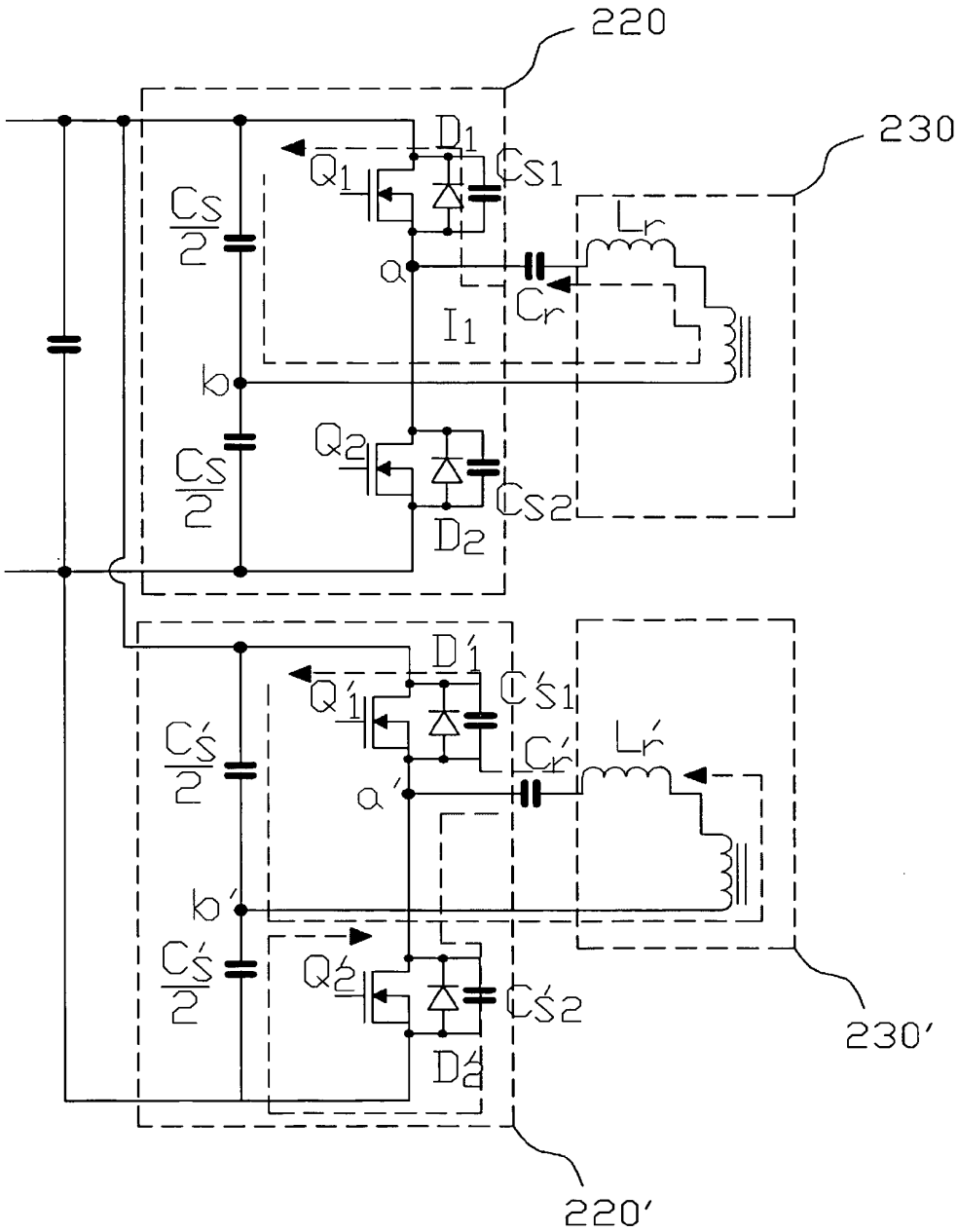
【FIG. 15】


220
230
D1
Q1
CS1
CS/2
Lr
a
Cr
I1
b
Q2
CS/2
CS2
D2
D'1
Q'1
C'S1
C'S/2
C'r
L'r
a'
b'
C'S/2
Q'2
C'S2
D'2
230'
220'

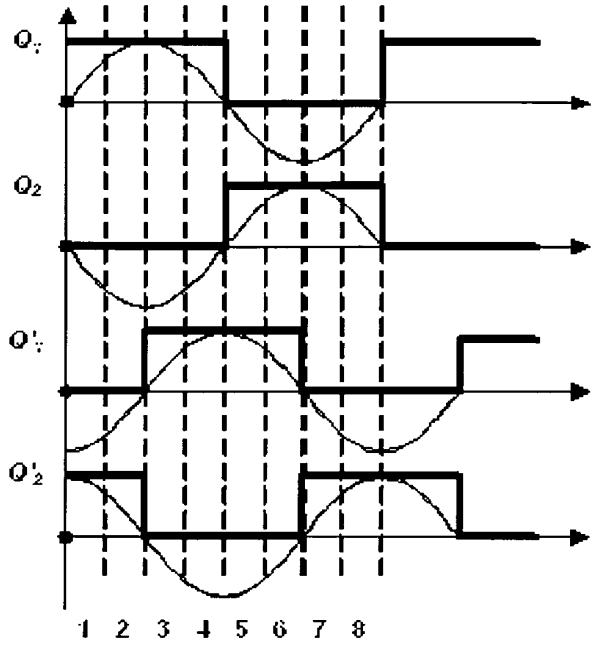
【FIG. 16】


220
230
D1
Q1
Cs1
Cs/2
Lr
a
Cr
I1
b
Q2
Cs/2
Cs2
D2
D'1
Q'1
C's1
C's/2
C'r
L'r
a'
b'
C's/2
Q'2
C's2
D'2
230'
220'

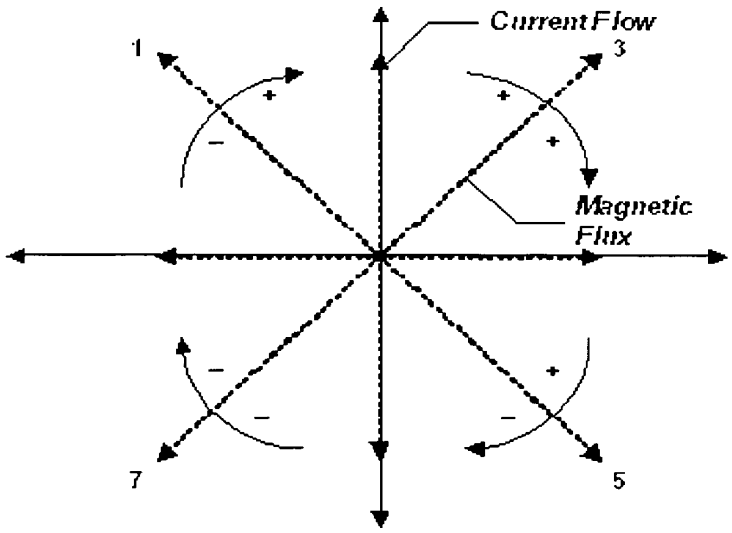
【FIG. 17】


220
230
D1
Q1
CS1
CS/2
Lr
a
Cr
I1
b
Q2
CS/2
CS2
D2
D'1
Q'1
C'S1
C'S/2
C'r
L'r
a'
b'
Q'2
C'S2
D'2
230'
220'

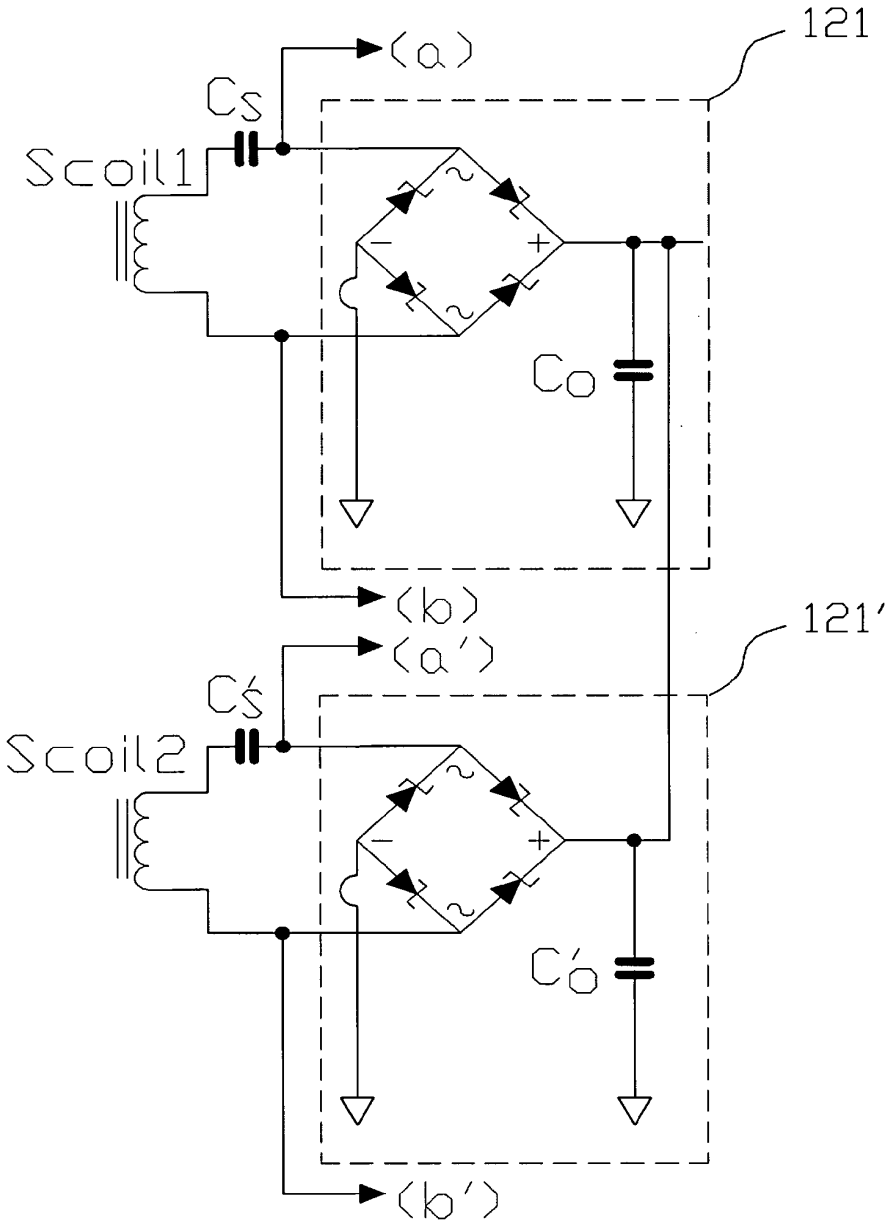
【FIG. 18】



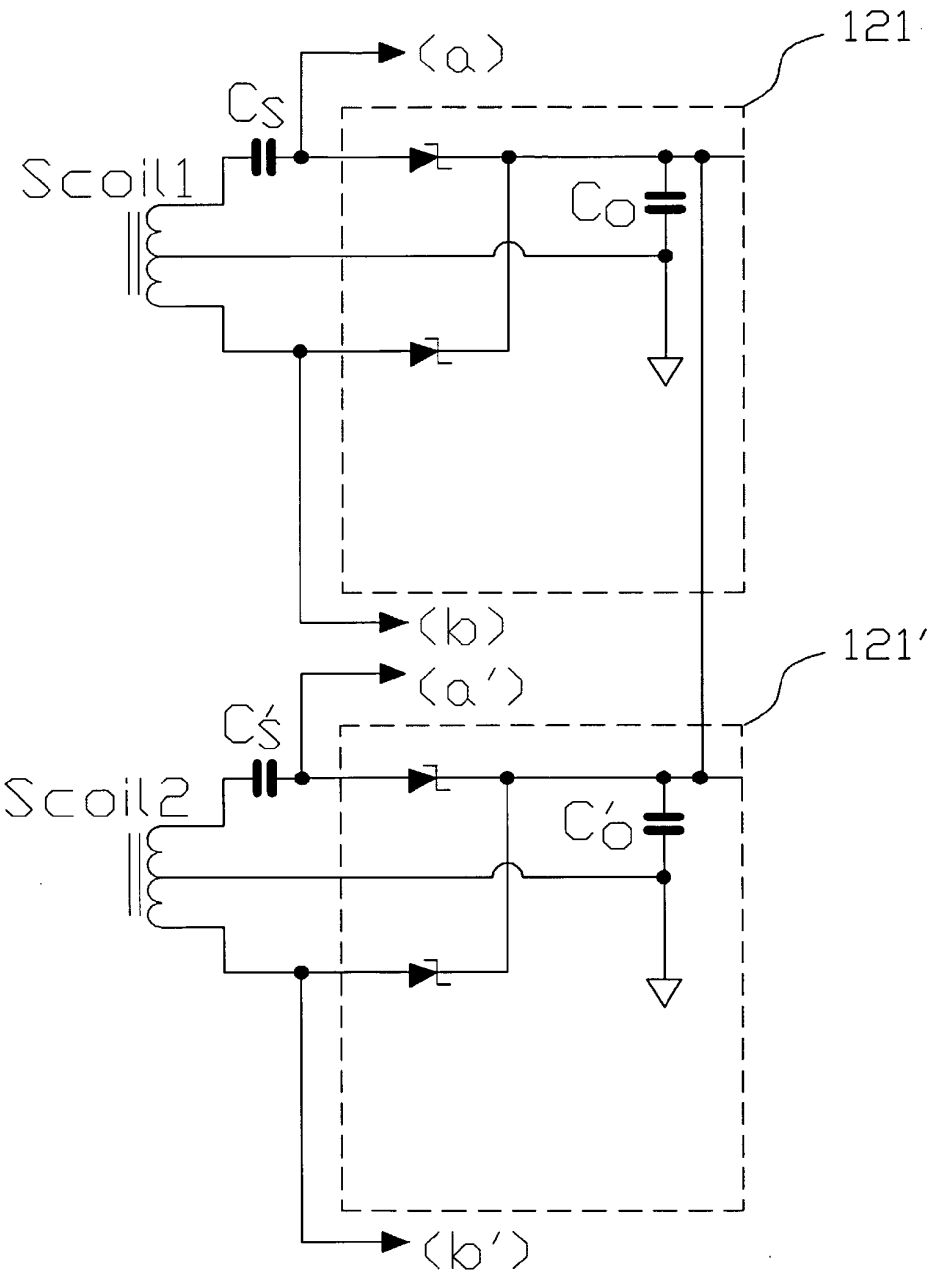
【FIG. 19】



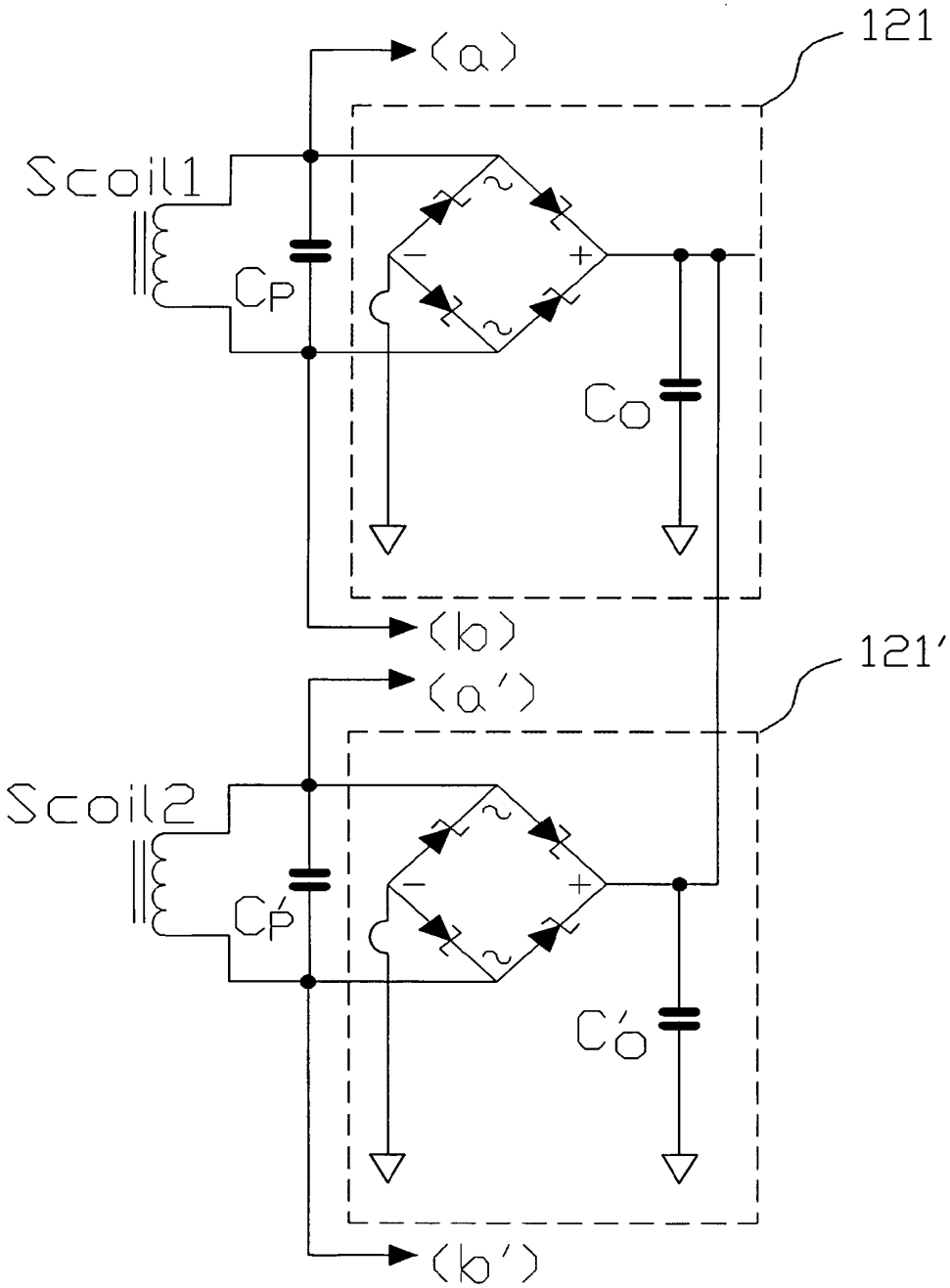
【FIG. 20】



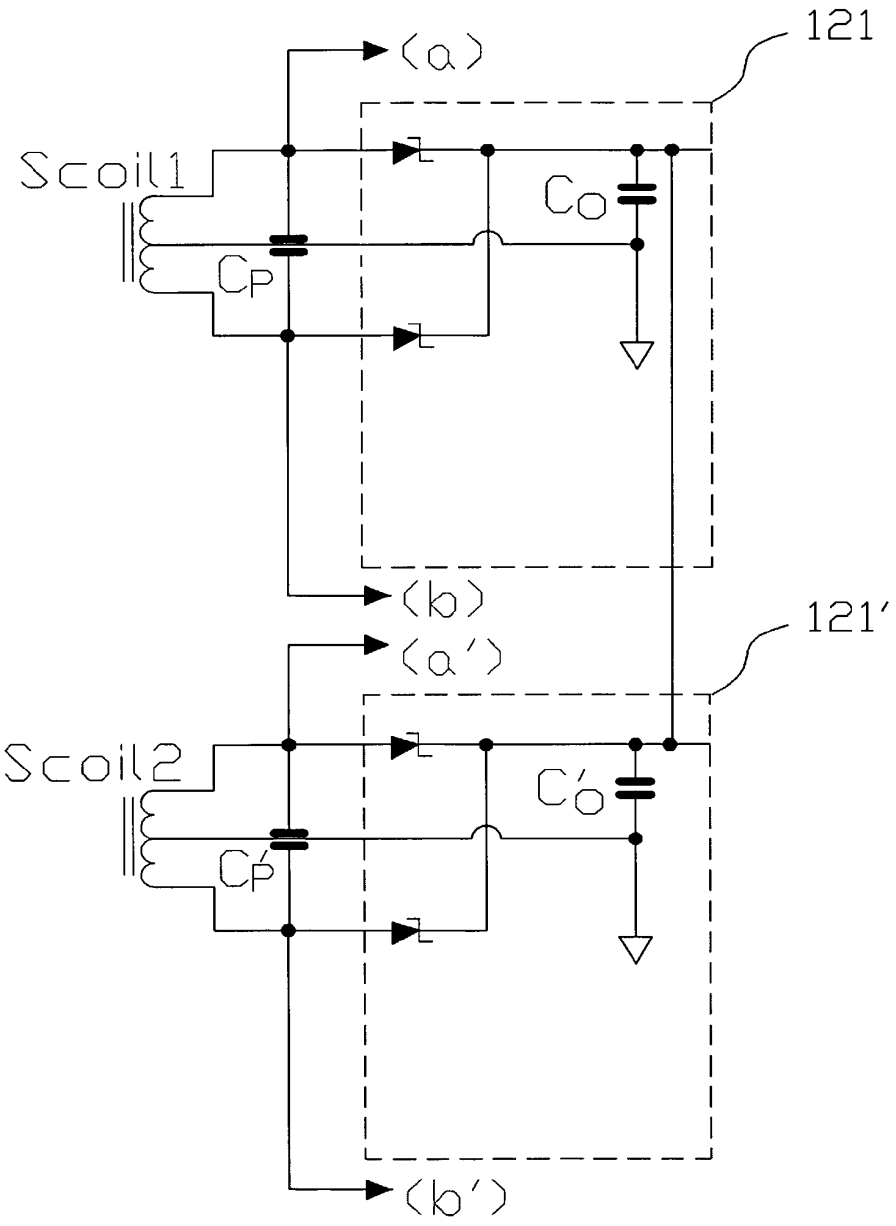
【FIG. 21】



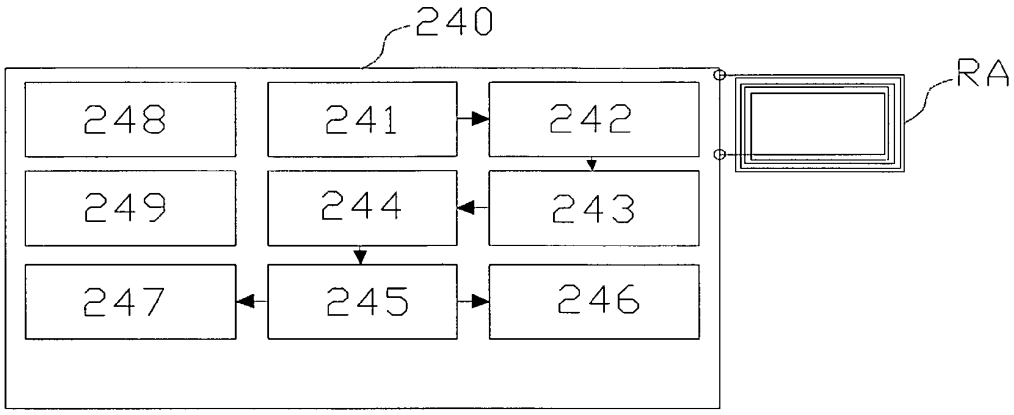
【FIG. 22】



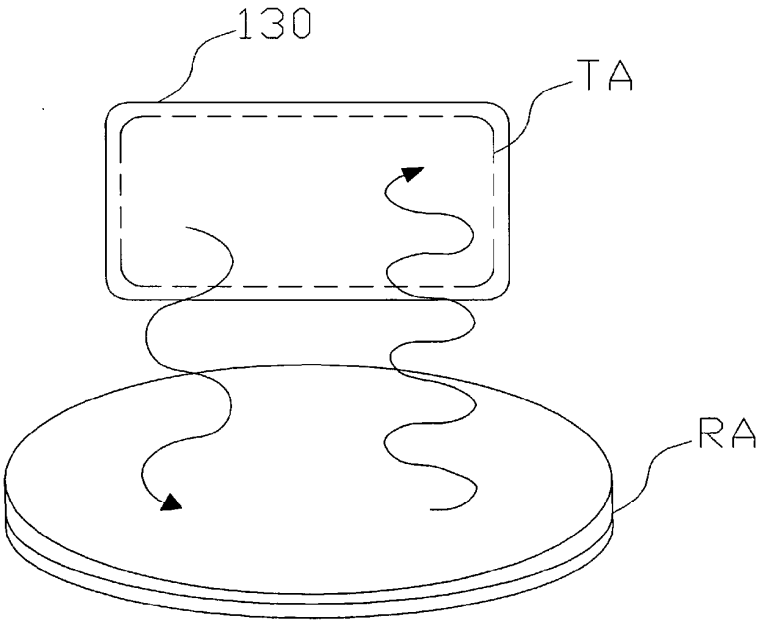
【FIG. 23】



【FIG. 24】



【FIG. 25】



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2004/002263

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 H02J 7/02

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)
IPC7: H02J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean Patents and application for inventions since 1975
Korean Utility Modles and application for Utility for Utility Models since 1975
Japanese Utility modles and application for Utility for Utility models since 1975

Electronic data base consulted during the intertnational search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5600225 A (NEC CO., LTD.) 4 FEB. 1997 Abstract, fig. 2, Claims 1-3	1, 9
A	JP 2003-047178 A (SONY CO., LTD.) 14 FEB. 2003 Abstract, fig. 1, Claims 1-3	1, 9
A	JP 11-178232 A (CANON INC.) 2 JUL. 1999 Fig. 1, Claims 1-3	1, 9
A	JP 2002-272020 A (SONY CO., LTD.) 20 SEP 2002 Abstract, fig. 1, Claims 1-4	1, 9
A	JP 09-233706 A (HITACHI CO., LTD) 5 SEP. 1997 Abstract, fig. 1, Claim 1	1, 9
A	JP 11-68837 A (CASIO COMPUTER CO., LTD) 22 JUN. 1999 See the whole document	1, 9
A	JP 10-201113 A (OKI ELECTRIC INDUSTRIAL CO., LTD.) 31 JUL. 1998 See the whole document	1, 9

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"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 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
25 MARCH 2005 (25.03.2005)	**26 MARCH 2005 (26.03.2005)**

Name and mailing address of the ISA/KR
Korean Intellectual Property Office
920 Dunsan-dong, Seo-gu, Daejeon 302-701,
Republic of Korea
Facsimile No. 82-42-472-7140

Authorized officer
JEON, Yong Hai
Telephone No. 82-42-481-5657

Form PCT/ISA/210 (second sheet) (January 2004)

Electronic Acknowledgement Receipt	
EFS ID:	44213140
Application Number:	17467032
International Application Number:	
Confirmation Number:	1075
Title of Invention:	System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes
First Named Inventor/Applicant Name:	Afshin Partovi
Customer Number:	33438
Filer:	Kent Bryan Chambers/Anita Chambers
Filer Authorized By:	Kent Bryan Chambers
Attorney Docket Number:	AFPA-01039US4
Receipt Date:	05-NOV-2021
Filing Date:	03-SEP-2021
Time Stamp:	11:32:22
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	AFPA-01039US4_IDS1_2021-11-05.pdf	1035468 328ce534c4f76fcd63b4373dc5fb4b5bec34dab8	no	6

Warnings:

Information:					
2	Foreign Reference	EP2396901B1.pdf	488937 0618297a4df59ee4d7f4e9aac6319eec7219c2e7	no	32
Warnings:					
Information:					
3	Foreign Reference	WO2006001557A1.pdf	2079527 2f5ec20a22a9b4760e1df8529865e9f857b47ad9	no	73
Warnings:					
Information:					
			Total Files Size (in bytes):	3603932	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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
17/467,032	09/03/2021	2859	830	AFPA-01039US4	1	1

CONFIRMATION NO. 1075

33438
TERRILE, CANNATTI & CHAMBERS, LLP
P.O. BOX 203518
AUSTIN, TX 78720

FILING RECEIPT

OC000000128428110

Date Mailed: 09/16/2021

Receipt is acknowledged of this non-provisional utility 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 FIRST INVENTOR, 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 corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction 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 provided that the request is grantable.

Inventor(s)

Afshin Partovi, Palo Alto, CA;

Applicant(s)

Mojo Mobility Inc., Palo Alto, CA

Assignment For Published Patent Application

Mojo Mobility Inc., Palo Alto, CA

Power of Attorney: The patent practitioners associated with Customer Number 33438

Domestic Priority data as claimed by applicant

This application is a CON of 16/819,503 03/16/2020 PAT 11114886
which is a CON of 15/830,411 12/04/2017 PAT 10594155
which is a CON of 14/252,627 04/14/2014 PAT 9837846
which claims benefit of 61/811,638 04/12/2013

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 Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 09/15/2021
The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 17/467,032**
Projected Publication Date: To Be Determined - pending completion of Corrected Papers
Non-Publication Request: No
Early Publication Request: No
**** SMALL ENTITY ****
Title

System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes

Preliminary Class

320

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).

SelectUSA

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop

technology, manufacture products, deliver services, and grow your business, visit http://www.SelectUSA.gov or call +1-202-482-6800.

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 17/467,032

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	80		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	350		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	400		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	1 minus 20 =	*	x 50 =	0.00	OR		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	1 minus 3 =	*	x 240 =	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	830		TOTAL	

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 (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
Application Size Fee (37 CFR 1.16(s))									
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

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 (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
Application Size Fee (37 CFR 1.16(s))									
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest 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	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
17/467,032	09/03/2021	Afshin Partovi	AFPA-01039US4

CONFIRMATION NO. 1075

33438
TERRILE, CANNATTI & CHAMBERS, LLP
P.O. BOX 203518
AUSTIN, TX 78720

FORMALITIES LETTER

OC000000128428111

Date Mailed: 09/16/2021

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:

- A substitute specification excluding claims in compliance with 37 CFR 1.52, 1.121(b)(3), and 1.125 is required. The substitute specification must be submitted with markings and be accompanied by a clean version (without markings) as set forth in 37 CFR 1.125(c) and a statement that the substitute specification contains no new matter (see 37 CFR 1.125(b)). Since a preliminary amendment was present on the filing date of the application and such amendment is part of the original disclosure of the application, the substitute specification must include all of the desired changes made in the preliminary amendment. See 37 CFR 1.115 and 1.215.

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.

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.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/kung/

Doc Code: TRACK1.REQ
Document Description: TrackOne Request

PTO/AIA/424 (04-14)

CERTIFICATION AND REQUEST FOR PRIORITIZED EXAMINATION UNDER 37 CFR 1.102(e) (Page 1 of 1)

First Named Inventor:	Afshin Partovi	Nonprovisional Application Number (if known):	
Title of Invention:	System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes		

APPLICANT HEREBY CERTIFIES THE FOLLOWING AND REQUESTS PRIORITIZED EXAMINATION FOR THE ABOVE-IDENTIFIED APPLICATION.

1. The processing fee set forth in 37 CFR 1.17(i)(1) and the prioritized examination fee set forth in 37 CFR 1.17(c) have been filed with the request. The publication fee requirement is met because that fee, set forth in 37 CFR 1.18(d), is currently $0. The basic filing fee, search fee, and examination fee are filed with the request or have been already been paid. I understand that any required excess claims fees or application size fee must be paid for the application.

2. I understand that the application may not contain, or be amended to contain, more than four independent claims, more than thirty total claims, or any multiple dependent claims, and that any request for an extension of time will cause an outstanding Track I request to be dismissed.

3. The applicable box is checked below:

I. ☑ Original Application (Track One) - Prioritized Examination under § 1.102(e)(1)

i. (a) The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a). This certification and request is being filed with the utility application via EFS-Web.

---OR---

(b) The application is an original nonprovisional plant application filed under 35 U.S.C. 111(a). This certification and request is being filed with the plant application in paper.

ii. An executed inventor's oath or declaration under 37 CFR 1.63 or 37 CFR 1.64 for each inventor, **or** the application data sheet meeting the conditions specified in 37 CFR 1.53(f)(3)(i) is filed with the application.

II. ☐ Request for Continued Examination - Prioritized Examination under § 1.102(e)(2)

i. A request for continued examination has been filed with, or prior to, this form.
ii. If the application is a utility application, this certification and request is being filed via EFS-Web.
iii. The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a), or is a national stage entry under 35 U.S.C. 371.
iv. This certification and request is being filed prior to the mailing of a first Office action responsive to the request for continued examination.
v. No prior request for continued examination has been granted prioritized examination status under 37 CFR 1.102(e)(2).

Signature /Kent B. Chambers/	Date September 3, 2021
Name (Print/Typed) Kent B. Chambers	Practitioner Registration Number 38,839

Note: *This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. Submit multiple forms if more than one signature is required.**

☑ *Total of 1 forms are submitted.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PTO/AIA/82A (07-12)
Approved for use through 11/30/2014. OMB 0651-0035
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 displays a valid OMB control number.

TRANSMITTAL FOR POWER OF ATTORNEY TO ONE OR MORE REGISTERED PRACTITIONERS

NOTE: This form is to be submitted with the Power of Attorney by Applicant form (PTO/AIA/82B or equivalent) to identify the application to which the Power of Attorney is directed, in accordance with 37 CFR 1.5. If the Power of Attorney by Applicant form is not accompanied by this transmittal form or an equivalent, the Power of Attorney will not be recognized in the application.

Application Number	Unassigned
Filing Date	September 3, 2021
First Named Inventor	Afshin Partovi
Title	System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes
Art Unit	Unassigned
Examiner Name	Unassigned
Attorney Docket Number	AFPA-01039US4

SIGNATURE of Applicant or Patent Practitioner

Signature	/Kent B. Chambers/	Date	September 3, 2021
Name	Kent B. Chambers	Telephone	512-338-9100
Registration Number	38,839		

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

■ *Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. 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 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application 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.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/SB/01 (06-12)
Approved for use through 11/30/2008. 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 displays a valid OMB control number.

DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes

As the below named inventor, I hereby declare that:

This declaration is directed to: ☒ The attached application, or

☐ United States application or PCT international application number _____

filed on _____

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

I believe that 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.

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.

LEGAL NAME OF INVENTOR

Inventor: Afshin Partovi Date (Optional): _____

Signature: _____

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. 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 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application 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.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82B (07-13)
Approved for use through 09/31/2021. OMB 0651-0035
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 displays a valid OMB control number

POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number	Filing Date

(Note. The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

☑ I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above: 33438

OR

☐ I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note. Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter or the boxes above to:

☑ The address associated with the above-mentioned Customer Number

OR

☐ The address associated with Customer Number:

OR

☐ Firm or Individual Name	
Address	
City	State / Zip
Country	
Telephone / Email	

I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

MOJO MOBILITY INC.

☐ Inventor or Joint Inventor (title not required below)

☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)

☑ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)

☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature	/Afshin Partovi/	Date (Optional)	
Name	Afshin Partovi		
Title	CEO		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.

☑ Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.191, 1.32, and 1.33. 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 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application 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.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes
First Named Inventor/Applicant Name:	Afshin Partovi
Filer:	Kent Bryan Chambers/Celeste Scarborough
Attorney Docket Number:	AFPA-01039US4

Filed as Small Entity

Filing Fees for Track I Prioritized Examination - Nonprovisional Application under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
UTILITY FILING FEE (ELECTRONIC FILING)	4011	1	80	80
UTILITY SEARCH FEE	2111	1	350	350
UTILITY EXAMINATION FEE	2311	1	400	400
REQUEST FOR PRIORITIZED EXAMINATION	2817	1	2100	2100
Pages:				
Claims:				
Miscellaneous-Filing:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
PUBL. FEE- EARLY, VOLUNTARY, OR NORMAL	1504	1	0	0
PROCESSING FEE, EXCEPT PROV. APPLS.	2830	1	70	70
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**3000**

Electronic Acknowledgement Receipt	
EFS ID:	43687585
Application Number:	17467032
International Application Number:	
Confirmation Number:	1075
Title of Invention:	System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes
First Named Inventor/Applicant Name:	Afshin Partovi
Customer Number:	33438
Filer:	Kent Bryan Chambers/Celeste Scarborough
Filer Authorized By:	Kent Bryan Chambers
Attorney Docket Number:	AFPA-01039US4
Receipt Date:	03-SEP-2021
Filing Date:	
Time Stamp:	19:12:39
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$3000
RAM confirmation Number	E202193J13084251
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	AFPA-01039US4_ADS.pdf	1256281 78987795f45048aeeeda73fde22e07fdde5a16d3	no	8
Warnings:					
Information:					
2		AFPA-01039US4_EarliestRegPriorityAppl.pdf	2587328 6d3d30d27da3983c8715f37c6585eca46b6269ee	yes	45

Multipart Description/PDF files in .zip description

Document Description	Start	End
Specification	1	29
Claims	30	32
Abstract	33	33
Drawings-only black and white line drawings	34	45

Warnings:					
Information:					
3	TrackOne Request	AFPA-01039US4_Track1.pdf	119558 5004d4f5218e35342ab7d86c0988158a8363554a	no	2
Warnings:					
Information:					
4	Preliminary Amendment	AFPA-01039US4_Preliminary_Amendment.pdf	190589 d4b88c193bafe8d54f6bbad2651194131f77a4ff	no	4
Warnings:					
Information:					

5	Power of Attorney	AFPA-01039US4_POA_82A.pdf	152055 146bdb3dccda343a6cdb8103404df1daa462fa9d	no	1
Warnings:					
Information:					
6	Oath or Declaration filed	AFPA-01039US4_Declaration-signed-PDF_A.pdf	550000 0e5b7f287a4ee489174d421586f456ff99ffc725	no	1
Warnings:					
Information:					
7	Power of Attorney	AFPA-01039US4_POA_82B-signedPDFA.pdf	500392 a5591672f7fd2bf2ea46894806c02a29a0bd5b79	no	1
Warnings:					
Information:					
8	Fee Worksheet (SB06)	fee-info.pdf	51235 ef34c101b758a4679e036a068232330da64036fb	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	5407438		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

<u>New Applications Under 35 U.S.C. 111</u>
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
<u>National Stage of an International Application under 35 U.S.C. 371</u>
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
<u>New International Application Filed with the USPTO as a Receiving Office</u>
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/AIA/14 (02-18)
Approved for use through 11/30/2020. 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	AFPA-01039US4
	Application Number	
Title of Invention	System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes	

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
	Afshin		Partovi	

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

City	Palo Alto	State/Province	CA	Country of Residence	US

Mailing Address of Inventor:

Address 1	3707 Heron Way
Address 2	

City	Palo Alto	State/Province	CA
Postal Code	94303	Country	US

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

Correspondence Information:

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	33438		
Email Address	celeste@tcciplaw.com	Add Email	Remove Email

Application Information:

Title of the Invention	System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes		
Attorney Docket Number	AFPA-01039US4	Small Entity Status Claimed	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	12	Suggested Figure for Publication (if any)	

PTO/AIA/14 (02-18)
Approved for use through 11/30/2020. 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	AFPA-01039US4
	Application Number	
Title of Invention	System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

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	33438		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim 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.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Continuation of	16819503	2020-03-16

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	AFPA-01039US4
	Application Number	
Title of Invention	System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes	

Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
16819503	Continuation of	15830411	2017-12-04	10594155	2020-03-17
Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
15830411	Continuation of	14252627	2014-04-14	9837846	2017-12-05
Prior Application Status	Expired				Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)		
14252627	Claims benefit of provisional	61811638	2013-04-12		
Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button.					Add

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

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.

PTO/AIA/14 (02-18)
Approved for use through 11/30/2020. 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	AFPA-01039US4
	Application Number	
Title of Invention	System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is 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 State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

PTO/AIA/14 (02-18)
Approved for use through 11/30/2020. 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	AFPA-01039US4
	Application Number	
Title of Invention	System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes	

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 — Remove

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. ☒

Organization Name	Mojo Mobility Inc.		
Mailing Address Information For Applicant:			
Address 1	3707 Heron Way		
Address 2			
City	Palo Alto	**State/Province**	CA
Country	US	Postal Code	94303
Phone Number		Fax Number	
Email Address			

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

Assignee Information including Non-Applicant Assignee 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.

PTO/AIA/14 (02-18)
Approved for use through 11/30/2020. 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	AFPA-01039US4
	Application Number	
Title of Invention	System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes	

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.

Remove

If the Assignee or Non-Applicant Assignee is an Organization check here. ☒

Organization Name	Mojo Mobility Inc.

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1	3707 Heron Way		
Address 2			
City	Palo Alto	**State/Province**	CA
Country i	US	Postal Code	94303
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button. Add

Signature:

Remove

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Kent B. Chambers/			Date (YYYY-MM-DD)	2021-09-03
First Name	Kent	Last Name	Chambers	Registration Number	38839

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

PTO/AIA/14 (02-18)
Approved for use through 11/30/2020. 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	AFPA-01039US4
	Application Number	
Title of Invention	System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes	

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.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1 The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3 A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent CooperationTreaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

SYSTEM AND METHOD FOR POWERING OR CHARGING RECEIVERS OR DEVICES HAVING SMALL SURFACE AREAS OR VOLUMES

Copyright Notice

A portion of the disclosure of this patent document contains material which is subject to copyright protection. The copyright owner has no objection to the facsimile reproduction by anyone of the patent document or the patent disclosure, as it appears in the Patent and Trademark Office patent file or records, but otherwise reserves all copyright rights whatsoever.

Claim of Priority and Cross-reference to Related Applications:

[0001] This application claims the benefit of priority to U.S. Provisional Patent Application No. 61/811,638, titled "SYSTEM AND METHOD FOR POWERING OR CHARGING ONE OR MULTIPLE RECEIVERS OR DEVICES HAVING SMALL SURFACE AREAS OR VOLUMES" filed April 12, 2013; and is related to U.S. Patent Publication No. 20130285604 (U.S. Patent Application No. 13/828,789), titled "SYSTEMS AND METHODS FOR WIRELESS POWER TRANSFER" filed March 14, 2013; and U.S. Patent Publication No. 20120235636 (U.S. Patent Application No. 13/352,096), titled "SYSTEMS AND METHODS FOR PROVIDING POSITIONING FREEDOM, AND SUPPORT OF DIFFERENT VOLTAGES, PROTOCOLS, AND POWER LEVELS IN A WIRELESS POWER SYSTEM", filed January 17, 2012, which claims the benefit of priority to U.S. Provisional Patent Application No. 61/433,883, titled "SYSTEM AND METHOD FOR MODULATING THE PHASE AND AMPLITUDE OF AN ELECTROMAGNETIC WAVE IN MULTIPLE DIMENSIONS", filed January 18, 2011; U.S. Provisional Patent Application No. 61/478,020, titled "SYSTEM AND METHOD FOR MODULATING THE PHASE AND AMPLITUDE OF AN ELECTROMAGNETIC WAVE IN MULTIPLE DIMENSIONS", filed April 21, 2011; and U.S. Provisional Patent Application No. 61/546,316, titled "SYSTEMS AND METHODS FOR PROVIDING POSITIONING FREEDOM, AND SUPPORT OF DIFFERENT VOLTAGES, PROTOCOLS, AND POWER LEVELS IN A WIRELESS POWER SYSTEM", filed October 12, 2011; each of which above applications are herein incorporated by reference.

Field of Invention:

[0002] Embodiments of the invention are generally related to systems and methods for enabling transfer of power, from a wireless charger or power supply, to one or more receivers placed on or near the wireless charger or power supply, including powering or charging one or multiple receivers or devices having small surface areas or volumes.

Background:

[0003] Wireless technologies for powering and charging mobile and other electronic or electric devices, batteries and vehicles have been developed. Such systems generally use a wireless power charger or transmitter, in combination with a wireless power receiver, to provide a means for transfer of power. In some systems, the charger and receiver coil parts of the system are aligned and of comparable size. However, in some applications, it would be preferable to use receiver coils or antennas that have smaller areas or volumes. These are the general areas that embodiments of the invention are intended to address.

Summary:

[0004] Described herein are systems and methods for enabling transfer of power, from a wireless charger or power supply, to one or more receivers placed on or near the wireless charger or power supply, including powering or charging one or multiple receivers or devices having small surface areas or volumes. In accordance with an embodiment, a receiver coil can be generally shaped as a blade or thin solenoid, which receives power inductively, which is then used to power or charge one or more electronic devices. Applications include inductive or magnetic charging and power, and particularly usage in mobile, electronic, electric, lighting, or other devices, batteries, power tools, kitchen, industrial, medical or dental, or military applications, vehicles, robots, trains, and other usages.

Brief Description of the Figures:

[0005] **Figure 1** illustrates a system for wireless powering or charging of devices, in accordance with an embodiment.

[0006] **Figure 2** illustrates another view of a wireless charger system, in accordance with an embodiment.

[0007] **Figure 3** illustrates an example of a charger coil, in accordance with an embodiment.

[0008] **Figure 4** illustrates a resulting magnetic field, in accordance with an embodiment.

[0009] **Figure 5** illustrates a charger geometry, in accordance with an embodiment.

[0010] **Figure 6** illustrates a return magnetic flux from a charger, in accordance with an embodiment.

[0011] **Figure 7** illustrates wire wrapped around a core to create a solenoid type receiver, in accordance with an embodiment.

[0012] **Figure 8** illustrates a ferrite lower magnetic shield or flux guide, in accordance with an embodiment.

[0013] **Figure 9** illustrates a receiver coil wrapped around a very thin magnetic material, in accordance with an embodiment.

[0014] **Figure 10** illustrates the use of additional magnetic or ferrite material or layers added to or otherwise integrated with the top and/or bottom of the receiver coil, in accordance with an embodiment.

[0015] **Figure 11** illustrates the use of additional magnetic or ferrite material or layers added to or otherwise integrated with the top and/or bottom of the receiver coil, in accordance with another embodiment.

[0016] **Figure 12** illustrates integration of a receiver into a wearable headset or electronic display device or glasses, in accordance with an embodiment.

[0017] **Figure 13** illustrates an embodiment that incorporates magnetic or ferrite material sections above and below the main coil section, in accordance with an embodiment.

[0018] **Figure 14** illustrates integration of a receiver into a mobile phone, in accordance with an embodiment.

[0019] **Figure 15** illustrates that incorporates magnetic or ferrite material sections above and below the main coil section, in accordance with an embodiment.

[0020] **Figure 16** illustrates integration of a receiver into a headset device, in accordance with an embodiment.

[0021] **Figure 17** illustrates a charger for use in coupling to a blade type receiver in the outer perimeter of the charger surface, in accordance with an embodiment.

[0022] **Figure 18** illustrates a charger that provides different sections with different operating principles or protocols and/or driving and/or communication sections, in accordance with an embodiment.

[0023] **Figure 19** illustrates a charger that provides different sections, in accordance with another embodiment.

[0024] **Figure 20** illustrates a charger that provides different sections, in accordance with another embodiment.

Detailed Description:

[0025] With the proliferation of electrical and electronic devices and vehicles (which are considered examples of devices herein), simple and universal methods of providing power and or charging of these devices is becoming increasingly important.

[0026] In accordance with various embodiments, the term device, product, or battery is used herein to include any electrical, electronic, mobile, lighting, or other product, batteries, power tools, cleaning, industrial, kitchen, lighting, military, medical, dental or specialized products and vehicles, automobiles, personal mobility (e.g., Segway type) devices, buses, or movable machines such as robots or other mobile machines or other devices whereby the product, part, or component is powered by electricity or an internal or external battery and/or can be powered or charged externally or internally by a generator or solar cell, fuel cell, hand or other mechanical crank or alike.

[0027] In accordance with an embodiment, a product or device can also include an attachable or integral skin, case, cover, battery door or attachable or add-on or dongle type of receiver component, to enable the user to power or charge the product, battery, or device.

[0028] Induction generally refers to generation of electromotive force (EMF) or voltage across a closed electrical path in response to a changing magnetic flux through any surface bounded by that path. In literature, sometimes magnetic induction is defined as if it is limited to tightly-coupled cases whereby the charger and receiver coils are of similar sizes or the gap between them is small. Magnetic resonance is a term that has been used recently for inductive power transfer where the charger and receiver may be far apart or the transmitter and receiver coils are of different size. The term loosely-coupled wireless charging has also been used for these systems. Since magnetic resonance or loosely-coupled wireless charging is in general a form of induction, as used herein in accordance with various embodiments the term induction is used for any of these systems (including inductive or tightly-coupled wireless power transfer, magnetic resonant or loosely-coupled wireless power transfer and hybrid systems), and induction and magnetic resonance are sometimes used interchangeably to indicate that the method of power transfer can be in either domain or a combination thereof.

[0029] In accordance with various embodiments, an inductive power transmitter employs a magnetic induction coil(s) transmitting energy to a receiving coil(s) in or on a device or product, case, battery door, or attachable or add-on component including attachments such as a dongle or a battery inside or outside of device or attached to device through a connector and/or a wire, or stand-alone placed near or on the power transmitter platform. The receiver can be an otherwise incomplete device that receives power wirelessly and is intended for installation or attachment in or on the final product, battery or device to be powered or charged, or the receiver can be a complete device intended for connection to a device, product or battery directly by a wire or wirelessly. As used herein, the term wireless power, charger, transmitter or inductive or magnetic resonance power and charger are used interchangeably.

[0030] In accordance with an embodiment, the wireless charger can include a flat or curved surface, or an open or enclosed volume or part that can provide energy wirelessly to a receiver. It can also be constructed of flexible materials and/or coils or even plastic electronics to enable mechanical flexibility and bending or folding to save space or for conformity to non-flat surfaces.

[0031] In accordance with an embodiment, the wireless charger can be directly powered by an AC power input, DC power, or other power source such as a car, motorcycle, truck or other vehicle or airplane or boat or ship power outlet, or vehicle, boat, ship or airplane itself, primary (non-rechargeable) or rechargeable battery, solar cell, fuel cell, mechanical (e.g., hand crank, wind, or water source), nuclear source, or other wireless charger or power supply or a combination thereof. In addition, the wireless charger can be powered by a part such as a rechargeable battery which is itself in turn recharged by another source such as an AC or DC power source, vehicle, boat or ship or airplane outlet or vehicle, boat or ship or airplane itself, solar cell, fuel cell, mechanical (e.g., hand crank, wind, or water source) or nuclear source, or a combination thereof.

[0032] In accordance with various embodiments, in applications where the wireless charger is powered by a rechargeable source such as a battery, the battery can also be itself in turn inductively charged by another wireless charger. The wireless charger can be a stand-alone part, device, or product, or can be incorporated into another electric or electronics device, table, desk chair, armrest, TV stand or mount or furniture or vehicle or airplane or marine vehicle or boat or objects such as a table, desk, chair, counter-top, shelving or check out or cashier counters, kiosk, car seat, armrest, car console, car door, netting, cup holder, dashboard, glove box, etc., airplane tray, computer, laptop, netbook, tablet, phone, display, TV, magnetic, optical or semiconductor storage or playback device such as hard drive, solid state storage drive, optical players, etc., cable or game console, computer pads, toys, clothing, bags, case or backpack, belt or holster, etc., industrial, medical, dental, military equipment or kitchen counter, area, devices and appliances, phones, cameras, radios, stereo systems, speakers, etc. The wireless charger can also have other functions built in, or be constructed such that it is modular and additional capabilities or functions can be added as needed.

[0033] In accordance with various embodiments, some of these capabilities or functions include an ability to provide higher power, charge more devices, exchange the top surface or exterior box or cosmetics, operate by internal power as described above through use of a battery and/or renewable source such as solar cells, communicate and/or store data from a device, provide communication between the device and other devices or the charger and/or a

network, etc. An example is a basic wireless charger that has the ability to be extended to include a rechargeable battery pack to enable operation without external power. Examples of products or devices powered or charged by the induction transmitter and receiver include but are not limited to batteries, cell phones, smart phones, cordless phones, communication devices, heads-up displays, wearable computer with head mounted display, 3-d TV glasses, wearable electronic glasses, wearable computer or communication devices, communication or display watches, pagers, personal data assistants, portable media players, global positioning (GPS) devices, powered headphones or noise cancelling headphones, Bluetooth headsets and other devices, shavers, watches, tooth brushes, calculators, cameras, optical scopes, infrared viewers, computers, laptops, tablets, netbooks, keyboards, computer mice, book readers or email devices, pagers, computer monitors, televisions, music or movie players and recorders, storage devices, radios, clocks, speakers, gaming devices, game controllers, toys, remote controllers, power tools, cash register, delivery or other type of scanners, construction tools, office equipment, robots including vacuum cleaning robots, floor washing robots, pool cleaning robots, gutter cleaning robots or robots used in hospital, clean room, military or industrial environments, industrial tools, mobile vacuum cleaners, medical or dental tools, medical stretcher batteries, military equipment or tools, kitchen appliances, mixers, cookers, can openers, food or beverage heaters or coolers such as electrically powered beverage mugs, massagers, adult toys, lights or light fixtures, signs or displays, or advertising applications, electronic magazines or newspapers or magazines or newspapers containing an electronic and/or display part, printers, fax machines, scanners, electric vehicles, electric golf carts, buses, trains, motorcycles or bicycles, personal mobility (e.g., Segway type) devices, trains or other vehicles or mobile transportation machines, and other battery or electrically powered devices or products or a product that is a combination of the products listed above.

[0034] In accordance with an embodiment, the receiver and/or the charger can be incorporated into a bag, carrier, skin, cover, clothing, case, packaging, product packaging or box, crate, box, display case or rack, table, bottle or device etc. to enable some function inside the bag, carrier, skin, clothing, case, packaging, product packaging or box, crate, box, display case or rack, table, bottle (such as, e.g., causing a display case or packaging to display promotional information or instructions, or to illuminate) and/or to use the bag, carrier, skin, clothing, case, packaging, product packaging or box, crate, box, stand or connector, display case or rack, table, bottle, etc., to power or charge another device or component somewhere on or nearby.

[0035] In accordance with various embodiments, the product or device does not

necessarily have to be portable and/or contain a battery to take advantage of induction or wireless power transfer. For example, a lighting fixture or a computer monitor that is typically powered by an AC outlet or a DC power supply can be placed on a table top and receive power wirelessly. The wireless receiver can be a flat or curved surface or part that can receive energy wirelessly from a charger. The receiver and/or the charger can also be constructed of flexible materials and/or coils or even plastic electronics to enable mechanical flexibility and bending or folding to save space or for conformity to non-flat surfaces.

[0036] In accordance with various embodiments, many of these devices contain internal batteries, and the device may or may not be operating during receipt of power. Depending on the degree of charge status of the battery, or its presence and the system design, the applied power may provide power to the device, charge its battery or a combination of the above. The terms charging and/or power are used interchangeably herein to indicate that the received power can be used for either of these cases or a combination thereof. In accordance with various embodiments, unless specifically described, these terms are therefore used interchangeably. Also, unless specifically described herein, in accordance with various embodiments, the terms charger, power supply, and transmitter are used interchangeably.

[0037] **Figure 1** illustrates a system for wireless powering or charging of devices in accordance with an embodiment. As shown in Figure 1, in accordance with an embodiment, a wireless charger or power system 100 comprises a first charger or transmitter part 110, and a receiver 120 connected to a mobile or stationary device, vehicle or battery or its charging or power circuit to provide electric power to power or charge the mobile or stationary device, vehicle or its battery.

[0038] Figure 1 shows an example where one charger or power transmitter is charging or powering one receiver. However, in a more general case, the transmitter may comprise one or more transmitters or chargers operating at different power levels and/or using different protocols to power one or more receivers operating at different power levels, voltages and/or protocols.

[0039] **Figure 2** illustrates a more detailed view of a wireless charger system 128, in accordance with an embodiment, with a resonant converter geometry, wherein a pair of transistors Q1 and Q2 in the charger 130 (such as FETs, MOSFETs, or other types of switch) are driven by a half-bridge driver IC and the voltage is applied to the coil L1 through one or more capacitors shown as C1. In accordance with an embodiment, the receiver 140 includes a coil and an optional capacitor (for added efficiency) shown as C2 that can be in series or in parallel with the receiver coil L2. The charger and/or receiver coils can also include impedance

matching circuits and/or appropriate magnetic material layers behind (on the side opposite to the coil surfaces facing each other) them to increase their inductance and/or to shield the magnetic field leakage to surrounding area. The charger and/or receiver can also include impedance matching circuits to optimize or improve power transfer between the charger and receiver.

[0040] In several of the embodiments and figures described herein, the resonant capacitor C2 in the receiver is shown in a series embodiment. This is intended only as a representative illustration, and in accordance with various embodiments this capacitor can be used in series or parallel with the receiver coil. Similarly, the charger is generally shown in accordance with an embodiment where the resonant capacitor is in series with the coil. System implementations with the capacitor C1 in parallel with the charger coil are also possible.

[0041] In accordance with an embodiment, the charger can also include a circuit that measures the current through and/or voltage across the charger coil (for example, in Figure 2, a current sensor is shown as an example). Communication between the receiver and the charger can also be provided through the same coils as used for the power transfer, through modulation of a load in the receiver. Various demodulation methods for detection of the communication signal on the charger current or voltage are available. This demodulation mechanism can be, e.g., an AM or FM receiver (depending on whether amplitude or frequency modulation is employed in the receiver modulator) similar to a radio receiver tuned to the frequency of the communication or a heterodyne detector.

[0042] In accordance with an embodiment, the communication and control between the charger and the receiver(s) is conducted over a separate or additional RF or optical or other channels. Optional methods of communication between the charger and receiver can be provided through the same coils as used for transfer of power, through a separate coil, through an RF or optical link, through, e.g., RFID, Bluetooth, WiFi, Wireless USB, NFC, Felica, Zigbee, or Wireless Gigabit (WiGig) or through such protocols as defined by the Wireless Power Consortium (WPC), Alliance for Wireless Power (A4WP) or other protocols or standards, developed for wireless power, or specialized protocols such as Dedicated Short Range Communications (DSRC) for automotive applications, or other communication protocol, or combinations thereof.

[0043] In accordance with an embodiment, the microcontroller unit (MCU) in the charger (shown as MCU1 in Figure 2) is responsible for decoding the communication signal from a detection/demodulation circuit and, depending on the algorithm used, making appropriate adjustments to the charger coil drive circuitry to achieve the desired output voltage, current or

power from the receiver output.

[0044] In accordance with various embodiments, it may be preferable for one or more receivers to receive power when placed at a variety of locations or anywhere on or near a wireless charger area. Such an implementation, in general would benefit from a charger and/or receiver design that allows a uniform power transfer over an area or the entire surface of the charger. To provide more uniform power transfer across a coil, in accordance with an embodiment, methods to provide a more uniform magnetic field across a coil can be used. For example, one method for achieving this uses a hybrid coil comprising a combination of a wire and PCB coils (e.g., X. Liu and S. Y. R. Hui, "Optimal design of a hybrid winding structure for planar contactless battery charging platform," IEEE Transactions on Power Electronics, vol. 23, no. 1, pp. 455–463, 2008). In another method, the transmitter coil can be constructed of Litz wire or patterned printed circuit board (PCB) and has a pattern that is very wide between successive turns at the center and is more tightly wound as one gets closer to the edges (e.g., J. J. Casanova, Z. N. Low, J. Lin, and R. Tseng, "Transmitting coil achieving uniform magnetic field distribution for planar wireless power transfer system," in Proceedings of the IEEE Radio and Wireless Symposium, pp. 530–533, January 2009). **Figure 3** shows an example of a coil 150 in accordance with an embodiment, while **Figure 4** shows a resulting magnetic field 152.

[0045] In a geometry described in U.S. Patent Publication No. 20080067874, a planar spiral inductor coil is demonstrated, wherein the width of the inductor's trace becomes wider as the trace spirals toward the center of the coil to achieve a more uniform magnetic field allowing more positioning flexibility for a receiver across a transmitter surface.

[0046] In yet other embodiments (e.g., F. Sato, et al., IEEE Digest of Intermag 1999, PP. GR09, 1999), the coil can be a meandering type of coil, wherein the wire is stretched along X or Y direction and then folds back and makes a back and forth pattern to cover the surface.

[0047] In accordance with an embodiment, the charger can operate continuously, and any appropriate receiver coil placed on or near its surface will bring it to resonance and will begin receiving power. The regulation of power to the output can be performed through a regulation stage and/or tuning of the resonant circuit at the receiver. Advantages of such a system include that multiple receivers with different power needs can be simultaneously powered in this way. The receivers can also have different output voltage characteristics.

[0048] In accordance with embodiments described in U.S. Patent Application No. 13/352,096, published as U.S. Patent Publication No. 20120235636, which application is herein incorporated by reference, two techniques have been described whereby through appropriate design of the system, a position-independent power transfer system with reduced or no

undesirable radiation and high efficiency can be achieved. These geometries use a saturable magnetic layer placed above the charger coil area to shield the charger magnetic layer from the surrounding area.

[0049] For example, in accordance with an embodiment, a Magnetic Aperture (MA) receiver includes an appropriate magnet in the receiver that can saturate the shield layer nearby the receiver and allow coupling of power only in that area of the charger, resulting in efficient power coupling with minimal residual electromagnetic emission from nearby areas. In accordance with an embodiment, a Magnetic Coupling (MC) system employs a similar geometry but uses the increase in the resonant electromagnetic field between the charger and receiver coils to self-saturate the layer, and does not require a receiver magnet to operate and achieve similar results. These two techniques are further described in the patent applications referenced above.

[0050] **Figure 5** shows an additional geometry 160 whereby a charger coil 162 is placed on a magnetic flux guide / shielding layer 164 that extends beyond the edges of the coil. The receiver similarly has a magnetic flux / shielding layer 166 that extends beyond the size of the coil 168, allowing an overlap area between these flux layers on the top and bottom sides of the receiver. **Figure 6** shows 170 the return magnetic flux from the charger that passes the receiver coil and is guided efficiently to close on itself. Such an efficient flux guide (FG) geometry results in confinement of power transfer to the area of overlap of a receiver and charger coil, and significant increase in power transfer efficiency and reduction of undesirable electromagnetic emission compared to Magnetic Resonance (MR) systems. It is also possible to further decrease any potential emissions from non-covered areas of the charger coil by covering the charger coil with a magnetic shield layer and combining the FG geometry with the earlier described MC or MA modes of operation.

[0051] In accordance with the MC geometry, the reluctance of the flux path in the receiver can be lowered by including high permeability material in the core of the receiver ring coil (similar to a solenoid) or a T-shape core or alike. Many geometries are possible, and these geometries are provided merely as examples. Additionally, while in accordance with an embodiment a Litz wire receiver coil can be used, in accordance with other embodiments, PCB coils and/or a combination of Litz wire and PCB coil can be used.

[0052] In accordance with an embodiment, to reduce the reluctance of the path, the receiver coil can be created by using a flux guide material (such as ferrite with permeability greater than 1), with an axis perpendicular (or an angle sufficient to catch the substantially perpendicular flux from the charger) to the surface of the charger. As shown 172 in **Figure 7**,

Litz wire can be wrapped around the core to create a solenoid type receiver with a relatively small cross section (several mm or smaller by 10 or 20 mm) substantially parallel to the surface of the charger. In one example, the solenoid height (along the direction of axis of wire wrapped around it, and perpendicular to the surface of the charger) can be varied from 10 to 20 mm, but can be shorter. A typical number of turns on the receiver coil can be 7 to 20 turns. Use of a series or parallel capacitor with such a receiver coil provides a resonant circuit whose output can be rectified and smoothed with a capacitor to provide a DC output. To provide regulated power output, as shown in Figures 1 and 2, a communication or feedback system between charger and receiver and/or an output stage regulator can also be added.

[0053] In one example, a charger coil similar to that shown in Figure 3 and with a thin (0.5 mm thick) ferrite lower magnetic shield / flux guide similar to that shown 174 in **Figure 8** was used. Substantial power transfer (over 20 W) and high efficiencies of up to 55% DC to DC (DC power output of receiver rectifier divided by input to DC charger circuit input power) was received over the entire surface of the charger coil when the charger coil and its associated resonant capacitor were tuned to be resonant at similar frequencies to the receiver coil and its associated capacitor. Power was received with the receiver coil having zero up to several cm of gap from the surface of the charger coil. Such a small solenoid can be provided having very small sizes in one or two dimensions, such that it is shaped as or otherwise resembles a blade, with the contact area being the thin edge of the blade.

[0054] In accordance with an embodiment, rotating the angle of the blade solenoid with respect to the perpendicular direction to the surface to the charger can produce large power transfers, confirming that as long as some component of the charger flux is along the axis of the receiver coil, efficient power transfer can be obtained. Both position-free and multiple receiver operation can be provided. As shown in Figure 7, optionally, an additional magnetic shield / guide layer on the top of the receiver and/or on the bottom of the charger can also be included. In many applications, it is beneficial to utilize receivers that occupy minimal space and are able to fit inside (or inside an optional part of) a small mobile or fixed position device.

[0055] In accordance with an embodiment shown in Figure 8, the charger does not utilize a top magnetic layer, and the flux guiding through the magnetic core and/or magnetic layers at the bottom of charger and/or top of receiver is used to provide a low reluctance path for magnetic flux flow and efficient power transfer.

[0056] Some examples of the types of devices that can include a small blade type receiver include mobile phones, MP3 players, and wearable computers such as displays, communication and display watches, and electronic glasses. In some applications, the device

to be charged has a small surface area that is in contact with the charger surface, for example cylindrical batteries that are placed vertically to be charged, or devices such as wearable electronic glasses or displays whereby the device has a small surface area when placed against a flat or curved charger. In accordance with an embodiment, use of the flux guide and a smaller cross-section parallel to the surface of the charger, as shown in Figure 7 or 8, may be useful for these types of applications.

[0057] In accordance with an embodiment, a receiver coil or solenoid with a magnetic flux guide can also be constructed to have a somewhat larger area parallel to the surface of the charger, approximating the embodiment illustrated in Figure 6, but with a flux guide layer or core in the middle of the coil. In this case, the height of this flux guide or core (along the length perpendicular to the surface of the charger) can be made quite short (e.g., 1-2 mm or less).

[0058] In accordance with an embodiment, shown in **Figure 9**, the receiver coil can be wrapped around a very thin magnetic material. By way of example, in accordance with an embodiment 180, 182 this material can be 1 mm or less in thickness. In one example, coils comprising 0.6 mm thick Litz wire of bundled wire can be wrapped around 0.3 mm thick sheet of 600 permeability ferrite material (20 x 10 x 0.3 mm size) and used for such a receiver. Using such a blade type receiver with a coil surface area of 20 x 0.3 mm on a charger surface of 170 mm x 170 mm or larger coil with pattern similar to Figure 3, power transfer levels exceeding 20 W, and DC to DC power transfer efficiencies of up to 55 %, were observed when the receiver coil was placed at any location and orientation (with the axis of the receiver coil having some component perpendicular to the surface of the charger) on or near the surface of the charger. Additionally, significant power transfer was observed when the receiver coil was moved away from the charger coil in a vertical direction (with coil to coil spacing of 20 mm or larger). Considering that the blade type receiver coil surface occupies an area of 0.02% of the area of the charger coil, achieving such a high level of power transfer and efficiency demonstrates that the flux generated at the surface of the charger coil is efficiently guided and channeled to the location of the receiver coil.

[0059] In accordance with an embodiment, such a coil can be made to be symmetrical along its winding axis, and can receive power when the coil is flipped vertically. Such a feature may provide additional flexibility and usage in some applications.

[0060] In accordance with another embodiment shown 190, 192 in **Figure 10**, and 202, 202 in **Figure 11**, additional magnetic or ferrite material or layers can be added to or otherwise integrated with the top and/or bottom of the receiver coil and its associated magnetic section. Such layers aid in the guidance of the flux generated in the receiver coil and can provide higher

efficiency and/or power.

[0061] In accordance with an embodiment, the receiver can be used to charge or power wearable mobile communication and display devices, such as wearable electronic glasses, watches, headsets, or other devices. An example of an embodiment for integration into wearable headsets or electronic display devices or glasses is shown 212 in **Figure 12**. In accordance with an embodiment, a device such as an electronic glasses can be oriented on a surface as shown, to receive charging. Alternately, the electronic glasses can be flipped vertically so the top flat side is in contact with a charging surface. In either orientation, the surface area of the device in or near contact with the charger surface can be quite small.

[0062] Figure 12 shows an embodiment that incorporates the receiver coil and/or its associated electronics in a section with a small horizontal (in the plane of the charger coil if the device is laid down on a charger surface) surface area. The embodiments of the receiver coil described above are useful for this implementation, and can also be incorporated in another embodiment 214 shown in **Figure 13** that incorporates magnetic or ferrite material sections above and below the main coil section to further guide the magnetic flux. These layers can also be used to guide or route the charger magnetic flux around the inside cavity and shield any PCB, circuit, battery, or metallic part that may be included in this space from the magnetic field of the charger.

[0063] Since, in accordance with an embodiment, such a receiver can be symmetrical in the Z axis (perpendicular to surface of charger or along the axis of the receiver coil winding), the electronic glasses can be laid down in any of the several orientations flatly on the surface and power will be received by the receiver. In addition, the X and Y position freedom created by the charger coil allows the user to place the electronic glasses at any location on the charger, and even at a Z distance, to receive power.

[0064] In accordance with an exemplary embodiment, when a receiver with integrated horizontal flux guide sections, such as the embodiment shown in Figure 11, was placed near the outer areas of a 170 mm x 170 mm charger coil such as that shown in Figure 8, with a charger under a layer of ferrite material flux guide, it was observed that the receiver can receive power even when its coil axis is parallel to the charger surface. This is due to the large parallel (to the surface) component of the charger magnetic flux in these outer areas. The smaller horizontal sections in the receiver coil (shown as the end flux guides in Figure 11) also aid in guiding the flux into and out of the receiver coil, and enable operation of the receiver in any orientation. This behavior enables a receiver such as that shown in Figure 11 to be generally rotatable at any angle along an axis perpendicular to the plane of the orientation shown in lower part of

Figure 11, when placed on a charger, and still receive power. This behavior can be useful for those applications where orientation independence is required.

[0065] In accordance with another embodiment, the receiver can be integrated into devices such as mobile phones, MP3 players, tablets, watches, batteries, headsets, or other devices where limited space is available. **Figure 14** shows an embodiment 220 for integration into a mobile phone at an edge of the phone, or somewhere within the body of the phone. Such a phone with the receiver integrated can be charged when placed at any location on a charger surface. In accordance with another embodiment 222, horizontal magnetic or ferrite layers on top and bottom can be used, as shown in **Figure 15**.

[0066] As described above, in accordance with an embodiment, the receiver coil can be made to be symmetrical along its winding axis, which enables, in either of the embodiments, the phone or other electronic device to be charged with either its back side or its front facing the charger surface. In accordance with an embodiment, the charger and/or the receiver can also be configured to detect the orientation or front-back placement of the device during charging and perform additional functionalities. For example, a phone can be configured so that when the phone is placed face-down on the charger, it can be charged but will enter a "Do Not Disturb" mode so that any incoming calls, messages, texts, emails, etc., will not provide audio, visual or other indications; but, when placed on the charger in its other orientation (display face-up), incoming information can be relayed to the user visually, by audio or even displayed or transmitted to another device (such as transmission to another display when used in cars).

[0067] The above illustration is an example of a contextually-aware operation; in accordance with various embodiments, such activities of tying wireless charging to, e.g., launching or performance of other activities or commands can be considered examples of contextually aware charging, additional examples of which are described in U.S. Patent Publication No. 20110050164, which examples can be combined or used with various embodiments of the charger and receiver technologies described herein.

[0068] **Figure 16** shows another embodiment 224 for integration of a sheet or blade type receiver coil within an electronic device, in this illustration a headset device, e.g., at the edge or back of the headset, or another suitable location within the body of the headset.

Charger and Receiver Interaction

[0069] In accordance with an embodiment, the receiver can be provided as an integral part of a device or battery as described above, or can be provided as an otherwise incomplete device that receives power wirelessly and is intended for installation or attachment in or on the

final product, battery or device to be powered or charged, or the receiver can be a complete device intended for connection to a device, product or battery directly by a wire or wirelessly. Examples include replaceable covers, skins, cases, doors, jackets, surfaces, etc for devices or batteries that would incorporate the receiver or part of the receiver and the received power would be directed to the device through connectors in or on the device or battery or the normal wired connector (or power jack) of the device or battery. The receiver can also be a part or device similar to a dongle or insert etc., that can receive power on or near the vicinity of a charger and direct the power to a device or battery to be charged or powered through a wire and/or appropriate connector. Such a receiver can also have a form factor that would allow it to be attached in an inconspicuous manner to the device, such as a part that is attached to the outer surface at the bottom, front, side, or back side of a laptop, netbook, tablet, phone, game player, camera, headset or other electronic device, and routes the received power to the input power connector, battery connector or jack of the device.

[0070] In accordance with an embodiment, the connector of such a receiver can be configured such that it has a pass-through or a separate connector integrated into it, so that a wire cable for providing wired charging or power or communication can be connected to the connector without removal of the connector, thus allowing the receiver and its connector to be permanently or semi-permanently be attached to the device throughout its operation and use.

[0071] In a more integrated approach, the coil, shield and/or the receiver circuit can be integrated into the construction of the electric or electronic device, and be an integral part of the operation of the device which is powered or charged primarily or as an option (in addition to wired charging) through the wireless power received from the receiver. Many other variations of the receiver implementation are possible, and these examples are not meant to be exhaustive.

[0072] In accordance with an embodiment, the receiver can also be provided as a whole or as a part of the electronics, coil, shield, or other part of the system required for receiving power wirelessly. The electronics can comprise discrete components or microcontrollers that when used together provide the wireless receiver functionality, or comprise an Application Specific Integrated Circuit (ASIC) chip or chipset or MCM that is specifically configured to function as the whole or a substantial part of the electronics for wireless receiver system.

[0073] In accordance with an embodiment, a system with largely mis-matched (i.e. dissimilar in size or shape) charger and receiver coils can potentially have several advantages. For example, power can be transferred to the receiver coils placed anywhere on the transmitter coil. Several receivers can be placed and powered on one transmitter allowing for simpler and lower cost of transmitter. The system with higher resonance Q can be configured so the gap

between the transmitter and receiver coil can be larger than a tightly-coupled system leading to design of systems with more design freedom. In practice, power transfer in distances of several cm or even higher have been demonstrated. Power can be transferred to multiple receivers simultaneously. In addition, the receivers can potentially be of differing power rating or be in different stages of charging or require different power levels and/or voltages.

[0074] In accordance with an embodiment, in order to achieve the above characteristics and to achieve high power transfer efficiency, the lower k value is compensated by using a higher Q through design of lower resistance coils, etc. The power transfer characteristics of these systems may differ from tightly-coupled systems and other power drive geometries such as use of resonant converters. Class E amplifiers or Zero Voltage Switching (ZVS) or Zero Current Switching (ZCS) or other power transfer systems may potentially operate more efficiently in these situations. In addition, impedance matching circuits at the charger transmitter and/or receiver may be required to enable these systems to provide power over a range of load values and output current conditions. General operation of the systems can, however be quite similar to the tightly-coupled systems and one or more capacitors in series or parallel with the transmitter and/or receiver coils is used to create a tuned circuit that may have a resonance for power transfer. Operating near this resonance point, efficient power transfer across from the transmitter to the receiver coil can be achieved. Depending on the size difference between the coils and operating points, efficiencies of over 50% up to near 80% have been reported in such loosely-coupled systems.

[0075] To provide communication and control between the charger and receiver or receivers, in accordance with an embodiment, a hardware Physical Communication and Control Layer (PCCL) and a software or firmware Command and Control Layer (CCL) can be implemented. Optional methods of communication between the charger and receiver(s) can be provided through the same coils as used for transfer of power, through a separate coil, through an RF or optical link, through RFID, Bluetooth, Wi-Fi, Wireless USB, NFC, Felica, Zigbee, Wireless Gigabit (WiGig), 3G, 4G, etc. or through such protocols as defined by the Wireless Power Consortium (WPC), Alliance for Wireless Power (A4WP), or Power Matters Alliance (PMA), or other protocols such as Dedicated Short Range Communication (DSRC) used for automotive applications or other standards, developed for wireless power, or other communication protocol, or combination thereof.

[0076] In simpler architectures, there may be minimal or no communication between the charger and receiver. For example, a charger can be configured to be in a standby power transmitting state, and any receiver in close proximity to it can receive power from the charger.

The voltage, power, or current requirements of the device or battery connected to the receiver circuit can be unregulated, or regulated or controlled completely at the receiver or by the device attached to it. In this instance, no regulation or feedback or communication between the charger and receiver may be necessary. In a variation of this, the charger can be configured to be in a state where a receiver in close proximity would bring it into a state of power transmission. Examples of this would be a resonant system where inductive and/or capacitive components are used, so that when a receiver of appropriate design is in proximity to a charger, power is transmitted from the charger to a receiver; but without the presence of a receiver, minimal or no power is transmitted from the charger.

[0077] In accordance with an embodiment, in those examples in which communication is provided through the power transfer coils, one method for communication from receiver or receivers to the charger is to modulate a load or impedance in the receiver to affect the voltage and/or current in the receiver coils and therefore create a modulation in the charger coil voltage or current parameters that can be detected through monitoring of its voltage or current. Other methods can include frequency modulation, by combining the received frequency with a local oscillator signal or inductive, capacitive, or resistive modulation of the output of the receiver coil. In addition to communication from receivers to a charger transmitter, it is also possible to modulate the charger voltage at a pre-determined frequency and communication protocol and detect at each receiver to provide communication from the charger to the receivers. Such bi-directional communication may be advantageous in cases where the charger is used to power multiple receivers as will be explained later.

[0078] In accordance with an embodiment, the communicated information from a receiver to the charger transmitter can be the output voltage, current, power, device or battery status, validation ID for receiver, end of charge or various charge status information, receiver battery, device, or coil temperature, and/or user data such as music, email, voice, photos or video, or other form of digital or analog data used in a device. It can also be patterns or signals or changes in the circuit conditions that are transmitted or occur to simply notify the presence of the receiver nearby.

[0079] In accordance with an embodiment, the data communicated can be any one or more of the information detailed herein, or the difference between these values and the desired value, or simple commands to increase or decrease power, or simply one or more signals that would confirm presence of a receiver or a combination of the above. The receiver and/or charger and/or their coils can also include elements such as thermistors, magnetic shields or magnetic cores, magnetic sensors, and input voltage filters, etc., for safety and/or emission

compliance reasons. The receiver can also be combined with other communication or storage functions, such as NFC, Wi-Fi, Bluetooth, etc. In addition, the charger and or receiver can include means to provide more precise alignment between the charger and receiver coils or antennas. These can include visual, physical, or magnetic means to assist the user in alignment of parts. To implement more positioning freedom of the receiver on the charger, the size of the coils can also be mismatched. For example, the charger can comprise a larger coil size, and the receiver a smaller one, or vice versa, so that the coils do not have to be precisely aligned for power transfer.

[0080] In accordance with an embodiment, to minimize stand-by power use, the charger can periodically be turned on to be driven with a periodic pattern (a ping process) and if a receiver in proximity begins to draw power from it, the charger can detect power being drawn from it and stay in a transmitting state. If no power is drawn during the ping process, the charger can be turned off or placed in a stand-by or hibernation mode to conserve power, and turned on and off again periodically to continue seeking a receiver.

[0081] In accordance with an embodiment, the charger also includes a circuit that measures the current through and/or voltage across the charger coil (for example, a current sensor is shown in Figure 2 by way of example). As described earlier, various demodulation methods for detection of the communication signal on the charger current or voltage can be used.

[0082] While a system for communication between the charger and receiver through the power transfer coils or antennas is described above, in accordance with an embodiment the communication can also be implemented through separate coil or coils, a radio frequency link (AM, FM or other communication method), an optical communication system, or a combination of the above. The communication in any of these methods can also be bi-directional rather than uni-directional as described above.

[0083] In accordance with another embodiment, a dedicated RF channel for uni-directional or bi-directional communication between the charger and receiver can be implemented for validation and/or regulation purposes. This system can be similar to the system shown in Figure 2, except rather than load modulation being the method of communication, the microcontroller (MCU) in the receiver transmits the required information over an RF communication path. A similar system with LED or laser transceivers or detectors and light sources can be implemented. Advantages of such a system include that the power received is not modulated and therefore not wasted during communication and/or that no noise due to the modulation is added to the system.

[0084] In accordance with an embodiment, the microcontroller unit (MCU) in the charger (MCU1) is responsible for recognizing and understanding the communication signal from the detection/demodulation circuit and, depending on the algorithm used, making appropriate adjustments to the charger coil drive circuitry to achieve the desired output voltage, current or power from the receiver output. In addition, MCU1 is responsible for processes such as periodic start of the charger to seek a receiver at the start of charge, keeping the charger on when a receiver is found and accepted as a valid receiver, continuing to apply power and making appropriate adjustments, and/or monitoring temperature or other environmental factors, providing audio or visual indications to the user on the status of charging or power process, etc., or terminating charging or application of power due to end of charge, or customer preference, or over temperature, over current, over voltage, or some other fault condition or to launch or start another program or process.

[0085] In accordance with an embodiment, once the charger MCU1 has received a signal and decoded it, it can take action to provide more or less power to the charger coil. This can be accomplished through known methods of adjusting the frequency, duty cycle or input voltage to the charger coil or a combination of these approaches. Depending on the system and the circuit used, the MCU1 can directly adjust the bridge driver, or an additional circuit such as a frequency oscillator can be used to drive the bridge driver or the FETs. A typical circuit for the receiver, in accordance with a load modulation communication system embodiment, is shown in Figure 2.

[0086] In accordance with an embodiment, the receiver circuit can include an optional capacitor C2 in parallel or series with the receiver coil to produce a tuned receiver circuit. This circuit is known to increase the efficiency of a wireless power system. The rectified and smoothed (through rectifiers and capacitors) output of the receiver coil and optional capacitor is either directly or through a switch or regulator applied to the output. A microcontroller MCU2 is used to measure various values such as voltage V_1, current, temperature, state of charge, battery full status, end of charge, etc. and to report back to the charger to provide a closed loop system with the charger as described above. In the circuit shown in Figure 2, the receiver MCU2 communicates back to the charger by modulating the receiver load by rapidly closing and opening a switch in series with a modulation load or impedance at a pre-determined speed and coding pattern. This rapid load modulation technique at a frequency distinct from the power transfer frequency can be easily detected by the charger. A capacitor and/or inductor can also be used as the modulation load.

[0087] In accordance with other embodiments, other methods of communication through

varying the reactive component of the impedance can also be used. The modulation scheme shown in Figure 2 is shown only as a representative method and is not meant to be exhaustive. As an example, the modulation can be achieved capacitively, by replacing the resistor with a capacitor. In this instance, the modulation by the switch in the receiver provides an advantage that by choosing the modulation frequency appropriately, it is possible to achieve modulation and signal communication with the charger coil and circuitry, with minimal power loss (compared to the resistive load modulation).

[0088] The receiver in Figure 2 also shows an optional DC regulator that is used to provide constant stable voltage to the receiver MCU2. This voltage supply may be necessary to avoid drop out of the receiver MCU2 during startup conditions where the power is varying largely or during changes in output current, and also to enable the MCU2 to have a stable voltage reference source so it can measure the V_1 voltage accurately. Alternatively, a switch to connect or disconnect the load can be used or combined with the regulator. To avoid voltage overshoots during placement of a receiver on a charger or rapid changes in load condition, a voltage limiter circuit or elements like Transit Voltage Suppressor (TVS), Zener diodes or regulators or other voltage limiters can also be included in the receiver.

[0089] In the above description, a uni-directional communication (from the receiver to the charger) is described. However, this communication can also be bi-directional, and data can be transferred from the charger to the receiver through modulation of the voltage or current in the charger coil and read back by the microcontroller in the receiver detecting a change in the voltage or current, etc.

[0090] In accordance with an embodiment, the communication between the receiver and charger needs to follow a pre-determined protocol, baud rate, modulation depth, etc. and a pre-determined method for hand-shake, establishment of communication, and signaling, etc., as well as optionally methods for providing closed loop control and regulation of power, voltage, etc., in the receiver.

[0091] In accordance with an embodiment, a typical wireless power system can be as follows: the charger periodically activates the charger coil driver and powers the charger coil with a drive signal of appropriate frequency. During this 'ping' process, if a receiver coil is placed on or close to the charger coil, power is received through the receiver coil and the receiver circuit is energized. The receiver microcontroller is activated by the received power and begins to perform an initiation process whereby the receiver ID, its presence, power or voltage requirements, receiver or battery temperature or state of charge, manufacturer or serial number and/or other information is sent back to the charger. If this information is verified and

found to be valid, then the charger proceeds to provide continuous power to the receiver. The receiver can alternately send an end of charge, over-temperature, battery full, or other messages that will be handled appropriately by the charger and actions performed. The length of the ping process should be configured to be of sufficient length for the receiver to power up its microcontroller and to respond back and for the response to be received and understood and acted upon. The length of time between the pings can be determined by the implementation designer. If the ping process is performed often, the stand-by power use of the charger is higher. Alternately, if the ping is performed infrequently, the system will have a delay before the charger discovers a receiver nearby; so in practice, a balance may be suitable.

[0092] Alternatively, in accordance with an embodiment, the ping operation can be initiated upon discovery of a nearby receiver by other means. This provides a very low stand-by power use by the charger and can be performed by including a magnet in the receiver and a magnet sensor in the charger or through optical, capacitive, weight, NFC or Bluetooth, RFID or other RF communication or other methods for detection.

[0093] Alternatively, in accordance with an embodiment, the system can be configured or implemented to be always ON (i.e., the charger coil is powered at an appropriate drive frequency) or pinged periodically and presence of the receiver coil brings the coil to resonance with the receiver coil and power transfer occurs. The receiver in this instance may not even contain a microcontroller and act autonomously and may simply have a regulator in the receiver to provide regulated output power to a device, its skin, case, or battery. In those embodiments in which periodic pinging is performed, the presence of a receiver can be detected by measuring a higher degree of current flow or power transfer or other means, and the charger can simply be kept on to continue transfer of power until either the power drawn falls below a certain level or an end of charge and/or no device present is detected.

[0094] In another embodiment, the charger can be in an OFF or standby, or low or no power condition, until a receiver is detected by means of its presence through a magnetic, RF, optical, capacitive or other methods. For example, in accordance with an embodiment the receiver can contain an RFID chip and once it is present on or nearby the charger, the charger can turn on or begin pinging to detect a receiver.

[0095] In accordance with an embodiment, the protocol used for communication can be any of, e.g., common RZ, NRZ, Manchester code, etc., used for communication. As described above, the charger can periodically start and apply a ping voltage of pre-determined frequency and length to the charger coil. The receiver is then activated, and can begin to send back communication signals. The communication signal can include an optional preamble that is

used to synchronize the detection circuit in the charger and prepare it for detection of communication. A communication containing a data packet may then follow, optionally followed by checksum and parity bits, etc. Similar processes are used in communication systems and similar techniques can be followed. In accordance with an embodiment, the actual data packet can include information such as an ID code for the receiver, a manufacturer's code, received voltage, power, or current values, status of the battery, amount of power in the battery, battery or circuit temperature, end of charge or battery full signals, presence of external wired charger, or a number of the above. Also this packet may include the actual voltage, power, current, etc. value or the difference between the actual value and the desired value or some encoded value that will be useful for the charger to determine how best to regulate the output.

[0096] Alternatively, in accordance with an embodiment, the communication signal can be a pre-determined pattern that is repetitive and simply lets the charger know that a receiver is present and/or that the receiver is a valid device within the power range of the charger, etc. Any combination of systems can be configured to provide the required performance.

[0097] In accordance with an embodiment, in response to the receiver providing information regarding output power or voltage, etc., the charger can modify voltage, frequency, duty cycle of the charger coil signal or a combination of the above. The charger can also use other techniques to modify the power out of the charger coil and to adjust the received power. Alternatively the charger can simply continue to provide power to the receiver if an approved receiver is detected and continues to be present. The charger can also monitor the current into the charger coil and/or its temperature to ensure that no extra-ordinary fault conditions exist. One example of this type of fault may be if instead of a receiver, a metal object is placed on the charger.

[0098] In accordance with an embodiment, the charger can adjust one or more parameters to increase or decrease the power or voltage in the receiver, and then wait for the receiver to provide further information before changing a parameter again, or it can use more sophisticated Proportional Integral Derivative (PID) or other control mechanism for closing the loop with the receiver and achieving output power control. Alternatively, as described above, the charger can provide a constant output power, and the receiver can regulate the power through a regulator or a charger IC or a combination of these to provide the required power to a device or battery.

[0099] Various manufacturers may use different encodings, and also bit rates and protocols. The control process used by different manufacturers or protocols may also differ, further causing interoperability problems between various chargers and receivers. A source of

interoperability differences may be the size, shape, and number of turns used for the power transfer coils. Furthermore, depending on the input voltage used, the design of a wireless power system may step up or down the voltage in the receiver depending on the voltage required by a device by having appropriate number of turns in the charger and receiver coils. However, a receiver from one manufacturer may then not be able to operate on another manufacturer charger due to these differences in designs employed.

[00100] In accordance with an embodiment, it is therefore beneficial to provide a system that can operate with different receivers or chargers and can be universal. Recently, there has been some movement to standardize the frequency of operation, the coil and electronics characteristics, the identification and communication method, messaging and protocol and other aspects of the systems to allow interoperability between systems from different manufacturers. Several interoperability Standards and Specifications in this area have been established or under consideration. These include the WPC interoperability specification, the Consumer Electronics Association Standard for wireless power, the Alliance for Wireless Power (A4WP), Power Matters Alliance (PMA), the Consumer Electronics Association (CEA) Wireless Power Standards working group and Wireless Power Standards for Electric Vehicle charging, and other international efforts for Specification and Standards development.

[00101] The resonant frequency, F of any LC circuit is given by:

$$F = 1 \ / \ 2\pi\sqrt{LC}$$

[00102] Where L is the Inductance of the circuit or coil in Henry and C is the Capacitance in Farads.

[00103] For example, in the system shown in Figure 3, one may use the values of C1 and L1 in the above calculation for a free running charger and, as a receiver is brought close to this circuit, this value is changed by the mutual coupling of the coils involved. In the example that a ferrite shield layer is used behind a coil in the charger and/or receiver, the inductance of the coil is affected by the permeability of the shield and this modified permeability should be used in the above calculation.

[00104] In accordance with an embodiment, to be able to detect and power or charge various receivers, the charger can be configured such that the initial ping signal is at such a frequency range to initially be able to power and activate the receiver circuitry in any receiver during the ping process. After this initial power up of the receiver, the charger communication circuit should be able to detect and decode the communication signal from the receiver. Many

microcontrollers are able to communicate in multiple formats and/or may have different input A/D converter pins that can be configured differently to simultaneously receive the communication signal and synchronize and understand the communication at different baud rates and protocols. In accordance with an embodiment, the charger firmware can then decide on which type of receiver is present and proceed to regulate or implement what is required (end of charge, shut-off, fault condition, etc.). Depending on the message received, the charger can then decide to change the charger driver voltage amplitude, frequency, or duty cycle, or a combination of these or other parameters to provide the appropriate regulated output at the receiver output.

[00105] In accordance with an embodiment, the charger's behavior can also take into account the difference in the coil geometry, turns ratio, etc. For example, a charger and receiver pair from one or more manufacturers may require operation of the charger drive voltage at 150 kHz. However, if the same receiver is placed on a charger from another manufacturer or driven with different coil or input voltage combination, to achieve the same output power, the charger frequency may need to be 200 kHz. The charger program may detect the type of receiver placed on it and shift the frequency appropriately to achieve a baseline output power and continue regulating from there. In accordance with an embodiment, the charger can be implemented so that it is able to decode and implement multiple communication and regulation protocols and respond to them appropriately. This enables the charger to be provided as part of a multi-protocol system, and to operate with different types of receivers, technologies and manufacturers.

[00106] Similar techniques can be used to allow a receiver to be chargeable on chargers utilizing different protocols for communication and control. For example, the receiver may recognize the type of charger being used by deciphering the frequency of the charger operation or its ping (through frequency filtering or other techniques) and communicate using different protocols and communication signals accordingly.

[00107] In accordance with an embodiment, for receivers that contain an onboard output stage regulator before the output power, stability of the input voltage to the regulator is not as critical since the regulator performs a smoothing function and keeps the output voltage at the desired level with any output load changes (such as during battery charging). The output of the regulator is then directed to circuitry such as a power management IC (PMIC), or to a battery for charging, or directly connected to the device for use in instances where the receiver acts as a power supply to a device without internal batteries, or a combination of the above. Where an output regulator stage is used in a receiver it is critical for the wireless receiver not to exceed

the maximum rated input voltage of the output stage regulator or to drop below a level required so that the output voltage from the regulator could no longer be maintained at the required value. Various types of output stage regulator such as buck, boost, buck-boost, linear etc., can be used as this output stage. However, in general, inclusion of a regulator and/or a charger IC or PMIC chip (for batteries) relaxes the power/voltage regulation requirements of the wireless power receiver portion of the circuit at the expense of the additional size and cost of this component. In accordance with some embodiments, simpler voltage limiting output stages such as Zener diodes, TVS or other voltage limiting or clamping ICs or circuits, can be used.

[00108] In accordance with another embodiment, the receiver can also include variable or switchable reactive components (capacitors and/or inductors) that would allow the receiver to change its resonant condition to affect the amount of power delivered to the device, load or battery. The receiver and/or charger and/or their coils can also include elements such as thermistors, magnetic shields or magnetic cores, magnetic sensors, and input voltage filters, for safety and/or emission compliance reasons.

[00109] In accordance with an embodiment, the systems described herein can use discrete electronics components or some or all of the functions described above can be integrated into an Application Specific Integrated Circuit (ASIC) or MCMs to achieve smaller footprint, better performance, noise, etc. and/or cost advantages. Such integration is common in the electronics industry and can provide additional advantages here.

[00110] While the system above describes a system wherein the communication is primarily through the coil, as described earlier, communication can also be implemented through a separate coil, RF, optical system or a combination of the above. In such circumstances, a multi-protocol system can also be used to interoperate between systems with different communication and/or control protocols or even means of communication.

Flexible Systems with Multiple Protocols and Technologies

[00111] In accordance with an embodiment, a receiver or receivers placed on or near a charger can communicate with the charger in a variety of communication protocols according to different wireless charging standards, protocols or different proprietary methods. To distinguish them and provide for efficient operation, the charger can be programmed to recognize different messages received, and operate differently.

[00112] For example, different protocols exist for communication and control for charging a single receiver placed on a charger. Some systems may require the charger to control the voltage output from the receiver coil (that is rectified and sent to an output of the system or to a

regulator) within a tight tolerance, and cannot tolerate a large range. An example of such a protocol or standard is the Wireless Power Consortium (WPC) or Chi, A4WP, PMA or other standard which is designed to provide tight receiver coil output voltage tolerances and also requires charger frequency range of 110 to 205 kHz or higher. In accordance with an embodiment a charger system can be configured so that it recognizes such a receiver and controls the output to within its target range. However, in other instances receivers may be designed as described above that can tolerate a larger V_1 range by using an output receiver regulator stage to allow multi-receiver charging.

[00113] In accordance with an embodiment, to address these use cases, the charger hardware, firmware or software can be configured to recognize the presence of such receivers and operate using a different algorithm to keep one or several receiver voltage ranges to within a larger acceptable range, and provide multi-receiver charging capability. This allows one charger to be interoperable with two or more protocols and systems.

[00114] In accordance with an embodiment, the charger systems or protocols can employ different power transfer and/or communication frequencies, or different communication methods (e.g., in-band through coil, and out of band through Wi-Fi or Bluetooth or proprietary systems) to communicate and also transfer power to receivers utilizing different protocols. The approaches described herein can be used to enable interoperability between such systems.

[00115] In accordance with an embodiment, the charger can use one or more driving circuits, communication methods or protocols and/or charger power or communication coils or antennas to simultaneously power different receiver coils utilizing different protocols, standards and/or power levels or voltages.

[00116] In accordance with an embodiment, the charger coil and resonant capacitor are tuned to provide the operating frequency of the charger, and the associated receiver and its resonant capacitor is similarly tuned to the vicinity of the same frequency for optimal power transfer. It is possible to provide and control power to two or more receivers simultaneously with one or more charger coils, by multiplexing the power transfer frequency.

[00117] In accordance with another embodiment, the charger can contain several resonant capacitors, such as C1 illustrated in Figure 2, which can be switched to form resonances with the charger coil L1, and to provide charger resonances at different frequencies. For example, depending on the protocol of the receiver, the charger can be configured to switch to use a different C1 in series with its coil to optimize power transfer at the preferred operating frequency of receivers from different protocols.

[00118] In accordance with an embodiment, the charger can first use one C1 value and

perform a ping operation to discover receivers adhering to a frequency of operation with that capacitor value and with the appropriate communication protocol. If an appropriate receiver is discovered, it can continue to provide power at that frequency and protocol. If no such receiver is found, it can switch to use a different value of C1, and repeat the ping and rotate between different C1 values and ping frequencies until appropriate receiver or receivers are discovered. An advantage of using several capacitors and switching between them for different protocols and/or operating frequencies is that higher power transfer efficiencies and/or communication may be obtained compared to using a fixed C1 value.

Multi-Device Charging

[00119] **Figure 17** illustrates a charger 230 for use in coupling to a blade type receiver in the outer perimeter of the charger surface, which can be used to power a device or receiver having a geometry similar to that shown in Figures 7 or 8, in this example an electronic glasses device 232.

[00120] In accordance with an embodiment, the system allows mixing or combining of different technologies on the same charger and/or receiver, or different locations or areas of the same charger. As an illustrative example, it may be desirable to charge two types of device simultaneously with different characteristics. For example, **Figure 18** and **Figure 19** show embodiments 240, 250 wherein the charger includes a large magnetic / ferrite layer below. A plurality (e.g., two or more) separate coil structures are used on top of the magnetic layer in the charger to provide, in this example, two or more different sections (areas) with different operating principles or protocols and/or driving and/or communication sections.

[00121] In the example shown in Figure 18, the central portion can use one central coil to create a flux guide charge section, as described above in accordance with the embodiment in Figure 5. In conjunction with an appropriate flux guide type of receiver coil, this can provide position-independent charging or power transfer in this central section. In addition, as further shown in Figure18, another larger coil area can be integrated into the charger and used to create a larger charger area to be used with a receiver similar to the solenoid or blade type receiver coils described above.

[00122] In accordance with an embodiment, since the operating frequency of each coil is defined by its inductance and associated resonant capacitor, the embodiments of the system shown in Figures 18 and 19 can be provided so that the two coils operate either in similar, or in completely different, frequency range (frequency multiplexing) to power any associated receivers. In accordance with an embodiment, each coil can be driven by a separate driver

circuit and communicate with the associated receivers using load modulation, RF or optical communication channels or combination thereof as described earlier, and can be completely independent.

[00123] In accordance with another embodiment 260 shown in Figure 20, two charger coils for charging two different types of devices or receivers can be provided as distinct coils that are physically separated from one another in space and location. For example, a charger coil can be used to provide magnetic field and efficient coupling to a blade type receiver in the outer perimeter of a charger surface and used to power a receiver in a geometry similar to shown in Figures 7 or 8, while a charger optimized for flux guide power transfer (using a geometry such as that shown in Figures 5 and 6) can be used in the center of the charger.

[00124] In accordance with an embodiment, the two coils can be distinct or driven by different power drivers and/or use different communication systems and/or protocols. As an example, one of the coils and its associated electronics may use in-band or load modulation for communication and control, and the other one may use out of band or RF communication. The two different sections can also use different or same frequency for power transfer as needed to optimize performance for the associated receivers.

[00125] In accordance with an embodiment, each charger section can also charge or power multiple receivers placed on that section. As can be seen, such an embodiment allows the system designer to optimize the performance of a charger to power or charge multiple device types appropriately. In the example shown in Figure20, an electronic display device with a very narrow and small receiver area can be charged position-free when it is placed on the outer regions of the pad, while another device such as a mobile phone with a receiver that may be larger (e.g., with a flat coil with flux guide as shown on the back of the device) can be charged in the central area of the charger. Such a combined performance charger may be useful in various applications, and for an end-user.

[00126] The above description and embodiments are not intended to be exhaustive, and are instead intended to only show some examples of the rich and varied products and technologies that can be envisioned and realized by various embodiments. It will be evident to persons skilled in the art that these and other embodiments can be combined to produce combinations of above techniques, to provide useful effects and products.

[00127] Some aspects of embodiments of the present invention can be conveniently implemented using a conventional general purpose or a specialized digital computer, microprocessor, or electronic circuitry programmed according to the teachings of the present

disclosure. Appropriate software coding can readily be prepared by skilled programmers and circuit designers based on the teachings of the present disclosure, as will be apparent to those skilled in the art.

[00128] In some embodiments, the present invention includes a computer program product which is a storage medium (media) having instructions stored thereon which can be used to program a computer to perform any of the processes of the present invention. The storage medium can include, but is not limited to, any type of disk including floppy disks, optical discs, DVD, CD-ROMs, microdrive, and magneto-optical disks, ROMs, RAMs, EPROMs, EEPROMs, DRAMs, VRAMs, flash memory devices, magnetic or optical cards, nanosystems (including molecular memory ICs), or any type of media or device suitable for storing instructions and/or data.

[00129] The foregoing description of the present invention has been provided for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Many modifications and variations will be apparent to the practitioner skilled in the art. The embodiments were chosen and described in order to best explain the principles of the invention and its practical application, thereby enabling others skilled in the art to understand the invention for various embodiments and with various modifications that are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the following claims and their equivalents.

Claims:

What is claimed is:

1. A system for powering or charging one or multiple receivers or devices having small surface areas or volumes, comprising:

a receiver coil generally shaped as a blade or thin solenoid, which receives power inductively from a charger, which is then used to power or charge one or more electronic devices.

2. The system of claim 1, wherein the charger includes a charger coil atop a magnetic flux guide or shielding material or layer that extends beyond the edges of the charger coil.

3. The system of claim 1, wherein additional magnetic or ferrite material or layers are added to or otherwise integrated with the top and/or bottom of the receiver coil, to aid in the guidance of flux generated in the receiver coil.

4. The system of claim 1, wherein the receiver coil includes a flux guide material such as ferrite with permeability greater than 1, with an axis perpendicular to or at an angle sufficient to receive a substantially perpendicular flux from the charger.

5. The system of claim 1 wherein the one or more electronic devices is one of a portable mobile phone, music player, wearable computer such as a display device, communication device, watch, electronic glasses, or other mobile or electrical or electric device or vehicle.

6. The system of claim 1, wherein the system includes a charger having at least two separate coil structures provided on top of a magnetic layer to provide two or more different sections with different operating principles or protocols or driving and/or communication sections, for use in powering or charging the electronic devices.

7. The system of claim 6, wherein the operating frequency of each coil is defined by its inductance and associated resonant capacitor, so that the two or more coil structures operate either in similar, different, frequency ranges to power associated receivers.

8. The system of claim 1, wherein the charger is included within an automobile or other vehicle.

9. The system of claim 1, wherein the charger and/or the receiver can be configured to detect the orientation or front-back placement of the device during charging and perform additional contextually-aware functions.

10. The system of claim 1, wherein the charger and the device to be powered or charged communicate to determine optimum powering or charging.

11. A method for powering or charging one or multiple receivers or devices having small surface areas or volumes, comprising:

a receiver coil generally shaped as a blade or thin solenoid, which receives power inductively from a charger, which is then used to power or charge one or more electronic devices.

12. The method of claim 11, wherein the charger includes a charger coil atop a magnetic flux guide or shielding material or layer that extends beyond the edges of the charger coil.

13. The method of claim 11, wherein additional magnetic or ferrite material or layers are added to or otherwise integrated with the top and/or bottom of the receiver coil, to aid in the guidance of flux generated in the receiver coil.

14. The method of claim 11, wherein the receiver coil includes a flux guide material such as ferrite with permeability greater than 1, with an axis perpendicular to or at an angle sufficient to receive a substantially perpendicular flux from the charger.

15. The method of claim 11 wherein the one or more electronic devices is one of a portable mobile phone, music player, wearable computer such as display device, communication device, watch, electronic glasses, or other mobile or electrical or electric device or vehicle.

16. The method of claim 11, wherein the system includes a charger having at least two separate coil structures provided on top of a magnetic layer to provide two or more different sections with different operating principles or protocols or driving and/or communication

sections, for use in powering or charging the electronic devices.

17. The method of claim 16, wherein the operating frequency of each coil is defined by its inductance and associated resonant capacitor, so that the two or more coil structures operate either in similar, different, frequency ranges to power associated receivers.

18. The method of claim 11, wherein the charger is included within an automobile or other vehicle.

19. The method of claim 11, wherein the charger and/or the receiver can be configured to detect the orientation or front-back placement of the device during charging and perform additional contextually-aware functions.

20. The method of claim 11, wherein the charger and the device to be powered or charged communicate to determine optimum powering or charging.

Abstract:

Systems and methods for enabling transfer of power, from a wireless charger or power supply, to one or more receivers placed on or near the wireless charger or power supply, including powering or charging one or multiple receivers or devices having small surface areas or volumes. In accordance with an embodiment, a receiver coil can be generally shaped as a blade or thin solenoid, which receives power inductively, which is then used to power or charge one or more electronic devices. Applications include inductive or magnetic charging and power, and particularly usage in mobile, electronic, electric, lighting, or other devices, batteries, power tools, kitchen, industrial, medical or dental, or military applications, vehicles, robots, trains, and other usages.

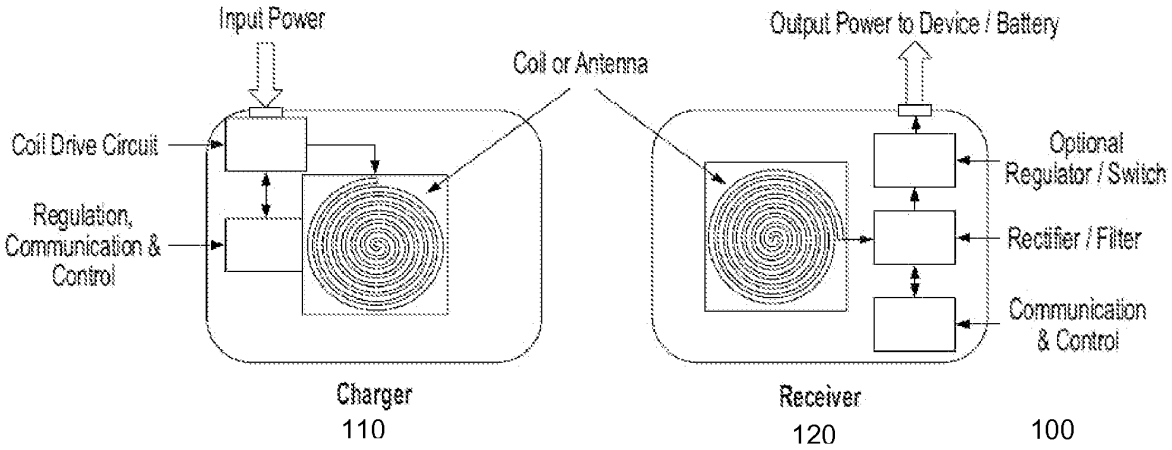


FIGURE 1

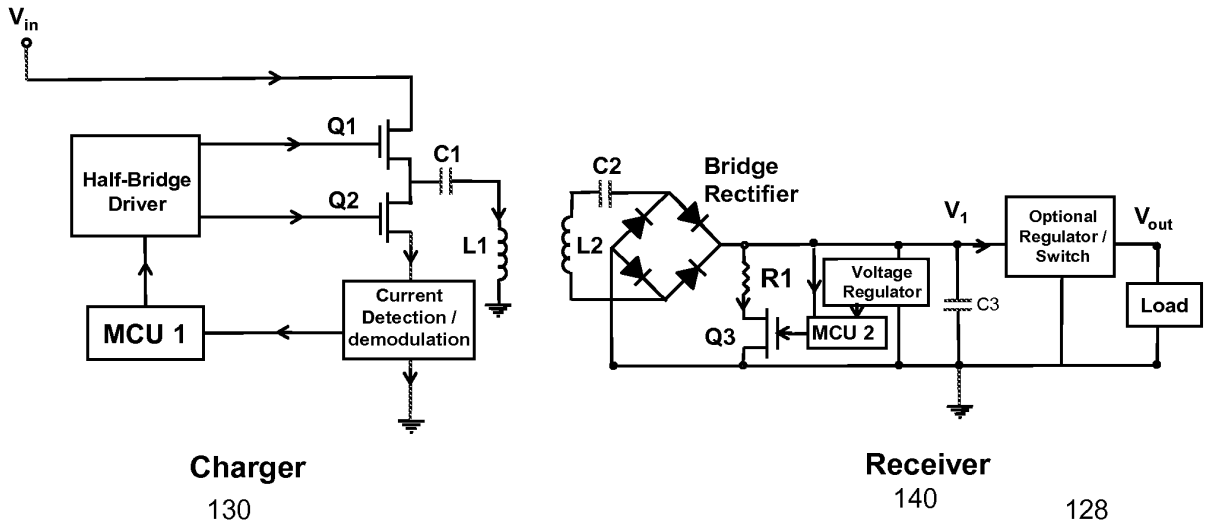
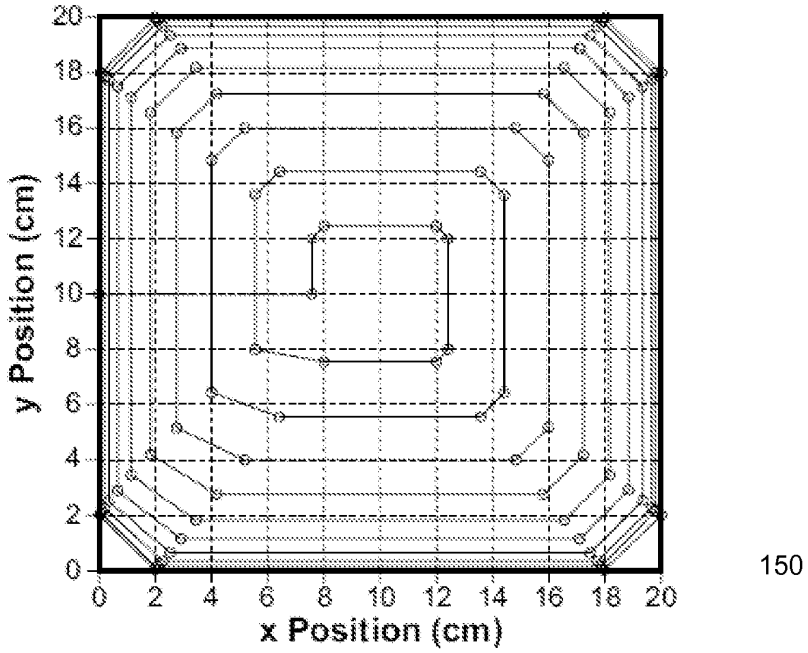
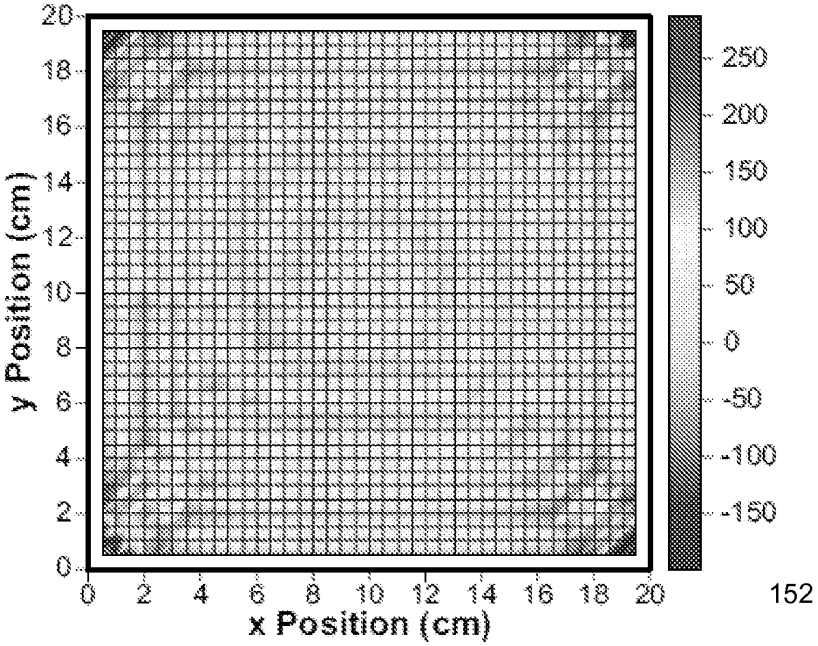


FIGURE 2



150

FIGURE 3



152

FIGURE 4

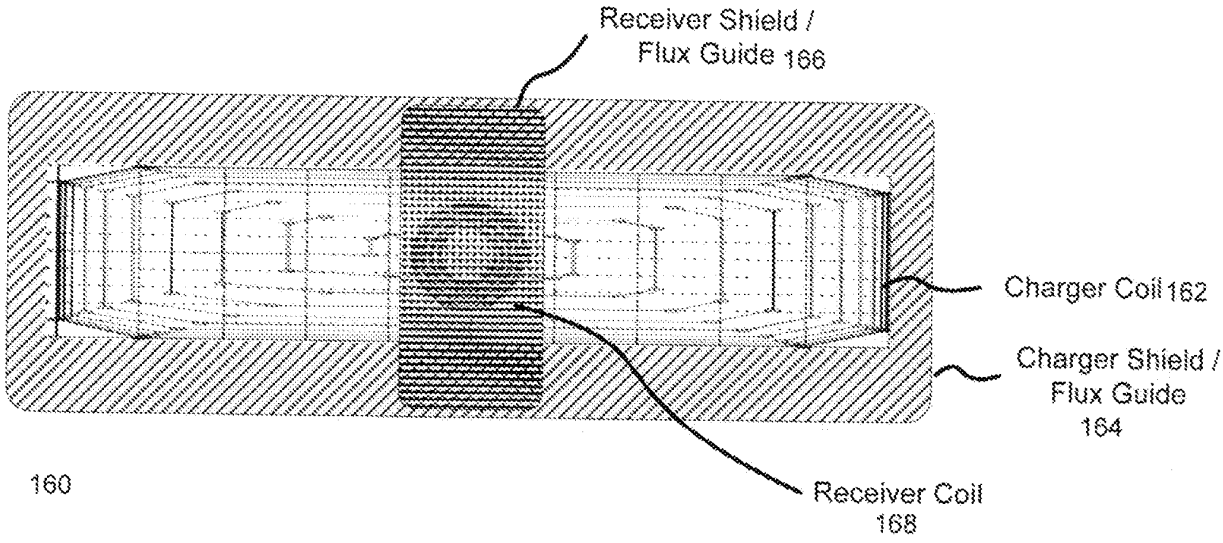


FIGURE 5

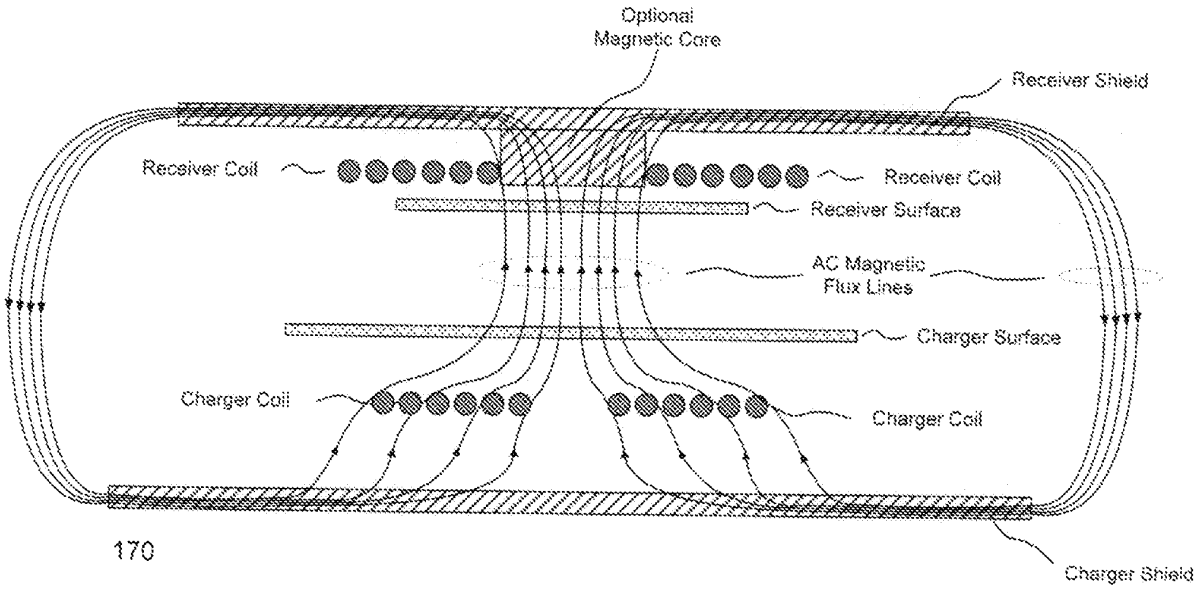


FIGURE 6

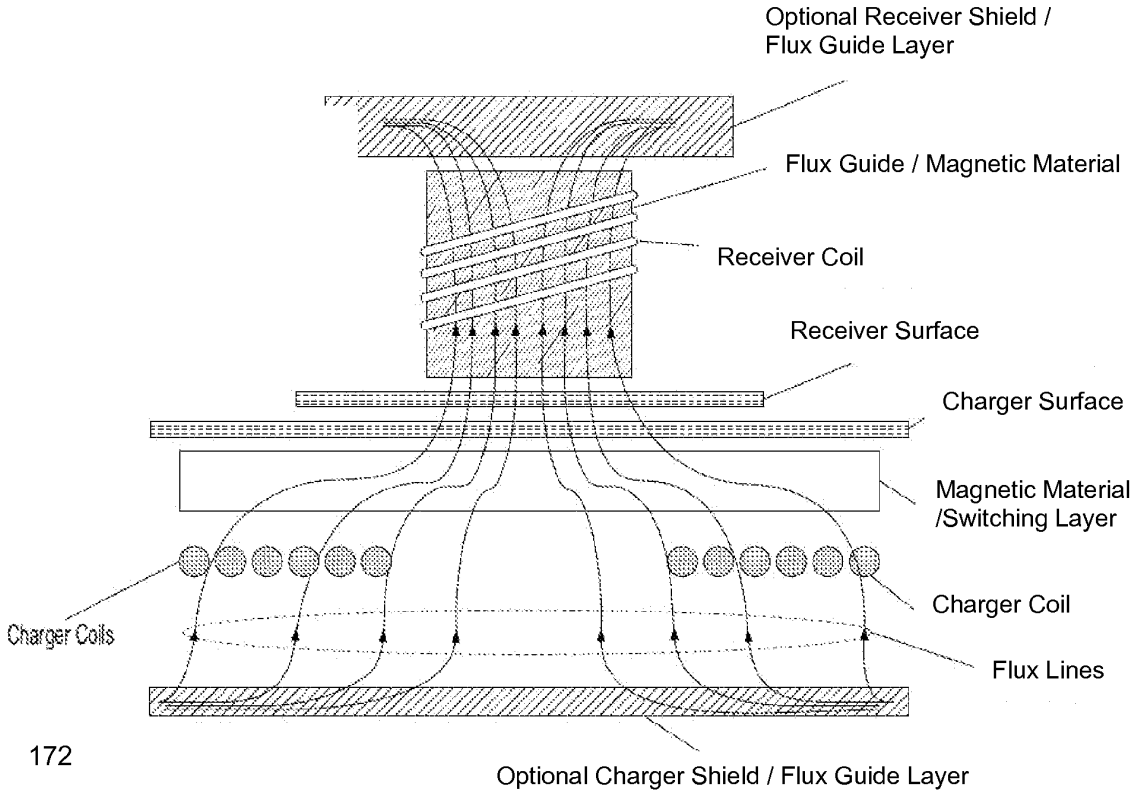


FIGURE 7

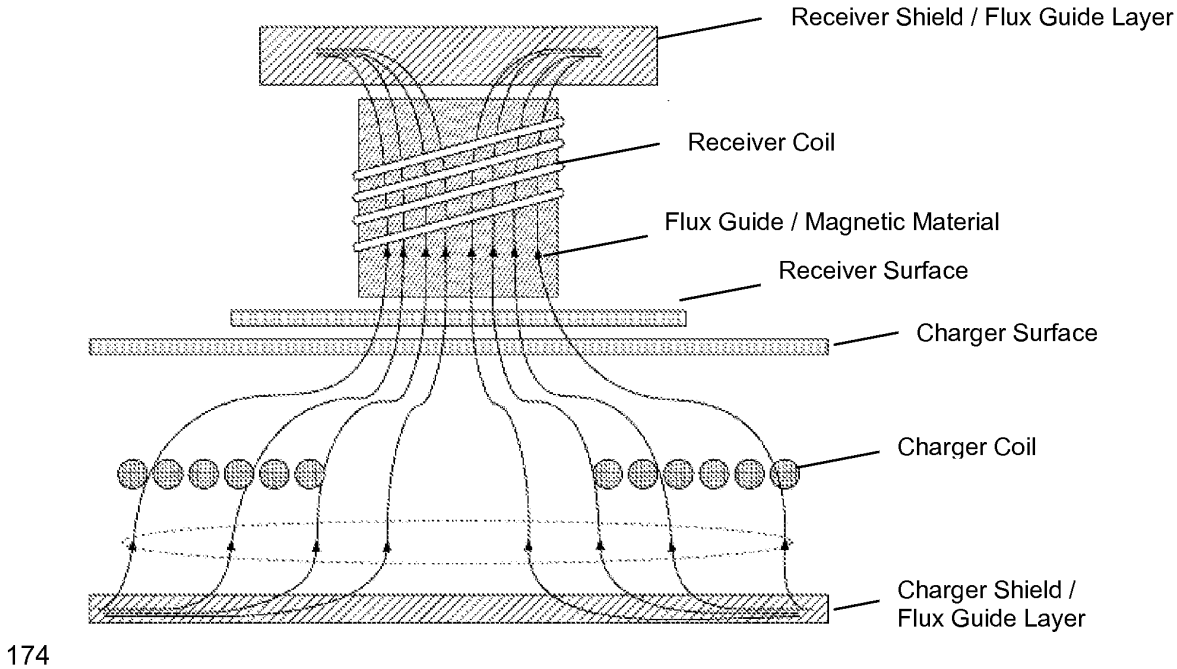


FIGURE 8

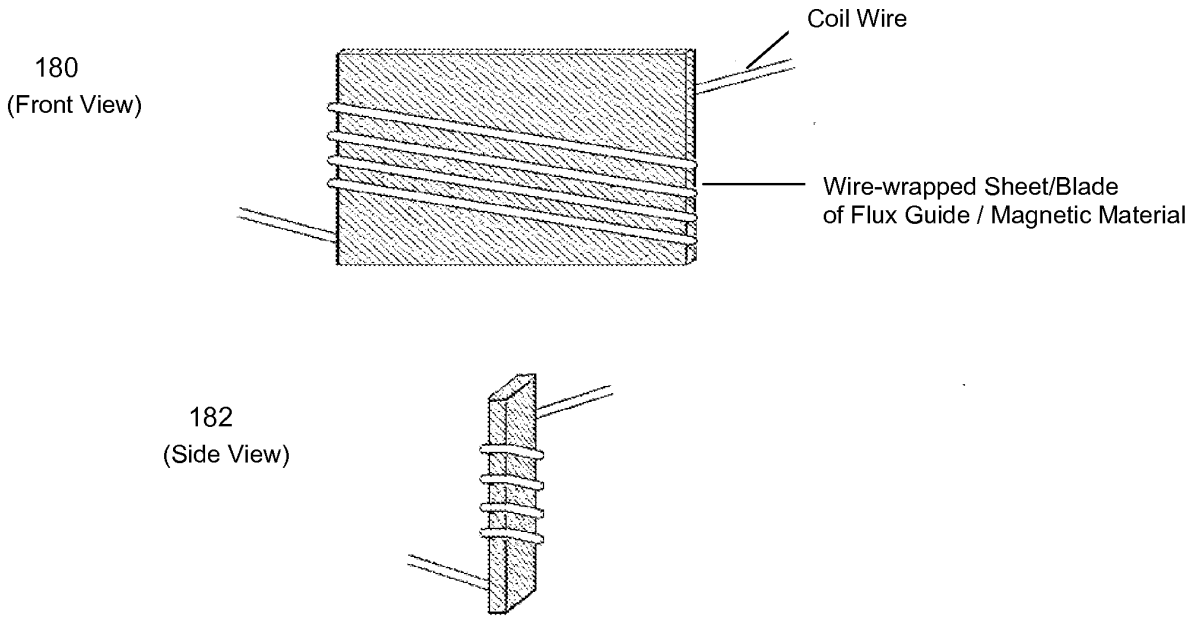


FIGURE 9

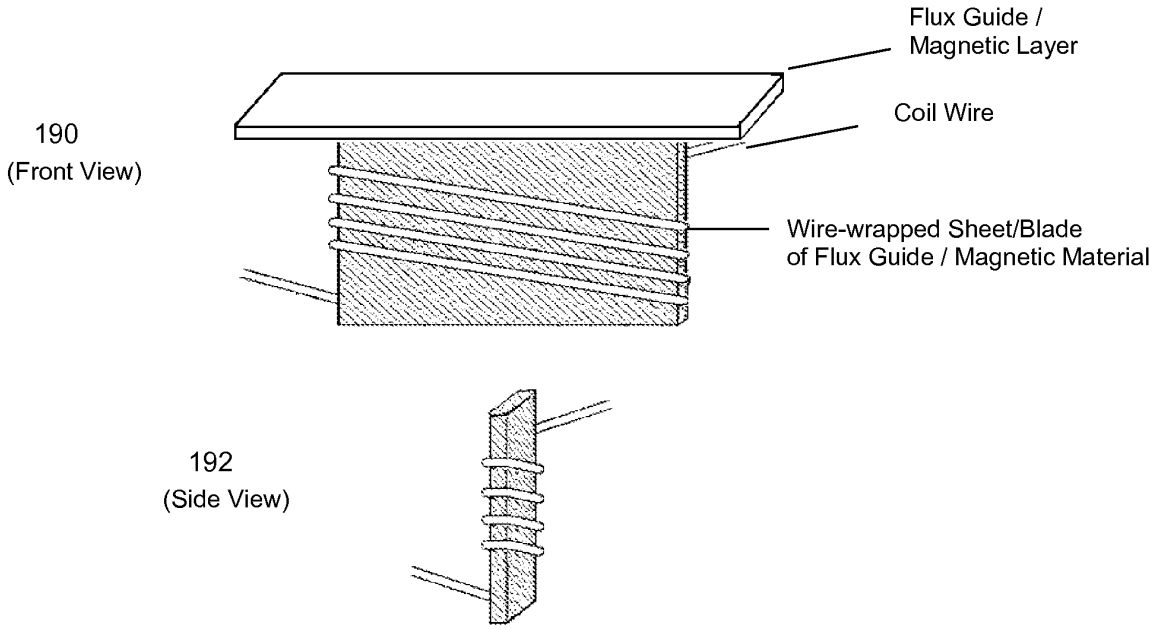


FIGURE 10

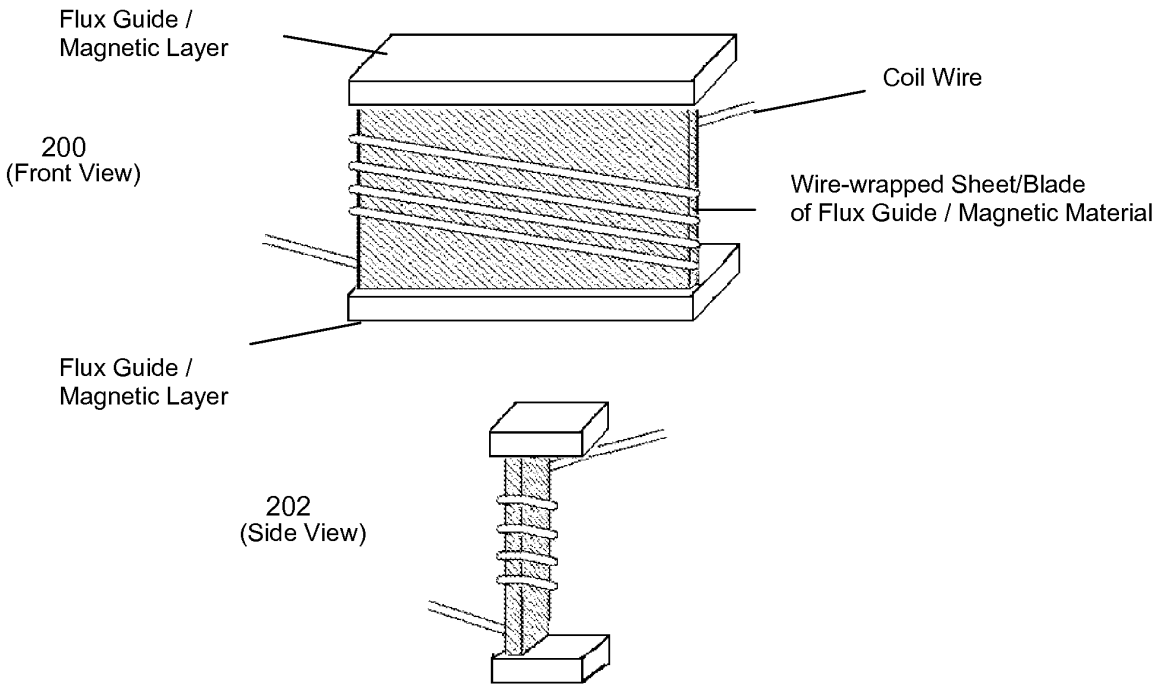

Flux Guide /
Magnetic Layer
Coil Wire
200
(Front View)
Wire-wrapped Sheet/Blade
of Flux Guide / Magnetic Material
Flux Guide /
Magnetic Layer
202
(Side View)

FIGURE 11

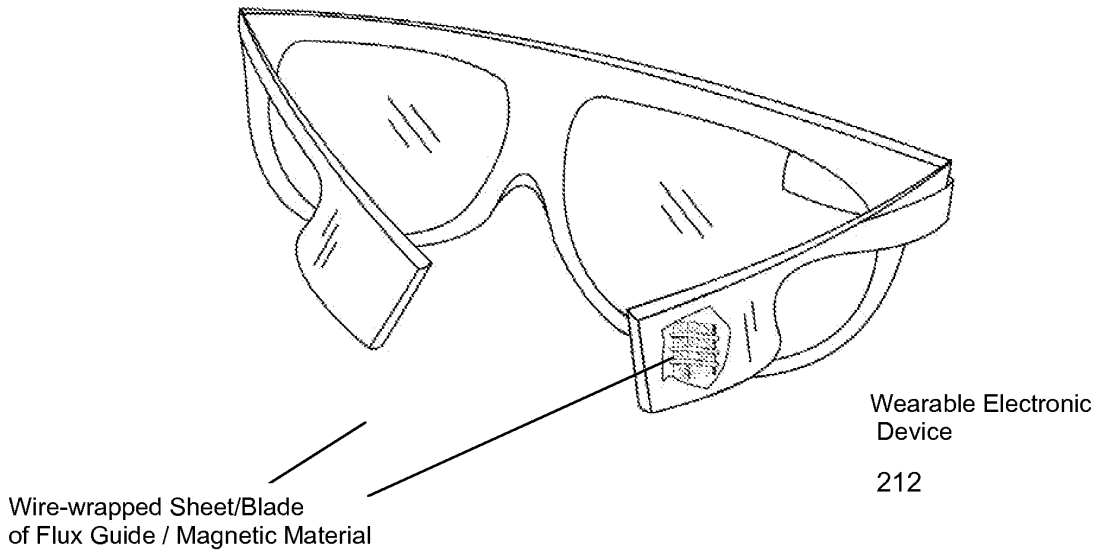


FIGURE 12

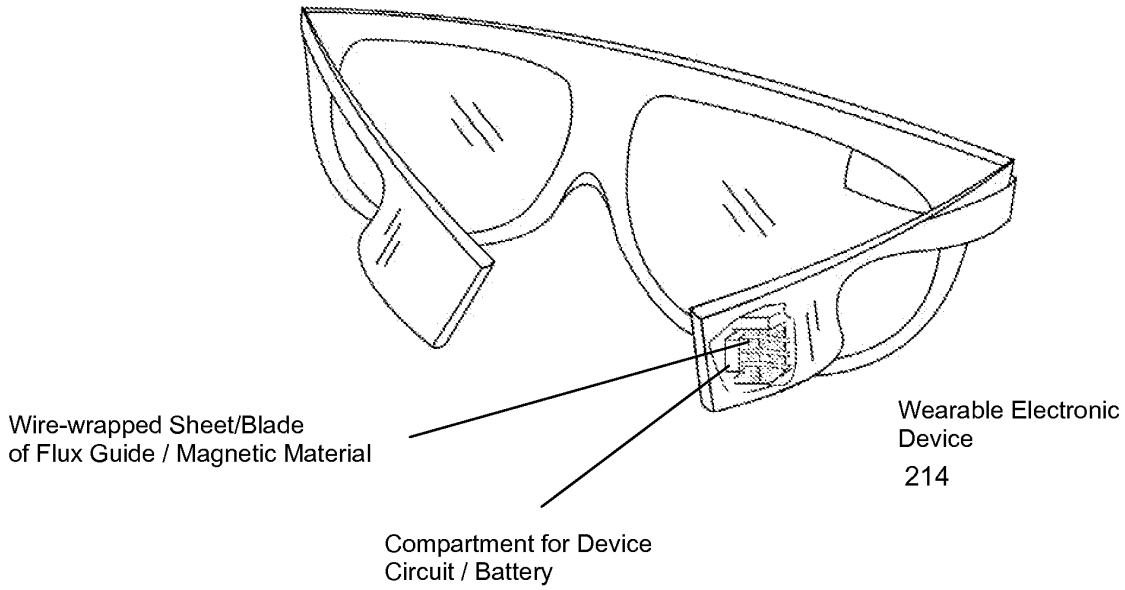


FIGURE 13

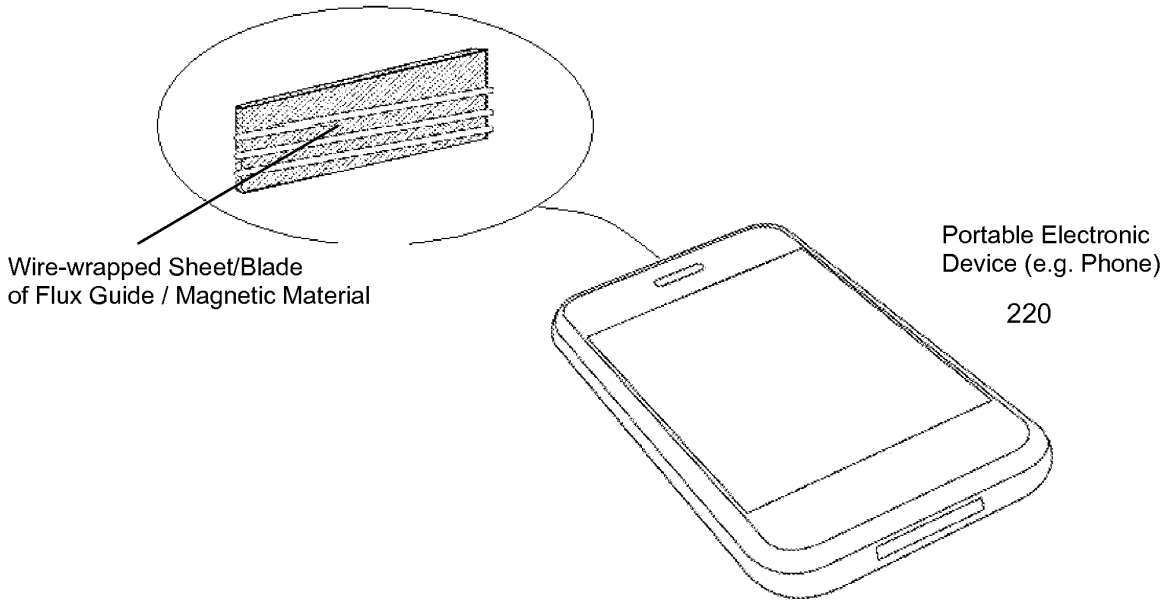


FIGURE 14

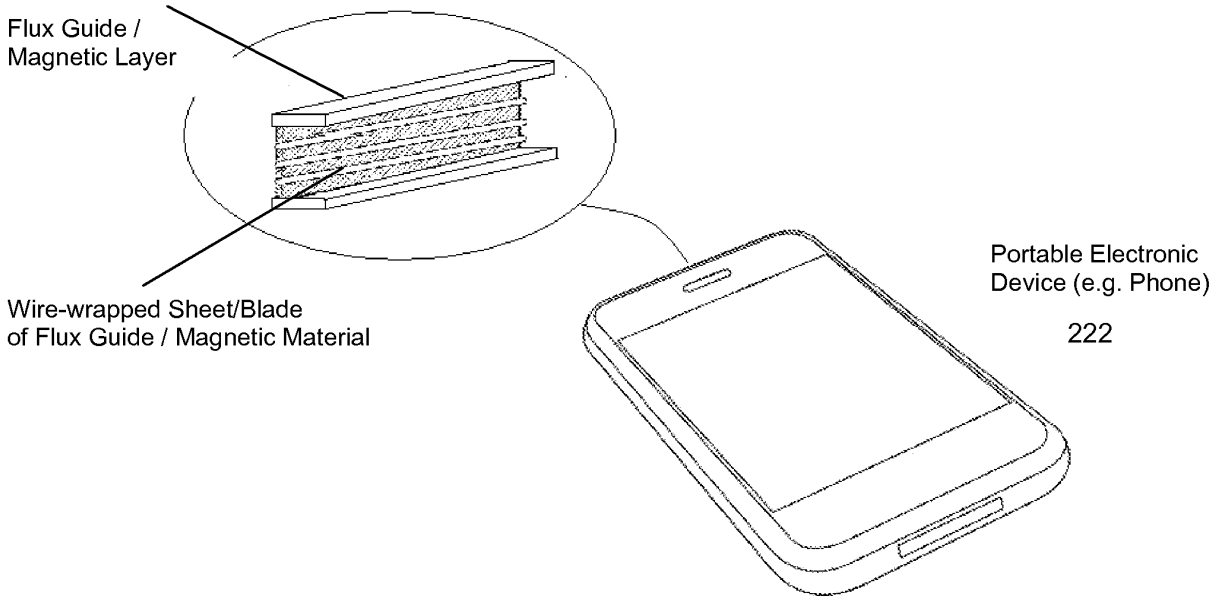


FIGURE 15

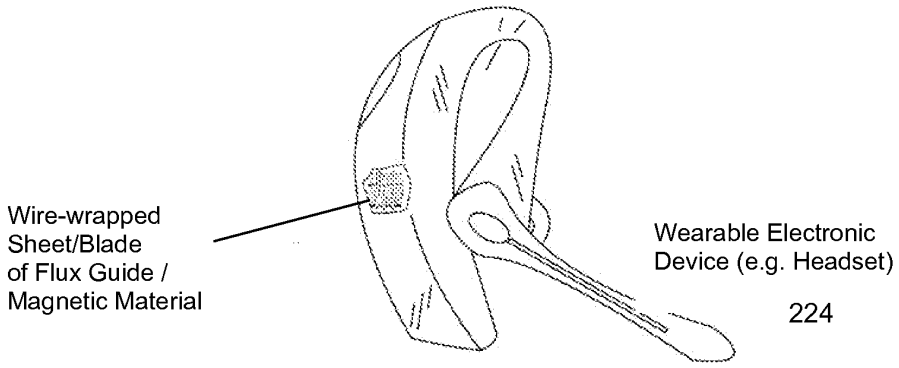


FIGURE 16

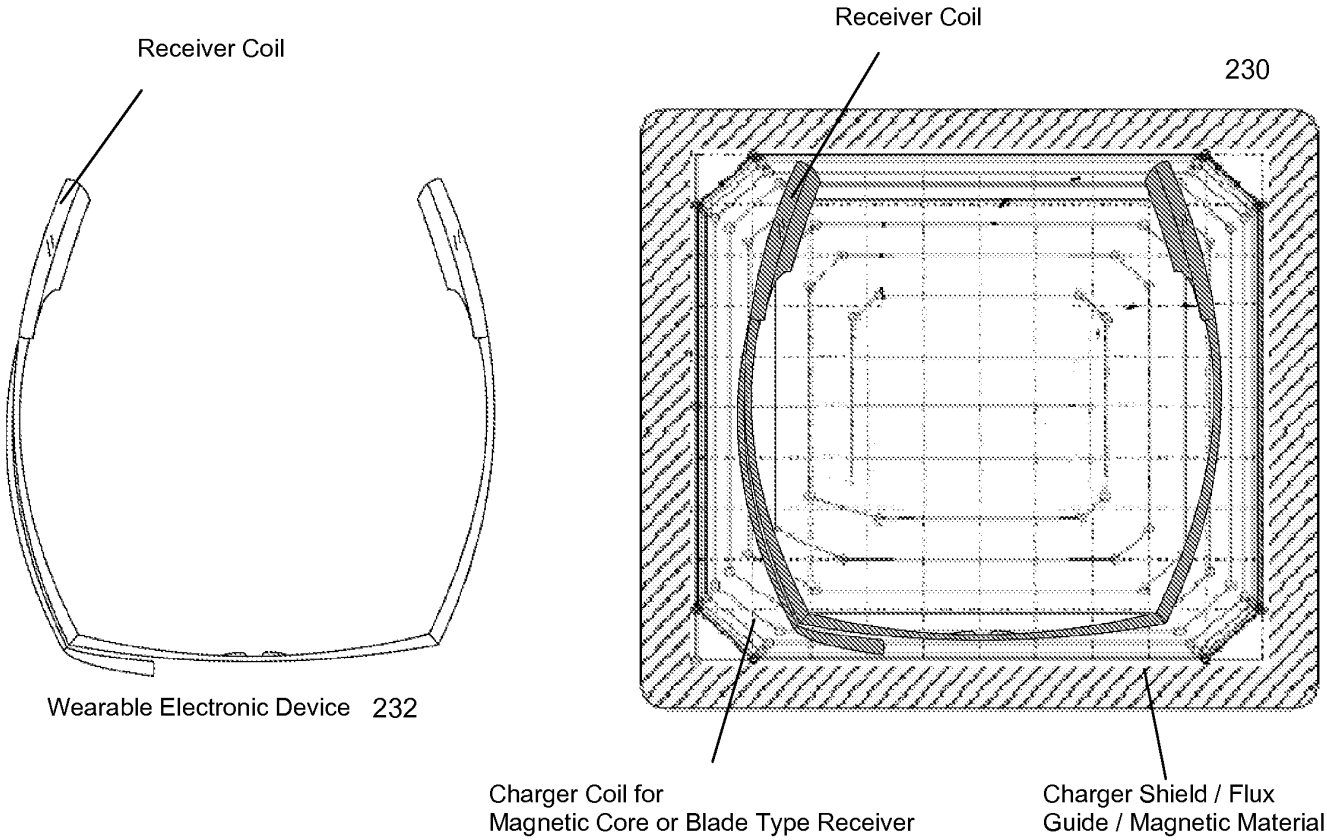


FIGURE 17

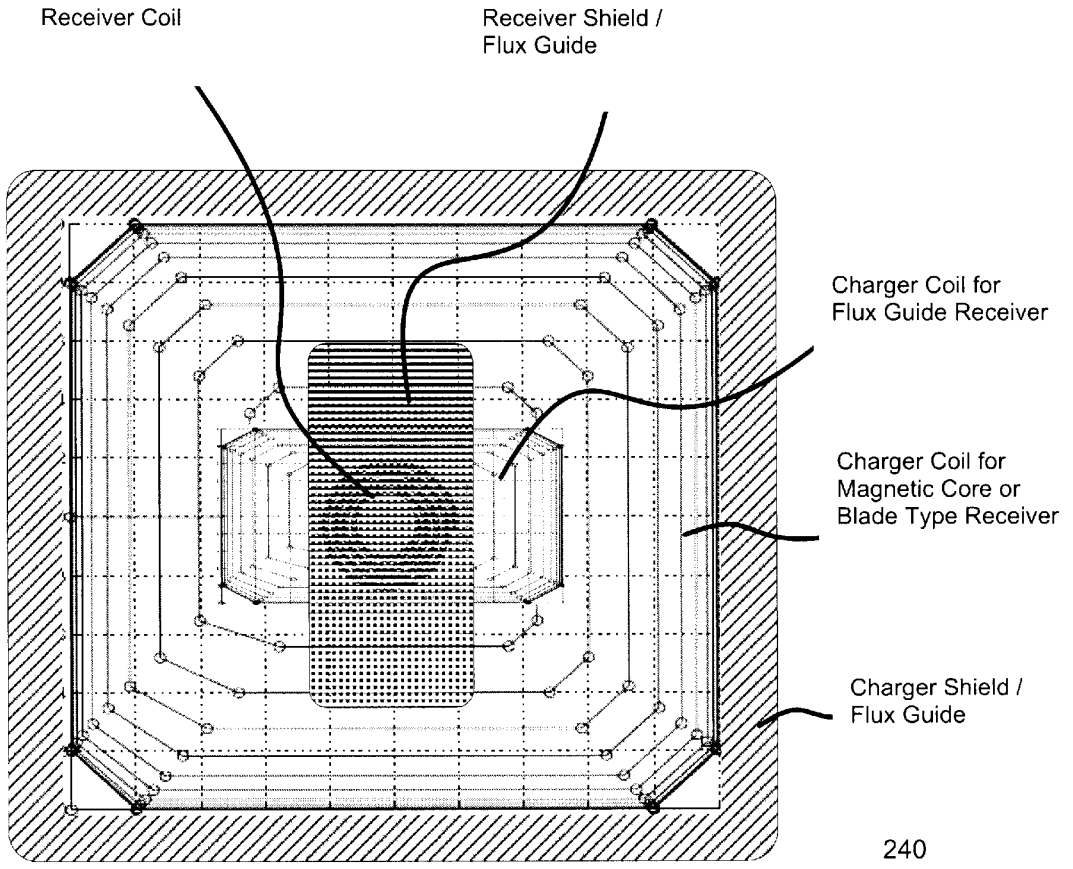

Receiver Coil
Receiver Shield / Flux Guide
Charger Coil for Flux Guide Receiver
Charger Coil for Magnetic Core or Blade Type Receiver
Charger Shield / Flux Guide
240

FIGURE 18

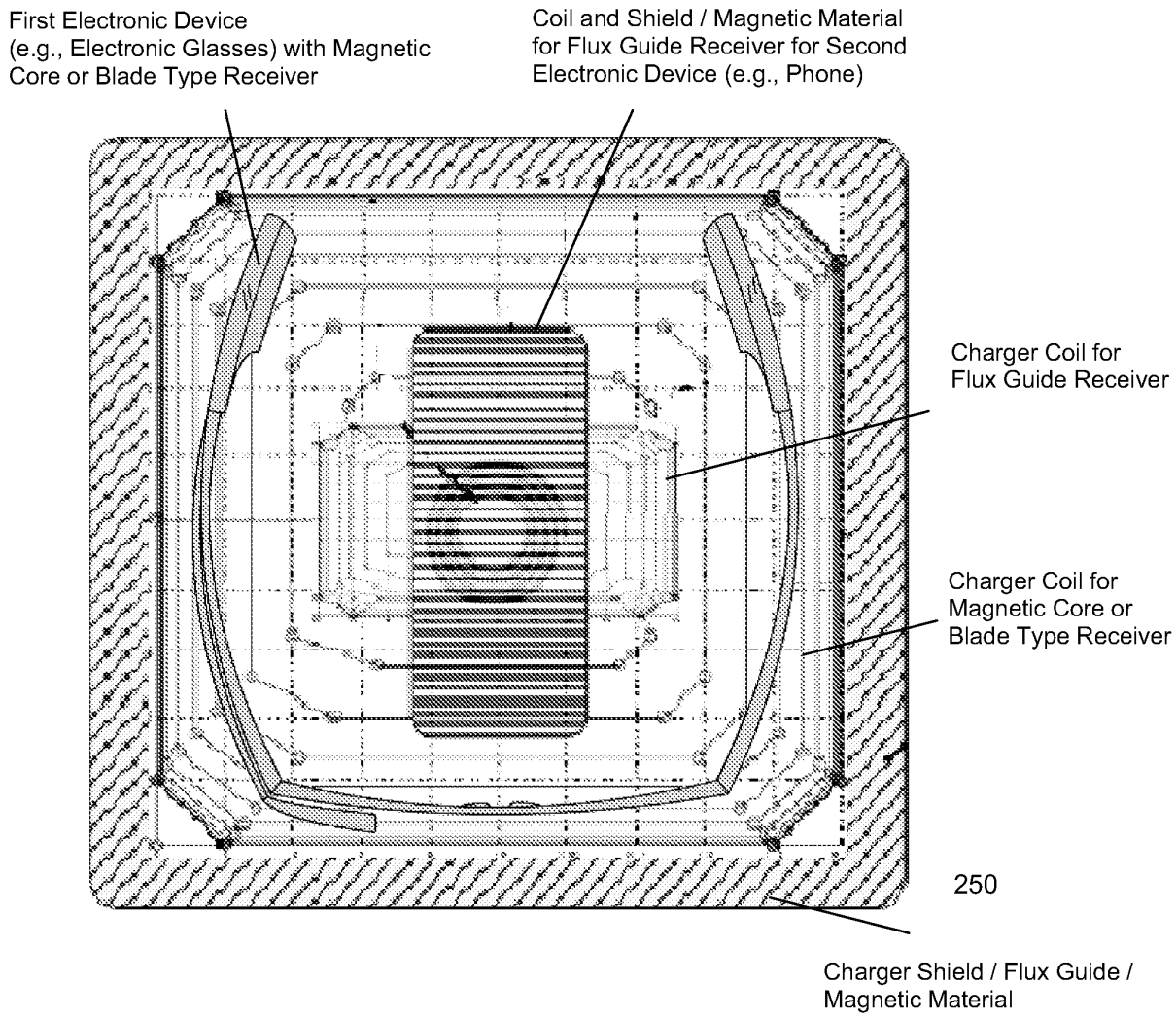

First Electronic Device
(e.g., Electronic Glasses) with Magnetic
Core or Blade Type Receiver
Coil and Shield / Magnetic Material
for Flux Guide Receiver for Second
Electronic Device (e.g., Phone)
Charger Coil for
Flux Guide Receiver
Charger Coil for
Magnetic Core or
Blade Type Receiver
250
Charger Shield / Flux Guide /
Magnetic Material

FIGURE 19

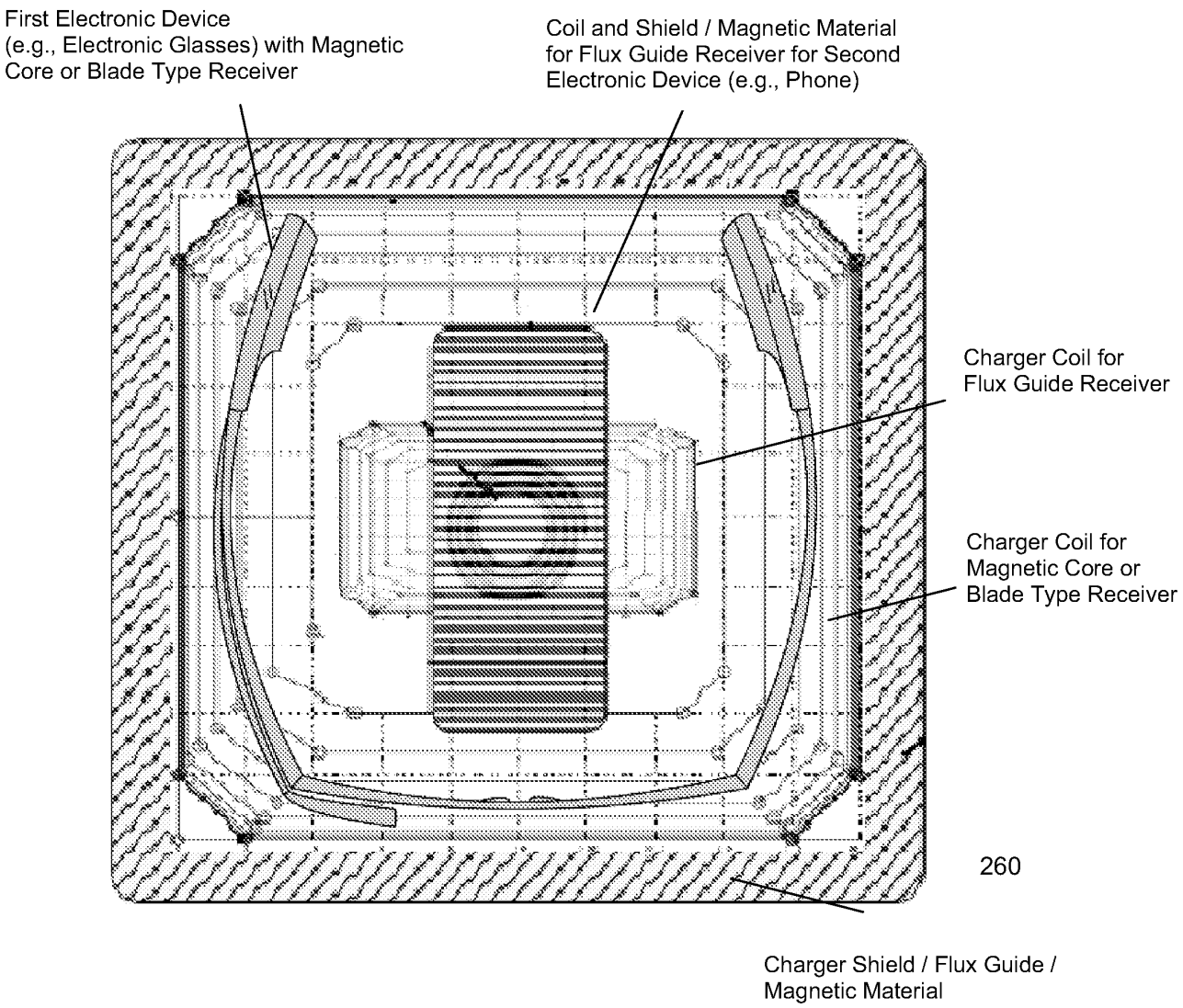

First Electronic Device
(e.g., Electronic Glasses) with Magnetic Core or Blade Type Receiver
Coil and Shield / Magnetic Material for Flux Guide Receiver for Second Electronic Device (e.g., Phone)
Charger Coil for Flux Guide Receiver
Charger Coil for Magnetic Core or Blade Type Receiver
260
Charger Shield / Flux Guide / Magnetic Material

FIGURE 20

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventors:	Afshin Partovi		
Applicant:	Mojo Mobility Inc.		
Title:	System and Method for Powering or Charging Receivers or Devices Having Small Surface Areas or Volumes		
Application No.:	Unassigned	Filing Date:	September 3, 2021
Examiner:	Unassigned	Group Art Unit:	Unassigned
Docket No.:	AFPA-01039US4	Customer No.:	33438

ELECTRONICALLY FILED

Austin, Texas
September 3, 2021

PRELIMINARY AMENDMENT

The following Amendment and Remarks are submitted for entry into the above referenced patent application.

AMENDMENT TO THE SPECIFICATION

Please amend paragraph 0118 as follows:

The resonant frequency, F of any LC circuit is given by: ~~F=l/2.pi. LC,~~

$$F = \frac{1}{2\pi\sqrt{LC}}$$

where Lis the Inductance of the circuit or coil in Henry and C is the Capacitance in Farads.

AMENDMENTS TO THE CLAIMS

1. (Original) A system for powering or charging one or multiple receivers or devices having small surface areas or volumes, comprising:

a receiver coil generally shaped as a blade or thin solenoid, which receives power inductively from a charger, which is then used to power or charge one or more electronic devices.

Claims 2-20 are canceled.

REMARKS

Claims 1-20 are pending.

Claims 2-20 have been canceled without prejudice or disclaimer of the subject matter recited therein.

Paragraph 0118 has been amended to correct the inadvertent error in the well-known resonant frequency formula. Further support for the amendment is found in ¶0051 of US Provisional Patent Application No. 61/546,316, which is incorporated by reference in paragraph 0001 of the *Present Application*. No new matter has been added.

CERTIFICATE OF TRANSMISSION

I hereby certify that on September 3, 2021 this correspondence is being transmitted via the U.S. Patent & Trademark Office's electronic filing system.

/Kent B. Chambers/

Respectfully submitted,

/Kent B. Chambers/

Kent B. Chambers
Attorney for Applicant(s)
Reg. No. 38,839