

15/26

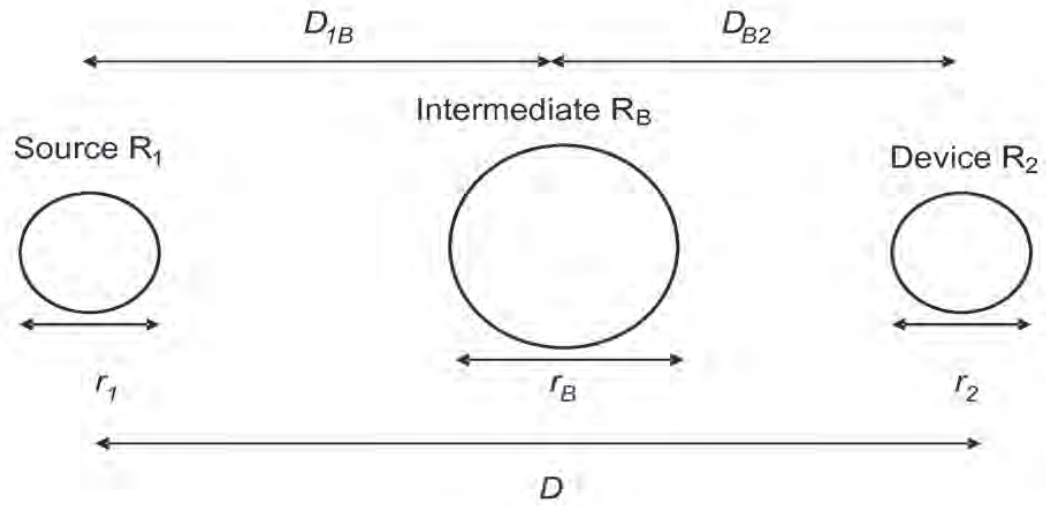


FIG. 16

SUBSTITUTE SHEET (RULE 26)

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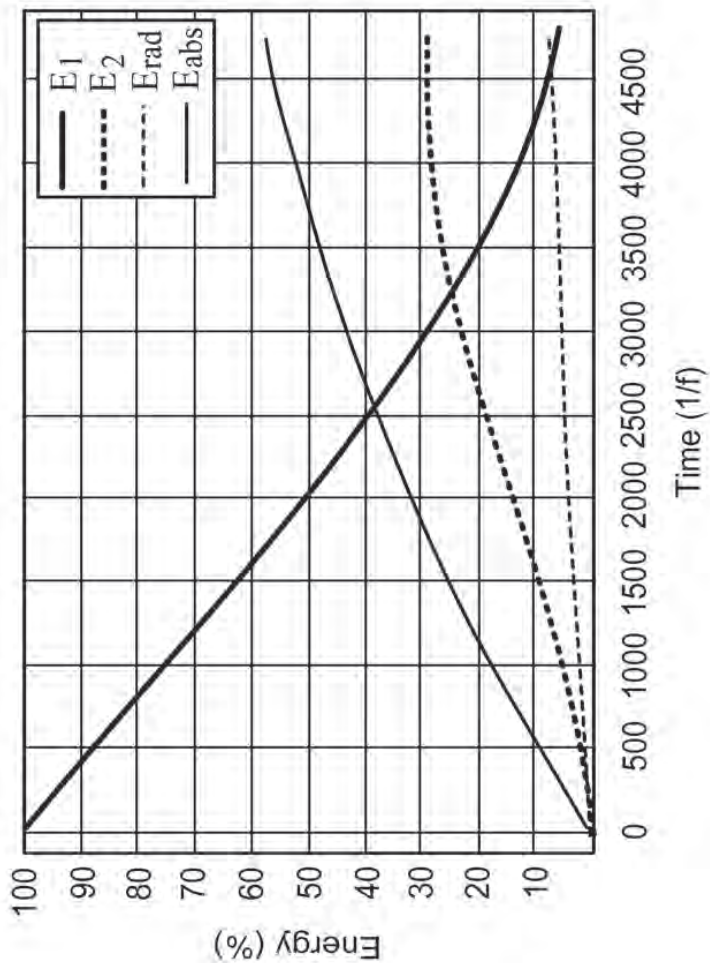
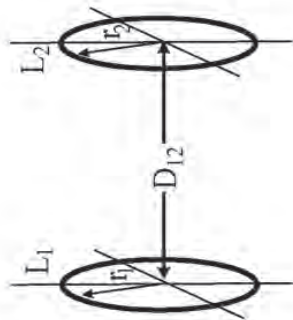


FIG. 17A



SUBSTITUTE SHEET (RULE 26)

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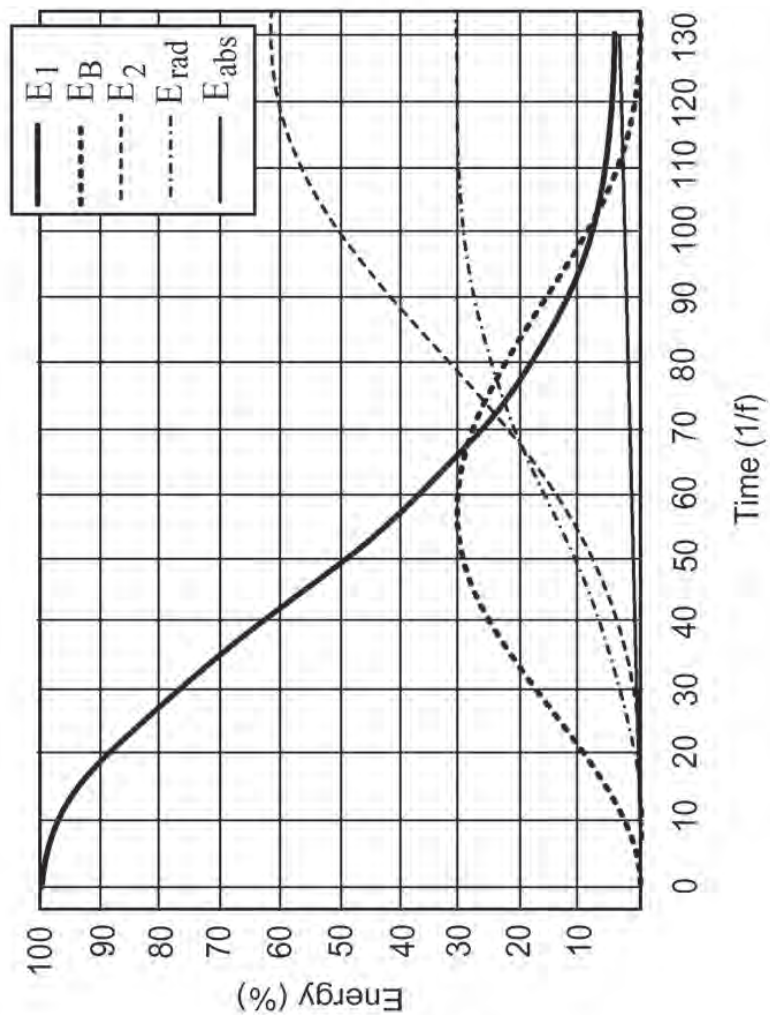
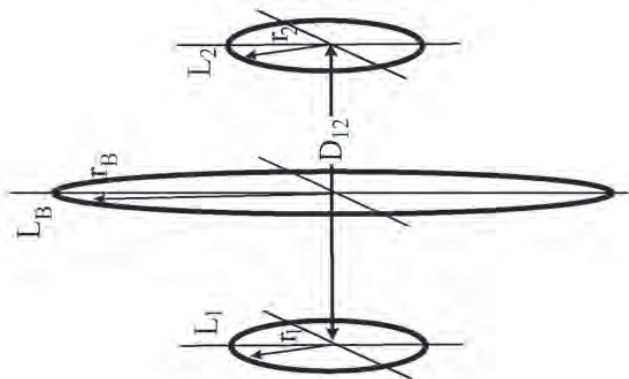


FIG. 17B



SUBSTITUTE SHEET (RULE 26)

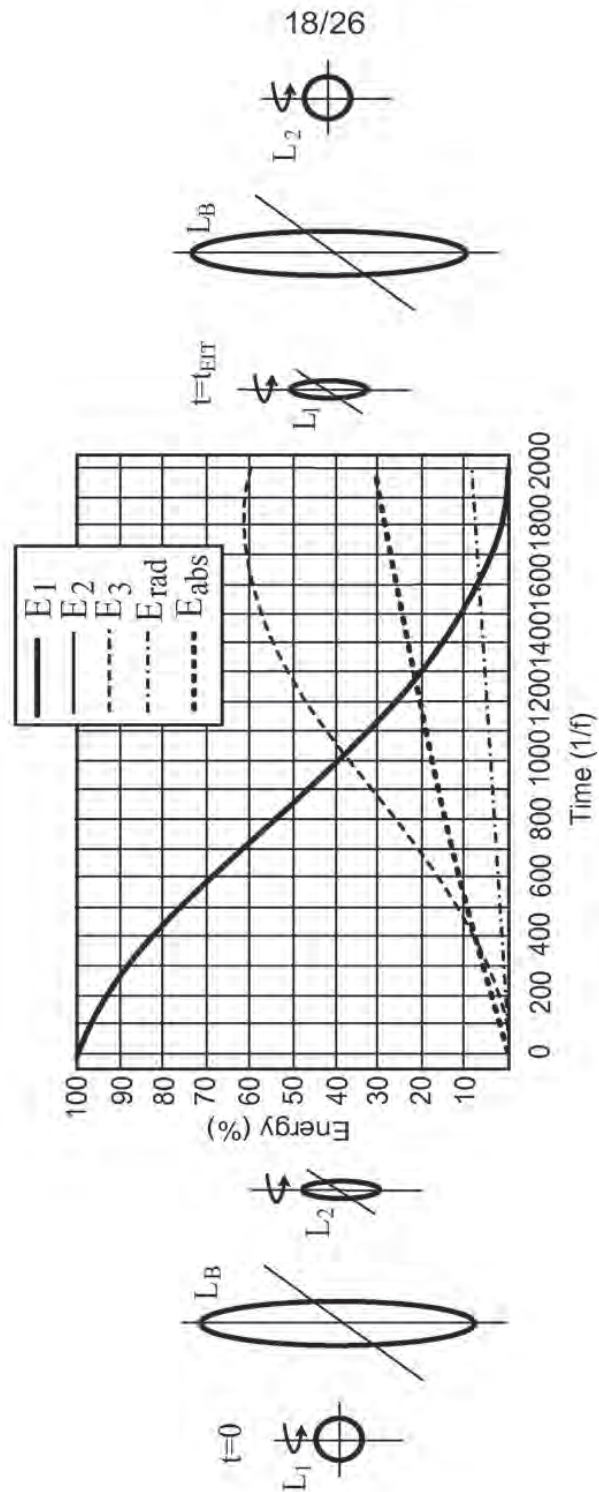


FIG. 17C

SUBSTITUTE SHEET (RULE 26)

19/26

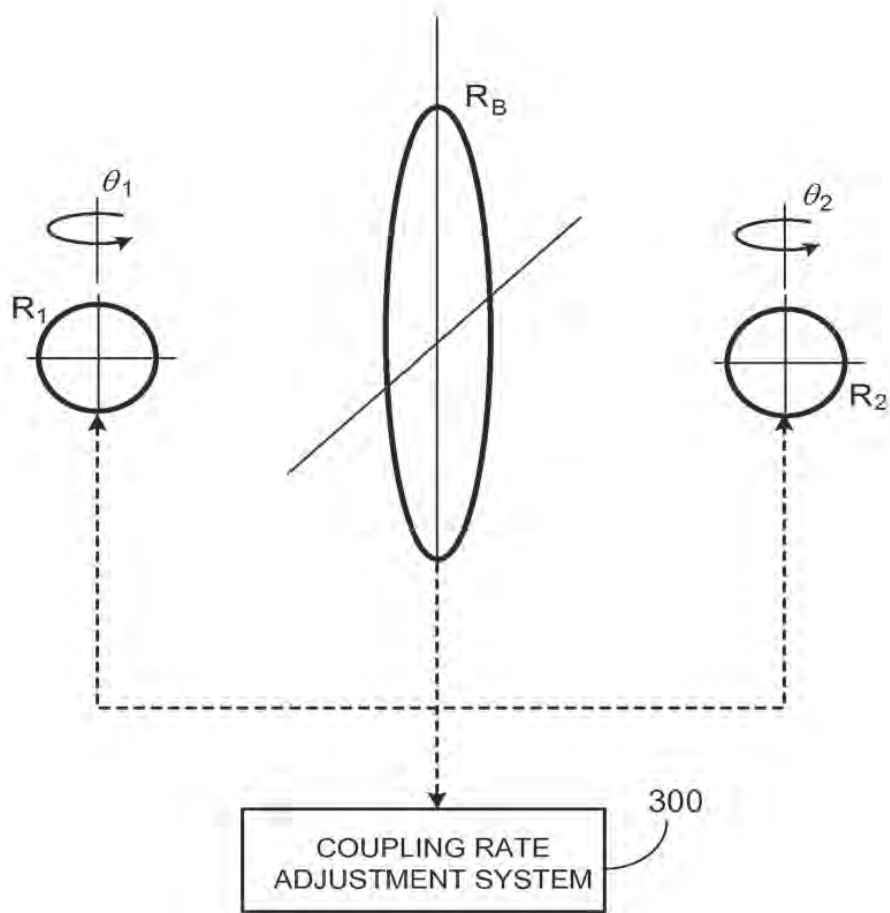


FIG. 18

SUBSTITUTE SHEET (RULE 26)

20/26

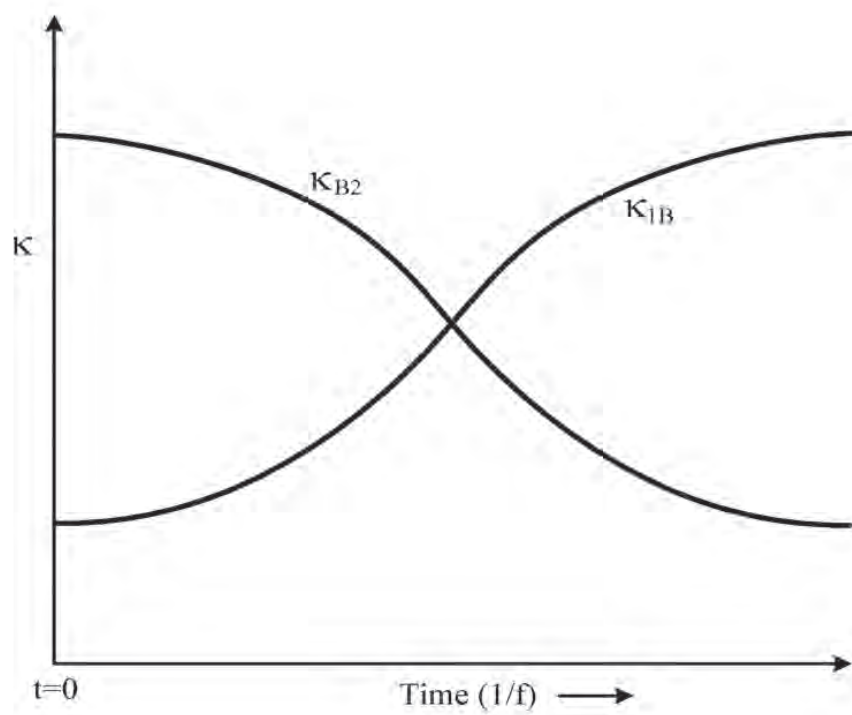


FIG. 19

SUBSTITUTE SHEET (RULE 26)

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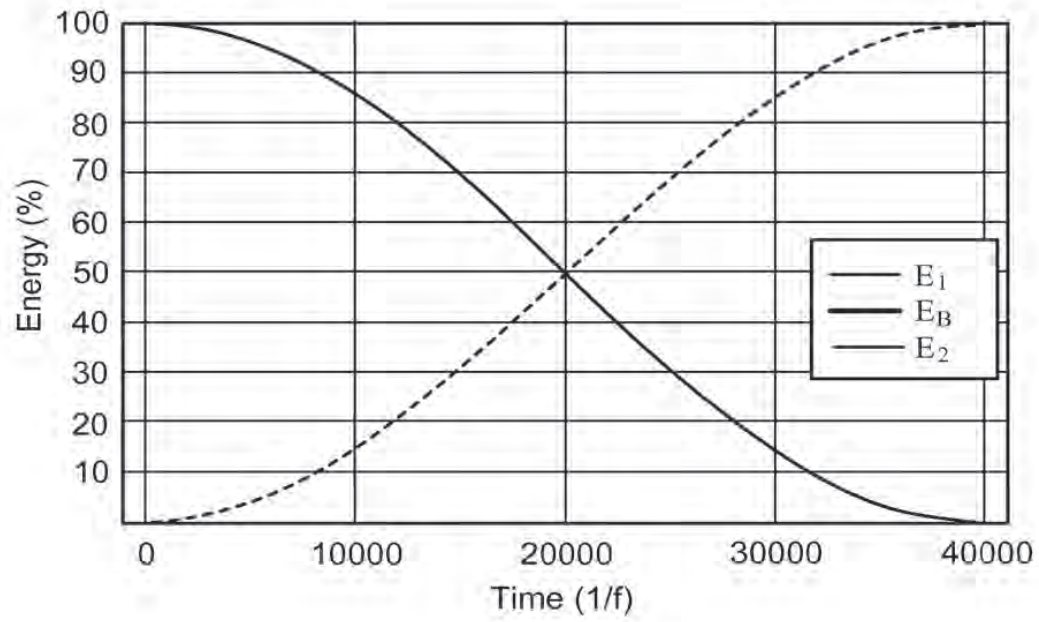


FIG. 20

SUBSTITUTE SHEET (RULE 26)

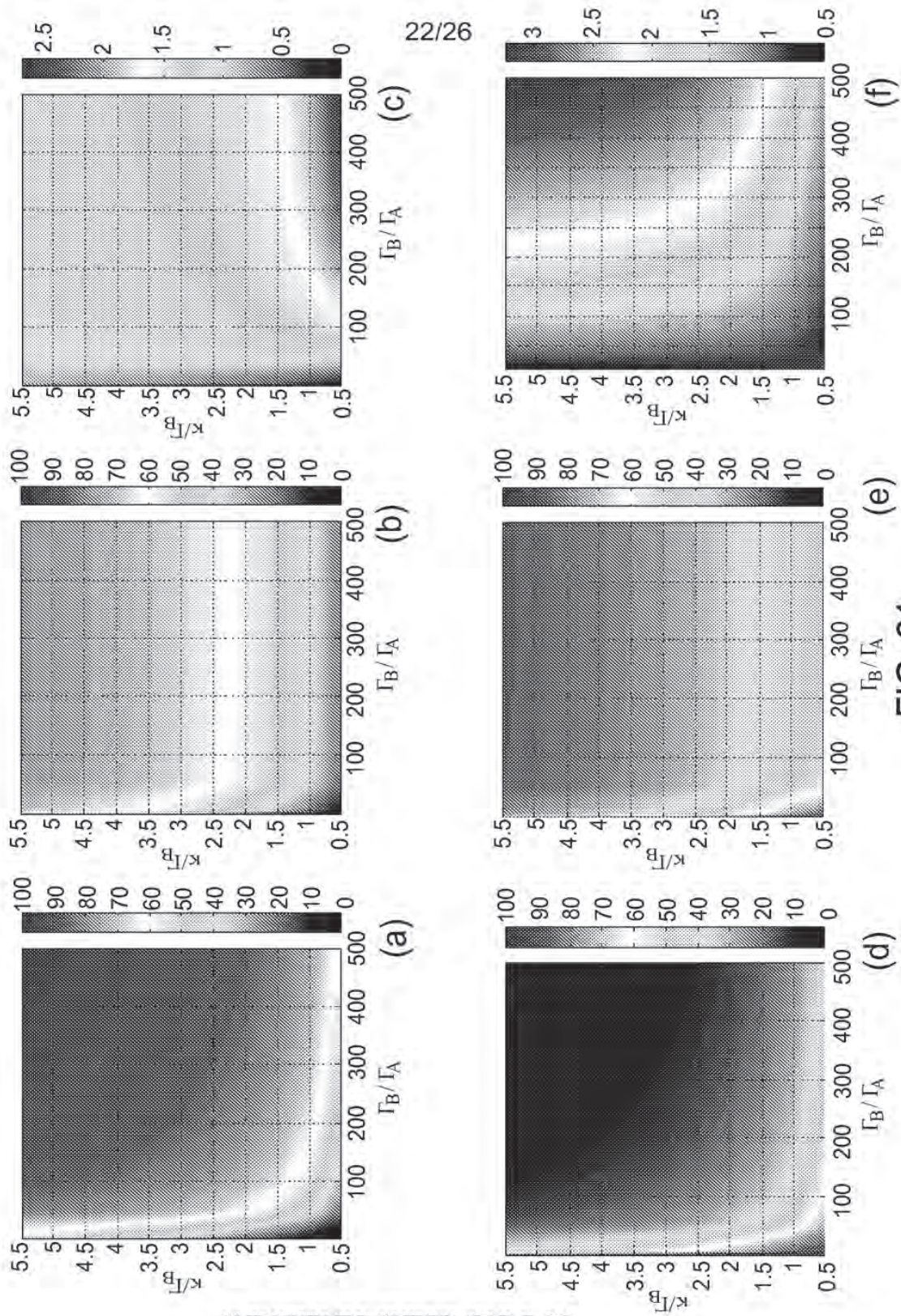


FIG. 21

SUBSTITUTE SHEET (RULE 26)

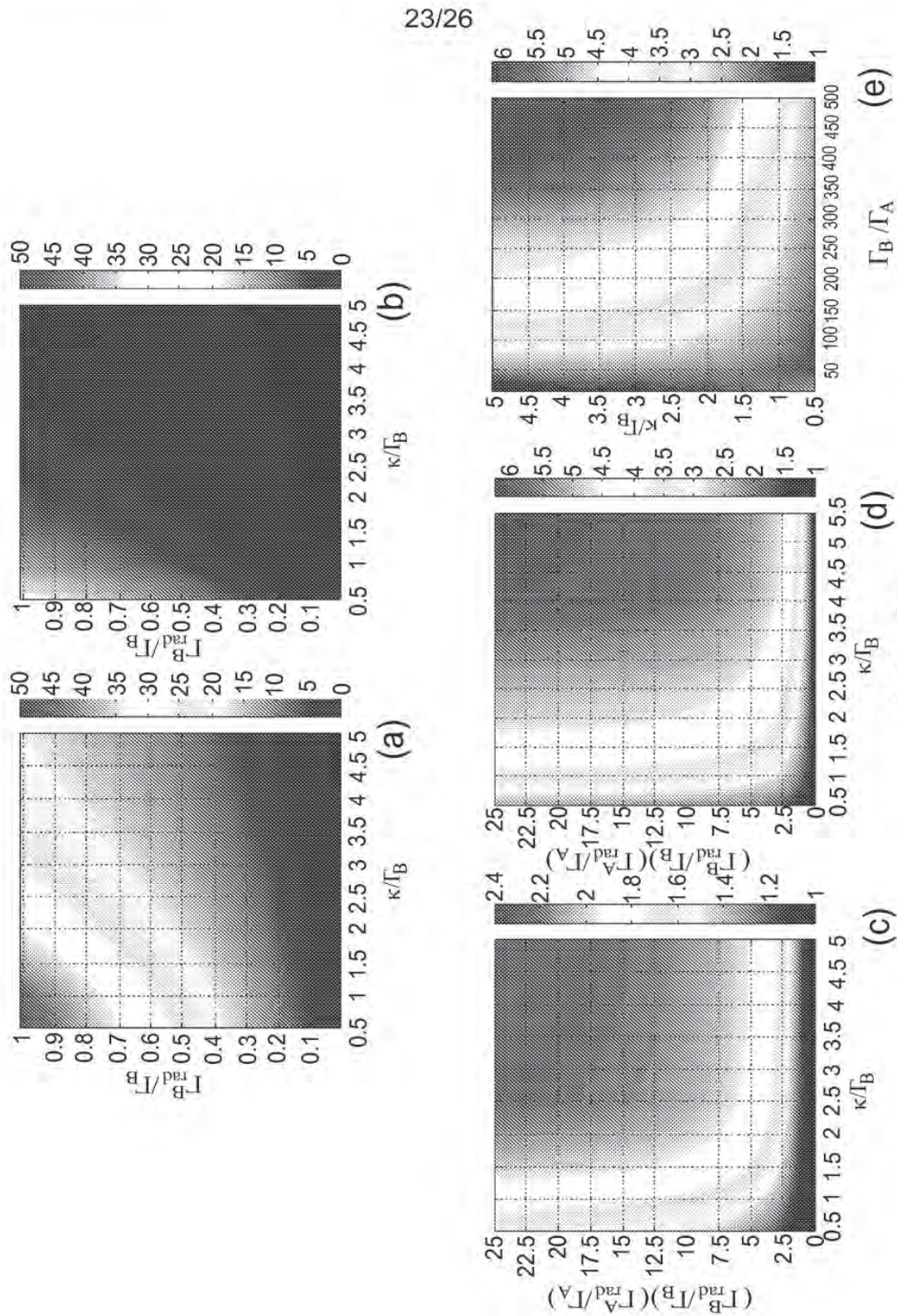


FIG. 22

SUBSTITUTE SHEET (RULE 26)

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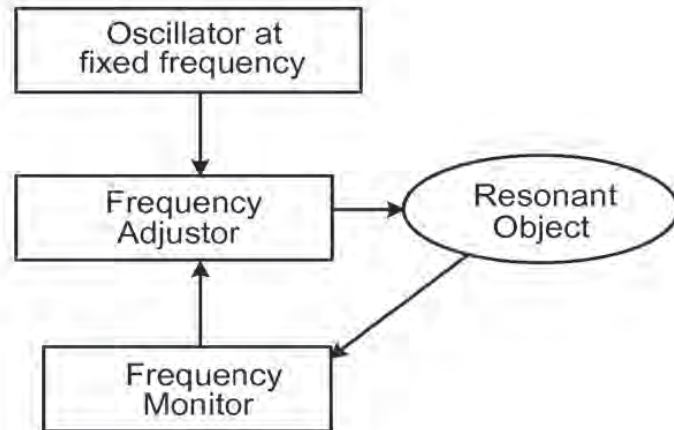


FIG. 23a

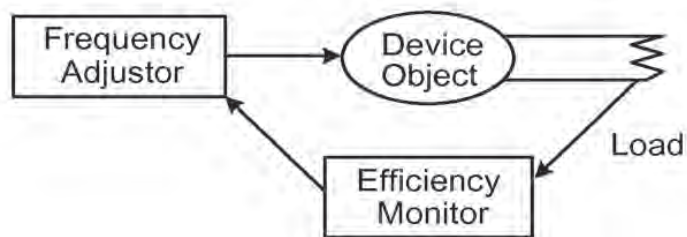


FIG. 23b

SUBSTITUTE SHEET (RULE 26)

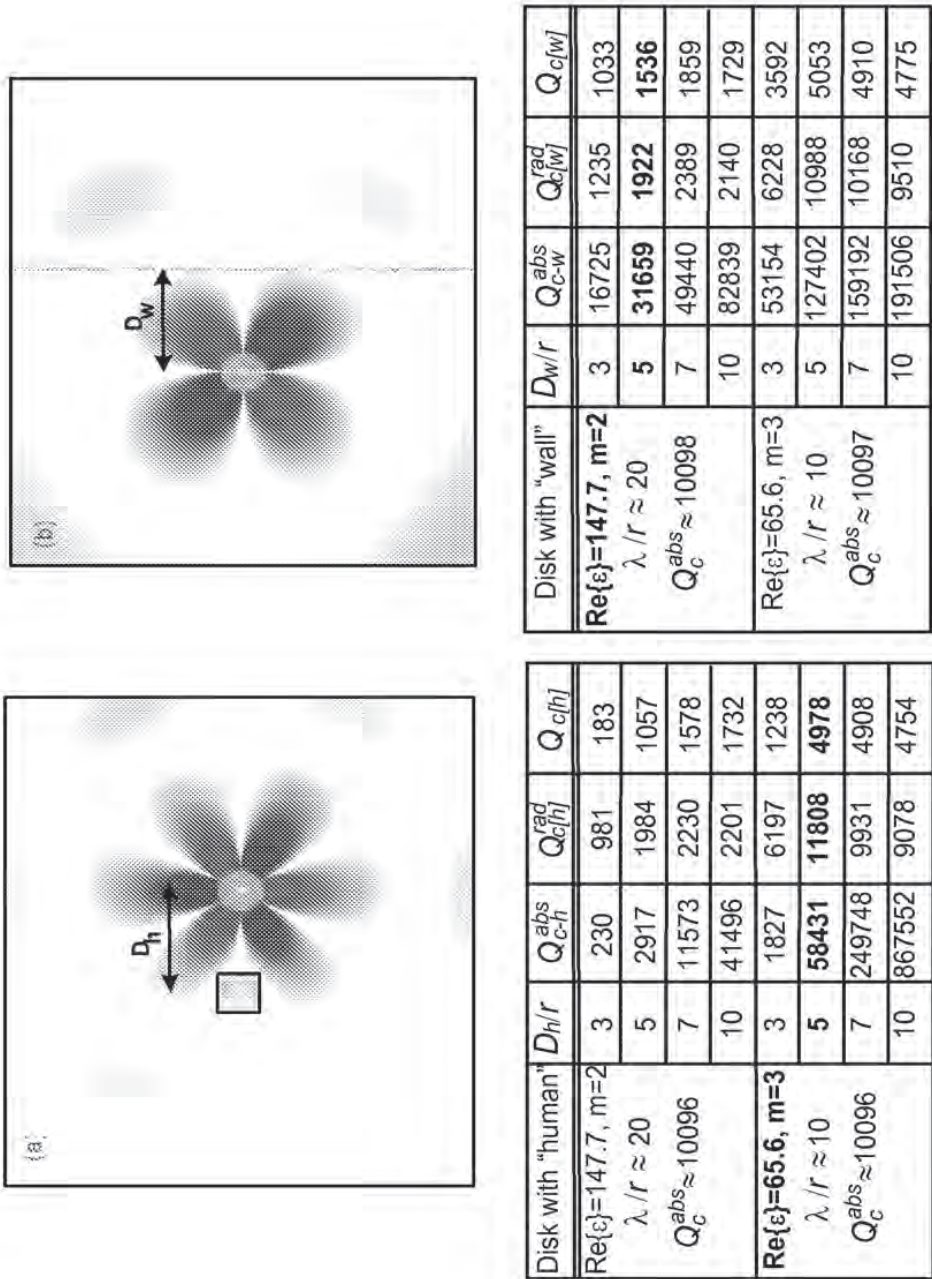
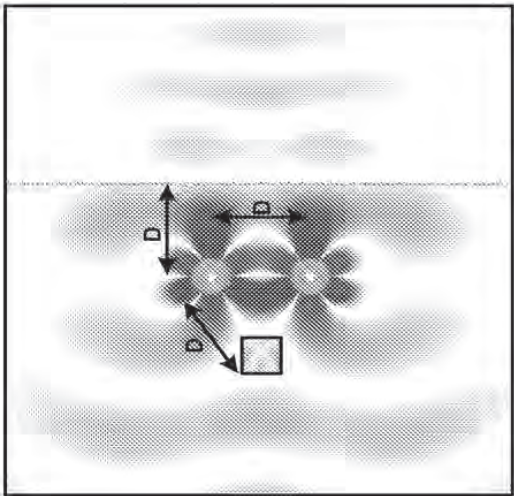


FIG. 24a

FIG. 24b



Two disks with "human" and "wall"	D/r	Q_{C-h}^{abs}	Q_{C-w}^{abs}	$Q_{C[hw]}^{rad}$	$Q_{C[hw]} = \omega/2\Gamma_C[hw]$	$\omega/2\kappa[hw]$	$\kappa[hw]/\Gamma_C[hw]$
$Re\{\epsilon\}=147.7, m=2$ $\lambda/r \approx 20$ $Q_C^{abs} \approx 10100$	3	3300	12774	536	426	48	8.8
	5	5719	26333	1600	1068	322	3.3
	7	13248	50161	3542	2097	973	2.2
	10	18447	68460	3624	2254	1768	1.3
$Re\{\epsilon\}=65.6, m=3$ $\lambda/r \approx 10$ $Q_C^{abs} \approx 10100$	3	2088	36661	6764	1328	141	9.4
	5	72137	90289	11945	4815	2114	2.3
	7	237822	129094	12261	5194	8307	0.6

FIG. 24c

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 09/59244

A. CLASSIFICATION OF SUBJECT MATTER IPC(8) - H01P 7/00 (2009.01) USPC - 333/219 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) USPC - 333/219 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched USPC - 333/219; 307/126; 455/522 (keyword limited - see terms below) Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) pubwest (DB=PGPB,USPT,EPAB,JPAB), Google Scholar Terms - wireless energy, coupling rate, resonate, energy accumulation, near-field, transfer, intermediate		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2007/0222542 A1 (Joannopoulos et al.) 27 September 2007 (27.09.2007), abstract, para [0013], [0015], [0016], [0026], [0027], [0035]	1-4, 6, 13, 20-24, 28-32, 50-53, 80, 81
Y	US 3,517,350 A (Beaver) 23 June 1970 (23.06.1970), col 2, ln 69-72; col 7, ln 22-39	1-4, 6, 13, 20-24, 28-32, 50-53, 80, 81
X, P	US 2009/0153273 A1 (Chen) 18 June 2009 (18.06.2009), entire document	1-4, 6, 13, 20-24, 28-32, 50-53, 80, 81
X, P	WO 2008/118178 A1 (Karalis et al.) 02 October 2008 (02.10.2008), entire document	1-4, 6, 13, 20-24, 28-32, 50-53, 80, 81
A	US 6,960,968 B2 (Odendaal et al.) 01 November 2005 (01.11.2005), entire document	1-4, 6, 13, 20-24, 28-32, 50-53, 80, 81
A	US 7,069,064 B2 (Gevorgian et al.) 27 June 2006 (27.06.2006), entire document	1-4, 6, 13, 20-24, 28-32, 50-53, 80, 81
A	US 1,119,732 A (Tesla) 01 December 1914 (01.12.1914), entire document	1-4, 6, 13, 20-24, 28-32, 50-53, 80, 81
☐ Further documents are listed in the continuation of Box C. ☐		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 16 November 2009 (16.11.2009)		Date of mailing of the international search report 07 DEC 2009
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201		Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (April 2007)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 09/59244

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

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

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☒ Claims Nos.: 5, 7-12, 14-19, 25-27, 33-49 and 54-79
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

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

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

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (2)) (April 2007)

Electronic Acknowledgement Receipt	
EFS ID:	12856746
Application Number:	12649635
International Application Number:	
Confirmation Number:	5891
Title of Invention:	WIRELESS ENERGY TRANSFER TO A MOVING DEVICE BETWEEN HIGH-Q RESONATORS
First Named Inventor/Applicant Name:	John D. Joannopoulos
Customer Number:	26161
Filer:	Marc M. Wefers/Cheryl Forrest
Filer Authorized By:	Marc M. Wefers
Attorney Docket Number:	01997-0359015 / MIT 11757
Receipt Date:	24-MAY-2012
Filing Date:	30-DEC-2009
Time Stamp:	13:58:52
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		359015-IDS.pdf	127406 52a0b06cb074c5a0e0d310b411a257853b4140fe	yes	3

	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Transmittal Letter		1	1	
	Information Disclosure Statement (IDS) Form (SB08)		2	3	
Warnings:					
Information:					
2	Foreign Reference	ART1-JP.pdf	159336	no	6
			(5e4810b197080394 121322127ed3e908e c9b18b)		
Warnings:					
Information:					
3	Foreign Reference	ART2.pdf	5247723	no	124
			988b46166800d74b2e031839d3d63900d a8957		
Warnings:					
Information:					
4	Foreign Reference	ART3.pdf	5869525	no	128
			166a18807ca89999528e181355ba7344b9 137d5		
Warnings:					
Information:					
5	Non Patent Literature	NPL1.PDF	759505	no	17
			ea6c3d119a6db77cdcd90016a19508a75d1 a6f8		
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6	Non Patent Literature	NPL2-13036177.pdf	1975605	no	31
			c571ee5fe3459f1c2e4a0900c75a18132e4 f7ba		
Warnings:					
Information:					
7	Non Patent Literature	NPL3.pdf	1152089	no	24
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Warnings:					
Information:					
8	Non Patent Literature	NPL4.pdf	1155419	no	24
			68717649f40bca2f02be55bed6f67f55159 6702		
Warnings:					
Information:					

9	Non Patent Literature	NPL5.pdf	1201125 b6051ff00367cddbd8c223328ade1933609 b251	no	26
Warnings:					
Information:					
10	Non Patent Literature	NPL6.pdf	1223512 f1be4e88acd994f2961ee32403ub21ca002a4c b593	no	25
Warnings:					
Information:					
Total Files Size (in bytes):			18871245		
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.					

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : John D. Joannopoulos et al. Art Unit : Unknown
Serial No. : 12/649,635 Examiner : Unknown
Filed : December 30, 2009 Conf. No. : 5891
Title : WIRELESS ENERGY TRANSFER TO A MOVING DEVICE BETWEEN HIGH-
Q RESONATORS

MAIL STOP AMENDMENT

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

INFORMATION DISCLOSURE STATEMENT

Please consider the references listed on the enclosed PTO-1449 form. Foreign patent documents and non-patent literature are enclosed; cited U.S. patents and patent application publications will be provided on request.

This statement is being filed within three months of the filing date of the application or before the receipt of a first Office Action on the merits. Please apply any necessary charges or credits to Deposit Account 06-1050, referencing the above attorney docket number.

Respectfully submitted,

Date: 5/24/12



Marc M. Wefers
Reg. No. 56,842

Customer Number
Fish & Richardson P.C.
Telephone: (617) 542-5070
Facsimile: (877) 769-7945

22850203.doc

Substitute Form PTO-1449 (Modified)	U.S. Department of Commerce Patent and Trademark Office	Attorney Docket No. 01997-0359015	Application No. 12/649,635
Information Disclosure Statement by Applicant (Use several sheets if necessary) (37 CFR §1.98(b))		Applicant John D. Joannopoulos et al.	
		Filing Date December 30, 2009	Group Art Unit

U.S. Patent Documents							
Examiner Initial	Desig. ID	Document Number	Publication Date	Patentee	Class	Subclass	Filing Date If Appropriate
	1	2010/0102639	4/29/2010	Joannopoulos et al.			
	2	2010/0117455	5/13/2010	Joannopoulos et al.			
	3	2010/0117456	5/13/2010	Karalis et al.			
	4	2010/0171370	7/8/2010	Karalis et al.			
	5	2010/0181844	7/22/2010	Karalis et al.			
	6	2010/0201205	8/12/2010	Karalis et al.			
	7	2010/0225175	9/9/2010	Karalis et al.			
	8	2010/0231053	9/16/2010	Karalis et al.			
	9	2010/0237706	9/23/2010	Karalis et al.			
	10	2010/0237707	9/23/2010	Karalis et al.			
	11	2010/0237708	9/23/2010	Karalis et al.			
	12	2010/0253152	10/7/2010	Karalis et al.			
	13	2010/0264745	10/21/2010	Karalis et al.			
	14	2010/0277005	11/4/2010	Karalis et al.			
	15	2010/0327660	12/30/2010	Karalis et al.			
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	18	2011/0018361	1/27/2011	Karalis et al.			
	19	2011/0025131	2/3/2011	Karalis et al.			
	20	2011/0049996	3/3/2011	Karalis et al.			
	21	2011/0049998	3/3/2011	Karalis et al.			
	22	2011/0140544	6/16/2011	Karalis et al.			
	23	2011/0148219	6/23/2011	Karalis et al.			
	24	2011/0162895	7/7/2011	Karalis et al.			
	25	2011/0169339	7/14/2011	Karalis et al.			
	26	2011/0181122	7/28/2011	Karalis et al.			
	27	2011/0198939	8/18/2011	Karalis et al.			

Examiner Signature	Date Considered
EXAMINER: Initials citation considered. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.	

Substitute Disclosure Form (PTO-1449)

Substitute Form PTO-1449 (Modified)	U.S. Department of Commerce Patent and Trademark Office	Attorney Docket No. 01997-0359015	Application No. 12/649,635
Information Disclosure Statement by Applicant (Use several sheets if necessary) (37 CFR §1.98(b))		Applicant John D. Joannopoulos et al.	
		Filing Date December 30, 2009	Group Art Unit

U.S. Patent Documents							
Examiner Initial	Desig. ID	Document Number	Publication Date	Patentee	Class	Subclass	Filing Date If Appropriate
	28	2011/0221278	9/15/2011	Karalis et al.			
	29	2011/0227528	9/22/2011	Karalis et al.			
	30	2011/0227530	9/22/2011	Karalis et al.			
	31	2011/0241618	10/6/2011	Karalis et al.			

Foreign Patent Documents or Published Foreign Patent Applications								
Examiner Initial	Desig. ID	Document Number	Publication Date	Country or Patent Office	Class	Subclass	Translation	
							Yes	No
	32	38 24 972	1/12/1989	Germany			Machine Translation	
	33	100 29147	12/20/2001	Germany			Machine Translation	
	34	6-341410	12/13/1994	Japan	F15B	15/18	English Abstract Only	
	35	11-188113	7/13/1999	Japan	A61N	1/378	English Abstract Only	
	36	2006/011769	2/2/2006	WIPO	H04B	7/14		

Other Documents (include Author, Title, Date, and Place of Publication)		
Examiner Initial	Desig. ID	Document
	37	

Examiner Signature	Date Considered
EXAMINER: Initials citation considered. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.	

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Tuesday, July 17, 2012

THOMSON INNOVATION

Patent/Publication: DE3824972A1**Bibliography****DWPI Title**

Decorative lights for christmas tree or sales display etc. use electromagnetic or IR energy beam for remote supply of each individual lamp

Original Title

Work of art, Christmas tree, decoration and decoration lighting

English Title

Illumination of christmas trees, decorations and artwork

Assignee/Applicant

Standardized: **HIERING ROLAND ILBERG VLADIMIR**

Original: Hiering Roland Ilberg Vladimir, DE

DWPI Assignee/Applicant

HIERING R (HIER-I)

Inventor

Hiering Roland, Ilberg Vladimir, DE

DWPI Inventor

HIERIG R; HIERING R; ILBERG V

Publication Date (Kind Code)

1989-01-12 (A1)

DWPI Accession / Update

1989-025293 / 198904

Application Number / Date

DE3824972A / 1988-07-22

Priority Number / Date / Country

DE3824972A / 1988-07-22 / DE

Abstract**DWPI Abstract**

(DE3824972A1)

Novelty

<https://www.thomsoninnovation.com/tip-innovation/translatedRecView.do?ResultSetId=2...> 7/17/2012

The decorative lights include one or more lamps which are remotely supplied without any galvanic coupling via an energy source (7) providing an electromagnetic or IR energy beam, e.g. a HF transmitter. The lamps may use electroluminescent elements, vacuum fluorescence elements, LED elements (1), or standard incandescent light bulbs. Each individual lamp has an associated oscillation circuit (2) incorporated in its socket or in a decorative glass ball or decorative item.

Advantage

Provides decorative lighting display without need for trailing leads.

Abstract

To abolish the multiplicity of electrical conductors, wires, double wires or cables, previously necessary for the illumination of christmas trees, decorations and artwork by means of electrical connections, the power supply of light-emitting elements is carried out without any electrical connection. The energy source consists of an RF transmitter which emits a constant frequency (e.g. 27 MHz) with a sufficient power (e.g. 2 watts) continuously or in a pulsed manner or of an infrared radiator, a laser, or a battery of electroluminescent diodes, connected in parallel and in series, which emit infrared light continuously or in a pulsed manner. The light-emitting elements are directly connected to an electrical resonant circuit (tuned circuit) which consists of an inductance and a capacitance (e.g. coil and capacitor). The light-emitting elements can be formed from electroluminescent elements (LE), electroluminescent diodes (LED), vacuum fluorescent diodes (VFE), glow lamps or incandescent lamps of different colours and shapes and can be used to illuminate christmas trees, decorations and artwork.

Classes/Indexing

IPC

IPC Code(1-7) **F21P 1/02** F21V 33/00 F21V 23/02 A44C 15/00 A63H 33/22 A63H 17/28 H01Q 9/28 H02J 17/00 G09F 13/00

(4)

Current IPC	Invention	Version	Additional	Version
Full	A44C 15/00	20060101		
	A47G 33/08	20060101		
	A63H 17/28	20060101		
	A63H 33/22	20060101		
	F21K 99/00	20100101		
	F21S 4/00	20060101		
	F21S 8/00	20060101		
	F21S 9/03	20060101	F21W 121/04	20060101
	F21V 23/02	20060101	F21Y 101/02	20060101
	F21V 23/04	20060101		
	F21V 33/00	20060101		
	G09F 9/33	20060101		
	G09F 13/00	20060101		
	H01Q 9/28	20060101		
	H02J 17/00	20060101		
Main Group	-	-	-	-
Subclass	-	-	-	-

Original IPC	Invention	Version	Additional	Version
Advanced/Full	A47G 33/08	20060101	-	-
	F21K 7/00	20060101		
	F21S 8/00	20060101		
	F21V 23/02	20060101		
	G09F 13/00	20060101		
	H02J 17/00	20060101		
Core/Main Group	A47G 33/00	20060101	-	-
	F21K 7/00	20060101		
	F21S 8/00	20060101		
	F21V 23/02	20060101		
	G09F 13/00	20060101		
	H02J 17/00	20060101		
Subclass	-	-	-	-

ECLA

F21S 6/00C A47G 33/08 F21K 99/00 F21V 23/02 F21V 23/04R G09F 13/00 H02J 17/00
 K47G 33/08E R21Y 101/02

DWPI Class

W05 X26 P23 P36 P85 Q71

DWPI Manual Codes

Collapse DWPI Manual Codes

EPI Manual Codes: W05-D04; W05-E03; X26-X

DWPI Chemistry Resource Numbers

Collapse DWPI Chemistry Resource Numbers

-

DWPI Registry Numbers

Collapse DWPI Registry Numbers

-

Plasdoc Punch Codes

Collapse Plasdoc Punch Codes

-

 Expand Plasdok Key Serial Codes**Enhanced Polymer Indexing** Expand Enhanced Polymer Indexing**Chemical Fragment Codes** Expand Chemical Fragment Codes**Legal Status****INPADOC Legal Status**

Gazette Date	Code	Description
1991-12-19	8131 -	REJECTION
1989-08-31	8110 +	REQUEST FOR EXAMINATION PARAGRAPH 44
1989-05-11	8105 +	SEARCH REPORT AVAILABLE
1989-02-16	8122	NONBINDING INTEREST IN GRANTING LICENSES DECLARED
1989-01-12	OR8	REQUEST FOR SEARCH AS TO PARAGRAPH 43 LIT. 1 SENTENCE 1 PATENT LAW
1989-01-12	OAV +	APPLICANT AGREED TO THE PUBLICATION OF THE UNEXAMINED APPLICATION AS TO PARAGRAPH 31 LIT. 2 Z1

Get Family Legal Status

Family**Family**

INPADOC Family (0)

 Collapse DWPI Family (2)

Publication	DWPI Update	Publication Date	IPC Code	Language
DE3824972A1	198904	1989-01-12	A47G003308	German
US5034658A	199132	1991-07-23	H01K000700	English

Claims**Claims** Collapse All Claims (20)**Claims (German)**<https://www.thomsoninnovation.com/tip-innovation/translatedRecView.do?ResultSetId=2...> 7/17/2012

1. Work of art and Christmas tree, decoration and decoration lighting, **thus characterized**, that at least one or more light-radiating elements from at least one energy source, which sends electromagnetic waves or infra-red light are supplied contactless i.e. without galvanic connection.
2. Christmas tree, decoration, marked work of art and decoration lighting according to requirement 1, by it that the light-radiating elements are attached directly to an electrical resonant circuit, that from an inductance and a capacity (e.g. Coil and condenser) exist.
3. Work of art, Christmas tree, decoration and decoration lighting according to requirement 1 and 2, by characterized that the light-radiating elements from Elektroluminiszenzdioden (LED) are formed, which radiates multi color light.
4. Work of art, Christmas tree, decoration and decoration lighting according to requirement 1 and 2, by characterized that at least two LED are attached antiparallely to the resonant circuit.
5. Work of art, Christmas tree, decoration and decoration lighting according to requirement 1 and 2, by characterized that the light-radiating elements from Elektroluminiszenzelementen (LE) are formed, Vacuumfluoreszenzelementen (VFE), and/or for plasma lights.
6. Work of art, Christmas tree, decoration and decoration lighting according to requirement 1 and 2, by characterized that the light-radiating elements from fluorescent lamps are formed.
7. Work of art, Christmas tree, decoration and decoration lighting according to requirement 1 and 2, by characterized that the light-radiating elements from lamps are formed.
8. Work of art, Christmas tree, decoration and decoration lighting according to requirement 1, 2, 3, 4, 5, 6 and 7, by characterized that the light-radiating elements with the resonant circuit in form of a candle are formed.
9. Work of art, Christmas tree, decoration and decoration lighting according to requirement 1, 2, 3, 4, 5, 6, 7 and 8, by characterized that the light-radiating elements with the resonant circuit are built into glass balls and/or into objects from glass.
10. Work of art, Christmas tree, decoration and decoration lighting according to requirement 1, 2, 3, 4, 5, 6 and 7, by characterized that the light-radiating elements with the resonant circuit are combined into decoration things.
11. Work of art, Christmas tree, decoration and Schmuckbeleuchtung according to requirement 1, 2, 3, 4, 5, 6 and 7, by characterized that the light-radiating elements are built into decoration of works of art from glass, jewels, precious metals, plastics or other materials.
12. Work of art, Christmas tree, decoration and decoration lighting according to requirement 1, 2, 3, 4, 5, 6 and 7, by characterized that the light-radiating elements are inserted consisting in toy, utensils, textiles or other articles, of materials of all kinds.
13. Work of art, Christmas tree, decoration and decoration lighting according to requirement 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12, by characterized that the coil of the resonant circuit is implemented as wide loop and makes possible thus different forms of supporters.
14. Work of art, Christmas tree, decoration and decoration lighting according to requirement 1, by characterized that the light-radiating elements directly at a solar cell panel, a sufficient tension (e.g. 2 V) and a sufficient river (e.g. 3 milliampere) supplies, to be attached.
15. Work of art, Christmas tree, decoration and decoration lighting according to requirement 1, by it characterized that the energy source consists of a HF-transmitter, the one constant frequency (e.g. 27 MHz) with a sufficient achievement (e.g. 2 Watts) continuously and/or impulsweise radiates.

16. Work of art, Christmas tree, decoration and decoration lighting according to requirement 1, by characterized that the energy source consists switched Elektroluminiszenzdioden, which and/or the infrared light radiates continuously, impulsweise or modulated of an infrared emitter, laser or a battery of parallel and in series.

17. Work of art, Christmas tree, decoration and decoration lighting according to requirement 1 to 15, by characterized that the antenna of the HF-transmitter is designed as staff, dipole or loop.

18. Work of art, Christmas tree, decoration and decoration lighting according to requirement 1 and 15, by characterized that the antenna is covered with a HF-Spannungsschutz.

19. Work of art, Christmas tree, decoration and decoration lighting according to requirement 2, 8, 9, 10, 13, 17 and 18, by characterized that the antenna, as well as the coils of the resonant circuit consist of a superconductor working at ambient temperature.

20. Work of art, Christmas tree, decoration and decoration lighting according to requirement 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15 and 19; by characterized that at least the lichtaustahlenden elements, attached co-ordinated with the frequency of the HF-transmitter in resonance, by the resonant circuits as well as in the proximity or directly in the area at least a wide loop of an auxiliary resonant circuit, which is co-ordinated with the same resonant frequency it is placed.

Description

Background/ Summary



Collapse Background/Summary

-

Drawing Description



Collapse Drawing Description

-

Description



Collapse Description

The invention concerns a lighting for Christmas trees, decorations, works of art and decoration with electrical, light-radiating elements, which are attached, fastened to these articles or built into these articles and for the enterprise of necessary energy are also supplied.

With such Christmas tree, decoration, and work of art lighting is necessary a current supply with sufficient achievement, in order to achieve a desired luminous intensity the most frequent electrical filament small lamp used of at. The filament small lamps are attached by means of electrical leaders and/or cables either to the plug socket with full mains voltage, or to a low tension over a Trafo, rarely to an accumulator or a battery.

Prior kind

With conventional Christmas tree and decoration lighting it is necessary that all filament small lamps are connected by means of electrical conductors, that are continued to attach with the help of a double wire and/or a cable to the plug socket with 220 V and/or 110 V of alternating voltage, 50 cycles per second and/or 60 cycles per second, or to a lower tension at the secondary winding of a Trafos.

The filament small lamps are switched with the connection at full 220 V and/or 110 V of alternating voltage into row and with connection to a lower tension, e.g. 12 V, parallel switched. With the lighting and/or fluoroscopy of works of art the same arrangement of the current supply is necessary.

The absolutely necessary connection of the individual filament small lamps with one another and up to the convenience outlet by means of galvanic connection with electrical conductors, insulating wires, double wire or cable continues to cause some disadvantages and problems:

The distribution and mounting of the filament small lamps at the branches of Christmas tree are limited and/or difficult by the connecting wires.

During the connection at 220 V and/or 110 V mains voltage with series connection of the filament small lamps when burning a filament small lamp the electric circuit through is interrupted, if not each individual filament small lamp became to provide with a special, bridging protection. Only if the defective filament small lamp is replaced by a new, the electric circuit is again closed.

During the connection to a mains voltage of 220 and/or 110 V particularly good electrical isolation of the wiring leads is necessary for safety reasons. During parallel connection of the filament small lamps these must be interconnected with two leaders and/or a double wire. Also the double wire and/or the electrical conductor must exhibit good electrical isolation, in order to prevent a short-circuit, particularly with humidity.

The conventional Christmas tree and work of art lighting by connecting leads and/or leads do not work aesthetically and are only very with difficulty at the desired place to be attached.

Unpacking and regranting particularly of electrical Christmas tree lighting bring substantial disadvantages to the electrical conductor, wires, double wires and cables by constant entangling with itself.

Problem of tons of Solve

The invention is the basis the task, the disadvantages of conventional Christmas tree, specified last to eliminate decoration and work of art lighting.

This task is solved according to invention thereby that during the new work of art, Christmas tree, decoration and decoration lighting at least one or more light-radiating elements from at least one energy source, which sends electromagnetic waves or infra-red light are supplied contactless - i.e. without galvanic connection -.

The light-radiating elements are attached directly according to invention to an electrical resonant circuit, that from an inductance and a capacity - e.g. Coil and condenser - exists. The coil can be provided favorably with a low-loss HF ferrite core and/or a good leader.

The light-radiating elements are according to invention favorably formed from Elektroluminiszenzdiöden (LED), those multi color light to radiate and in addition only a low tension (e.g. 1,5 to 4 V) and a river (e.g. 2 to 20 milliamperes) need.

According to invention at least two LED's can be antiparallely attached to the resonant circuit.

The light-radiating elements know also according to invention from Elektroluminiszenzleuchten (EL), Vacuumfluoreszenzelementen (VFE) and/or from plasma lights to be formed.

The light-radiating elements from fluorescent lamps and lamps are formed just as according to invention.

Particularly for the Christmas tree and decoration lighting the light-radiating elements with the resonant circuit in form of a candle are according to invention formed.

Favorably the light-radiating elements with the resonant circuit can be built into glass balls and/or into objects from glass.

According to invention the light-radiating elements with the resonant circuit can be combined into decoration things.

The light-radiating elements can be built according to invention to the lighting and/or fluoroscopy into decoration works of art from glass, plastics, jewels, precious metals or other materials.

It is also according to invention possible, the light-radiating elements with the resonant circuit in toy, utensils, textiles or other articles, consisting of materials of all kinds to insert.

Favorably according to invention inductances of the resonant circuit know star, letter, number or another art form as wide loop or in different forms as a supporter like e.g. a circle, square, multiplehit a corner, to be implemented.

The lichtaustahlenden elements know also according to invention to a solar cell panel, a sufficient tension (e.g. 3 V) and a sufficient river (e.g. 10 milliamperes) supplies, to be attached.

The energy source of the Christmas tree, decoration, work of art and decoration lighting consists favorably according to invention of a high-frequency transmitter, the one constant frequency, (e.g. 27 megahertz) with a sufficient achievement (e.g. 2 Watts) continuously and/or impulsweise radiates.

The energy source of the Christmas tree, decoration, work of art and decoration lighting consists also according to invention of an infrared emitter, a laser or of a battery of parallel and in series switched Elektroluminiszenzdioden, continuously, impulsweise or modulated radiate which and/or the infra-red light. This is appropriate, if the lichtsahlenden elements are attached directly according to invention to a solar cell panel.

Both energy sources are supplied either by a mains voltage, an accumulator, a battery, by solar cells or other forms of energy.

The antenna of the HF-transmitter of the Christmas tree, decoration, work of art and decoration lighting can be designed according to invention as staff, dipole or loop, whereby it can be covered with higher radiated achievement with a HF-Spannungsschutz from insulation material.

In order to achieve low losses during the wireless power supply of the light-radiating elements of the Christmas tree, decoration, work of art and decoration lighting, the coils of the resonant circuit as well as the antenna can consist according to invention of a material, which works as superconductor at a temperature, which is not many lower than the ambient temperature and thus as superconductor with a resistance close zero works.

So that the resonant circuits are supplied with the attached light-radiating elements additionally and more effectively with the HF-energy from the auxiliary resonant circuit, which has high quality, at least according to invention one of the resonant circuits as well as the attached light-radiating elements in the proximity, co-ordinated with the frequency of the HF-transmitter in resonance, can be placed or directly in the area at least a wide loop of an auxiliary resonant circuit, which is co-ordinated with the same

resonance.

The following advantages are obtained by the invention:

The current supply of light-radiating elements is accomplished without galvanic connection from the energy source. Thus the problems with wires and cables, which cause much annoyance with conventional Christmas tree, decoration and work of art lighting, do not arise.

During the mounting of the light-radiating elements, particularly in the form of candles at the Christmas tree, as well as when the out and packing up the lighting, one must pay attention not to the connecting wires and/or double wires or cables.

Possible burning of a light-radiating element through has erfindungsemäß no disturbing effect on the remaining light-radiating elements.

It is not possible a short-circuit disturbance, since the connecting double wires and cables are void according to invention.

The aesthetics both with lighting up the Christmas tree and with the lighting and fluoroscopy of Kuntwerken from glass and other transparent materials or plastics is no more disturbed by connecting wires of the current supply according to invention.

The light-radiating elements can be inserted, fastened more simply into or to these works of art or interconnected, whereby beautiful, colored light effects are reached.

The light-radiating elements can be implemented with the resonant circuit in very small dimensions - particularly with Elektroluminiszenzdioden (LED) - and thus substantially more suitably its for the installation, the attachment, the lighting and fluoroscopy of decoration and jewels, as conventional sources of light. Also in this case the esthetic effect is obtained nich disturbed to separate on the contrary a new light-radiating effect by decoration and jewels, what puts the effect out of the object concerned still more.

The coil of the resonant circuit and the antenna can be implemented from a material, which works as superconductor at a Temperatur, which is not many lower than the ambient temperature, whereby a high efficiency of the wireless current supply from the energy source is obtained, since the enormously low resistance of the superconductor a high quality of the coils of the resonant circuit and the antenna effectuation and accordingly very low losses arise.

Working Examples

Some execution examples of the invention are represented and in the following are more near described in the designs to 7. It shows

Fig. 1 Christmas tree lighting,

- a) Arrangement in principle,
- b) LED with resonant circuit as electrical candle.

Fig. 2 electrical circuit of the resonant circuit LC with LED at the pick-up of the coil,

- a) with an LED,
- b) with two antiparallely switched LED's,
- c) wide L-loop for attaching.

Fig. 3 glass ball for Christmas tree and/or decoration.

Fig. 4 Lampion for decoration purposes.

Fig. 5 work of art Christ at the cross with heart lighting.

Fig. 6 work of art cat with bright eyes.

Fig. 7 decoration earrings with bright jewel.

In **Fig. 1a** is represented the arrangement in principle of a Christmas tree lighting, with the Elektroluminiszenzdioden LED (1), which radiate multi color light, ever with that LC- Resonant circuit (2), that with the resonant frequency is 27 MHz co-ordinated and from an air coil (3) and a trimmer capacitor (4) exists, together with the mounting plate (5) the form of an electrical candle (6) form, whereby for the contactless current supply as energy source a HF-transmitter (7) serves. The HF-transmitter (7) an output of 20 Watts from a $\lambda/4$ radiates is enough for blade antenna (8) in the direction of the Christmas tree out, which is distant from the antenna for 0.5 to 5 meters. The antenna (8) can with a reflector (9) to be provided, in order to cause the radiant emittance in the desired direction. The LED's (1) are with a screen (10) provide from glass and/or transparent plastic, which is verspiegelt also down, in order to radiate the rays of light more laterally and downward.

In **Fig. 2** is the electrical circuit of the LC- Resonant circuit (2) represented with LED's (1) at the pick-up of the coil (3), in order to create an optimal power adaptation for the delivery of the electricity of the resonant circuit to the LED's.

In **Fig. 2a** is the circuit of the LC- Resonant circuit (2) with an LED (1) at the pick-up of the coil (3) represented.

In **Fig. 2b** is that LC- Resonant circuit (2) represented, with two antiparallely switched on LED's, which use both half waves of the HF of signal for the power supply favorably.

In **Fig. 2c** is the circuit one LC- Resonant circuit (2) represented with wide coil loop (3), which forms and for attaching be used favorably can sufficient inductance. By the large loop surface of the coil with fewer turns or with a turn a good power supply of the LED's is reached.

Fig. 3 shows a glass ball with a diameter from 6 to 10 cm and/or more largely for Christmas tree or decoration purposes, with than coil (3) depending upon ball size two to five turns from a good electrical conductor the surface to be re-clamped and/or the turns directly at the surface be formed and with a chip and/or a trimmer capacitor (4), which is 27 MHz co-ordinated with the resonant frequency, one LC- Resonant circuit (2) form, whereby at the pick-up of the coil (3) or two LED's in antiparallel a circuit switching on and in the interior of the glass ball for the fluoroscopy are fastened.

Fig. 4 a Lampion for decoration purposes, with that shows 4 the turns of the coil (3) are wound at the Lampionszylinder and with a trimmer capacitor (4) with the resonant frequency 27 MHz are co-ordinated. The condenser is fastened to the top of the Lampions and forms one LC- Resonant circuit (2), whereby as light-radiating elements (1) and/or two LED's at the pick-up of the coil (3) to be switched on and in the interior of the Lampions to the fluoroscopy be fastened. Fluorescence elements (VFE) and/or plasma elements, which to the full coil, can do in addition, of the coil (3) to be switched on, for the fluoroscopy used.

Fig. 5 a work of art shows 5, in which the Christ body at the cross with light-radiating heart as symbol the love is represented. The light becomes from an LED (1) forms radiated and at the pick-up of a coil with several turns (3), which are aesthetically as spiral halo circles around the Christ head implemented, with the trimmer capacitor (4), which is 27 MHz co-ordinated with the resonant frequency, one LC- Resonant

circuit. The heart can be implemented symbolically also from a polished jewel or from glass and/or another transparent material, which analyzed with the inserted LED. Likewise also two LED's in antiparallel connection for the fluoroscopy can be used.

In **Fig.** another Kustwerk is represented 6, which shows a black cat with green shining eyes. The light becomes from two becomes green to LED's (1) radiated or analyzes the cat eyes from green glass or jewels, whereby the LED's directly to a solar cell panel (11) to be attached, that when irradiation with infra-red light from an energy source (7) a tension of 3 V has and a river of 20 milliamperes supplies. The energy source (7) meter consists toward the solar cell panel of an infrared lamp with an achievement more largely than 200 Watts and radiates from a distance smaller than 3 (11). Instead of it also possible, e.g. a white rabbit with red shining eyes is to be represented to the cat.

Fig. decoration shows 7 in form of an earring with polished jewel, that by and/or two LED's (1) analyzed. The LED is inserted and electrical to inden jewel at the pick-up of a resonant circuit (2) attached, the one rectangular, spiral coil (3) with a chip and/or a trimmer capacitor (4) forms. The coil (3) can be formed also as a circle spiral.

As in **Fig. 1** the LED's becomes (1) also in **Fig. 3, 4, 5** and **7** from an energy source (7) supplies, which of a HF-transmitter consists, electromagnetic waves within the range of 27 MHz with an output of 200 Watts from an antenna (8) radiates in the direction decoration and of the works of art and over those LC- Resonant circuits (2) the light-radiating elements contactless with energy supplies.

Citations

Citation



Collapse Citing Patents (25)

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					completely integrated into lighting object
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Expand Cited Patents (24)



Expand Cited Non-patents (1)

Other**DWPI Title Terms**

DECORATE LIGHT CHRISTMAS TREE SALE DISPLAY ELECTROMAGNET INFRARED ENERGY BEAM REMOTE
SUPPLY INDIVIDUAL LAMP

Custom Fields**Test**

-

Relevance

-

Product Name

-

Docket number

-

Notes

-

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Tuesday, July 17, 2012

THOMSON INNOVATION

Patent/Publication: DE10029147A1**Bibliography****DWPI Title**

Installation for supplying toys with electrical energy, preferably for production of light, comprises a sender of electromagnetic waves which is located at a small distance above a play area with the toys

Original Title

Plant for the supply of toys with electricity with the help of a transmitter, which send electromagnetic waves, and a receiver with antenna

English Title

Installation for supplying toys with electrical energy, preferably for production of light, comprises a sender of electromagnetic waves which is located at a small distance above a play area with the toys

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TIEMENS U

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Priority Number / Date / Country

DE10029147A / 2000-06-14 / DE

Abstract**DWPI Abstract**

<https://www.thomsoninnovation.com/tip-innovation/translatedRecView.do?ResultSetId=2...> 7/17/2012

(DE10029147A1)

Novelty

The installation for supplying toys with electrical energy, preferably for production of light, comprises a sender of electromagnetic waves which is located at a small distance above a play area with the toys provided with appropriate receiver antennas and electronic energy conversion circuits.

Use

For toys which are to emit light.

Advantage

Need for batteries is eliminated.

Drawing Description

The drawing shows the proposed installation.

- 1 - Signal generator.
- 2 - Sender antenna.
- 5 - Play area.
- 6 - Toy.
- 7 - Receiver antenna.
- 8, 9, 10 - Energy conversion unit.
- 11 - Light source.

Technology Focus

POLYMERS - The toys incorporate acrylic light guides for conducting light to required points on the toys.

Abstract

The installation for supplying toys with electrical energy, preferably for production of light, comprises a sender of electromagnetic waves which is located at a small distance above a play area with the toys provided with appropriate receiver antennas and electronic energy conversion circuits.

German Abstract

Mit einem Generator 1 und einer Antenne 2 wird ein Sendesignal erzeugt, das eine Modellfläche 5 bestrahlt. Auf der Modellfläche stehen Spielzeuge, in denen sowohl die Empfangsantennen 7 als auch je eine nachgeschaltete Elektronik integriert sind. Die Sendeenergie wird von der Empfangsantenne empfangen und entweder direkt an Glühlampen 11 weitergeleitet, um diese zum Leuchten zu bringen, oder über die nachgeschaltete Elektronik, bestehend aus dem Empfänger-Eingangskreis 8, dem Gleichrichter 9 und der Anpaßelektronik 10, an die Licht emittierenden Dioden 11 weitergegeben, um diese zum Leuchten anzuregen.

<https://www.thomsoninnovation.com/tip-innovation/translatedRecView.do?ResultSetId=2...> 7/17/2012

IPCIPC Code(1-7) **A63H 17/28** A63H 17/00 A63H 19/20 H02J 17/00

(7)

Current IPC	Invention	Version	Additional	Version
Full	A63H 17/28	20060101	-	-
	A63H 19/20	20060101		
	H02J 17/00	20060101		
Main Group	-	-	-	-
Subclass	-	-	-	-

Original IPC	Invention	Version	Additional	Version
Advanced/Full	A63H 17/28	20060101	-	-
	A63H 19/20	20060101		
	H02J 17/00	20060101		
Core/Main Group	A63H 17/00	20060101	-	-
	A63H 19/00	20060101		
	H02J 17/00	20060101		
Subclass	-	-	-	-

ECLA

A63H 17/28 A63H 19/20 H02J 17/00

DWPI Class

A89 U24 X12 P36

DWPI Manual Codes
 Collapse DWPI Manual Codes

CPI Manual Codes: A99-A

EPI Manual Codes: U24-H; X12-H01X

DWPI Chemistry Resource Numbers
 Collapse DWPI Chemistry Resource Numbers

-

DWPI Registry Numbers
 Collapse DWPI Registry Numbers

-

Plasdoc Punch Codes Collapse Plasdoc Punch Codes**Plasdoc Key Serial Codes** Expand Plasdoc Key Serial Codes**Enhanced Polymer Indexing** Expand Enhanced Polymer Indexing**Chemical Fragment Codes** Expand Chemical Fragment Codes**Legal Status****INPADOC Legal Status**

Gazette Date	Code	Description
2004-04-15	8139 -	DISPOSAL/NON-PAYMENT OF THE ANNUAL FEE
2003-12-04	8170 +	REINSTATEMENT OF THE FORMER POSITION
2003-04-10	8139 -	DISPOSAL/NON-PAYMENT OF THE ANNUAL FEE
2002-01-31	8122	NONBINDING INTEREST IN GRANTING LICENSES DECLARED

Get Family Legal Status

Family**Family**

INPADOC Family (0)

 Collapse DWPI Family (1)

Publication	DWPI Update	Publication Date	IPC Code	Language
DE10029147A1	200210	2001-12-20	A63H001728	German

Claims**Claims** Collapse All Claims (11)**Claims (German)**<https://www.thomsoninnovation.com/tip-innovation/translatedRecView.do?ResultSetId=2...> 7/17/2012

1. Plant for the supply of toys with electricity, preferably for the production of light, consisting of a transmitter, which sends and mdst a signal with a certain frequency. with a receiver equipped toy, **thus characterized** that the transmitter from a small distance (preferably in the meter range) is directed in a model surface, and that on this surface the positioned take up and with one receiver each provided toys the energy radiated from the transmitter over an antenna and convert this taken up transmitting power by means of an electronic circuit into light.

2. Plant according to requirement 1, by the fact characterized that the broadcasting signal is an oscillation with adjustable amplitude, adjustable in the frequency, which is produced by a generator.

3. Plant according to requirement 1, by the fact characterized that the oscillation is preferably a sinus oscillation.

4. Plant after requirement 1 and one following, thereby marked that the transmitter frequency is selected dependant on the size of the mechanical extents of the toys, into which the receiving antenna is integrated.

(With toys, which have a size of few cm, a transmitter frequency is necessary in the GHz range) because of the optimal antenna size.

5. Plant after requirement 1 and one the following, by the fact characterized that the sensitivity of the receiver to the broadcasting signal is maximally co-ordinated.

6. Plant after requirement 1 and one the following, by the fact characterized that the transmitter is so dimensioned that it sends energy essentially only to the toys placed in the model surface.

7. Plant after requirement 1 and one the following, by the fact characterized that the complete receiver, including which antenna with electronics downstream, in the toy is integrated.

8. Plant according to requirement 1 to 7, by the fact characterized that the taken up energy with a memory (e.g. Reservoir capacitors, so-called one buffers gold caps, or accumulators) buffered, and/or, so that brief interruptions of the energy transmission can be bridged.

9. Plant according to requirement 1 to 7, by the fact characterized that from switching the broadcasting signal on and off the impression of a flashing source of light results.

10. Plant after requirement 1 and one the following, thereby marked that the light of the source of light with light conductors (e.g. particularly bent acrylic glass) is steered to the places of the toy, at which the light it is to appear.

11. Plant after requirement 1 and one the following, by the fact characterized that also different aggregates/components than a source of light, e.g. Relay, engines etc., with the help of which transferred electricity are operated.

Description

Background/ Summary



Collapse Background/Summary

DWPI Drawing Description

The drawing shows the proposed installation.

- 1 - Signal generator.
- 2 - Sender antenna.
- 5 - Play area.
- 6 - Toy.
- 7 - Receiver antenna.
- 8, 9, 10 - Energy conversion unit.
- 11 - Light source.

Drawing Description

Collapse Drawing Description

Description

Collapse Description

The invention concerns a plant for the wireless supply of toys with electricity, which transfers electromagnetic waves with the help of a transmitter, which will receive from a receiver with an antenna, and which brings a source of light to shining. With this kind of the supply it is important that the toys themselves do not need an own current supply, like batteries, accumulators or the like, and that the supply takes place localindependently. A further substantial characteristic of this kind of supply is the simple production of the broadcasting signal by a function table with an adjustable frequency. The antenna input of the receiver is optimized on the given frequency.

The wireless energy transmission by means of an alternating field is in principle well-known from EP-B1-91-971. With a such plant the magnetic field in parallel to a distance covered led staff leaders is produced, whereby driving toys can be led.

A further procedure is described, in which "control signals" will transfer over a transmitter/a receiver system (DE 39 03 535 A1). These control signals will transfer a receiving coil over an air coil as transmitters and to the toy, then however with relatively complex means (band filter, microprocessor, signal molder etc.) for the controlling of the toy used. The toys for their part are operated with external supply terminals.

A further procedure of the wireless energy transmission by means of induced tensions is described in the patent application 100 24 648,6.

All these procedures use the principle of the induction for the transmission of energy or information.

The invention is the basis from there the task, in a defined clearance, the model surface, to transfer with the help of in the spatial proximity (within the meter range) of the clearance of arranged transmitter over a transmitting antenna energy to the electrical consumer integrated in a toy. The toys do not need to have thereby own supply terminals. The energy is preferably used for the lighting of the toys.

In the case of use of today's technology, e.g. Low current LEDs (light-along-animal-end diodes), are needed for the enterprise an LED only approx. 2 mW. With an obtained tension of only approx. 2 V an low current LED can be operated with a river by 1 mA. If it concerns a red LED, this light can be used e.g. in a miniature car as taillight. The light can be steered with a passive light conductor (e.g. consisting of acrylic glass) at each desired place.

For the solution of this task the characteristics and measures marked by requirement 1-11 are suggested. The subject of the invention is below described on the basis an execution example, which is schematically illustrated in the design. In the design show:

Fig. 0 overview, principle picture;

Fig. 1 arrangement of the transmitter relative to the Spielfläche;

Fig. 2 schematic representation of the receiver;

Fig. 3 execution example of the conversion of the received energy to light.

With that below the arrangement according to invention of the wireless supply of a toy with energy, which is used e.g. for the operation of a source of light, serves specified execution example.

In addition becomes **Fig. 1** an antenna **2** voh a generator **1** with a transmission Rome with a given frequency operated, so that a model surface **5** evenly from direction **4** one illuminates. In the model surface **5** becomes as in **Fig. 2** suggested, a toy **6** arranged, in that a complete receiver computer unit einschließlich the receiving antenna **7**, is integrated. This receiver computer unit consists of a receiving antenna **7**, and electronics downstream, those again from the antenna input circle **8**, the electric rectifier **9** and adjustment electronics **10** exists. At this adjustment electronics are the sources of light **11** attached. In **Fig. 3** one shows again, how in the execution example the transformation transmitting power takes place in light. In the antenna **7** taken up energy to electronics downstream one passes on. Adjustment electronics **8** with resonant circuit (L1, L2, C) it ensures for the fact that the tension and/or the river the attached source of light **11** does not overload. In a simple case is sufficient for the operation a light of an emitting diode an adapted pre-resistor. In addition the transmitting power of the generator must **1** out **Fig. 1** to be regulated in such a way that the received energy becomes parallel and at the connections of the electric rectifier **9** remains constant. There is conceivable in addition, further executions of adjustment electronics, as would e.g. bring in a breakdown diode for voltage stabilization and/or would bring in a reservoir capacitor for bridging voltage fluctuations.

During sufficient power transmission also the direct connection of a lamp is enough to the contacts of the antenna input circle **8** out. In this case the electric rectifier becomes **9** and adjustment electronics **10** does not use. **Figure legend1** Generator for the supply of the transmitting antenna

2 Transmitting antenna

3 By the transmitter of caused radiation cones and surface illuminated

4 Radiation pattern of the transmitter

5 Spielfläche/model surface

6 Toy

7 Receiving antenna

8 Electric rectifier

9 Adjustment electronics

10 Source of light**Citations****Citation**
 Collapse Citing Patents (11)

Publication Number	Publication Date	Application Date	Assignee / Applicant	Title
US7741734B2	2010-06-22	2006-07-05	MASSACHUSETTS INST TECHNOLOGY	Wireless non-radiative energy transfer
US7825543B2	2010-11-02	2008-03-26	MASSACHUSETTS INST TECHNOLOGY	Wireless energy transfer
US8022576B2	2011-09-20	2009-03-31	MASSACHUSETTS INST TECHNOLOGY	Wireless non-radiative energy transfer
US8035255B2	2011-10-11	2009-11-06	WITRICITY CORP	Wireless energy transfer using planar capacitively loaded conducting loop resonators
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US8076801B2	2011-12-13	2009-05-14	MASSACHUSETTS INST TECHNOLOGY	Wireless energy transfer, including interference enhancement
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WO2008118178A1	2008-10-02	2007-06-11	MASSACHUSETTS INST TECHNOLOGY	WIRELESS ENERGY TRANSFER

Cited Patents (0)

Cited Non-patents (0)

Other**DWPI Title Terms**

INSTALLATION SUPPLY TOY ELECTRIC ENERGY PREFER PRODUCE LIGHT COMPRISE SEND
ELECTROMAGNET WAVE LOCATE DISTANCE ABOVE PLAY AREA

DWPI Related Accession Numbers
<https://www.thomsoninnovation.com/tip-innovation/translatedRecView.do?ResultSetId=2...> 7/17/2012

Custom Fields

Test

Relevance

Product Name

Docket number

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UNIVERSAL HYDRAULIC DEVICE

Inventor(s): HIRAI ATSUYUKI; HIRAGA YOSHIJI; AOYAMA YOSHIO ***Applicant(s):** YASKAWA ELECTRIC CORP; AOYAMA YOSHIO *

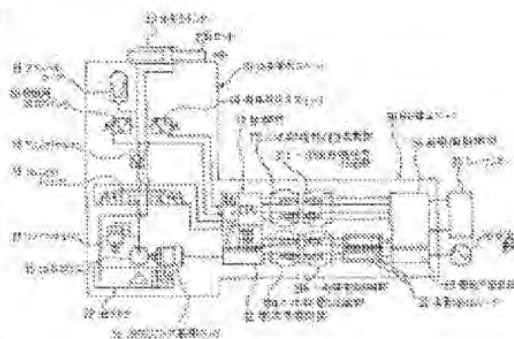
Classification:

- **international:** **F15B1/00; F15B11/00; F15B15/18; H02J17/00;** (IPC1-7): F15B1/00; F15B11/00; F15B15/18; H02J17/00

- **European:****Application number:** JP19930132088 19930602**Priority number (s):** JP19930132088 19930602**Also published as:** JP3207294 (B2)

Abstract of JP6341410 (A)

PURPOSE:To enable a hydraulic actuator to mode freely and to be replaced without generation of problem in hydraulic piping and electric wiring between a hydraulic actuator and its driving means and with a simple structure. **CONSTITUTION:**A feeder unit 30 has a primary side power transmission part 31a and primary side information signal transmission part 31b to which high frequency voltage is applied by a high frequency inverter 32 and a feeding side control part 34 respectively.; A hydraulic pressure generation unit 10 has a hermetical structure and is provided with a hydraulic circuit composed of a hydraulic pump 15, solenoid valve 16 and check valve 18, a hydraulic cylinder 23 controlled by the hydraulic circuit, and a secondary side power transmission part 11a and a secondary side information signal transmission part 11b to which part 11a power is supplied and to which part 11b


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information signal is transmitted respectively from the primary side information signal transmission part 31b and the primary side power transmission part 31a, by a noncontact manner by high frequency electromagnetic induction.

Last updated: 14/03/2012 - Worldwide Database: 5/7,38/ 82p

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特開平6-341410

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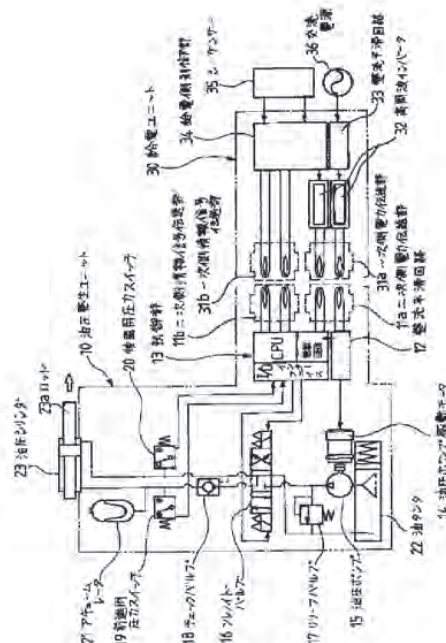
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(54)【発明の名称】 自在油圧装置

(57)【要約】

【目的】 油圧アクチュエータとその駆動手段との間の油圧配管や電気配線の問題を生じることなく、しかも簡単な構成で油圧アクチュエータの自律移動や交換を行なえるようにする。

【構成】 給電ユニット30は、それぞれ高周波インバータ32および給電側制御部34より高周波電圧が印加される一次側電力伝送部31aおよび一次側情報信号伝送部31bを有する。油圧発生ユニット10は密閉構造で、油圧ポンプ15、ソレノイドバルブ16、およびチェックバルブ18等からなる油圧回路と、油圧回路により制御される油圧シリンダ23と、高周波電磁誘導により無接触で、一次側情報信号伝送部31bおよび一次側電力伝送部31aから、電力が供給される二次側電力伝送部11aおよび情報信号が伝送される二次側情報信号伝送部11bとを有する。



【特許請求の範囲】

【請求項1】 高周波電圧が印加される一次側伝送部を有する給電ユニットと、

前記給電ユニットからの電力が供給され、該電力により油圧力を発生させて油圧アクチュエータに所定の作業を行なわせるための油圧シリンダを駆動する油圧発生ユニットとからなり、

該油圧発生ユニットは、前記高周波電圧の印加により生じる高周波電磁誘導を利用して前記一次側伝送部と無接触で前記給電ユニットから電力の供給および情報信号の伝送が行なわれる二次側伝送部と、該二次側伝送部を経由して前記給電ユニットから供給される電力により駆動される油圧ポンプと、該油圧ポンプと前記油圧シリンダとの間に設けられ、前記二次側伝送部を経由して前記給電ユニットから伝送される情報信号により制御されるソレノイドバルブと、該ソレノイドバルブと前記油圧シリンダとの間に設けられたチェックバルブと、前記油圧シリンダとが一つの密閉された構造体の中に設けられていることを特徴とする自在油圧装置。

【請求項2】 前記給電ユニットに、前記一次側伝送部へ高周波電圧を印加する手段を駆動するためのバッテリーを内蔵した請求項1に記載の自在油圧装置。

【請求項3】 高周波電圧が印加される一次側伝送部を有する給電ユニットと、

前記給電ユニットからの電力が供給され、該電力により油圧力を発生させて油圧アクチュエータに所定の作業を行なわせるための油圧シリンダを駆動する油圧発生ユニットとからなり、

該油圧発生ユニットは、前記高周波電圧の印加により生じる高周波電磁誘導を利用して前記一次側伝送部と無接触で前記給電ユニットから電力の供給および情報信号の伝送が行なわれる二次側伝送部と、前記給電ユニットからの電力の供給および情報信号の伝送により制御される油圧回路と、前記油圧シリンダとが一つの密閉された構造体の中に設けられるとともに、

前記給電ユニットおよび前記油圧発生ユニットには、前記一次側伝送部と前記二次側伝送部とが互に対向して配置されるように、前記給電ユニットと前記油圧発生ユニットとを機械的にかつ着脱自在に結合する結合手段が設けられていることを特徴とする自在油圧装置。

【請求項4】 前記油圧発生ユニットは、産業用ロボットのアーム部の先端に、前記結合手段により結合可能となっている請求項3に記載の自在油圧装置。

【請求項5】 高周波電圧が印加される、細長いループ状の一次側巻線が基台上に固定して配置された一次側伝送部を有する給電ユニットと、

前記給電ユニットからの電力が供給され、該電力により油圧力を発生させて油圧アクチュエータに所定の作業を行なわせるための油圧シリンダを駆動する油圧発生ユニットとからなり、

該油圧発生ユニットは、前記高周波電圧の印加により生じる高周波電磁誘導を利用して前記一次側伝送部と無接触で前記給電ユニットから電力の供給および情報信号の伝送が行なわれる二次側伝送部と、前記給電ユニットからの電力の供給および情報信号の伝送により制御される油圧回路と、前記油圧シリンダとが一体となって設けられているとともに、

前記二次側伝送部は、前記一次側巻線を二つの中空部に遊嵌して、前記基台上を前記一次側巻線の長手方向に移動自在に設けられた二次側コアと、前記一次側巻線に対向して前記二次側コアに巻回された二次側巻線とを有することを特徴とする自在油圧装置。

【請求項6】 前記一次側巻線を基台上に複数設けるとともに、前記油圧発生ユニットを前記各一次側巻線毎に設け、

前記一次側巻線へ高周波電圧を印加する手段を、高周波電磁誘導を利用して電力および情報信号を無接触で伝送する、さらにもう1段の一次側伝送部および二次側伝送部を介して設けた請求項5に記載の自在油圧装置。

【請求項7】 前記給電ユニットには、前記一次側伝送部に印加する高周波電圧の周波数を複数種に変換する周波数変換手段が設けられるとともに、

前記油圧発生ユニットには、前記高周波電磁誘導により前記二次側伝送部に生じた高周波電圧の周波数を測定する周波数測定回路と、該周波数測定回路で測定された高周波電圧の周波数に対応して、前記油圧回路の制御を行なうための情報信号を発生させるデコーダとが設けられている請求項1ないし6のいずれか1項に記載の自在油圧装置。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、自在油圧装置に関する。

【0002】

【従来の技術】近年、工作機械を取り扱う職場の多くは、作業環境が厳しいことによる労働者の不足と、多品種少量生産への生産形態という社会背景のもとで、工作機械の段取り工程の自動化は着実に進んできている。自動化治具や産業用ロボットの先端ツールなど大きな力を発生する必要があるアクチュエータの駆動源は未だ油圧が中心である。油圧アクチュエータの駆動は、一般に電動機で油圧ポンプを加圧して行なっているが、そのためには必ず油圧配管や電気配線が必要となる。これは、自動化治具を自律移動させる場合すなわち油圧アクチュエータの駆動手段に対する自律移動を考えた場合や、産業用ロボットの先端ツールの交換対応を考えた場合、油圧配管や電気配線の接続の問題が生じることになるが、最近は自動油圧カップラなどの実用化が進められその解決が図られようとしている。

【0003】

【発明が解決しようとする課題】しかしながら、油圧カップラを用いても依然として油圧アクチュエータと駆動手段との間の油圧配管や電気配線の必要性はあり、油のリークの問題などが完全に解決されているわけではないし、油圧カップラ操作自体も自動化が容易でなく、駆動手段に対する油圧アクチュエータの自律移動や産業用ロボットの先端ツールの交換対応を考えた場合に、信頼性の不安が残る。また、情報信号の伝送を平行して行なわないと、動作させる治具アクチュエータの数が増えるにつれてカップラの数も増え、信頼性低下と装置の大型化につながることになる。そこで本発明は、油圧アクチュエータとその駆動手段との間の油圧配管や電気配線の問題を生じることなく、しかも簡単な構成で油圧アクチュエータの自律移動や交換を行なえる自在油圧装置を提供することを目的とする。

【0004】

【課題を解決するための手段】上記目的を達成するため本発明の自在油圧装置は、高周波電圧が印加される一次側伝送部を有する給電ユニットと、前記給電ユニットからの電力が供給され、該電力により油圧力を発生させて油圧アクチュエータに所定の作業を行なわせるための油圧シリンダを駆動する油圧発生ユニットとからなり、該油圧発生ユニットは、前記高周波電圧の印加により生じる高周波電磁誘導を利用して前記一次側伝送部と無接触で前記給電ユニットから電力の供給および情報信号の伝送が行なわれる二次側伝送部と、該二次側伝送部を経由して前記給電ユニットから供給される電力により駆動される油圧ポンプと、該油圧ポンプと前記油圧シリンダとの間に設けられ、前記二次側伝送部を経由して前記給電ユニットから伝送される情報信号により制御されるソレノイドバルブと、該ソレノイドバルブと前記油圧シリンダとの間に設けられたチェックバルブと、前記油圧シリンダとが一つの密閉された構造体の中に設けられていることを特徴とする。

【0005】この場合、前記給電ユニットに、前記一次側伝送部へ高周波電圧を印加する手段を駆動するためのバッテリーを内蔵したものであってもよい。また、高周波電圧が印加される一次側伝送部を有する給電ユニットと、前記給電ユニットからの電力が供給され、該電力により油圧力を発生させて油圧アクチュエータに所定の作業を行なわせるための油圧シリンダを駆動する油圧発生ユニットとからなり、該油圧発生ユニットは、前記高周波電圧の印加により生じる高周波電磁誘導を利用して前記一次側伝送部と無接触で前記給電ユニットから電力の供給および情報信号の伝送が行なわれる二次側伝送部と、前記給電ユニットからの電力の供給および情報信号の伝送により制御される油圧回路と、前記油圧シリンダとが一つの密閉された構造体の中に設けられるとともに、前記給電ユニットおよび前記油圧発生ユニットには、前記一次側伝送部と前記二次側伝送部とが互いに対向して配

置されるように、前記給電ユニットと前記油圧発生ユニットとを機械的にかつ着脱自在に結合する結合手段が設けられていることを特徴とするものとし、前記油圧発生ユニットは、産業用ロボットのアーム部の先端に、前記結合手段により結合可能となっているものでもよい。

【0006】さらに、高周波電圧が印加される、細長いループ状の一次側巻線が基台上に固定して配置された一次側伝送部を有する給電ユニットと、前記給電ユニットからの電力が供給され、該電力により油圧力を発生させて油圧アクチュエータに所定の作業を行なわせるための油圧シリンダを駆動する油圧発生ユニットとからなり、該油圧発生ユニットは、前記高周波電圧の印加により生じる高周波電磁誘導を利用して前記一次側伝送部と無接触で前記給電ユニットから電力の供給および情報信号の伝送が行なわれる二次側伝送部と、前記給電ユニットからの電力の供給および情報信号の伝送により制御される油圧回路と、前記油圧シリンダとが一体となって設けられているとともに、前記二次側伝送部は、前記一次側巻線を二つの中空部に遊嵌して、前記基台上を前記一次側巻線の長手方向に移動自在に設けられた二次側コアと、前記一次側巻線に対向して前記二次側コアに巻回された二次側巻線とを有するものであってもよく、この場合には、前記一次側巻線を基台上に複数設けるとともに、前記油圧発生ユニットを前記各一次側巻線毎に設け、前記一次側巻線へ高周波電圧を印加する手段を、高周波電磁誘導を利用して電力および情報信号を無接触で伝送する、さらにもう1段の一次側伝送部および二次側伝送部を介して設けたものとしてもよい。

【0007】そして、上記本発明の各自在油圧装置において、前記給電ユニットには、前記一次側伝送部に印加する高周波電圧の周波数を複数種に変換する周波数変換手段が設けられるとともに、前記油圧発生ユニットには、前記高周波電磁誘導により前記二次側伝送部に生じた高周波電圧の周波数を測定する周波数測定回路と、該周波数測定回路で測定された高周波電圧の周波数に対応して、前記油圧回路の制御を行なうための情報信号を発生させるデコーダとが設けられているものでもよい。

【0008】

【作用】上記のとおり構成された請求項1に記載の発明では、給電ユニットから油圧発生ユニットへは、高周波電磁誘導を利用して無接触で電力の供給および情報信号の伝送が行なわれるので、給電ユニットと油圧発生ユニットとの間には油圧配管や電気配線が必要なくなり、油の漏れや電気回路の接続不良がなくなる。また、ソレノイドバルブと油圧シリンダとの間にチェックバルブが設けられているので、給電ユニットから油圧発生ユニットへの電力の供給およびソレノイドバルブの制御信号の入出力は、油圧シリンダの動作の開始時と終了時以外は必要なくなる。よって、それ以外には給電ユニットと油圧発生ユニットとを分離しても、油圧シリンダはその状態

を維持し続け、油圧アクチュエータの機能を維持した状態で油圧発生ユニットを自在に移動できる。

【0009】

【実施例】次に、本発明の実施例について図面を参照して説明する。

（第1実施例）図1は、本発明の自在油圧装置の第1実施例の概略構成図である。図1に示すように、この自在油圧装置は密閉構造の油圧発生ユニット10と、油圧発生ユニット10と分離可能な給電ユニット30とに大別される。まず、油圧発生ユニット10について説明する。油圧発生ユニット10は、油圧ポンプ駆動モータ14からの駆動力により油タンク22内の油を汲み上げて油圧力を発生させ、この油圧力により油圧シリンダ23のロッド23aを図示矢印方向に前進させたり、その逆方向に後退させるものであり、ロッド23aの移動方向を切り換えるためのソレノイドバルブ16を有する。油タンク22は、油温の変化による容積変化と、アクチュエータの移動に伴う容積変化に追従するために、容積変化型のものが用いられている。

【0010】また、ソレノイドバルブ16と油圧シリンダ23のロッド前進側油室とを連通する配管には、チェックバルブ18と、ロッド23aの前進移動が完了したことを検知するための前進用圧力スイッチ19と、油圧回路を密閉構造の中に収めた場合の温度変化による油量の変化を吸収し、油圧発生特性の変化が生じないようにするためのアキュムレータ21とが設けられている。一方、ソレノイドバルブ16と油圧シリンダ23のロッド後退側油室とを連通する配管には、ロッド23aの後退移動が完了したことを検知するための後退用圧力スイッチ20が設けられている。さらに、油圧ポンプ15とソレノイドバルブ16とを連通する配管にはリリーフバルブ17が設けられている。ここで、前進用圧力スイッチ19と、後退用圧力スイッチ20は、それぞれマイクロスイッチ等を用いた近接スイッチで代用することができる。

【0011】二次側電力伝送部11aおよび二次側情報信号伝送部11bは、それぞれ後述する給電ユニット30から高周波電磁誘導により電力および情報信号を授受するためのものであり、コアと、それに巻回された巻線とからなる。二次側情報信号伝送部11bを通じて伝送された情報信号は制御部13のCPUに入力され、この情報信号に基づいて制御部13では、I/Oインターフェースを介してソレノイドバルブ16を制御したり、各圧力スイッチ19、20の確認信号を二次側情報信号伝送部11bを介して給電ユニットにフィードバックする。情報信号伝送の点数が少ないときには、制御部13のCPUによるシリアル通信ではなく、信号点数分の高周波電磁カップリングを備えてCPUを用いない並列通信を行なうことができる。一方、二次側電力伝送部11aを通じて伝送された高周波電圧は、制御部13の電源

回路に供給されるとともに、整流平滑回路12において整流および平滑されて直流電圧に変換された後油圧ポンプ駆動モータ14に供給される。また、整流平滑回路12で生成された直流電圧の一部は、必要に応じて制御部13の電源回路に供給される。

【0012】次に、給電ユニット30について説明する。給電ユニット30は、上位コントローラであるシーケンサ35からの信号が入力される給電側制御部34と、給電側制御部34で生成された情報信号を高周波電磁誘導により二次側情報信号伝送部11bに無接触で伝送するための、二次側情報信号伝送部11bに対向して配置された一次側情報信号伝送部31bと、交流電源36からの交流電圧を整流および平滑して直流電圧に変換する整流平滑回路33と、給電側制御部34および整流平滑回路33からの直流電圧をそれぞれ高周波電圧に変換する二つの高周波インバータ32と、各高周波インバータ32からの高周波電圧を高周波電磁誘導により二次側電力伝送部11aに無接触で供給するための、二次側電力伝送部11aに対向して配置された一次側電力伝送部31aとを有する。一次側電力伝送部31aおよび一次側情報信号伝送部31bについても、二次側電力伝送部11aおよび二次側情報信号伝送部11bと同様に、それぞれコアと、それに巻回された巻線とからなる。

【0013】ここで、給電ユニット30から油圧発生ユニット10への電力供給の原理について説明する。高周波インバータ32で作られた高周波電圧が一次側電力伝送部31aの巻線に加えられると、二次側電力伝送部11aの巻線との巻線比に従って、電磁結合により二次側電力伝送部11aの巻線に高周波電圧を生じさせる。そして、この誘導電圧が整流平滑回路12で整流、平滑化され、油圧ポンプ駆動モータ14に供給される。また、供給側制御部34と制御部13との間での情報信号の伝送も、電力供給と同様の原理で行なわれる。上述した自在油圧装置において油圧シリンダ23のロッド23aを前進させる際には、交流電源36から供給されて給電ユニット30で変換された高周波電圧は、一次側電力伝送部31aから二次側電力伝送部11aに高周波電磁誘導により無接触で供給される。二次側電力伝送部11aに供給された高周波電圧は、整流平滑回路12で直流電圧に変換されて油圧ポンプ駆動モータ14を駆動させる。油圧ポンプ駆動モータ14の駆動により、油タンク22に蓄えられた油が油圧ポンプ15で汲み上げられ、油圧が発生する。油圧を発生させた後に、ソレノイドバルブ16のロッド前進側バルブをオンするための信号が、給電側制御部34から制御部13へ、一次側情報信号伝送部31bと二次側情報信号伝送部11bとの間の高周波電磁誘導により無接触で伝送される。これにより、油圧シリンダ23のロッド前進側油室に加圧油が供給され、ロッド23aが前進する。ロッド23aの前進端までの移動完了は前進用圧力スイッチ19の信号を確認するこ

とによって行なわれるが、この信号は二次側情報信号伝送部11bと一次側情報信号伝送部31bとの間の高周波電磁誘導により無接触で給電側制御部34にフィードバックされる。

【0014】ロッド23aの前進端までの移動完了の確認後に、ソレノイドバルブ16をオフするための信号を、給電側制御部34から制御部13へ、一次側情報信号伝送部31bと二次側情報信号伝送部11bとの間の高周波電磁誘導により伝送すると、ソレノイドバルブ16がオフされるが、このとき、チェックバルブ18の働きにより油圧シリンダ23内の油圧は保持される。従って、油圧発生ユニット10と給電ユニット30とを分離しても、油圧発生ユニット10はサポートやジャッキなどの強度メンバ、あるいはチャックやバイス、クランプ装置として機能し続けることができるため、油圧配管も電気配線もない自律した治具が形成される。このような構成によって、加工物や被支持物と一体となって移動することもできる、自在で有効な支持物が構成される。

【0015】一方、治具としての機能を解除する場合、すなわち油圧シリンダ23のロッド23aを後退させる場合には、再度、油圧ポンプ駆動モータ14を駆動させた後、ソレノイドバルブ16のロッド後退側バルブをオンし、油圧シリンダ23のロッド23aを後退させる。ロッド23aの後退完了の確認は後退用圧力スイッチ20からの信号を二次側情報信号伝送部11bから一次側情報信号伝送部31bを経た情報信号の伝送によって行なわれる。この信号が給電側制御部34に送られた時点でソレノイドバルブ16をオフし、その後、油圧ポンプ駆動モータ14を停止させる。そして、油圧発生ユニット10と給電ユニット30とを分離し、機能解除動作が完了する。以上の動作において、油圧ポンプ駆動モータ14の駆動と停止、およびソレノイドバルブ16のオンとオフの制御は、いずれも給電側制御部34からの信号による、一次側電力伝送部31aから二次側電力伝送部11aへの高周波電圧の供給、および一次側情報信号伝送部31bから二次側情報信号伝送部11bへの情報信号の伝送を経て行なわれる。

【0016】図1に示したものでは、ソレノイドバルブ16によって、油圧シリンダ23のロッド23aの前進および後退を制御していたが、ソレノイドバルブ16に代えて、図2に示すようにシングルソレノイドバルブ16'を設け、ソレノイド操作をばねの反力による単動操作とすることで、制御を簡略することができる。また、アキュムレータ21（図1参照）をも省略できる。なお、給電ユニット30および油圧発生ユニット10のその他の構成は図1に示したものと同様であるので、その説明は省略する。本実施例では、油圧ポンプ駆動モータ14の回転制御やソレノイドバルブ16（またはシングルソレノイドバルブ16'）の制御のために、油圧発生ユニット10と給電ユニット30との間の情

報信号の伝送を、電力の供給と同様に高周波電磁誘導により行なっているが、装置構成の単純簡素化のためには、供給電力上に情報信号を重畳する方法が有効である。

【0017】以下に、図3を参照して供給電力上に情報信号を重畳する方法について説明する。図3は、図1に示した自在油圧装置において供給電力上に情報信号を重畳する場合の要部ブロック図であり、油圧回路については省略している。図3において、給電ユニット60は、シーケンス指令スイッチパネル65と、シーケンス指令スイッチパネル65からの指令に基づいて所定の周波数の高周波電圧を発生する高周波インバータ62と、一次側伝送部61とを有する。一方、油圧発生ユニット40は、二次側伝送部41と、二次側伝送部41に生じた高周波電圧を整流、平滑化し直流電圧に変換する整流平滑回路42と、整流平滑回路42から得た信号用電源で駆動する周波数測定回路54と、デコーダ55とを有する。上記構成に基づき、供給電力上への情報信号の重畳は、電力伝送周波数を伝送特性が変化しない範囲で変化させることで容易に行なうことができる。すなわち、シーケンス指令スイッチパネル65により n ($n=0, \pm 1, \pm 2, \dots, \pm k$) の値を指定し、この n の値に基づき、高周波インバータ62では周波数が $f_0 + n \Delta f$ （ただし、 f_0 = インバータ中心周波数、 Δf は十分に f_0 よりも小さい、とする）なるパルス波形が作られる。例えば、本実施例ではシーケンス指令は3ビット（8通り）程度で十分であるので、整流平滑回路42での直流電圧変換後の供給電力が変化しない範囲で高周波励磁周波数を8通りに変化させる。そして、周波数測定回路54によって、分圧後の高周波励磁電圧の周波数を測定し、周波数に対応する指令シーケンス信号をデコーダ55で発生させることによって情報信号を供給電力上に重畳して伝送することができる。

【0018】一方、電力供給が間違いなくなされていることや、油圧ポンプ駆動モータ14により正常に油圧が発生し、油圧シリンダ23が所定の動作を行なっているかなどのシーケンスフィードバック確認は、電力供給と同様の原理により、しかも別の無接触伝送ユニットにより行なうこともできるが、人の目視確認で十分な場合には外部から見えるLEDなどの表示で十分である。本実施例では、図1に示したようにソレノイドバルブ16と油圧シリンダ23との間にチェックバルブ18を設けたものの例を示したが、特に、油圧シリンダ23をグリッパなど、機能解除動作時に油圧力を保持する必要のない用途に用いる場合においては、チェックバルブ18のような圧力保持機能は不要である。

（第2実施例）図4は、本発明の自在油圧装置の第2実施例の概略構成図である。本実施例の自在油圧装置は、ロボット先端のATC（自動工具交換）対応工具やAH C（自動ヘッド交換）に適用することを考えた例であ

り、油圧発生ユニット110が、二次側電力伝送部111と、整流平滑回路112と、油圧ポンプ駆動モータ114と、油圧ポンプ115と、ロッド123aを後退させる向き（図示右向き）に付勢するばね123bを内蔵した油圧シリンダ123と、油圧シリンダ123と油圧ポンプ115との間に設けられたリリーフバルブ116と、油量調整のためのリザーバタンク117とを有する。このため、油は油圧ポンプ115と油圧シリンダ123との間で循環して使われ、油タンクを使わない構造となっている。さらに、第1実施例で述べたようなクランプ治具やグリップ用のものとは異なり、圧着や切断など、油圧シリンダ123が移動している間のみ油圧が発生していればよく、油圧シリンダ123が定位置において力を保持する必要のないものに用いる構造となっている。

【0019】また、油圧発生ユニット110と給電ユニット130とは、互いにプルスタッド方式のチャックで着脱自在に結合される構造となっており、二次側電力伝送部111にはスタッド部124が一体的に設けられる一方、給電ユニット130の一次側電力伝送部131にはスタッド部124が着脱自在に嵌合されるソケット部135が一体的に設けられている。そして、スタッド部124がソケット部135に嵌合することにより、二次側電力伝送部111が一次側電力伝送部131の内周面に空隙を介して互に対向配置される構成となっている。この自在油圧装置の動作開始時には、油圧シリンダ123のロッド123aはばね123bの力によって後退端（図示右端）に位置しているが、スタッド部124とソケット部135との嵌合が確認された時点で、給電ユニット130で生じた高周波電圧が、一次側電力伝送部131と二次側電力伝送部111との間で生じる高周波電磁誘導により油圧発生ユニット110に供給される。油圧発生ユニット110に供給された高周波電圧は整流平滑回路112で直流電圧に変換された後、油圧ポンプ駆動モータ114を駆動させる。これにより、油圧ポンプ115内の油が圧縮されて油圧シリンダ123内に送り込まれる。油圧シリンダ123内に油が充填されると、ロッド123aはばね123bの力に抗して図示矢印方向に前進し始め、前進端まで移動する。このロッド123aの前進移動を利用して加工物の圧縮や切断などの作業を行なう。

【0020】また、本実施例では油圧の保持機能を有していないので、油圧シリンダ123が圧力を持続して発生させるためにはリリーフバルブ116の開放後も油圧ポンプ駆動モータ114を駆動し続ける必要があるが、油圧ポンプ駆動モータ114が過負荷状態に達するおそれがある場合は、給電ユニット130側において電流の大きさと通電時間とを監視することによってその状態を検出し、一次側電力伝送部131への電圧供給を停止する。油圧ポンプ駆動モータ114の駆動を停止すれば、

油圧ポンプ115内部の隙間を通して油圧シリンダ123内の油圧が開放されるので油圧アクチュエータの発生力はゼロに落ちる。

（第3実施例）図5は、本発明の自在油圧装置の第3実施例の概略斜視図である。本実施例では、給電ユニット230は、高周波インバータ232と、高周波インバータ232に接続され、細長いループ状に巻回された一次側巻線231とを有する。一方、油圧発生ユニット210は、一次側巻線231を遊嵌する2つの中空部が形成され、かつテーブル（不図示）上に一次側巻線231の長手方向に直線移動可能に設けられた二次側コア211aと、二次側コア211aの2つの中空空間にまたがって巻回され、一次側巻線231と対向する二次側巻線211bとを有し、これら二次側コア211aと二次側巻線211bとによって、二次側伝送部が構成されている。また、油圧発生ユニット210の内部には、図1または図2に示した油圧回路および油圧回路からの油圧力で動作する油圧シリンダ（不図示）を有し、このシリンダのロッド223aの前進および後退移動により駆動されるクランプ225が搭載されている。そして、油圧発生ユニット210の油圧回路の制御は、図3に示した回路によって、給電ユニット230から供給される電力上に油圧回路を制御するための情報信号を重畳して行なわれる構成となっている。

【0021】これにより、油圧発生ユニット210の移動可能な範囲内であれば任意の位置において給電ユニット230からの電力および情報信号を無接触で油圧発生ユニット210に伝送することができ、加工物の大きさや形状に応じて加工物のクランプ位置を変えられる自在治具を構成することができる。また、油圧発生ユニット210をテーブル上に固定するために、油圧発生ユニット210で発生した油圧を使ってくさびを打ち込むことによる固定アクチュエータ（ロック227）を必要に応じて設けてもよい。さらに、油圧発生ユニット210に、ロッド223aの動作に連動して開閉動作を行なうグリップ226を搭載すれば、加工物を把持しながら搬送する装置を構成することができる。また、図6に示すように、パレット240上に、3つの一次側巻線231を電氣的に並列に接続して放射状に配置するとともに、各一次側巻線231に沿って移動可能に、クランプ225とロック227とが搭載された3つの油圧発生ユニット210を設ける。そして、各一次側巻線231への高周波電圧の印加を、図3に示したものと同様の給電ユニット60により、さらにもう1段の一次側伝送部61と二次側伝送部241とを介して無接触で行なう。これにより、パレット240に加工物245を固定した状態でパレット240を移動させることができ、FMS対応のフレキシブルな治具パレットを構成することができる。

【0022】ここで、図5および図6に示した油圧発生ユニット210の移動機構について図7を参照して説明

する。図7は、図5および図6に示した油圧発生ユニットの移動機構の概略斜視図である。図7において、サーボモータ250にはカップリング251およびサポート軸受252を順次介してボールねじ253が連結されている。一方、油圧発生ユニット210は、ボールねじナット256が固定された移動クランプ台255に搭載されており、ボールねじナット256にボールねじ253が螺合している。これにより、サーボモータ250を駆動してボールねじ253を回転させることで、油圧発生ユニット210が図示矢印方向に往復移動可能な構成となっている。また、図5および図6には示していないが、油圧発生ユニット210にはワーク基準面215を有し、このワーク基準面215上に加工物（不図示）を載置する。

【0023】なお、図5および図6では、油圧発生ユニット210の固定をロック227により行なうものとしたが、図7では、位置決め後の固定ボルトの代用としてTナット方式クランプを用いた場合の例を示す。以下に、これについて説明する。移動クランプ台255には、油圧発生ユニット210で発生した油圧の一部を駆動源とするTナットクランプシリンダ257が設けられている。Tナットクランプシリンダ257にはTナット方式クランプ片258が連結されている。Tナット方式クランプ片258は、パレット240（図6参照）に、油圧発生ユニット210の移動方向に沿って形成された溝（不図示）に摺動自在に嵌合するものである。サーボモータ250で油圧発生ユニット210の位置決めを精密に行なった後に、油圧発生ユニット210で発生する油圧の一部を使ってTナットクランプシリンダ257を駆動することで、Tナット方式クランプ片258がパレット240の溝に押し付けられて油圧発生ユニット210が固定される。このように、Tナット方式クランプを用いることで、油圧発生ユニット210をより確実に固定することができる。

【0024】図7において、油圧発生ユニット210への給電方法は示していないが、図5および図6に示したように直動式の無接触給電を移動ストローク内で連続的に行なったり、あるいは定位置における無接触給電によってもよい。信号の伝送に関しても同様である。さらに、油圧発生ユニット210を回転テーブル（不図示）上に搭載し、回転型の給電装置と組み合わせて駆動することで、外部の油圧発生設備および従来から回転体への油圧供給に用いられてきた回転カップラを用いずに、回転テーブル上の油圧アクチュエータを制御することも可能である。

（第4実施例）図8は、本発明の自在油圧装置の第4実施例の概略斜視図であり、ロボット先端ATC対応のグリッパに適用した例である。図8において、油圧発生ユニット310は、図4に示したものと同様の油圧回路が構成されているとともに、内蔵された油圧シリンダ（不

図示）に連動して加工物360を把持するグリッパ320を有する。一方、給電ユニットも図4に示したものと同様な構成を有し、その一次側伝送部331はロボットアーム340の先端に設けられている。

【0025】また、油圧発生ユニット310とロボットアーム340とは、互いにブルスタッド方式のチャックで着脱自在に結合される構造となっており、二次側伝送部311にはスタッド部324が一体的に設けられる一方、ロボットアーム340の一次側伝送部331にはスタッド部324が着脱自在に嵌合されるソケット部335が一体的に設けられている。そして、スタッド部324がソケット部335に嵌合することにより、二次側伝送部311が一次側伝送部331の内周面に空隙を介して互いに対向配置される構成となっている。以上説明したように構成することにより、グリッパ320とロボットアーム340との間の油圧配管や電気配線の必要がなくなるため、自在な交換に対応できるツール（グリッパ）を構成することができる。

【0026】（第5実施例）図9は、本発明の自在油圧装置の第5実施例の給電ユニットの概略構成図である。この給電ユニット430は、シーケンス指令スイッチ435からの指令で所定の周波数の高周波を発振する高周波発振回路436と、高周波インバータ432と、高周波磁性材料製の一次側コア431aおよび一次側巻線431bからなる一次側伝送部431とを有する。しかも、高周波発振回路436および高周波インバータ432に電力を供給するためのバッテリー437も内蔵されており、持ち運び自由となっている。これにより、図10に示すような油圧発生ユニット410を用い、油圧発生ユニット410によって基台450の所定の位置に加工物460、460'を保持させることができる。保持の際には、給電ユニット430の一次側伝送部431と油圧発生ユニット410の二次側伝送部411を対向させて、油圧配管や電気配線を行わずに油圧発生ユニット410に電力の供給および情報信号の伝送を行ない、油圧シリンダアクチュエータ420を動作させることを行なう。なお、油圧発生ユニット410は図3に示したような周波数測定回路およびデコードを有し、情報信号は供給電力上に重畳して行なわれる。また、給電ユニット430は持ち運び自由なので、油圧発生ユニット410の位置や向きに関わらず、油圧発生ユニット410へ電力の供給や情報信号の伝送を行なうことができる。従って、工作機械加工の段取り工程、あるいは車両や船舶をはじめとする重量物の組立や、建設現場において、油圧配管も電気配線もない状況のもとで大トルクを発生させ、短時間に強度メンバを作り上げる必要がある場合には、非常に有効である。

【0027】

【発明の効果】本発明は以上説明したとおり構成されているので、以下に記載する効果を奏する。請求項1に記

載の発明では、給電ユニットから油圧発生ユニットへは、高周波電磁誘導を利用して無接触で電力の供給および情報信号の伝送が行なわれるので、給電ユニットと油圧発生ユニットとの間には油圧配管や電気回路をなくすることができる。また、ソレノイドバルブと油圧シリンダとの間にはチェックバルブが設けられているので、油圧シリンダの動作開始時と終了時以外には給電ユニットと油圧発生ユニットとを分離しても、油圧シリンダはその状態を維持することができ、さらに、油圧発生回路には二次側伝送部、油圧回路、および油圧シリンダが一つの構造体の中に設けられているので、給電ユニットと油圧発生ユニットとを分離しても外部には油圧配管や電気配線がない状態となる。その結果、油圧シリンダにより油圧アクチュエータの機能を維持した状態で、油圧発生ユニットを自在に移動させることができる。

【0028】請求項2に記載の発明では、給電ユニットに、一次側伝送部へ高周波電圧を印加する手段を駆動するためのバッテリーを内蔵することで、給電ユニットをポータブルなものとすることができ、重量物組立や建設の現場において、油圧配管や電気配線も状況のもとで重量物を支持する必要がある場合にも使用することができる。請求項3および4に記載の発明では、結合手段により給電ユニットと油圧発生ユニットとを着脱自在に結合することで、特に油圧発生ユニットを産業用ロボットの先端ツールとして使用した場合、先端ツール交換時の油圧配管や電気配線の問題がなくなり、自在な交換に対応できる。請求項5および6に記載の発明では、給電ユニットの一次側伝送部の巻線を細長いループ状とし、この巻線の長手方向に沿って油圧発生ユニットを移動可能に設けることで、加工物の大きさや形状に応じて油圧アクチュエータの作用点の位置を自由に変えられる自在治具を構成することができる。

【0029】請求項7に記載の発明では、給電ユニットに周波数変換手段を設けるとともに、ゆあつ発生ユニットに周波数測定回路とデコーダとを設けることにより、油圧発生ユニットの油圧回路を制御する情報信号を、一次側伝送部から二次側伝送部への電力の供給に重畳して伝送することができるので、装置構成を簡略化することができる。

【図面の簡単な説明】

【図1】本発明の自在油圧装置の第1実施例の概略構成図である。

【図2】図1に示した自在油圧装置を簡略した一例を示す概略構成図である。

【図3】図1に示した自在油圧装置において伝送電力上に情報信号を重畳する場合の要部ブロック図である。

【図4】本発明の自在油圧装置の第2実施例の概略構成図である。

【図5】本発明の自在油圧装置の第3実施例の概略斜視図である。

【図6】図5に示した自在油圧装置の応用例の概略平面図である。

【図7】図5および図6に示した油圧発生ユニットの移動機構の概略斜視図である。

【図8】本発明の自在油圧装置の第4実施例の概略斜視図である。

【図9】本発明の自在油圧装置の第5実施例の給電ユニットの概略構成図である。

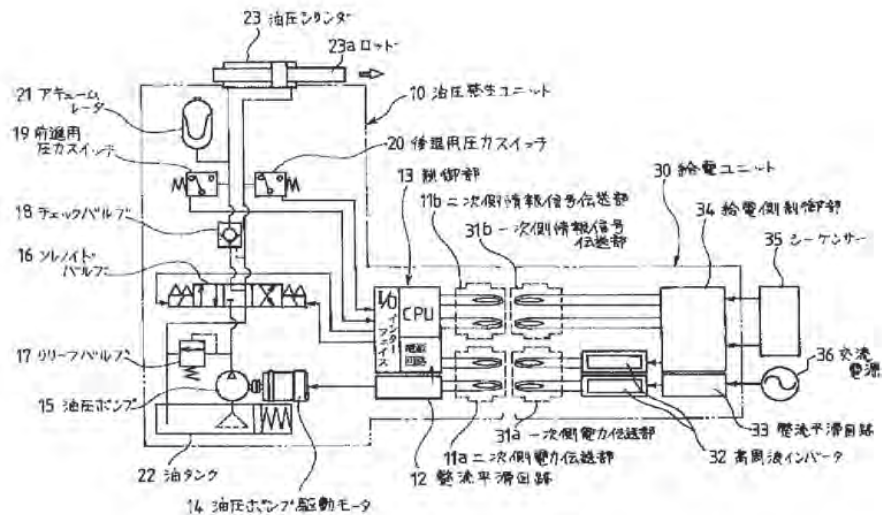
【図10】図8に示した給電ユニットの使用状態の一例を示す図である。

【符号の説明】

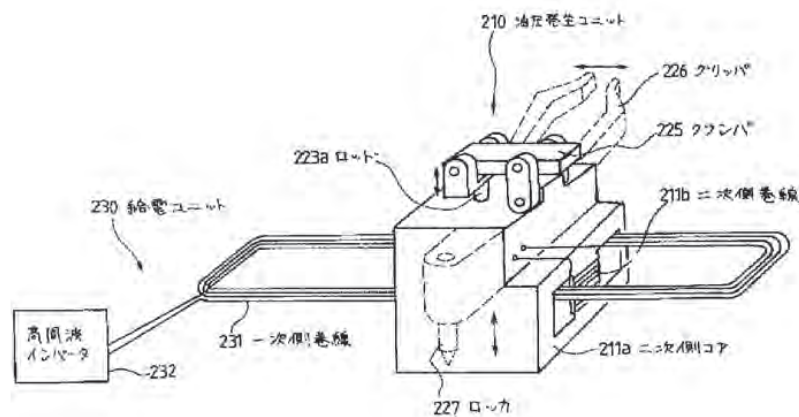
10、40、110、210、310、410 油圧発生ユニット
 11a、111 二次側電力伝送部
 11b 二次側情報信号伝送部
 12、33、42、112 整流平滑回路
 13 制御部
 14、114 油圧ポンプ駆動モータ
 15、115 油圧ポンプ
 16 ソレノイドバルブ
 16' シングルソレノイドバルブ
 17、116 リリーフバルブ
 18 チェックバルブ
 19 前進用圧力スイッチ
 20 後退用圧力スイッチ
 21 アキュムレータ
 22 油タンク
 23、123 油圧シリンダ
 23a、123a、223a ロッド
 30、60、130、230、430 給電ユニット
 31a、131 一次側電力伝送部
 31b 一次側情報信号伝送部
 32、62、232、432 高周波インバータ
 34 給電側制御部
 35 シーケンサ
 36 交流電源
 41、241、311、411 二次側伝送部
 54 周波数測定回路
 55 デコーダ
 61、331、431 一次側伝送部
 65 シーケンス指令スイッチパネル
 117 リザーバタンク
 123b ばね
 124、324 スタッド部
 135、335 ソケット部
 211a 二次側コア
 211b 二次側巻線
 215 ワーク基準面
 225 クランパ
 226、320 グリップ

- | | | | |
|------------------|----------|------|---------------|
| 227 | ロック | 257 | Tナットクランプシリンダ |
| 231、431b | 一次側巻線 | 258 | Tナット方式クランプ片 |
| 240 | パレット | 340 | ロボットアーム |
| 245、360、460、460' | 加工物 | 420 | 油圧シリンダアクチュエータ |
| 250 | サーボモータ | 435 | シーケンス指令スイッチ |
| 251 | カップリング | 436 | 高周波発振回路 |
| 252 | サポート軸受 | 437 | バッテリー |
| 253 | ボールねじ | 431a | 一次側コア |
| 255 | 移動クランプ台 | 450 | 基台 |
| 256 | ボールねじナット | | |

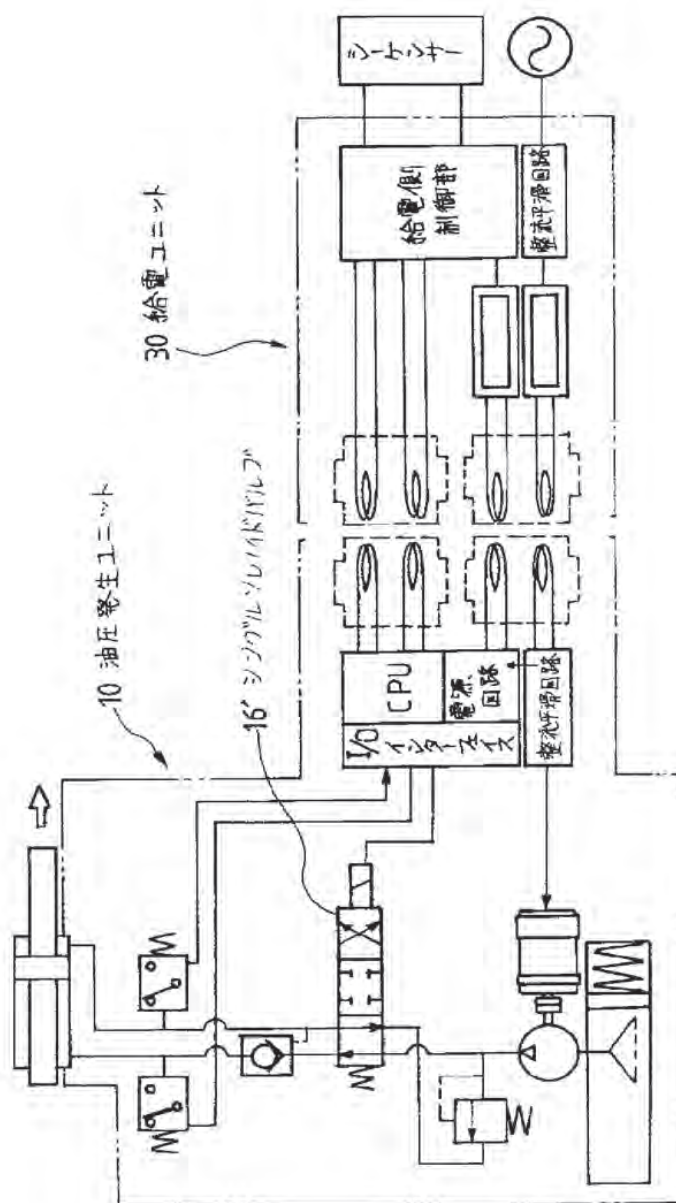
【図1】



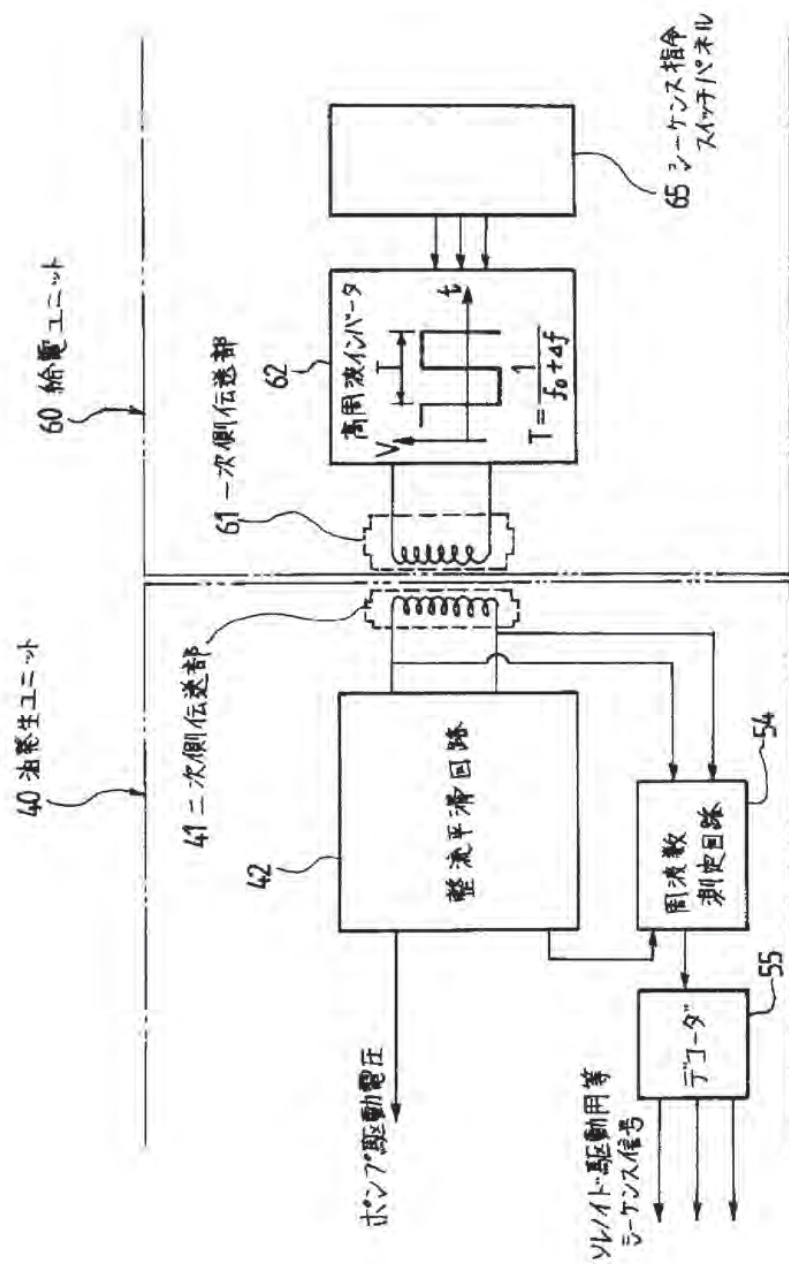
【図5】



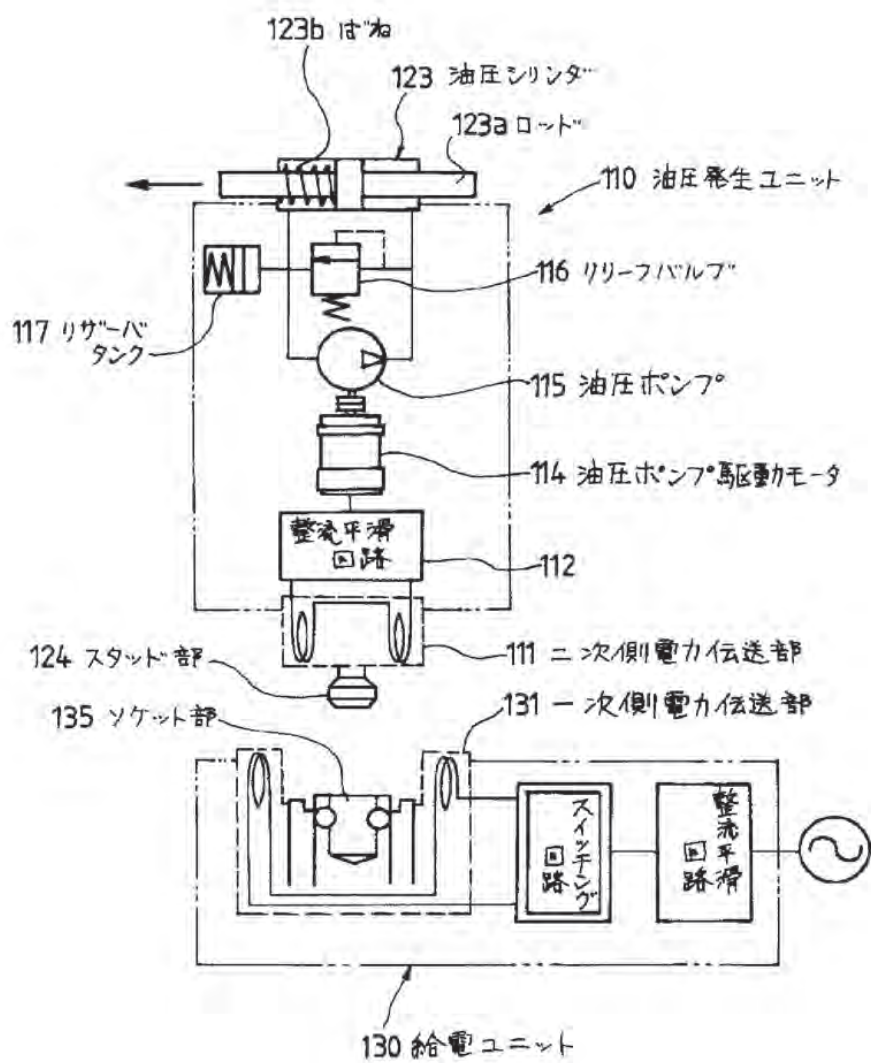
【図2】



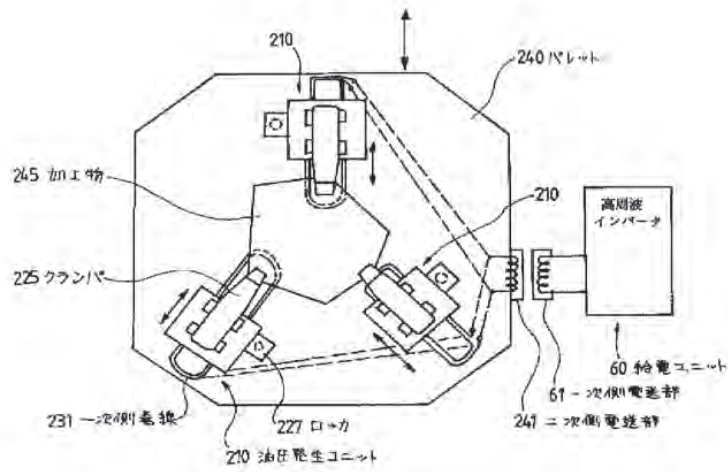
【図3】



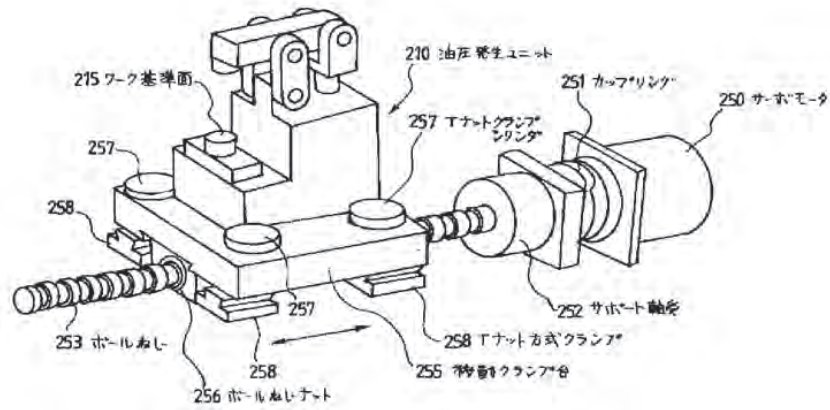
【図4】



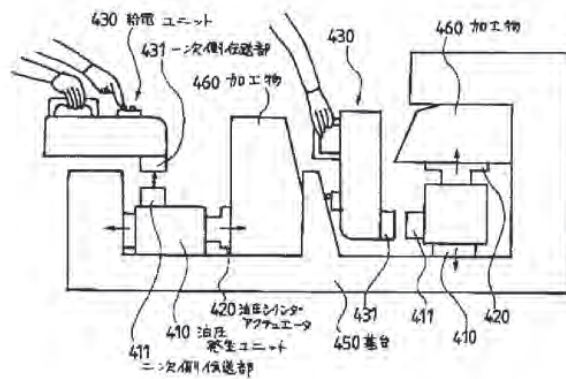
【図6】



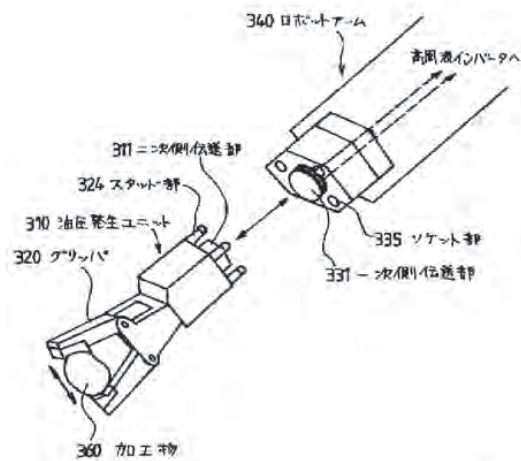
【図7】



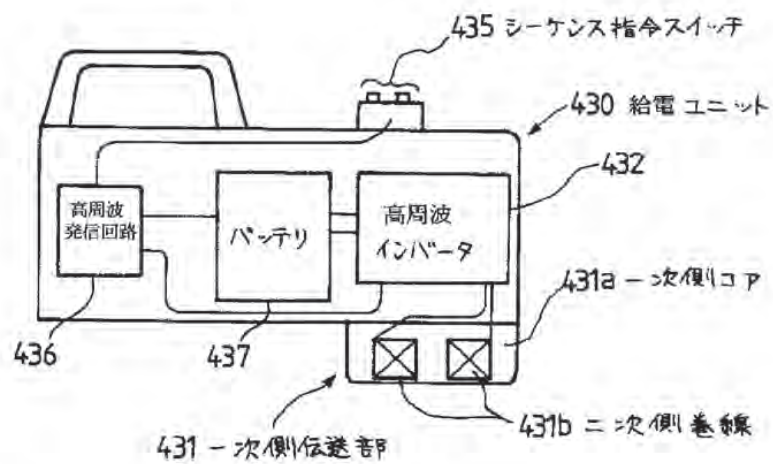
【図10】



【図 8】



【図 9】



フロントページの続き

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**POWER TRANSMISSION SYSTEM, POWER TRANSMISSION METHOD AND
ELECTRIC STIMULATION DEVICE PROVIDED WITH THE POWER TRANSMISSION
SYSTEM**

Inventor(s): ISHIKAWA SEIICHI ±

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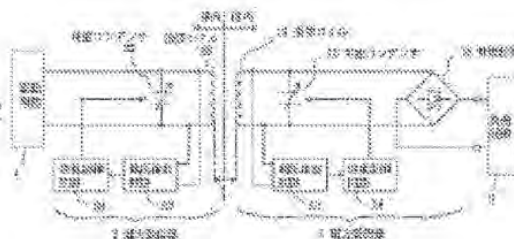
Classification: - **international:** A61N1/378; H02J17/00; (IPC1-7): A61N1/378
- **European:**

Application number: JP19970359519 19971226

Priority number (s): JP19970359519 19971226

Abstract of JP11188113 (A)

PROBLEM TO BE SOLVED: To stably transmit power without destroying the resonance state of a coil even when the distance of transmission and reception coils fluctuates. **SOLUTION:** This system is provided with a transmission coil 21 and a reception coil 11 oppositely arranged holding skin between them, a variable capacitor 22 for constituting a resonance circuit by being connected to the transmission coil 21, a variable capacitor 12 for constituting the resonance circuit by being connected to the reception coil 11, voltage detection circuits 23 and 13 for respectively detecting voltage levels in the transmission coil 21 and the reception coil 11, a capacity control circuit 24 for inputting the voltage level detected in the voltage detection circuit 23 and varying the capacity of the variable capacitor 22 so that the detected voltage level takes a highest value at all times and a capacity control circuit 14 for inputting the voltage level detected in



<http://worldwide.espacenet.com/publicationDetails/biblio?DB=EPODOC&II=0&ND=3&ad...> 6/5/2012

the voltage detection circuit 13 and varying the capacity of the variable capacitor 12 so that the detected voltage level takes the highest value at all times.

Last updated: 14.03.2012 Worldwide Database: 57,38'32p.

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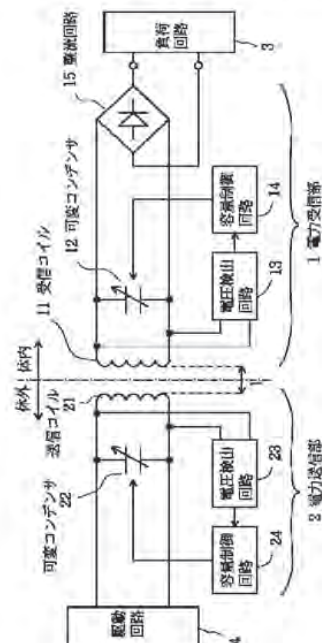
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(54)【発明の名称】 電力伝送システムおよび電力伝送方法ならびにその電力伝送システムを備えた電気刺激装置

(57)【要約】

【課題】送受コイルの距離が変動しても、コイルの共振状態がくずれることがなく、安定した電力伝送を行うことができるようにする。

【解決手段】皮膚を挟んで対向配置された送信コイル21、受信コイル11と、送信コイル21と接続されて共振回路を構成する可変コンデンサ22と、受信コイル11と接続されて共振回路を構成する可変コンデンサ12と、送信コイル21、受信コイル11における電圧レベルをそれぞれ検出する電圧検出回路23、13と、電圧検出回路23にて検出された電圧レベルを入力とし、該検出電圧レベルが常に最高値をとるように可変コンデンサ22の容量を可変する容量制御回路24と、電圧検出回路13にて検出された電圧レベルを入力とし、該検出電圧レベルが常に最高値をとるように可変コンデンサ12の容量を可変する容量制御回路14とを有する。



【特許請求の範囲】

【請求項1】 対向配置された1対の電力供給コイルを備え、一方を送信コイル、他方を受信コイルとして電力が誘導的に伝送される電力伝送システムにおいて、前記送信コイルと接続されて共振回路を構成する第1の可変コンデンサと、前記受信コイルと接続されて共振回路を構成する第2の可変コンデンサと、前記送信コイルにおける電圧レベルを検出する第1の電圧検出手段と、前記受信コイルにおける電圧レベルを検出する第2の電圧検出手段と、前記第1の電圧検出手段にて検出された電圧レベルを入力とし、該検出電圧レベルが常に最高値をとるように前記第1の可変コンデンサの容量を可変する第1の容量制御手段と、前記第2の電圧検出手段にて検出された電圧レベルを入力とし、該検出電圧レベルが常に最高値をとるように前記第2の可変コンデンサの容量を可変する第2の容量制御手段と、を有することを特徴とする電力伝送システム。

【請求項2】 請求項1に記載の電力伝送システムにおいて、前記第1の容量制御手段が、電力搬送波の周波数で前記送信コイルおよび第1の可変コンデンサからなる共振回路が共振するように制御し、前記第2の容量制御手段が、電力搬送波の周波数で前記受信コイルおよび第2の可変コンデンサからなる共振回路が共振するように制御することを特徴とする電力伝送システム。

【請求項3】 対向配置された1対の電力供給コイルを備え、一方を送信コイル、他方を受信コイルとして電力が誘導的に伝送される電力伝送システムにおいて、前記送信コイルと接続されて共振回路を構成する第1の可変コンデンサと、前記受信コイルと接続されて共振回路を構成する第2の可変コンデンサと、前記受信コイルにおける電圧レベルを検出する電圧検出手段と、前記電圧検出手段にて検出された電圧レベルを入力とし、該検出電圧レベルが常に最高値をとるように前記第1および第2の可変コンデンサの容量をそれぞれ可変する容量制御手段と、を有することを特徴とする電力伝送システム。

【請求項4】 請求項3に記載の電力伝送システムにおいて、前記電力供給コイル対とは異なる、対向配置された送信コイルおよび受信コイルと、前記送信コイルと接続されて第1の共振回路を構成する第1のコンデンサと、

前記受信コイルと接続されて第2の共振回路を構成する第2のコンデンサと、前記容量制御手段から出力される制御信号を入力とし、該入力信号を前記第1の共振回路へ供給する信号送信手段と、前記第2の共振回路を介して受信される前記制御信号を入力とし、該入力制御信号を前記第1の可変コンデンサへ出力する信号受信手段と、をさらに有することを特徴とする電力伝送システム。

【請求項5】 請求項1乃至請求項4のいずれかに記載の電力伝送システムを備える電気刺激装置であって、前記受信コイルとともに体内に埋め込まれ、該受信コイルを介して電力供給を受けて生体の麻痺した部分を電気的に刺激する刺激手段と、前記送信コイルに接続され、体外から前記刺激手段に電力を供給して刺激動作を制御する制御手段と、を有することを特徴とする電気刺激装置。

【請求項6】 対向配置された1対の電力供給コイル間で、一方を送信コイル、他方を受信コイルとして電力を誘導的に伝送する電力伝送方法において、前記送信コイルおよび受信コイルにおける電圧レベルをそれぞれ検出し、それぞれの検出電圧レベルが常に最高値をとるように前記送信コイルおよび受信コイルの共振状態を制御することを特徴とする電力伝送方法。

【請求項7】 対向配置された1対の電力供給コイル間で、一方を送信コイル、他方を受信コイルとして電力を誘導的に伝送する電力伝送方法において、前記受信コイルにおける電圧レベルを検出し、該検出電圧レベルが常に最高値をとるように前記送信コイルおよび受信コイルの共振状態を制御することを特徴とする電力伝送方法。

【請求項8】 請求項6または請求項7に記載の電力伝送方法において、電力搬送波の周波数で前記送信コイルおよび受信コイルが共振するように制御することを特徴とする電力伝送方法。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、対向配置された1対の電力供給コイルを用いて、両コイル間で電気エネルギーを伝送する電力伝送システムおよび電力伝送方法に関する。より具体的には、種々の生体機能の外的制御を行う装置、例えば脳卒中や脊髄損傷等、中枢性神経障害で麻痺した生体の機能を電氣的刺激で治療、再建する電気刺激装置などに適用される電力伝送システムおよび電力伝送方法に関する。ここでいう電力伝送とは、電力の伝送だけでなく制御信号などの伝送をも含む。

【0002】

【従来の技術】麻痺した身体の機能を電氣的刺激で治療、再建する電気刺激装置は、基本的には、体内に埋め

込まれて生体の麻痺した部分を電氣的に刺激する刺激装置と、体外に配置され、体内に埋め込まれた刺激装置に電力や信号を送って駆動する装置本体とから構成される。このような電気刺激装置において、装置本体側から体内に埋め込まれた刺激装置に電力や信号を送る電力伝送システムとしては、皮膚を挟んで対向配置された電力供給コイル対（例えば、空芯コイルや磁芯コイルなどにより構成される）を用い、体外の電力供給コイルから体内の電力供給コイルへ電力や信号を送送することにより、体内に埋め込まれた刺激装置に電力や信号を送送するようにしたものが知られている。その一例として、例えば特開平5-317434号公報には、非接触型電力供給コイルを備えたものが開示されている。

【0003】上記公報に開示されたシステムは、電気刺激装置とともに体内に完全に埋め込まれる第1の電力供給コイルと、その第1の電力供給コイルと皮膚を介して平行に対向配置される第2の電力供給コイルとを備えており、体外に置かれた第2の電力供給コイルに高周波電力を供給することにより、その供給された高周波電力が体内の第1の電力供給コイルへ誘導的に伝送され、第1の電力供給コイルで所望の周波数に変換されるようになっている。

【0004】この他、特開平4-285436号公報には、外部の送出コイルから、植え込まれた容量性要素に接続されているターゲットコイルへ電力を誘導的に伝送するシステムで、両コイル間の共振結合を維持できるようにしたものが開示されている。

【0005】

【発明が解決しようとする課題】上述したような、対向配置された1対の電力供給コイル間で電力伝送が行われる電力伝送システムにおいては、両コイルを共振状態として電力伝送が誘導的に行われる。しかしながら、このような従来のシステムでは、送受側のコイルの共振パラメータは固定で一定とされるため、例えば両コイル間の距離が変わったり、あるいはコイルが横ずれしたりすると、両コイルの相互インダクタンスが変化してしまい、コイルの共振状態がくずれてしまう。この結果、受信側コイルにおける受信電圧が低くなり、受信コイルに接続された刺激装置などの負荷回路が動作しなくなるという問題が生じる。

【0006】本発明の目的は、送受コイルの距離が変動しても、コイルの共振状態がくずれることがなく、安定した電力伝送を行うことができる電力伝送システムおよび電力伝送方法を提供することにある。さらには、その電力伝送システムを備えた電気刺激装置を提供することにある。

【0007】

【課題を解決するための手段】上記目的を達成するため、本発明の第1の電力伝送システムは、対向配置された1対の電力供給コイルを備え、一方を送信コイル、他

方を受信コイルとして電力が誘導的に伝送される電力伝送システムにおいて、前記送信コイルと接続されて共振回路を構成する第1の可変コンデンサと、前記受信コイルと接続されて共振回路を構成する第2の可変コンデンサと、前記送信コイルにおける電圧レベルを検出する第1の電圧検出手段と、前記受信コイルにおける電圧レベルを検出する第2の電圧検出手段と、前記第1の電圧検出手段にて検出された電圧レベルを入力とし、該検出電圧レベルが常に最高値をとるように前記第1の可変コンデンサの容量を可変する第1の容量制御手段と、前記第2の電圧検出手段にて検出された電圧レベルを入力とし、該検出電圧レベルが常に最高値をとるように前記第2の可変コンデンサの容量を可変する第2の容量制御手段と、を有することを特徴とする。

【0008】本発明の第2の電力伝送システムは、対向配置された1対の電力供給コイルを備え、一方を送信コイル、他方を受信コイルとして電力が誘導的に伝送される電力伝送システムにおいて、前記送信コイルと接続されて共振回路を構成する第1の可変コンデンサと、前記受信コイルと接続されて共振回路を構成する第2の可変コンデンサと、前記受信コイルにおける電圧レベルを検出する電圧検出手段と、前記電圧検出手段にて検出された電圧レベルを入力とし、該検出電圧レベルが常に最高値をとるように前記第1および第2の可変コンデンサの容量をそれぞれ可変する容量制御手段と、を有することを特徴とする。

【0009】上記の場合、前記電力供給コイル対とは異なる、対向配置された送信コイルおよび受信コイルと、前記送信コイルと接続されて第1の共振回路を構成する第1のコンデンサと、前記受信コイルと接続されて第2の共振回路を構成する第2のコンデンサと、前記容量制御手段から出力される制御信号を入力とし、該入力信号を前記第1の共振回路へ供給する信号送信手段と、前記第2の共振回路を介して受信される前記制御信号を入力とし、該入力制御信号を前記第1の可変コンデンサへ出力する信号受信手段と、をさらに有するものとしてもよい。

【0010】本発明の電気刺激装置は、上述のいずれかの電力伝送システムを備える電気刺激装置であって、前記受信コイルとともに体内に埋め込まれ、該受信コイルを介して電力供給を受けて生体の麻痺した部分を電氣的に刺激する刺激手段と、前記送信コイルに接続され、体外から前記刺激手段に電力を供給して刺激動作を制御する制御手段と、を有することを特徴とする。

【0011】本発明の第1の電力伝送方法は、対向配置された1対の電力供給コイル間で、一方を送信コイル、他方を受信コイルとして電力を誘導的に伝送する電力伝送方法において、前記送信コイルおよび受信コイルにおける電圧レベルをそれぞれ検出し、それぞれの検出電圧レベルが常に最高値をとるように前記送信コイルおよび

受信コイルの共振状態を制御することを特徴とする。

【0012】本発明の第2の電力伝送方法は、対向配置された1対の電力供給コイル間で、一方を送信コイル、他方を受信コイルとして電力を誘導的に伝送する電力伝送方法において、前記受信コイルにおける電圧レベルを検出し、該検出電圧レベルが常に最高値をとるように前記送信コイルおよび受信コイルの共振状態を制御することを特徴とする。

【0013】（作用）本発明によれば、送信コイルと第1の可変コンデンサにより共振回路が構成され、受信コイルと第2の可変コンデンサにより共振回路が構成されており、各共振回路の共振周波数はそれぞれの変可変コンデンサの容量を可変することにより制御可能になっている。したがって、例えば送受コイル間の距離が変動して、送受コイルの相互インダクタンスが変化しても、その変化に応じて各共振回路の共振状態を制御することができ、送受コイル間における電力伝送を常に最適な状態で行うことができる。

【0014】

【発明の実施の形態】次に、本発明の実施形態について図面を参照して説明する。

【0015】（実施形態1）図1は、本発明の第1の実施形態の電力伝送システムの概略構成を示すブロック図である。この電力伝送システムは、生体の機能を電氣的刺激で治療、再建する電気刺激装置に適用されるもので、生体の麻痺した部分を電氣的に刺激する負荷回路3（刺激装置）が接続され、該負荷回路3とともに体内に埋め込まれる電力受信部1と、体内に埋め込まれた負荷回路3に電力や信号を伝送して刺激動作を制御する駆動回路4（装置本体）が接続され、該駆動回路4とともに体外に設置される電力送信部2とを有する。

【0016】電力受信部1は、体外から供給される電力を受信するための受信コイル11とこれに並列に接続された可変コンデンサ12とからなるLC回路（共振回路）と、受信コイル11にて受信される電圧レベルを検出する電圧検出回路13と、該電圧検出回路13にて検出された電圧レベルを入力とし、該検出電圧レベルが常に最高値をとるように可変コンデンサ12の容量を可変する容量制御回路14と、受信コイル11にて受信される電圧を交流から直流に整流する整流回路15とを有する。

【0017】電力送信部2は、体内に埋め込まれた受信コイル11と平行に対向して配置され、該受信コイル11へ誘導的に電力を伝送する送信コイル21とこれに並列に接続された可変コンデンサ22とからなるLC回路（共振回路）と、送信コイル21にて伝送される電圧レベルを検出する電圧検出回路23と、該電圧検出回路23にて検出された電圧レベルを入力とし、該検出電圧レベルが常に最高値をとるように可変コンデンサ22の容量を可変する容量制御回路24とを有する。

【0018】送受信コイル11、21は、両コイル間で誘導的に電力伝送が可能であればどのようなものを用いてもよく、例えば空芯コイル、磁芯コイルなど種々のコイルを使用することができる。

【0019】上述のように構成された電力伝送システムでは、駆動回路4から負荷回路3を駆動するための電力が電力送信部2の送信コイル21に供給されると、送信コイル21から電力受信部1の受信コイル11に誘導的に電力が伝送される。このとき、電力搬送波の周波数に電力受信部1および電力送信部2の各共振回路が共振した状態になっていれば、駆動回路4から供給される電力のほとんどが負荷回路3にて使用され、共振していない場合には、電力受信部1の受信コイル11とこれに接続された各回路（電圧レギュレータ）で浪費される。受信コイル11にて受信された電力は整流回路15を介して負荷回路3へ供給される。

【0020】いま、電力搬送波の周波数に電力受信部1および電力送信部2の各共振回路が共振した状態で電力伝送が行われている状態とする。ここで、送信コイル21と受信コイル11間の距離1が変化すると、これら送受コイルの相互インダクタンスが変化し、これにより共振パラメータも変化する。共振パラメータが変化すると、電力搬送波の電圧レベルが小さくなり、この電圧レベルの変化が電力受信部1および電力送信部2の各電圧検出回路13、23で検出される。

【0021】電圧レベルが低下すると、容量制御回路14は、電圧検出回路13の出力を基に、その検出電圧レベルが最高値になるように可変コンデンサ12の容量を可変する。同様に、容量制御回路24は、電圧検出回路23の出力を基に、その検出電圧レベルが最高値になるように可変コンデンサ22の容量を可変する。これにより、送受コイルの相互インダクタンスが変化しても、常に電力搬送波の周波数に共振した状態で電力伝送を行うことができる。

【0022】以上のように、本実施形態の電力伝送システムでは、送信電圧、受信電圧の検出をそれぞれ送信部、受信部個々に設けられた電圧検出部で行い、送信部、受信部の個々の共振回路のコンデンサの容量を共振状態を維持するように自動的に補正するようになっているので、最適の状態での電力伝送が行われる。

【0023】なお、以上の説明では、生体機能の外的制御を行う装置に適用される例について説明したが、本発明はこれに限定されるものではなく、対向配置された1対の電力供給コイルを用いて、電気エネルギーを誘導的に伝送することにより電力供給を行うことが可能な装置であればどのようなものにも適用可能である。

【0024】（実施形態2）上述した第1の実施形態では、送信部、受信部個々に独立して送受コイルの共振状態を制御するようになっているが、受信コイルの電圧レベルを検出して、その検出結果に基づいて送受コイルの

共振状態を制御することもできる。

【0025】図2は、本発明の第2の実施形態の電力伝送システムの概略構成を示すブロック図である。同図中、図1に示した第1の実施形態の構成と同じ構成には同じ符号を付してある。

【0026】本形態の電力伝送システムは、上述の第1の実施形態の電力送信部2側の電圧検出回路23および容量制御回路24を取り除き、電力受信部1側の容量制御回路14が電圧検出回路13にて検出された電圧レベルに基づいて、可変コンデンサ12、22の容量をそれぞれ制御するようになっている。そのための構成として、電力受信部1側に、送信コイル17とコンデンサ18からなる共振回路と、該共振回路に容量制御回路14から送出された制御信号をフィードバック信号（電力送信部2側の可変コンデンサ22の容量を制御するための制御信号）として供給するフィードバック信号送信回路19とを備え、電力送信2側に、送信コイル17に平行に対向して配置された受信コイル27とコンデンサ28からなる共振回路と、受信コイル27を介して受信される容量制御回路14から送出されたフィードバック信号を受け、該受信信号を制御信号として可変コンデンサ22へ出力するフィードバック信号受信回路29とを備える。

【0027】上述のように構成された電力伝送システムでは、第1の実施形態の場合と同様に、駆動回路4から負荷回路3を駆動するための電力が電力送信部2の送信コイル21に供給されると、送信コイル21から電力受信部1の受信コイル11に誘導的に電力が伝送される。受信コイル11にて受信された電力は整流回路15を介して負荷回路3へ供給される。

【0028】いま、電力搬送波の周波数に電力受信部1および電力送信部2の各共振回路が共振した状態で電力伝送が行われている状態とする。ここで、送信コイル21と受信コイル11間の距離1が変化すると、これら送受コイルの相互インダクタンスが変化し、これにより共振パラメータも変化する。共振パラメータが変化すると、電力搬送波の電圧レベルが小さくなり、この電圧レベルの変化が電力受信部1の電圧検出回路13で検出される。

【0029】電圧レベルが低下すると、容量制御回路14は、電圧検出回路13の出力を基に、その検出電圧レベルが最高値になるように可変コンデンサ12の容量を変化するとともに、可変コンデンサ22の容量を変化するためフィードバック信号をフィードバック信号送信回路19へ送出する。フィードバック信号を受けたフィードバック信号送信回路19は、該フィードバック信号を所定の周波数で変調して各共振回路を介してフィードバック信号受信回路29へ送信する。フィードバック信号受信回路29は、受信した変調信号を復調して、これを制御信号として可変コンデンサ22へ出力する。これに

より、可変コンデンサ22は電力受信部1の容量制御回路14によって制御されることになる。

【0030】上述のようにして、電力受信部1側の容量制御回路14は、電圧検出回路13にて検出された電圧レベルに基づいて、検出電圧レベルが最高値になるように可変コンデンサ12、22の容量を変化させる。これにより、送受コイル11、21の相互インダクタンスが変化しても、常に電力搬送波の周波数に共振した状態で電力伝送を行うことができる。

【0031】本実施形態では、送信コイル17と受信コイル27における信号伝送は、送信コイル21と受信コイル11間で行われる誘導的な電力伝送と同じ原理で行われるが、これら送受コイル17、27と接続されるコンデンサ18、28は変調周波数に応じて所定の容量のものが用いられる。このようなフィードバック系では、共振パラメータが固定であるため、送受コイル17、27間の距離が変動すると、受信されるフィードバック信号の電圧レベルが変動することが予想されるが、この変動は刺激装置への電力の供給に直接影響するものではないので問題とはならない。しかも、フィードバック信号を受信する部分は体外に設けられる装置本体側に設けられるので、増幅回路など付加することができ、これによりフィードバック信号の電圧レベルの変動を回避することもできる。

【0032】

【発明の効果】以上説明したように構成される本発明によれば、送受コイルの相互インダクタンスの変化に応じてコイルの共振状態を制御することができるので、送受コイルの距離が変動しても、コイルの共振状態がくずれることがなく、安定した電力伝送を行うことができるという効果がある。

【0033】受信コイルにおける電圧レベルを検出し、該電圧レベルが常に最高値をとるように送受コイルの共振状態を制御する発明においては、より確実に受信コイルを電力搬送波の周波数で共振するようにでき、より安定的に電力伝送を行うことができるという効果がある。

【0034】本発明の電力伝送システムを備える電気刺激装置においては、体内に埋め込まれた刺激装置に安定して電力供給を行うことができるので、従来のような受信側コイルにおける受信電圧が低下して刺激装置などの負荷回路が動作しなくなるといった問題を防止でき、信頼性の高い電気刺激装置を提供することができる。

【図面の簡単な説明】

【図1】本発明の第1の実施形態の電力伝送システムの概略構成を示すブロック図である。

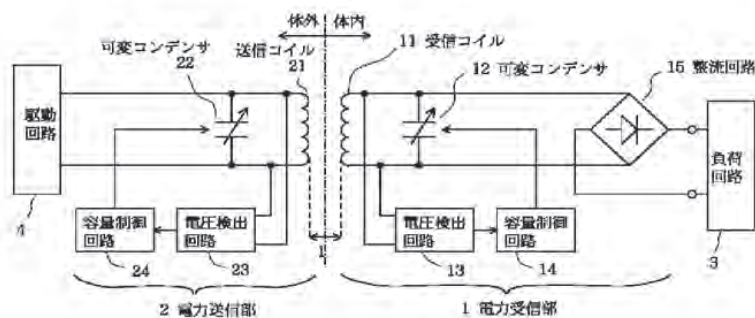
【図2】本発明の第2の実施形態の電力伝送システムの概略構成を示すブロック図である。

【符号の説明】

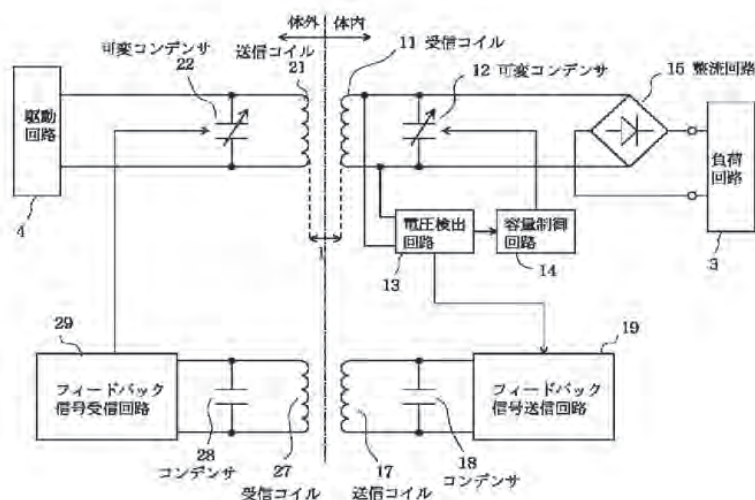
- 1 電力受信部
- 2 電力伝送部

- | | |
|----------------|------------------|
| 3 負荷回路 | 15 整流回路 |
| 4 駆動回路 | 17, 21 送信コイル |
| 11, 27 受信コイル | 18, 28 コンデンサ |
| 12, 22 可変コンデンサ | 19 フィードバック信号送信回路 |
| 13, 23 電圧検出回路 | 29 フィードバック信号受信回路 |
| 14, 24 容量制御回路 | |

【図 1】



【図 2】



フロントページの続き

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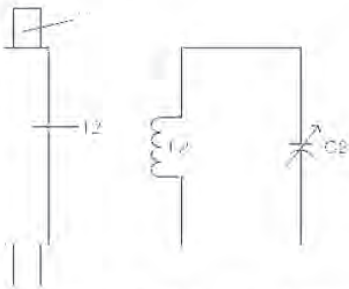
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(54) Title: AN AMPLIFICATION RELAY DEVICE OF ELECTROMAGNETIC WAVE AND A RADIO ELECTRIC POWER CONVERSION APPARATUS USING THE ABOVE DEVICE



(57) Abstract: The present invention provides an amplifying repeater, which is constructed in such a manner that a ferrite core is inserted into a coil with a predetermined number of winds to increase an induced electromotive force caused by an increase in flux linkage using a time-varying magnetic field of electromagnetic waves at a position distant from various electromagnetic wave generating sources by a predetermined distance and the induction coil and a variable condenser for inducing resonance are connected to each other to increase current while reducing a resistant component existing in the induction coil to intensify and amplify the magnetic field of electromagnetic waves. Furthermore, the present invention provides a wireless power conversion charging device using the magnetic field of electromagnetic waves, which is located between an electromagnetic wave generating source transmitter and a receiving coil or attached to the transmitter and receiving coil. The wireless power conversion charging device includes a rectifying diode for rectifying

an electromotive force induced in a construction in which a resonance and impedance matching variable condenser is connected to a coil in series or in parallel in order to transmit maximum induced power to a charging battery that is a load using electromagnetic waves amplified by the amplifying repeater, and a smoothing condenser for smoothing the rectified voltage. Accordingly, charging power required for various small power electronic devices can be provided and power can be supplied to various loads.

WO 2006/011769 A1

Description

AN AMPLIFICATION RELAY DEVICE OF ELECTROMAGNETIC WAVE AND A RADIO ELECTRIC POWER CONVERSION APPARATUS USING THE ABOVE DEVICE

Technical Field

- [1] The present invention relates to an amplifying repeater, which is constructed in such a manner that a ferrite core is inserted into a coil with a predetermined number of winds to increase an induced electromotive force caused by an increase in flux linkage using a time-varying magnetic field of electromagnetic waves at a position distant from an electromagnetic wave generating source by a predetermined distance, and that the coil and a variable condenser for inducing resonance are connected to each other to intensify and amplify the magnetic field of electromagnetic waves, and a wireless power converter using electromagnetic waves, which is located at a predetermined distance from the amplifying repeater, connects a resonance and impedance matching variable condenser to a coil to effectively transmit an induced power to a load, and rectifies and smoothes the induced power using a diode to supply the power to a charging battery or various loads.

Background Art

- [2] The induced electromotive force obtained from a time variation of the magnetic field of electromagnetic waves using Faraday's law is generated in proportion to the number of winds of an induction coil and a time variation of flux linkage. However, the intensity of the magnetic field is abruptly decreased in response to a distance from an electromagnetic wave generating source. Thus, the induced electromotive force is hardly induced to the induction coil at more than a predetermined distance so that energy according to wireless power conversion cannot be obtained. Furthermore, the induction coil must be disposed within a very short range from the electromagnetic wave generating source in a prior art so that its installation position is greatly restricted or it cannot be installed because of its bad appearance.

Disclosure of Invention

Technical Problem

- [3] Accordingly, the present invention has been made in view of the above-mentioned problem, and it is an object of the present invention to provide an electromagnetic wave amplifying repeater, which is constructed in such a manner that a ferrite core is inserted into a coil with a predetermined number of winds to increase an induced electromotive force caused by an increase in flux linkage using a time-varying magnetic

field of electromagnetic waves at a position distant from an electromagnetic wave generating source by a predetermined distance, connect the induction coil to a variable condenser for inducing resonance to construct an amplifying repeater that maximizes a current while reducing a resistant component existing in the induction coil to intensify and amplify the magnetic field of electromagnetic waves, and to provide a wireless power converter using the amplifying repeater, which includes a rectifying diode for rectifying an electromotive force induced in a structure in which a resonance and impedance matching variable condenser is connected in parallel with a coil to effectively transmit an induced electromotive force using the electromagnetic waves amplified by the amplifying repeater, having a predetermined distance from the amplifying repeater, and a smoothing condenser for smoothing the rectified voltage.

- [4] Another object of the present invention is to provide an amplifying repeater located at a very short distance from an electromagnetic wave generating source or attached to a wireless power converter to intensify and amplify the magnetic field of electromagnetic waves such that the amplifying repeater is installed unrestrictedly and an amplifying repeater and wireless power converter are applied in various ways according to wireless power conversion using the amplified electromagnetic waves.

Technical Solution

- [5] To achieve the above objects, according to the present, there is provided an electromagnetic wave amplifying repeater capable of amplifying and repeating the magnetic field of electromagnetic waves generated artificially or generated from various electromagnetic wave generating sources, including: an induction coil formed by winding a coil with a predetermined thickness in a desired size and form by a predetermined number of winds; a magnetic substance having a predetermined size and form, the magnetic substance being combined with the induction coil to increase flux; and a variable condenser connected to the induction coil to construct a resonance circuit.

Brief Description of the Drawings

- [6] Further objects and advantages of the invention can be more fully understood from the following detailed description taken in conjunction with the accompanying drawings, in which:
- [7] FIG. 1 illustrates the appearance and configuration of an amplifying repeater according to the present invention;
- [8] FIG. 2 illustrates a wireless power converter having a charging function according to the present invention;
- [9] FIG. 3 illustrates a construction for measuring a charging voltage, a charging current and a charging power using only a wireless power converter without using an

amplifying repeater;

- [10] FIG. 4 illustrates a construction for measuring a charging voltage, a charging current and a charging power using a single magnetic field amplifying repeater and a wireless power converter;
- [11] FIG. 5 illustrates a construction for measuring a charging voltage, a charging current and a charging power using two magnetic field amplifying repeaters and a wireless power converter (combined with one of the amplifying repeaters);
- [12] FIG. 6 illustrates a construction for measuring a charging voltage, a charging current and a charging power using two magnetic field amplifying repeaters and a wireless power converter (independent);
- [13] FIG. 7 illustrates a construction for measuring a charging voltage, a charging current and a charging power using magnetic field amplifying repeaters, a repeating amplifier and a wireless power converter, which are combined with each other;
- [14] FIG. 8 illustrates a construction in which a transmission coil generates a magnetic field, and a voltage, current and power are measured using an amplifying repeater, a receiving coil and a wireless power converter;
- [15] FIG. 9 illustrates a construction in which a transmission coil generates a magnetic field, and a voltage, current and power are measured at an output terminal using an amplifying repeater, a receiving coil wound on the upper part of a common core, and an amplifying repeater disposed at the lower part of the common core;
- [16] FIG. 10 illustrates a transmitter and a receiver constructed in such a manner that an amplifying repeater and a transmission coil or a receiving coil are wound around a single core;
- [17] FIG. 11 illustrates a construction in which an amplifying repeater composed of a spiral coil is attached onto a spiral coil, and a voltage, current and power are measured at an output terminal of a receiving coil;
- [18] FIG. 12 illustrates a construction in which an amplifying repeater composed of a spiral coil is located between a transmission coil and a receiving coil, and a voltage, current and power are measured at an output terminal;
- [19] FIG. 13 illustrates a construction in which an amplifying repeater is located outside a transmission coil, and a voltage, current and power are measured at an output terminal of a receiving coil; and
- [20] FIG. 14 illustrates a construction in which an amplifying repeater is located outside each of a transmission coil and a receiving coil, and a voltage, current and power are measured at an output terminal of the receiving coil
- [21] 11; Core, 12; Inducing Coil
- [22] 20; AC Power Generator
- [23] 21; Electromagnetic Wave Generating Source

- [24] 22; Receiver 23; Output Part
- [25] 24; Ruler
- [26] 25,26,27,28,30,32,34; Amplifying Repeater
- [27] 29; Transmission Coil
- [28] 31; Receiver1 , 33; Receiving Coil
- [29] 51; Spiral Coil Type Receiving Coil
- [30] 52; Spiral Coil Type Amplifying Repeater
- [31] 53; Spiral Coil Type Transmission Coil
- [32] L1: Receiving Coil,
- [33] C1: Condenser for Impedance Matching,
- [34] C2: Smoothing Condenser,
- [35] 1.3V: Battery Voltage for Charging

Mode for the Invention

- [36] The present invention will now be described in detail in connection with preferred embodiments with reference to the accompanying drawings. For reference, like reference characters designate corresponding parts throughout several views.
- [37] The present invention provides an amplifying repeater, which is constructed in such a manner that a ferrite core is inserted into a coil with a predetermined number of winds to increase an induced electromotive force caused by an increase in flux linkage using a time-varying magnetic field of electromagnetic waves using Faraday's law at a position distant from an electromagnetic wave generating source by a predetermined distance and the induction coil and a variable condenser for inducing resonance are connected to each other to maximize an induced current while reducing a resistant component existing in the induction coil to amplify the magnetic field of electromagnetic waves. Furthermore, the present invention provides a wireless power converter located at a predetermined distance from the amplifying repeater or attached to the amplifying repeater. The wireless power converter includes a rectifying diode for rectifying an electromotive force induced in a construction in which a magnetic core such as a ferrite core is inserted in an induction coil with a predetermined number of winds for transmitting maximum induced power to a charging battery that is a load using electromagnetic waves amplified by the amplifying repeater and the induction coil is connected to a variable condenser for controlling resonance and impedance matching, a smoothing condenser for smoothing the rectified voltage, and a receiving coil having a predetermined DC voltage and current.
- [38] In receiving electromagnetic power using Faraday's law, the present invention amplifies the magnetic field of time-varying electromagnetic waves generated in a television receiver or a monitor or electromagnetic waves artificially generated by

connecting a transmission coil to a load of an AC power generating circuit using an amplifying repeater to obtain an induced electromotive force using an induction coil at a position distant from an electromagnetic wave generating source by a predetermined distance and maximizes the obtained induced voltage and current, to thereby provide a magnetic field amplifying repeater for receiving electromagnetic power, which enables high efficiency electric energy conversion, and a high efficiency wireless power converter using the amplifying repeater.

[39] The construction of the amplifying repeater for amplifying an induced magnetic field of electromagnetic waves will now be described.

[40] The electromagnetic wave amplifying repeater according to the present invention obtains an induced electromotive force using electromagnetic waves generated from an electromagnetic wave generating source and emits the obtained induced power to the air. The present invention winds a coil round a bobbin having a predetermined diameter and size (having an internal diameter of 10mm and an external diameter of 15mm) by a predetermined number of times and a ferrite core is inserted in the bobbin to manufacture an induction coil. The diameter and the number of winds of the induction coil and the size of the ferrite core are designed such that the induced electromotive force is maximized. The induction coil can be constructed in parallel or in series in consideration of its resistance value. In the present invention, the diameter and length of the ferrite core are 9mm and 110mm, respectively, and two induction coils each have a diameter of 0.3mm and a number of winds of 160 are connected in parallel with each other. The induction coils are wound round the aforementioned bobbin, the ferrite core is inserted into the bobbin and a variable condenser is connected in parallel with the induction coils to construct a resonance circuit to maximize induced power and emit electromagnetic waves.

[41] The wireless power converter according to the present invention is located at a predetermined distance from the amplifying repeater or attached to the amplifying repeater and includes a ferrite core having a diameter of 9mm and a length of 110mm and two induction coils having a diameter of 0.3mm and a number of winds of 100, connected in parallel with each other. The induction coils are wound round a bobbin having a predetermined size (an internal diameter of 10mm and an external diameter of 15mm), the ferrite core is inserted into the bobbin and a variable condenser is connected in parallel with the induction coils to impedance-match with a resonance and load electronic circuit to maximize an induced electromotive force. The wireless power converter further includes a diode for rectifying the induced electromotive force and a smoothing condenser for smoothing the rectified voltage. The wireless power converter can be used as a power supply of a charging device because it generates a DC voltage having a specific current.

[42] FIG. 1 illustrates the electromagnetic field amplifying repeater manufactured according to the present invention on the left and a circuit constructing the amplifying repeater on the right. FIG. 2 is a circuit diagram of the wireless power converter constructed to obtain an electric energy using electromagnetic waves amplified by the amplifying repeater. In FIG. 2, L1 denotes a receiving coil, C1 represents a capacitor for impedance matching of resonance and maximum power transmission, C2 denotes a smoothing capacitor, and 1.3V represents a charging battery voltage. Table 1 represents a charging voltage, a charging current and a charging power obtained when the wireless power converter of FIG. 2 is located having a predetermined distance from an electromagnetic wave generating source 21, as shown in FIG. 3, without using the electromagnetic field amplifying repeater. From Table 1, it can be known that the charging current and charging power are hardly induced when the distance of a ruler 24 exceeds 4cm.

[43]

[44] Table 1 : A charging voltage, a charging current and a charging power Using the wireless power converter in Fig2.

[45]

Distance(cm)	Charging Voltage(V)	Charging Current (mA)	Charging Power(mW)
0	1.3	27	35.1
1	1.3	12.4	23.9
2	1.3	10.7	13.9
3	1.3	4	5.2
4	1.3	0	0

[46]

[47] FIG. 4 illustrates a construction in which a single electromagnetic field amplifying repeater 25 designed and manufactured according to the present invention is located in proximity to the electromagnetic wave generating source 21 and a charging voltage, a charging current and a charging power are measured using a receiver wireless power converter according to the present invention while varying the distance between the electromagnetic field amplifying repeater and the wireless power converter. The measurement result is represented in Table 2. Referring to Table 2, the charging current and charging power can be obtained even at a point at which the distance of the ruler is approximately 10cm.

[48]

[49] Table 2 : A charging voltage, a charging current and a charging power Using the wireless power converter in Fig4.

[50]

Distance(cm)	Charging Voltage(V)	Charging Current(mA)	Charging Power(mW)
5	1.3	44.0	57.2
6	1.3	26.2	34.1
7	1.3	21.7	28.2
8	1.3	15.7	20.4
9	1.3	10.7	13.9
10	1.3	4.9	6.4
11	1.3	0	0
12	1.3	0	0

[51] FIG. 5 illustrates a construction using two electromagnetic field amplifying repeaters 25 and 26 according to the present invention. One of the amplifying repeaters is located having a predetermined distance from the electromagnetic wave generating source 21 and the other one is disposed in proximity of the receiver 22 and the wireless power converter. Here, the amplifying repeater 26 and the receiver 22 are combined with each other. Table 3 represents a charging voltage, a charging current and a charging power measured using this construction while varying the distance between the electromagnetic wave generating source and the amplifying repeater 26 and the receiver 22 attached to each other. Referring to Table 3, the charging current and charging power can be obtained even at a point distant from the electromagnetic wave generating source 21 by 12cm.

[52] Table 3 : A charging voltage, a charging current and a charging power Using the wireless power converter in Fig5.

[53]

Distance(cm)	Charging Voltage(V)	Charging Current(mA)	Charging Power(mW)
5	1.3	51.2	66.5
6	1.3	36.8	47.8
7	1.3	29.2	37.9
8	1.3	21.4	27.8
9	1.3	16.6	21.5
10	1.3	12.7	16.5
11	1.3	4.7	6.1
12	1.3	1.2	1.6

[54] FIG. 6 illustrates a construction using two electromagnetic field amplifying repeaters 25 and 27 designed and manufactured according to the present invention. In this construction, one of the amplifying repeaters is located having a predetermined distance from the electromagnetic wave generating source 21, the other one is disposed having a distance of 5cm from the electromagnetic wave generating source 21, and a charging voltage, a charging current and a charging power are measured using the wireless power converter while varying the distance between the wireless power converter and the amplifying repeaters. Table 4 represents the measurement result. Referring to Table 4, a slightly increased charging power can be obtained and a specific charging current and charging power can be obtained even at a point distant from the electromagnetic wave generating source 21 by 13cm.

[55]

[56] Table 4 : A charging voltage, a charging current and a charging power Using the wireless power converter in Fig6.

[57]

Distance(cm)	Charging Voltage(V)	Charging Current(mA)	Charging Power(mW)
10	1.3	34	44.2
11	1.3	22.3	29.0
12	1.3	6.3	3.2
13	1.3	1.7	2.2

[58] FIG. 7 illustrates a construction in which an electromagnetic field amplifying repeater 25 is manufactured in such a manner that a coil having the same diameter as the aforementioned coil is wound round a bobbin having the same size as the aforementioned bobbin by a number of winds of 200 to connect two induction coils in

parallel, a ferrite core is inserted into the induction coils and a variable condenser is connected in parallel with the induction coils to construct a resonance circuit, and the amplifying repeater 25 is located having a predetermined distance from the electromagnetic wave generating source 21. In addition, another amplifying repeater 27 identical to those used in FIGS. 3, 4, 5 and 6 is located at a point corresponding to 5cm of the ruler, and an amplifying repeater 28 and the wireless power converter are attached to each other to measure a charging voltage, a charging current and a charging power while varying the distance between the electromagnetic wave generating source and the wireless power converter. Table 5 represents the measured charging voltage, charging current and charging power. It can be known from Table 5 that a specific charging current and charging power can be obtained even at a point distant from the electromagnetic wave generating source 21 by 16cm.

[59] Table 5 : A charging voltage, a charging current and a charging power Using the wireless power converter in Fig7.

[60]

Distance(cm)	Charging Voltage(V)	Charging Current(mA)	Charging Power(mW)
10	1.3	41.0	53.3
11	1.3	29.8	38.7
12	1.3	20.2	26.2
13	1.3	15.8	20.5
14	1.3	10.7	13.9
15	1.3	3.2	4.1
16	1.3	1	1.3

[61] Various experiments were made using the electromagnetic field amplifying repeater designed and manufactured as above and the wireless power converter according to the present invention, as shown in FIGS. 3 through 7. In the case where only the wireless power converter is installed without having the amplifying repeater, as shown in FIG. 3, the induced electromotive force is hardly generated from the induction coil when the wireless power converter is located distant from the electromagnetic wave generating source by 4cm, as represented in Table 1. Thus, a charging current does not flow in a charging battery that is a load and charging battery power indicates zero. In the case where the amplifying repeater is added, as shown in FIG. 4, the maximum charging current of 44mA and charging power of 57.2mW are obtained when the wireless power converter is located distant from the electromagnetic wave generating source by 5cm and charging power of 6.4mW is obtained when the wireless power converter is

located distant from the electromagnetic wave generating source by 10cm, as represented in Table 2.

[62] When the wireless power converter is combined with the amplifying repeater, as shown in FIG. 5, the charging current and charging power are higher than those obtained from the construction of FIG. 4 at the same distance. When the two amplifying repeaters are used as shown in FIG. 6, the charging power at the point distant from the electromagnetic wave generating source by 10cm is 44.2mW as represented in Table 4, which is approximately seven times the charging power of 6.4mW obtained using only one amplifying repeater in FIG. 4. Furthermore, the charging current and charging power can be obtained even at a point distant from the electromagnetic wave generating source by a distance corresponding to 12cm of the ruler. Thus, it can be known that electromagnetic power is transmitted and induced-converted into an electrical energy to be transmitted to a load even at a distance four times the distance when the wireless power converter is used without using any amplifying repeater.

[63] In the construction in which two different amplifying repeaters 25 and 27 are installed and the amplifying repeater 28 is combined with a receiving coil and the wireless power converter, as shown in FIG. 7, increased charging current and charging power are measured at the same distance in the construction having no amplifying repeater of FIG. 6 and a distance capable of obtaining the charging current and charging power is increased to 16cm, as represented in Table 5.

[64] In another embodiment of the present invention, a transmission coil is connected to a load of an AC power generating circuit of a TV receiver, which is an artificial electromagnetic generating source, to construct a source of generating AC power waveform having a frequency of 130kHz, and the transmission coil, a repeater and coils used in first and second receivers are constructed, as shown in Table 6, to measure a receiving voltage, a receiving current and a receiving power in response to a ruler distance using the wireless power converter of FIG. 2.

[65] Table 6 : Coil Construction of Transmission coil, Repeater, Receiver1, Receiver2

[66]

	Transmission Coil	Repeater	Receiver1	Receiver2
Coil	0.3	0.3	0.3	0.3
Core(mm) (Dia.*Length)	3*55	7*45	7*45	7*45
No. of winding	40 회	40 회	15	Upper Receiver(10Times) Lower Repeater(40Times)

[67] In Table 6, the first receiver is constructed of a general solenoid coil constructed such that a coil is wound round a core and the second receiver includes a receiving coil wound round the upper part of a common core ten times and a repeater constructing a resonance circuit of a coil wound round the lower part of the common core forty times and a capacitor.

[68] FIG. 10 illustrates a transmitter and a receiver constructed by winding a transmission coil outputting power generated from the electromagnetic wave generating source or a receiving coil receiving electromagnetic waves round a common core provided with an electromagnetic wave amplifying repeater. This construction can obtain high wireless power conversion efficiency because it can maximize generation and reception of electromagnetic waves in the resonance circuit of the amplifying repeater.

[69] Table 7 represents the voltage, current and power measured at an output load terminal (tens of parallel LEDs) of a receiver 31 when a transmission coil 29, an amplifying repeater 30 and the receiver 31 manufactured as shown in Table 6 are installed as shown in FIG. 8. The amplifying repeater is located in proximity to an electromagnetic wave generating source. The voltage, current and power are measured while moving the receiver from the electromagnetic wave generating source to distances 5cm, 10cm and 15cm.

[70] Table 7 : A receiving voltage, current and power measured at an output load terminal of a receiver1.

[71]

Distance(cm)	Receiving voltage (V)	Receiving current (A)	Receiving power(W)
5	3.9	1.900	7.410
10	2.6	1.000	2.600
15	1.4	0.200	0.280

[72] Table 8 represents the voltage, current and power measured at an output load terminal of receivers 33 and 34 when the transmission coil 29, amplifying repeater 32 and receivers 33 and 34 manufactured as shown in Table 6 are installed as shown in FIG. 9. The amplifying repeater is located in proximity to an electromagnetic wave generating source. The voltage, current and power are measured while moving the receivers from the electromagnetic wave generating source to distances 5cm, 10cm, 15cm and 20cm.

[73] Table 8 : A receiving voltage, current and power measured at an output load terminal of a receiver2.

[74]

Distance(cm)	Receiving voltage(V)	Receiving current(A)	Receiving power (W)
5	4.6	3.500	16.100
10	4.4	3.500	15.400
15	2.7	1.700	4.590
20	2.0	0.700	1.400

[75] It can be known from Tables 7 and 8 that the receiving voltage, receiving current and receiving power in response to a distance are much larger when they are obtained using the receiver 31 manufactured by winding only an induction coil round a core than when they are obtained using the receivers 33 and 34 including an induction coil and a repeater constructed of a resonance circuit, which are attached to a single common core.

[76] Another embodiment of the present invention constructs induction coils by winding coils having various diameters round bobbins having various sizes by different numbers of winds in consideration of the size and scale of an electromagnetic wave generating source, connects the induction coils in series or in parallel, inserts ferrite cores having diameters and lengths fitted into the internal diameters of the bobbins, and connects the induction coils to a variable condenser to construct a resonance circuit. In this manner, an electromagnetic field amplifying repeater can be constructed

in various sizes and forms and an apparatus capable of obtaining charging voltage, charging current and charging power with various levels can be realized using the amplifying repeater and the wireless power converter.

[77] Another embodiment of the present invention constructs a transmission coil, a repeater and a receiver using the spiral structure disclosed in Korean Patent Application No. 10-2004-0000528 applied by the Applicant. In this case, an electromagnetic wave generating source that generates a voltage of AC 220V and 60Hz converted into an AC voltage waveform having a frequency of 120kHz through an AC-AC adapter is connected to the transmission coil in a spiral form, a receiving coil is connected to a charging circuit, and a received charging current and voltage are measured. The distance between the transmission coil and the receiving coil is 5cm. FIG. 11 shows a case where the amplifying repeater is located on the transmission coil in proximity to the transmission coil. Table 9 represents the internal diameters, external diameters, types and numbers of winds of the spiral transmission coil, repeater coil and receiving coil.

[78] Table 9 : Internal diameters, external diameters, types and numbers of winds of the spiral transmission coil, repeater coil and receiving coil.

[79]

	Internal diameters (mm)	External diameters (mm)	Coil spec.	Numbers of winds
Receiving coil	30	80	0.2*9	24
Repeater coil	30	80	0.2*9	24
Transmission coil	30	40	0.2*9	4

[80] In FIG. 11, transmission power output through the transmission coil of the electromagnetic wave generating source is 16W, charging voltage measured by the wireless power converter of FIG. 2 is 1.4V, charging current is 0.36A, and charging power is 0.50W. When the amplifying repeater is located between the transmission coil and the receiver, which are spiral coils having the dimension represented in Table 6, as shown in FIG. 12, charging voltage is 1.4V, charging current is 0.4A and charging power is 0.56W. In this case, current and power slightly higher than those obtained in the case of FIG. 11 can be obtained. For reference, when only the transmission coil 53

and receiving coil 51 are used without using the repeater and the distance between the transmission coil and the receiving coil is 5cm, charging voltage is 1.4V, charging current is 0.01A and charging power is 0.014W, which are very small.

[81] FIG. 13 shows a case where the amplifying repeater surrounds the transmission coil. Here, the repeater is not connected to the transmission coil through wire. Table 10 represents the internal diameters, external diameters, types and numbers of winds of the spiral transmission coil, repeater and receiver used in the construction shown in FIG. 13.

[82] In FIG. 13, transmission power output through the transmission coil of the electromagnetic wave generating source is 16W, charging voltage measured by the wireless power converter of FIG. 2 is 1.4V, charging current is 0.9A, and charging power is 1.26W. When the amplifying repeaters respectively surround the transmission and receiving coils, which are spiral coils having the dimension of Table 10, as shown in FIG. 14, charging voltage is 1.4V, charging current is 1.0A and charging power is 1.4W. That is, the highest current and power can be obtained in the experiments using the spiral coils. Here, the distance between the transmission coil and the receiving coil is 5cm.

[83] Table 10 : Internal diameters, external diameters, types and numbers of winds of the spiral transmission coil, repeater coil and receiving coil.

[84]

	Internal diameters (mm)	External diameters (mm)	Coil spec.	Numbers of winds
Receiving coil	30	30	0.2*9	24
Repeater coil	40	80	0.2*9	20
Transmission coil	30	40	0.2*9	4

[85] Furthermore, the present invention can construct a wireless charging device that generates an induced voltage and current with high efficiency and charges the induced voltage and current in a charger using a rectifying diode and a smoothing condenser by simultaneously winding two wires of the spiral coil disclosed in Korea Patent Application No. 10-2004-0000528 in the form of plate such that they are located in parallel vertically, placing a ferromagnetic substance in a doughnut shape on the coil in order to increase flux caused by flux linkage per hour and connecting a variable condenser to the coil in series or in parallel to construct a resonance circuit. Here, an

electromagnetic field amplifying repeater can be manufactured by constructing the resonance circuit using the spiral plate type coil, ferromagnetic substance in a doughnut shape and variable condenser. A method of manufacturing the electromagnetic field amplifying repeater is described in detail in Korea Patent Application No. 10-2004-0000528.

- [86] The present invention constructs a magnetic field amplifying repeater for amplifying a magnetic field at a position having a predetermined distance from an electromagnetic wave generating source and locates an electromagnetic wave amplifying repeater and a wireless power conversion charging device converter at a position distant from the amplifying repeater by a predetermined distance. The wireless power conversion charging device include a rectifying diode that rectifies an electromotive force induced in a structure in which a resonance and impedance matching variable condenser and a coil are connected in parallel with each other to induce maximum power using electromagnetic waves amplified by the amplifying repeater to transmit the induced power to a load and a smoothing condenser smoothing the rectified voltage and a wireless power. Accordingly, the present invention can repeat power to a predetermined distance from the electromagnetic wave generating source and convert electromagnetic power to improve industrial applicability. For example, the present invention can be used to charge contactless wireless battery or transmit power in real time at a short distance in the air or an insulator of a small power electronic device.
- [87] The present invention can locate the magnetic field amplifying repeater at a position having a predetermined distance from the electromagnetic wave generating source to install the wireless power converter using electromagnetic waves, and thus the wireless power converter can be freely located and applied in various ways.
- [88] While the present invention has been described with reference to the particular illustrative embodiments, it is not to be restricted by the embodiments but only by the appended claims. It is to be appreciated that those skilled in the art can change or modify the embodiments without departing from the scope and spirit of the present invention.

Claims

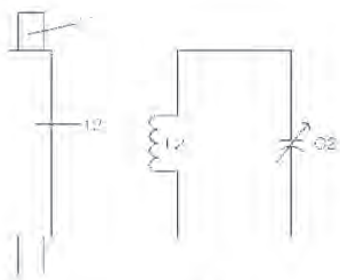
- [1] An electromagnetic wave amplifying repeater capable of amplifying and repeating the magnetic field of electromagnetic waves generated artificially or generated from various electromagnetic wave generating sources, comprising: an induction coil formed by winding a coil with a predetermined thickness in a desired size and form by a predetermined number of winds; a magnetic substance having a predetermined size and form, the magnetic substance being combined with the induction coil to increase flux; and a variable condenser connected to the induction coil to construct a resonance circuit.
- [2] The electromagnetic wave amplifying repeater as claimed in claim 1, wherein the induction coil wound by the predetermined number of winds is designed and manufactured in a solenoid or spiral form.
- [3] The electromagnetic wave amplifying repeater as claimed in claim 1 or 2, wherein the magnetic substance combined with the induction coil to increase flux is a ferrite core or a substance having magnetism.
- [4] The electromagnetic wave amplifying repeater as claimed in claim 3, wherein induction coils wound by a predetermined number of winds are connected in series or in parallel to control the resistance and inductance of the induction coils, to thereby effectively generate the magnetic field of electromagnetic waves.
- [5] The electromagnetic wave amplifying repeater as claimed in claim 4, wherein the variable condenser constructing the resonance circuit is connected to the induction coil in series or in parallel to amplify the magnetic field of electromagnetic waves.
- [6] A wireless power converter comprising:
an electromagnetic wave amplifying repeater including an induction coil formed by winding a coil with a predetermined diameter in a desired size and form by a predetermined number of winds, a magnetic substance, and a variable condenser, the electromagnetic wave amplifying repeater serving to amplify and repeat the magnetic field of electromagnetic waves generated artificially or generated from various electromagnetic wave generating sources;
an induction coil and a magnetic substance for generating an induced electromotive force using the magnetic field amplified by the amplifying repeater;
a variable condenser for performing resonance and impedance matching, the variable condenser being connected to the induction coil to improve power conversion efficiency;

a rectifying diode for rectifying a voltage induced by the induction coil and the variable condenser; and
a condenser for smoothing the voltage to form a voltage having a desired DC component.

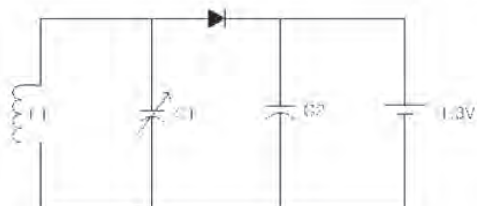
- [7] The wireless power converter as claimed in claim 6, wherein induction coils wound by a predetermined number of winds are connected in series or in parallel to control the resistance and inductance of the induction coils, to thereby improve power conversion efficiency.
- [8] The wireless power converter as claimed in claim 6 or 7, wherein the amplifying repeater is attached to an electromagnetic wave generating source transmission coil and a receiving coil or to one of the electromagnetic wave generating source transmission coil and the receiving coil, and at least one amplifying repeater is installed between the electromagnetic wave generating source transmission coil and the receiving coil in consideration of the distance between the electromagnetic wave generating source and the receiving coil.
- [9] The wireless power converter as claimed in claim 8, wherein the amplifying repeater and the receiving coil are designed and manufactured in a solenoid or spiral form.
- [10] The wireless power converter as claimed in claim 6, wherein the amplifying repeater and the wireless power converter including the amplifying repeater further comprise an electromagnetic wave generating source to which a spiral or solenoid transmission coil artificially generating electromagnetic waves is attached.
- [11] The wireless power converter as claimed in claim 6, wherein the wireless power converter is constructed in such a manner that an induction coil is wound round one side of a core wound by a transmission coil of an artificial electromagnetic wave generating source and the induction coil is connected to a capacitor to construct an amplifying repeater, that an induction coil is wound round one side of a core wound by a receiving coil and the induction coil is connected to a capacitor to construct an amplifying repeater, or that amplifying repeaters are respectively set at both sides of the core of the transmission coil and receiving coil.
- [12] The wireless power converter using an electromagnetic wave amplifying repeater as claimed in claim 6, wherein the wireless power converter is constructed in such a manner that a spiral coil is wound round the outside of a transmission spiral coil of an artificial electromagnetic wave generating source and connected to a capacitor to construct an amplifying repeater, that a spiral coil is wound round the outside a receiving spiral coil and connected to a capacitor to construct an amplifying repeater, and that spiral coils are respectively wound around the

outsides of transmission and receiving spiral coils and connected to a capacitor to construct an amplifying repeater.

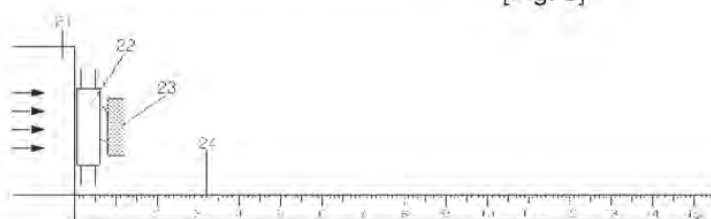
[Fig. 1]



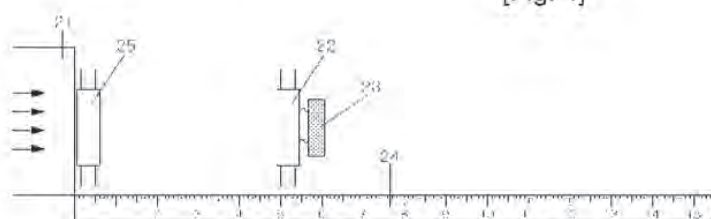
[Fig. 2]



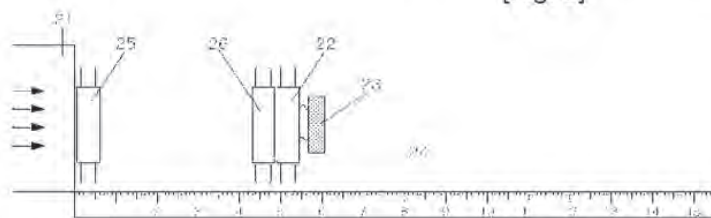
[Fig. 3]



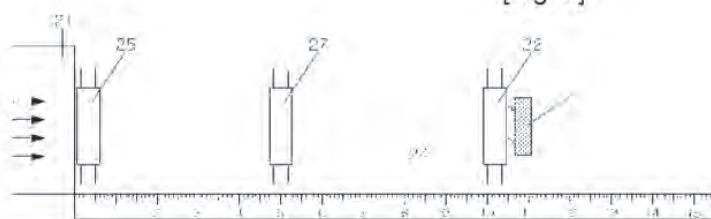
[Fig. 4]



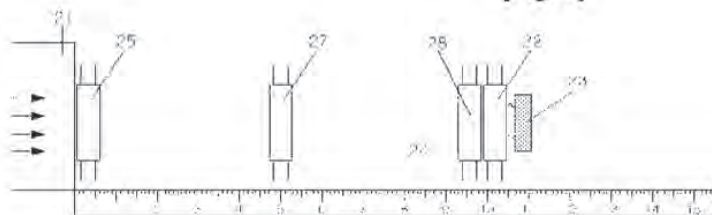
[Fig. 5]



[Fig. 6]



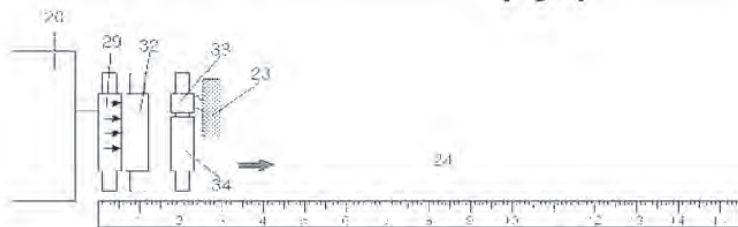
[Fig. 7]



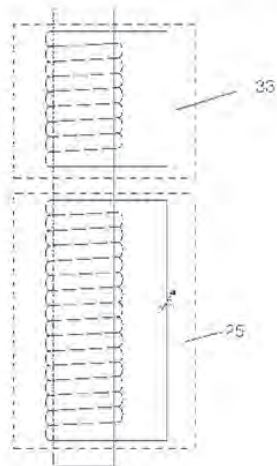
[Fig. 8]



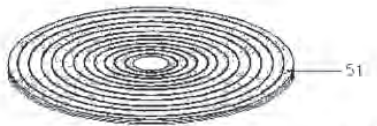
[Fig. 9]



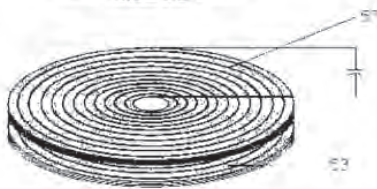
[Fig. 10]



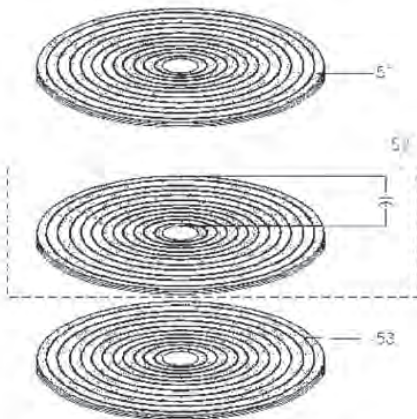
[Fig. 11]



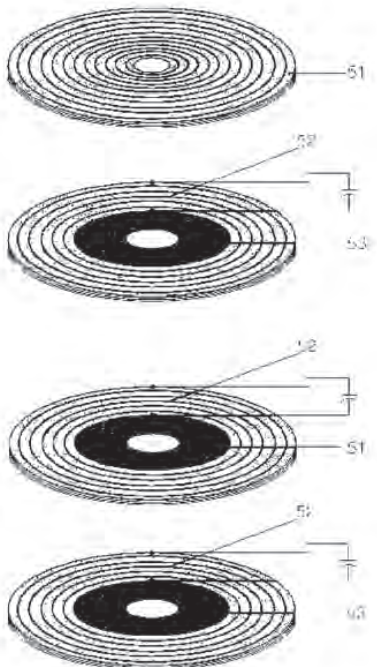
[Fig. 12]



[Fig. 13]



[Fig. 14]



PATENT COOPERATION TREATY

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference PCT_E0502	FOR FURTHER ACTION see Form PCT/ISA/220 as well as, where applicable, item 5 below.	
International application No. PCT/KR2005/002468	International filing date (<i>day/month/year</i>) 29 JULY 2005 (29.07.2005)	(Earliest) Priority Date (<i>day/month/year</i>) 29 JULY 2004 (29.07.2004)
Applicant JC PROTEK CO.,LTD. et al		

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

This international search report consists of a total of 3 sheets.

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

1. Basis of the report

a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ The international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. ☐ **Certain claims were found unsearchable** (See Box No. II)

3. ☐ **Unity of invention is lacking** (See Box No. III)

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

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

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

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

6. With regard to the **drawings**,

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

☒ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

b. ☐ none of the figure is to be published with the abstract.

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

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2005/002468

A. CLASSIFICATION OF SUBJECT MATTER**IPC7 H04B 7/14**

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04B, H02J, H05F, H02M, G09G

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
SEARCH TERMS : RECHARGE, BATTERY, WIRELESS, POWER

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 0 533 247 A1 (ERICSSON RADIO SYSTEMS B.V.) 09-09-1992 SEE ABSTRACT; FIGURES 1&2; column 4;	1-5, 6
Y	JP 10-257697 (HITACHI ELECTRON SERVICE CO LTD) 25-09-1998 SEE THE WHOLE DOCUMENT	1-5, 6
Y	JP 2003-88005 A (SEIKO INSTR KK) 20-03-2003 SEE ABSTRACT; FIGURES 2; CLAIMS;	1-5, 6
A	US 2003/0048254 A1 (PRIMAX ELECTRONICS LTD) SEE ABSTRACT; FIGURES 1&2;	1-12

☐ 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

"I" 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

29 NOVEMBER 2005 (29.11.2005)

Date of mailing of the international search report

29 NOVEMBER 2005 (29.11.2005)

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

JANG, JIN HWAN

Telephone No. 82-42-481-5711



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

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.:
PCT/KR2005/002468

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0 533 247 A1	09-09-1992	DE 89207313 C0 NL 9101590 A US 5367242	15-02-1996 16-04-1993 22-11-1994
JP 10-257697	25-09-1998	NONE	
JP 2003-38005 A	20-03-2003	EP 1263114 A2 US 20020190689 A1	04-12-2002 19-12-2002
US 2003/0048254	12-03-2003	DE 10253662 A1 TW 535341 B	27-05-2004 01-06-2003

Form PCT/ISA/210 (patent family annex) (April 2005)

Electronic Acknowledgement Receipt	
EFS ID:	13382419
Application Number:	12649635
International Application Number:	
Confirmation Number:	5891
Title of Invention:	WIRELESS ENERGY TRANSFER TO A MOVING DEVICE BETWEEN HIGH-Q RESONATORS
First Named Inventor/Applicant Name:	John D. Joannopoulos
Customer Number:	26161
Filer:	Marc M. Wefers/Cheryl Forrest
Filer Authorized By:	Marc M. Wefers
Attorney Docket Number:	01997-0359015 / MIT 11757
Receipt Date:	31-JUL-2012
Filing Date:	30-DEC-2009
Time Stamp:	14:21:33
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		359015-IDS.pdf	150339 7dec0cf2c9da0951092ca4f6b9f60ba5202b da3d0	yes	6

	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Transmittal Letter		1	4	
	Information Disclosure Statement (IDS) Form (SB08)		5	6	
Warnings:					
Information:					
2	Foreign Reference	0art1.pdf	353621	no	13
			1/3085350bb692/375204011nc1578f010a c010		
Warnings:					
Information:					
3	Foreign Reference	0art2.pdf	263673	no	9
			b56e9073aa2aa0734ee4d67638d-7a010aa c010		
Warnings:					
Information:					
4	Foreign Reference	0art3.pdf	1282355	no	16
			544b6a51b02aa07ce2809587b180d7ccf c009		
Warnings:					
Information:					
5	Foreign Reference	0art4.pdf	744192	no	8
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Warnings:					
Information:					
6	Foreign Reference	0art5.pdf	1108171	no	25
			79ae7fc410f9a81e9532ce9f180f487d2a0 87b		
Warnings:					
Information:					
Total Files Size (in bytes):			3902351		

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

Applicant : John D. Joannopoulos et al. Art Unit : Unknown
 Serial No. : 12/649,635 Examiner : Unknown
 Filed : December 30, 2009 Conf. No. : 5891
 Title : WIRELESS ENERGY TRANSFER TO A MOVING DEVICE BETWEEN HIGH-Q RESONATORS

MAIL STOP AMENDMENT

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

INFORMATION DISCLOSURE STATEMENT

Please consider the references listed on the enclosed PTO-1449 form. Foreign patent documents and non-patent literature are enclosed; cited U.S. patents and patent application publications will be provided on request.

Applicants note that the two German references listed on the enclosed PTO-1449 form (Desig. ID Nos. 32 and 33) were previously cited in an Information Disclosure Statement on April 23, 2010, however only the English Abstract was referenced at that time. Applicant is now submitting machine translations of both German references.

The applicants invite the examiner to consider the position of the examiner and replies by the applicants that have been set forth in the prosecution of the following U.S. patent applications. These applications are related to the present application under Section 120 and/or contain at least some material that is similar to the material set forth in the specification of this application. The applicants assume that the examiner has direct access to these files, but will be happy to provide copies to the examiner upon request.

<u>Application No.</u>	<u>Filing Date</u>	<u>Status</u>
11/481,077	July 5, 2006	Issued
12/055,963	March 26, 2008	Issued
12/415,650	March 31, 2009	Issued
12/415,616	March 31, 2009	Issued
12/415,655	March 31, 2009	Issued
12/415,667	March 31, 2009	Published
12/437,641	May 9, 2009	Issued

Applicant : John D. Joannopoulos et al.
Serial No. : 12/649,635
Filed : December 30, 2009
Page : 2 of 4

Attorney's Docket No.: 01997-0359015 / MIT Case No.
11757

<u>Application No.</u>	<u>Filing Date</u>	<u>Status</u>
12/466,065	May 14, 2009	Issued
12/553,957	September 3, 2009	Published
12/571,949	October 1, 2009	Published
12/639,958	December 16, 2009	Published
12/639,961	December 16, 2009	Published
12/639,962	December 16, 2009	Published
12/639,963	December 16, 2009	Published
12/639,966	December 16, 2009	Published
12/639,967	December 16, 2009	Published
12/639,972	December 16, 2009	Published
12/646,442	December 23, 2009	Published
12/646,524	December 23, 2009	Published
12/649,777	December 30, 2009	Published
12/649,813	December 30, 2009	Published
12/649,852	December 30, 2009	Published
12/649,904	December 30, 2009	Published
12/649,973	December 30, 2009	Published
12/688,305	January 15, 2010	Published
12/688,339	January 15, 2010	Published
12/708,850	February 19, 2010	Published
12/713,556	February 26, 2010	Published
12/717,559	March 4, 2010	Published
12/726,742	March 18, 2010	Published
12/726,913	March 18, 2010	Published
12/726,953	March 18, 2010	Published
12/732,399	March 26, 2010	Published
12/766,232	April 23, 2010	Published

Applicant : John D. Joannopoulos et al.
Serial No. : 12/649,635
Filed : December 30, 2009
Page : 3 of 4

Attorney's Docket No.: 01997-0359015 / MIT Case No.
11757

<u>Application No.</u>	<u>Filing Date</u>	<u>Status</u>
12/784,615	May 21, 2010	Published
12/787,765	May 26, 2010	Published
12/837,675	July 16, 2010	Published
12/862,907	August 25, 2010	Published
12/868,852	August 26, 2010	Published
12/879,263	September 10, 2010	Published
12/879,395	September 10, 2010	Published
12/896,328	October 1, 2010	Published
12/896,400	October 1, 2010	Published
12/939,400	November 4, 2010	Published
12/949,504	November 18, 2010	Published
12/949,544	November 18, 2010	Published
12/949,580	November 18, 2010	Published
13/030,395	February 18, 2011	Published
13/030,400	February 18, 2011	Published
13/036,177	February 28, 2011	Published
13/040,810	March 16, 2011	Published
13/051,098	March 18, 2011	Published
13/051,153	March 18, 2011	Published
13/078,511	April 1, 2011	Published
13/102,498	May 6, 2011	Pending
13/107,293	May 20, 2011	Published
13/112,476	May 20, 2011	Published
13/116,474	May 26, 2011	Published
13/163,020	June 17, 2011	Published
13/288,308	November 3, 2011	Published
13/477,459	May 22, 2012	Pending

Applicant : John D. Joannopoulos et al.
Serial No. : 12/649,635
Filed : December 30, 2009
Page : 4 of 4

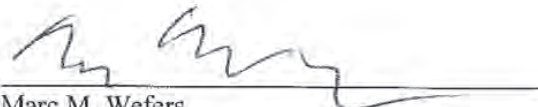
Attorney's Docket No.: 01997-0359015 / MIT Case No.
11757

This statement is being filed within three months of the filing date of the application or before the receipt of a first Office Action on the merits. Please apply any necessary charges or credits to Deposit Account 06-1050, referencing the above attorney docket number.

Respectfully submitted,

Date:

7/30/12


Marc M. Wefers
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Substitute Form PTO-1449 (Modified)	U.S. Department of Commerce Patent and Trademark Office	Attorney Docket No. 01997-0359015	Application No. 12/649,635
Information Disclosure Statement by Applicant (Use several sheets if necessary) (37 CFR §1.98(b))		Applicant John D. Joannopoulos et al.	
		Filing Date December 30, 2009	Group Art Unit

U.S. Patent Documents							
Examiner Initial	Desig. ID	Document Number	Publication Date	Patentee	Class	Subclass	Filing Date If Appropriate
	1	2005/0151511	07/14/2005	Chary			
	2	2005/0288741	12/29/2005	Hassler, Jr. et al.			

Foreign Patent Documents or Published Foreign Patent Applications								
Examiner Initial	Desig. ID	Document Number	Publication Date	Country or Patent Office	Class	Subclass	Translation	
							Yes	No
	3							

Other Documents (include Author, Title, Date, and Place of Publication)		
Examiner Initial	Desig. ID	Document
	4	Copy of Non-Final Office Action with regard to U.S. Application Serial No. 12/639,958 by Examiner Fritz M. Fleming dated August 16, 2012 (21 pages)
	5	Copy of Non-Final Office Action with regard to U.S. Application Serial No. 12/639,963 by Examiner Fritz M. Fleming dated August 31, 2012 (20 pages)

Examiner Signature	Date Considered
EXAMINER: Initials citation considered. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.	

Substitute Disclosure Form (PTO-1449)

Electronic Acknowledgement Receipt	
EFS ID:	13721087
Application Number:	12649635
International Application Number:	
Confirmation Number:	5891
Title of Invention:	WIRELESS ENERGY TRANSFER TO A MOVING DEVICE BETWEEN HIGH-Q RESONATORS
First Named Inventor/Applicant Name:	John D. Joannopoulos
Customer Number:	26161
Filer:	Marc M. Wefers/Cheryl Forrest
Filer Authorized By:	Marc M. Wefers
Attorney Docket Number:	01997-0359015 / MIT 11757
Receipt Date:	12-SEP-2012
Filing Date:	30-DEC-2009
Time Stamp:	13:13:24
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		359015-IDS.pdf	78744	yes	2
			e1d0066c97d551de5d5f7341b9409c5e9e05c b6d2		

Multipart Description/PDF files in .zip description					
Document Description			Start	End	
Transmittal Letter			1	1	
Information Disclosure Statement (IDS) Form (SB08)			2	2	
Warnings:					
Information:					
2	Non Patent Literature	OAdated8-16-12.pdf	1092877	no	21
			710ad0b67c8520be6726a7540a4476e45d79a190f		
Warnings:					
Information:					
3	Non Patent Literature	OAdated8-31-12.pdf	1047490	no	20
			c1882f2dd44dc0a258c3621e20481cc8d5f5d		
Warnings:					
Information:					
Total Files Size (in bytes):			2219111		
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.					

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : John D. Joannopoulos et al. Art Unit : Unknown
Serial No. : 12/649,635 Examiner : Unknown
Filed : December 30, 2009 Conf. No. : 5891
Title : WIRELESS ENERGY TRANSFER TO A MOVING DEVICE BETWEEN HIGH-
Q RESONATORS

MAIL STOP AMENDMENT

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

INFORMATION DISCLOSURE STATEMENT

Please consider the references listed on the enclosed PTO-1449 form. Foreign patent documents and non-patent literature are enclosed; cited U.S. patents and patent application publications will be provided on request.

This statement is being filed within three months of the filing date of the application or before the receipt of a first Office Action on the merits. Please apply any necessary charges or credits to Deposit Account 06-1050, referencing the above attorney docket number.

Respectfully submitted,

Date: 9/12/12



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Facsimile: (877) 769-7945

22908189.doc

Substitute Form PTO-1449 (Modified)	U.S. Department of Commerce Patent and Trademark Office	Attorney Docket No. 01997-0359015	Application No. 12/649,635
Information Disclosure Statement by Applicant (Use several sheets if necessary) (37 CFR §1.98(b))		Applicant John D. Joannopoulos et al.	
		Filing Date December 30, 2009	Group Art Unit

U.S. Patent Documents							
Examiner Initial	Desig. ID	Document Number	Publication Date	Patentee	Class	Subclass	Filing Date If Appropriate
	1						

Foreign Patent Documents or Published Foreign Patent Applications								
Examiner Initial	Desig. ID	Document Number	Publication Date	Country or Patent Office	Class	Subclass	Translation	
							Yes	No
	2	102 21 484	11/27/2003	Germany	G06F	1/26	X	
	3	200 16 655	2/14/2002	Germany	H02J	17/00	X	

Other Documents (include Author, Title, Date, and Place of Publication)		
Examiner Initial	Desig. ID	Document
	4	Copy of Non-Final Office Action with regard to U.S. Application Serial No. 12/949,544 by Examiner Fritz M. Fleming dated September 5, 2012 (41 pages)
	5	Copy of Non-Final Office Action with regard to U.S. Application Serial No. 12/646,524 by Examiner Fritz M. Fleming dated October 1, 2012 (11 pages)
	6	Copy of Non-Final Office Action with regard to U.S. Application Serial No. 12/415,667 by Examiner Fritz M. Fleming dated October 5, 2012 (20 pages)
	7	Copy of Final Office Action with regard to U.S. Application Serial No. 12/639,967 by Examiner Fritz M. Fleming dated October 5, 2012 (21 pages)
	8	Copy of Final Office Action with regard to U.S. Application Serial No. 12/639,966 by Examiner Fritz M. Fleming dated October 9, 2012 (20 pages)
	9	Copy of Non-Final Office Action with regard to U.S. Application Serial No. 12/868,852 by Examiner Fritz M. Fleming dated October 10, 2012 (26 pages)

Examiner Signature	Date Considered
EXAMINER: Initials citation considered. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.	

Substitute Disclosure Form (PTO-1449)

DERWENT- 2004-036374
ACC-NO:
DERWENT- 200404
WEEK:

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TITLE: Inductive coils are used to provide electrical energy for inductive coupling used to transmit data from identification tag on animal to processing unit

INVENTOR: HOLM H; LAUE H

PATENT-ASSIGNEE: HOLM H[HOLMI] , LAUE H[LAUEI]

PRIORITY-DATA: 2002DE-1021484 (May 15, 2002)

PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE
DE 10221484 A1	November 27, 2003	DE

APPLICATION-DATA:

PUB-NO	APPL-DESCRIPTOR	APPL-NO	APPL-DATE
DE 10221484A1	N/A	2002DE-1021484	May 15, 2002

INT-CL-CURRENT:

TYPE	IPC DATE
CIPS	A01K11/00 20060101

ABSTRACTED-PUB-NO: DE 10221484 A1

BASIC-ABSTRACT:

NOVELTY - The stall has a watering station (18) that is used by such as a milk cow. The animal has a data memory element implanted that is read by coils (28) set into the sides of the stall. These are supplied by an ac generator (32). A sensor (34) is used to detect the presence of the cow.

USE - Monitoring of animal condition.

ADVANTAGE - Simple means of supplying energy.

DERWENT-ACC-NO: 2004-036374

DESCRIPTION OF DRAWING(S) - The figure shows a schematic of the system.

Stall (10)

Watering station (18)

Coils (28)

Generator (32)

Sensor (34)

CHOSEN- Dwg.1/2
DRAWING:

TITLE- INDUCTIVE COIL ELECTRIC ENERGY COUPLE TRANSMIT DATA
TERMS: IDENTIFY TAG ANIMAL PROCESS UNIT

DERWENT-CLASS: P14 T01 V02 W02 W06 X25

EPI- T01-J07A; V02-G01D; W02-G05A; W02-G05B; W06-A04B5A;
CODES: X25-N02A;

SECONDARY-ACC-NO:

Non-CPI Secondary Accession Numbers: 2004-029639

This text has been taken over by the DPMA from original sources. It contains no drawings. The representation of tables and formulas can be unsatisfactory.

DE 000010221484 A1

Application Country: DE

Application number: 10221484

Join date: 15.05.2002

Release date: 27.11.2003

International Class: G06F 1/26

MCD coset: A01K 11/00 (2006.01 A)

ECLA: A01K 11/00 C

Citation (PL): DE 000 002 015 295 C2

Citation (PL): DE 000020016655 U1

Citation (PL): WO A1 001998047351

Inventor: Laue, Hans-Joachim, Professor, 24783 Osterrönnfeld, DE

Inventor: Holm, Hans-Joachim, 24784 Westerrönnfeld, DE

Applicant: Laue, Hans-Joachim, Professor, 24783 Osterrönnfeld, DE

Applicant: Holm, Hans-Joachim, 24784 Westerrönnfeld, DE

[DE] An apparatus for supplying power to a data acquisition and
Data transfer unit as well as data acquisition and transmission unit

[EN] Inductive coils are used to Ooops electrical energy for inductive coupling used to transmit data from one animal identification tag to processing unit

[DE] An apparatus for supplying power to a data acquisition and data transmission unit, the physiological data of a via sensors Farm-animal is detected and the detected data, sends a station for the livestock, the two side walls and a feeding trough, a drinking bowl or the like, each with a ring-shaped coil in each of the side walls which are aligned with each other, and with a AC voltage generator, which is connected to the coils.

[EN] The stall has a watering station (18) that is used by search as a milk cow. The animal has a data memory element implanted that is read by coils (28) set into the sides of the stall. These are supplied by an ac generator (32). A sensor (34) is used to detect the presence of the cow.

[0001] The invention relates to a device for supplying power to a data acquisition and data transmission unit. Also relates to the Invention itself, a data acquisition and transmission unit

[0002] DE 199 01 124, the applicant is a device for the controlled supply of farm animals known. A probe in the stomach / intestines the domestic animal detected physiological data of the animal, and sends the corresponding results to a supply device, for example for Concentrated feed, or they are used to control rutting and / or for general health monitoring.

[0003] WO 98/47351 is known to animals with an electronic identification device. The electronic identification device may, in addition to the measured values of an identification characteristic physiological condition of the animal to receive a recipient. The Identification means is provided as a passive component without its own energy supply. For this purpose, a transponder is in the unit provided which is excited by an electromagnetic radiation to and emits a corresponding resonant frequency identification.

[0004] In addition to the above mentioned passive devices, devices with an active power supply are known in which a quality battery's energy supply is ensured. An advantage of the active power supply is that for example, a Can take place between storage of data. It proves to be a disadvantage, however, that a battery has a limited service life and must be replaced.

[0005] The invention has the object of providing an apparatus for supplying power to a data acquisition and data transmission unit as a data collection and data transmission unit itself provide the energy supply at low cost with simple means allow.

[0006] According to the invention is achieved by a device according to claim 1 and by a data collection and data transmission unit achieved according to claim 7. The dependent claims form advantageous

embodiments of the invention.

[0007] The inventive device for power supply provides for data acquisition and data transfer unit, the electrical Energize. For data collection, the physiological data of the farm animal is detected and subsequently the acquired data are a Receiving station sent. The inventive device has a station for the livestock, the two side walls and a feed trough one, Water Bowl or the like. In each of the side walls each having an annular coil is provided, the coils on each other aligned and connected to an alternating voltage generator. Of the alternating voltage generator applies an AC voltage to the coil on, generating a first time-varying magnetic field in the space between the coils. In this manner, electromagnetic energy in the Area between the coils provided, which can serve to supply a data collection and data transmission unit. Particularly advantage of the inventive device, is that the power supply takes place during the food or water consumption of the farm animal.

[0008] In a preferred embodiment, the station is provided with a stay sensor detecting one animal in the station, and Initiates charging signal for controlling the charging process. During charging, the generator produces the AC voltage and the Coil pair radiates from the time varying magnetic field.

[0009] To the charging only then to carry out when it is required, the sensor can be configured in such a stay that detects is that animal is located in the station. The control of the charging process will then check how long the last load operation for the detected Utilization lags and solves one of charging only when the last charging place more than a predetermined time period.

[0010] In a preferred embodiment, the coils have the same diameter of preferably about 1 m, wherein the coils one Distance of about 0.8 m have. The distance corresponds to the distance of the walls in the station. The coils are coplanar, wherein the center has the same distance from the bottom of the station. The pair of coils produced in his space an approximately homogeneous Magnetic field, similar to a helmet wooden spools pair.

[0011] According to the invention, the object is also achieved by a data collection and data transmission unit, the sensors detecting physiological data of the domestic animal, and send the detected data. The data acquisition and data transfer unit is connected to a provided or a plurality of coils, a rectifier and a storage device for electrical energy, wherein the memory means all or partially providing the energy required for the sensors and the transmission means. The coil (s) is (are) electrically connected to the rectifier conductively connected to an AC induced voltage is rectified forwarded to the memory means. Can as a storage device for example, a capacitor or a rechargeable battery can be provided.

[0012] In order to ensure a good position in any energy consumption, are a plurality of coils around a cuboid or cube-shaped base body wound. Preferred as the main body, a cube made of ferrite material is

provided.

[0013] The invention is explained in more detail by way of example. It shows:

[0014] Figure 1 is a charging station and

[0015] FIG. 2 a bolus in a schematic view

[0016] Figure 1 below refers to a drinking water for dairy cows. In a so playpen, the cows kept free running and enter daily recurring a water drinker. Automatic water trough is known from the publication DE 100 57 989 known. As an alternative to the automatic water drinking device of the invention may also be in a polling station for concentrates, a Parlor or another visited periodically place the livestock be provided.

[0017] The water station 10 consists of a tubular construction with plastic sheets 12, 14, 16, which close the water station on three sides. Head side in the feeding station a drinking bowl with an inlet 20 and an outlet 22 is provided. For a better overview in Figure 1 is an imaginary opening 26 shown by the wall 12.

[0018] In the side walls 12 and 14, respectively, a coil 28 is provided and 30. The coils 28 and 30 are fed by a generator 32. A presence sensor 34 detects whether the cow has entered the potions.

[0019] data acquisition and transmission units can be designed for farm animals in different ways. It is, for example, possible to use this set as an implant under the skin or placed on a so-called bolus in the gastrointestinal tract. It is particularly preferred in Ruminants to place these in the rumen, where they can remain without problems for the animal for many years. This so-called rumen bolus the animal is entered through the throat, and since it is not digested in the contrast to the feed, it will remain in the front part of the rumen. Shall such a rumen bolus operated with a high-quality battery, so it works only for a few months, at most a few years guaranteed. Since cows but certainly over 10 years' standing in milk "may be the power supply of a rumen bolus through a battery insufficient.

[0020] Figure 2 shows the schematic structure of a rumen bolus in a block diagram. The rumen bolus receives its power via three Coils 34 to 38, wherein the coil 34 is arranged in an XY plane, coil 36 in a YZ-plane and the coil 38 in the XZ plane. With this relative orientation of the three coils to each other it is ensured that, regardless of the spatial orientation of the rumen bolus relative to the pair of coils 28 and 30 through the coil, a magnetic flux is present. In the coil induces the time-varying magnetic field AC voltage, which is converted via a rectifier to a DC voltage. The thus obtained direct current is to an accumulator 42 and / or capacitors as storage unit for the electrical energy to. The accumulator 42 feeds the sensors shown schematically 44 to 48, which measure, for example, pressure, temperature, electrical conductivity, and pH. The measured data to a Microprocessor 50 transmitted from which the corresponding measured data are forwarded to a reclaimed transmission device 52.

First

Apparatus for supplying power to a data acquisition and data transmission unit, the physiological data of a via sensors Domestic animal is detected and the detected data sent with, - a station (10) for livestock, the two side walls (12, 14) and a feed trough one, Drinking bowl (18) or the like, - in each case an annular coil (28, 30) in each of the side walls, the aligned, and - an AC generator (32) which is connected to the coils.

Second

Apparatus according to claim 1, characterized in that, in the sensor station, a stay (34) is provided which detects a farm animal in the station and a load signal for a control of the Charging triggers.

Third

Apparatus according to claim 2, characterized in that the sensor detects stay which animal in the Station is located, and the controller checks the charging process, as long as the last load operation for the detected animal is returned and a Charging triggers when the last load operation dates back more than a predetermined period.

4th

Device according to one of claims 1 to 3, characterized in that the coils have the same diameter of preferably about 1 m.

5th

Apparatus according to claim 4, characterized in that the coils are at a distance of about 0.8 m.

6th

Device according to one of claims 1 to 5, characterized in that the coils are arranged co-planar and their centers have the same distance from the ground.

7th

Data acquisition and Data transmission unit, which sensors detects physiological data of the livestock animal and transmits the detected data with, - one or more Coils, a rectifier and a storage device for electrical energy, the whole or part of the energy necessary for the sensors and the transmitting means provides, - wherein the coil (s) is (34, 36, 38) connected to a rectifier (40) is electrically conductive / are a induced alternating voltage is rectified to be applied to the storage device (42),

8th

Data acquisition and data transfer unit according To claim 7, characterized in that a plurality of coils are wound around a cuboid or cube-shaped base body.

9th

Data acquisition and Data transmission unit according to claim 8, characterized in that the base body is formed as a cube, and three pairs of vertically each stationary coils.

10th

Data acquisition and data transfer unit according to claim 8 or 9, characterized in that the basic body consists of a ferrite material.

11th

Data acquisition and data transfer unit according to any one of claims 7 to 10, characterized in that it is formed as a bolus, in particular a ruminal bolus



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Die folgenden Angaben sind den vom Anmelder eingereichten Unterlagen entnommen

- 54 Vorrichtung zur Energieversorgung einer Datenerfassungs- und Datenübertragungseinheit sowie Datenerfassungs- und Übertragungseinheit
- 57 Vorrichtung zur Energieversorgung einer Datenerfassungs- und Datenübertragungseinheit, die über Sensoren physiologische Daten eines Nutztiers erfaßt und die erfaßten Daten sendet, mit einer Station für das Nutztier, die zwei Seitenwände und einen Futtertrog, ein Tränkebecken oder dergleichen aufweist, mit jeweils einer ringförmigen Spule in jeder der Seitenwände, die aufeinander ausgerichtet sind, und mit einem Wechselspannungsgenerator, der an die Spulen angeschlossen ist.

DE 102 21 484 A 1

[0001] Die Erfindung betrifft eine Vorrichtung zur Energieversorgung einer Datenerfassungs- und Datenübertragungseinheit. Ebenfalls betrifft die Erfindung eine Datenerfassungs- und Datenübertragungseinheit selbst.

[0002] Aus DE 199 01 124 der Anmelder ist eine Vorrichtung zur gesteuerten Versorgung von Nutztieren bekannt. Eine Sonde im Magen-/Darmkanal des Nutztieres erfaßt physiologische Daten des Tieres und sendet entsprechende Ergebnisse an eine Versorgungseinrichtung, beispielsweise für Kraftfutter, oder diese werden zur Brunfkontrolle und/oder zur allgemeinen Gesundheitsüberwachung eingesetzt. [0003] Aus WO 98/47351 ist bekannt, Nutztiere mit einem elektronischen Identifikationsgerät zu versehen. Das elektronische Identifikationsgerät kann neben einem Identifikationsmerkmal Meßgrößen zum physiologischen Zustand des Tieres an einen Empfänger senden. Die Identifikations-einrichtung ist als ein passives Bauelement ohne eigene Energieversorgung ausgestattet. Hierzu ist ein Transponder in dem Gerät vorgesehen, der durch eine elektromagnetische Strahlung zur Resonanz angeregt wird und mit einer entsprechenden Identifikationsfrequenz abstrahlt.

[0004] Neben den oben genannten passiven Geräten sind auch Geräte mit einer aktiven Energieversorgung bekannt, bei denen über eine hochwertige Batterie die Energieversorgung sichergestellt wird. Vorteilhaft an der aktiven Energieversorgung ist, daß beispielsweise eine Zwischenspeicherung von Daten erfolgen kann. Als nachteilig erweist es sich jedoch, daß eine Batterie nur eine begrenzte Lebensdauer hat und ausgetauscht werden muß.

[0005] Der Erfindung liegt die Aufgabe zugrunde, eine Vorrichtung zur Energieversorgung einer Datenerfassungs- und Datenübertragungseinheit wie eine Datenerfassungs- und Datenübertragungseinheit selbst bereitzustellen, die bei geringem Aufwand mit einfachen Mitteln eine Energieversorgung ermöglichen.

[0006] Erfindungsgemäß wird die Aufgabe durch eine Vorrichtung nach Anspruch 1 und durch eine Datenerfassungs- und Datenübertragungseinheit nach Anspruch 7 gelöst. Die Unteransprüche bilden vorteilhafte Ausgestaltungen der Erfindung.

[0007] Die erfindungsgemäße Vorrichtung zur Energieversorgung stellt für eine Datenerfassungs- und Datenübertragungseinheit die elektrische Energie bereit. Bei der Datenerfassung werden die physiologischen Daten des Nutztieres erfaßt und nachfolgend werden die erfaßten Daten an eine Empfangsstation gesendet. Die erfindungsgemäße Vorrichtung besitzt eine Station für das Nutztier, die zwei Seitenwände und einen Futtertrog, ein Tränkebecken oder dergleichen aufweist. In jeder der Seitenwände ist jeweils eine ringförmige Spule vorgesehen, wobei die Spulen aufeinander ausgerichtet und mit einem Wechselspannungsgenerator verbunden sind. Der Wechselspannungsgenerator legt eine Wechselspannung an die Spulen an, die ein sich zeitlich änderndes Magnetfeld im Raum zwischen den Spulen erzeugen. Auf diese Weise wird elektromagnetische Energie in dem Bereich zwischen den Spulen bereitgestellt, die zur Versorgung einer Datenerfassungs- und Datenübertragungseinheit dienen kann. Als besonders vorteilhaft an der erfindungsgemäßen Vorrichtung ist, daß die Energieversorgung während der Futter- oder Wasseraufnahme des Nutztieres stattfindet.

[0008] In einer bevorzugten Ausgestaltung ist die Station mit einem Aufenthaltssensor versehen, der ein Nutztier in der Station erfaßt und ein Ladesignal für eine Steuerung des Ladevorgangs auslöst. Während des Ladevorgangs erzeugt der Generator die Wechselspannung und das Spulenpaar

strahlt das zeitlich veränderliche Magnetfeld ab.

[0009] Um den Ladevorgang lediglich dann durchzuführen, wenn dieser erforderlich ist, kann der Aufenthaltssensor so ausgestaltet sein, daß erfaßt wird, welches Nutztier sich in der Station befindet. Die Steuerung des Ladevorgangs überprüft dann, wie lange der letzte Ladevorgang für das erfaßte Nutztier zurückliegt und löst einen Ladevorgang nur dann aus, wenn der letzte Ladevorgang mehr als eine vorbestimmte Zeitdauer zurückliegt.

[0010] In einer bevorzugten Ausgestaltung besitzen die Spulen den gleichen Durchmesser von vorzugsweise ungefähr 1 m, wobei die Spulen einen Abstand von ungefähr 0,8 m besitzen. Der Abstand entspricht dem Abstand der Wände in der Station. Die Spulen sind koplanar angeordnet, wobei der Mittelpunkt den gleichen Abstand vom Boden der Station aufweist. Das Spulenpaar erzeugt in seinem Zwischenraum ein annähernd homogenes Magnetfeld, ähnlich dem eines Helmholzspulenpaars.

[0011] Erfindungsgemäß wird die Aufgabe ebenfalls durch eine Datenerfassungs- und Datenübertragungseinheit gelöst, die über Sensoren physiologische Daten des Nutztieres erfassen und die erfaßten Daten senden. Die Datenerfassungs- und Datenübertragungseinheit ist mit einer oder mehreren Spulen, einem Gleichrichter und einer Speichereinrichtung für elektrische Energie versehen, wobei die Speichereinrichtung ganz oder teilweise die notwendige Energie für die Sensoren und die Sendeeinrichtung bereitstellt. Die Spule(n) ist (sind) mit dem Gleichrichter elektrisch leitend verbunden, um eine induzierte Wechselspannung gleichgerichtet an die Speichereinrichtung weiterzuleiten. Als Speichereinrichtung kann beispielsweise ein Kondensator oder ein Akkumulator vorgesehen sein.

[0012] Um in jeder Position eine gute Energieaufnahme sicherzustellen, sind mehrere Spulen um einen quader- oder würfelförmigen Grundkörper gewickelt. Bevorzugt ist als Grundkörper ein Kubus aus Ferritmaterial vorgesehen.

[0013] Die Erfindung wird nachfolgend anhand eines Ausführungsbeispiels näher erläutert. Es zeigt:

[0014] Fig. 1 eine Ladestation und

[0015] Fig. 2 einen Bolus in einer schematischen Ansicht,

[0016] Fig. 1 bezieht sich nachfolgend auf eine Wassertränke für Milchkühe. In einem sogenannten Laufstall werden die Kühe freilaufend gehalten und betreten täglich wiederkehrend eine Wassertränke. Eine automatische Wassertränke ist beispielsweise aus der Offenlegungsschrift DE 100 57 989 bekannt. Alternativ zu der automatischen Wassertränke könnte die erfindungsgemäße Vorrichtung auch in einer Abrufstation für Kraftfutter, einem Melkstand oder einem anderen in regelmäßigen Abständen besuchten Ort für das Nutztier vorgesehen sein.

[0017] Die Wasserstation 10 besteht aus einer Rohrkonstruktion mit Kunststoffplatten 12, 14, 16, die die Wasserstation dreiseitig abschließen. Kopfseitig in der Tränkestation ist ein Tränkebecken mit einer Zuleitung 20 und einer Ableitung 22 vorgesehen. Zur besseren Übersicht ist in Fig. 1 ein gedachter Durchbruch 26 durch die Wand 12 dargestellt.

[0018] In den Seitenwänden 12 und 14 ist jeweils eine Spule 28 und 30 vorgesehen. Die Spulen 28 und 30 werden von einem Generator 32 gespeist. Ein Anwesenheitssensor 34 erkennt, ob die Milchkuh die Tränke betreten hat.

[0019] Datenerfassungs- und -übertragungseinheiten können für Nutztiere in unterschiedlicher Form ausgebildet sein. So ist es beispielsweise möglich, diese als Implantat unter die Haut zu setzen oder als sogenannter Bolus im Magen-/Darmtrakt zu platzieren. Besonders bevorzugt ist es bei Wiederkäuern, diese im Pansen zu platzieren, wo sie ohne Probleme für das Tier über viele Jahre verbleiben kann. Dieser sogenannte Pansenbolus wird dem Tier über den

Schlund eingegeben und da er im Gegensatz zum Futter nicht verdaut wird, bleibt er im vorderen Teil des Pansens. Wird ein solcher Pansenbolus mit einer hochwertigen Batterie betrieben, so ist seine Funktionsweise lediglich für einige Monate, allenfalls wenige Jahre gewährleistet. Da Kühe jedoch durchaus über 10 Jahre "in Milch stehen" können, ist die Stromversorgung eines Pansenbolus über eine Batterie unzureichend.

[0020] Fig. 2 zeigt den schematischen Aufbau eines Pansenbolus in einer Blockdarstellung. Der Pansenbolus empfängt seine Energie über drei Spulen 34 bis 38, wobei die Spule 34 in einer XY-Ebene, Spule 36 in einer YZ-Ebene und Spule 38 in der XZ-Ebene angeordnet ist. Mit dieser relativen Ausrichtung der drei Spulen zueinander wird sichergestellt, daß unabhängig von der räumlichen Orientierung des Pansenbolus relativ zu dem Spulenpaar 28 und 30 durch die Spulen ein magnetischer Fluß vorhanden ist. In den Spulen induziert das zeitlich veränderliche Magnetfeld eine Wechselspannung, die über einen Gleichrichter in eine Gleichspannung umgesetzt wird. Der so gewonnene Gleichstrom liegt an einem Akkumulator 42 und/oder Kondensatoren als Speichereinheit für die elektrische Energie an. Der Akkumulator 42 speist die schematisch dargestellten Sensoren 44 bis 48, die beispielsweise Druck, Temperatur, elektrische Leitfähigkeit und einen pH-Wert messen. Die gemessenen Daten werden an einen Mikroprozessor 50 weitergeleitet, von dem die entsprechend aufgearbeiteten Meßdaten an eine Sendeeinrichtung 52 weitergeleitet werden.

Patentansprüche

1. Vorrichtung zur Energieversorgung einer Datenerfassungs- und Datenübertragungseinheit, die über Sensoren physiologische Daten eines Nutztieres erfaßt und die erfaßten Daten sendet, mit
 - einer Station (10) für das Nutztier, die zwei Seitenwände (12, 14) und einen Futtertrog, ein Tränkebecken (18) oder dergleichen aufweist,
 - jeweils einer ringförmigen Spule (28, 30) in jeder der Seitenwände, die aufeinander ausgerichtet sind, und
 - einem Wechselspannungsgenerator (32), der an die Spulen angeschlossen ist.
2. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß in der Station ein Aufenthaltssensor (34) vorgesehen ist, der ein Nutztier in der Station erfaßt und ein Ladesignal für eine Steuerung des Ladevorgangs auslöst.
3. Vorrichtung nach Anspruch 2, dadurch gekennzeichnet, daß der Aufenthaltssensor erfaßt, welches Nutztier sich in der Station befindet, und die Steuerung des Ladevorgangs überprüft, wie lange der letzte Ladevorgang für das erfaßte Nutztier zurückliegt und einen Ladevorgang auslöst, wenn der letzte Ladevorgang mehr als eine vorbestimmte Dauer zurückliegt.
4. Vorrichtung nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß die Spulen einen gleichen Durchmesser von vorzugsweise ungefähr 1 m besitzen.
5. Vorrichtung nach Anspruch 4, dadurch gekennzeichnet, daß die Spulen einen Abstand von ungefähr 0,8 m aufweisen.
6. Vorrichtung nach einem der Ansprüche 1 bis 5, dadurch gekennzeichnet, daß die Spulen koplanar angeordnet sind und deren Mittelpunkte den gleichen Abstand vom Boden aufweisen.
7. Datenerfassungs- und Datenübertragungseinheit, die über Sensoren physiologische Daten des Nutztiers erfaßt und die erfaßten Daten sendet, mit

- einer oder mehreren Spulen, einem Gleichrichter und einer Speichereinrichtung für elektrische Energie, die ganz oder teilweise die notwendige Energie für die Sensoren und die Sendeeinrichtung bereitstellt,

- wobei die Spule(n) (34, 36, 38) mit einem Gleichrichter (40) elektrisch leitend verbunden ist/sind, um eine induzierte Wechselspannung gleichgerichtet an die Speichereinrichtung (42) anzulegen.

8. Datenerfassungs- und Datenübertragungseinheit nach Anspruch 7, dadurch gekennzeichnet, daß mehreren Spulen um einen quader- oder würfelförmigen Grundkörper gewickelt sind.

9. Datenerfassungs- und Datenübertragungseinheit nach Anspruch 8, dadurch gekennzeichnet, daß der Grundkörper als Kubus ausgebildet ist und drei paarweise senkrecht zueinander stehende Spulen aufweist.

10. Datenerfassungs- und Datenübertragungseinheit nach Anspruch 8 oder 9, dadurch gekennzeichnet, daß der Grundkörper aus einem Ferriematerial besteht.

11. Datenerfassungs- und Datenübertragungseinheit nach einem der Ansprüche 7 bis 10, dadurch gekennzeichnet, daß diese als ein Bolus, insbesondere als ein Pansen-Bolus ausgebildet ist.

Hierzu 2 Seite(n) Zeichnungen

- Leerseite -

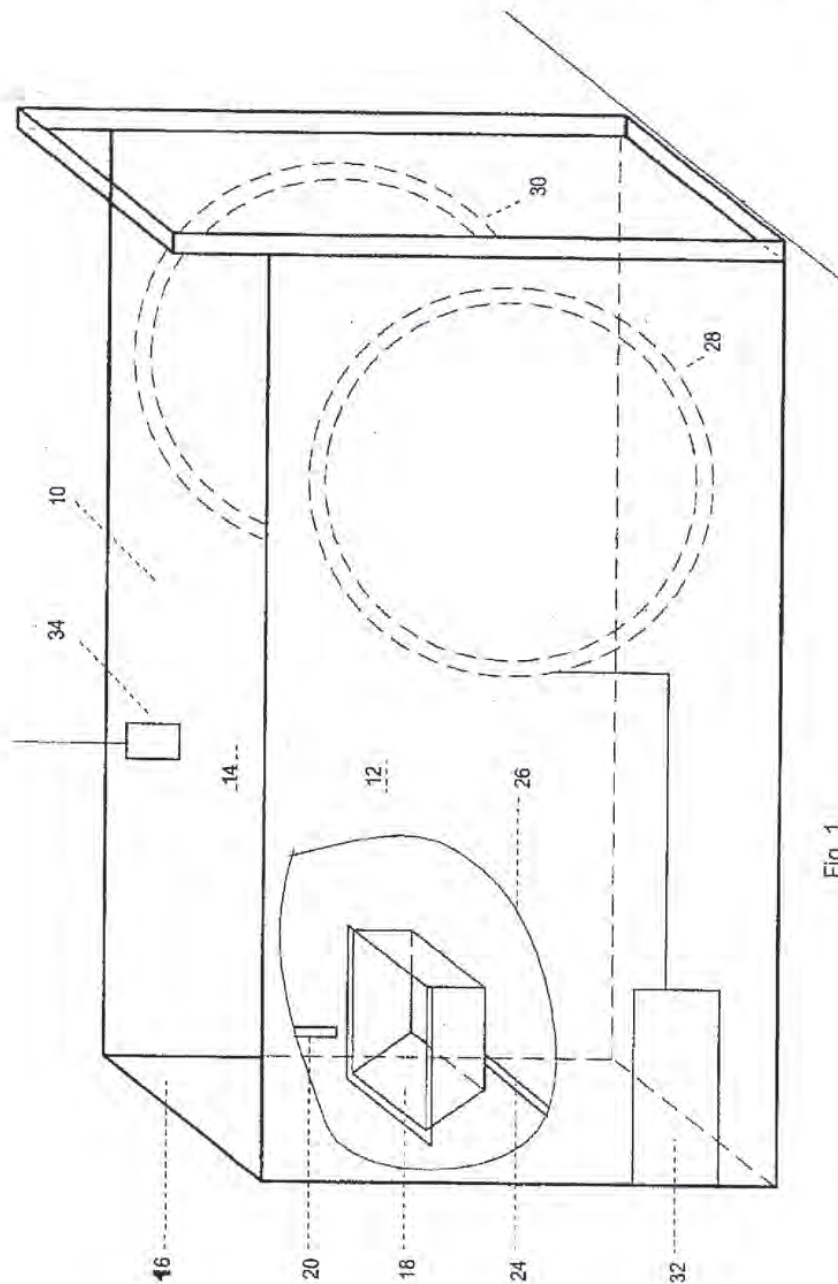


Fig. 1

103 480/413

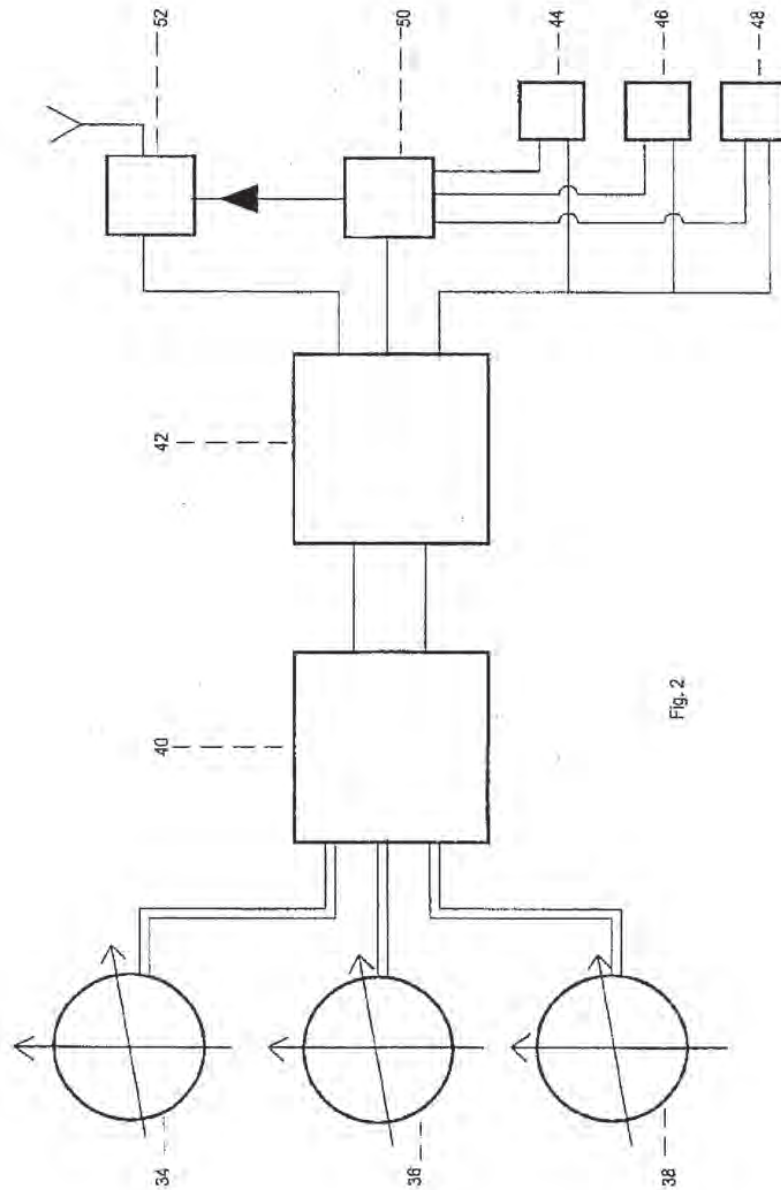


Fig. 2

103 480/413

DERWENT- 2003-560319

ACC-NO:

DERWENT- 200353

WEEK:

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TITLE: System for wireless energy and data transmission has detector of received energy level, regulator producing control signal for sending transmitter/receiver depending on detector signal

PATENT-ASSIGNEE: IC HAUS GMBH[ICHAN]

PRIORITY-DATA: 2000DE-2016655 (September 25, 2000)

PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE
DE 20016655 U1	February 14, 2002	DE

INT-CL-CURRENT:

TYPE	IPC DATE
CIPS	G08C17/02 20060101
CIPS	H02J7/02 20060101

ABSTRACTED-PUB-NO: DE 20016655 U1

BASIC-ABSTRACT:

NOVELTY - The system has a first transmitter/receiver with a regulated supply for supplying a second transmitter/receiver and a wireless data and energy transmitter with a transmitted energy receiver, a rectifier, a device for storing transmitted energy, an energy level detector, a regulator producing a control signal for the first transmitter/receiver and a transmitter for sending the signal to the first transmitter/receiver

DESCRIPTION - The system has a first transmitter/receiver (10) with a regulated supply device for supplying a second transmitter/receiver (20) and a transmitter for wireless data and energy transmission. The second transmitter/receiver has a receiver (30) for the transmitted energy, a rectifier (22), a device (24) for at least partly storing the transmitted energy, a detector (40) of the energy level, a regulator (50) for producing a control signal for the first transmitter/receiver and a transmitter (60) for sending the signal to the first transmitter/receiver. AN INDEPENDENT

CLAIM is also included for the following: a transmitter/receiver, especially an implantable transponder for use in an inventive system.

USE - For wireless energy and data transmission.

ADVANTAGE - Enables a transmitter/receiver with no batteries to be supplied with energy in a certain manner, preferably regulated as required for operation of the transmitter/receiver.

DESCRIPTION OF DRAWING(S) - The drawing shows a schematic representation of an inventive system

first transmitter/receiver (10)

second transmitter/receiver (20)

receiver (30)

rectifier (22)

device (24)

detector (40)

regulator (50)

transmitter (60)

CHOSEN- Dwg.1/1

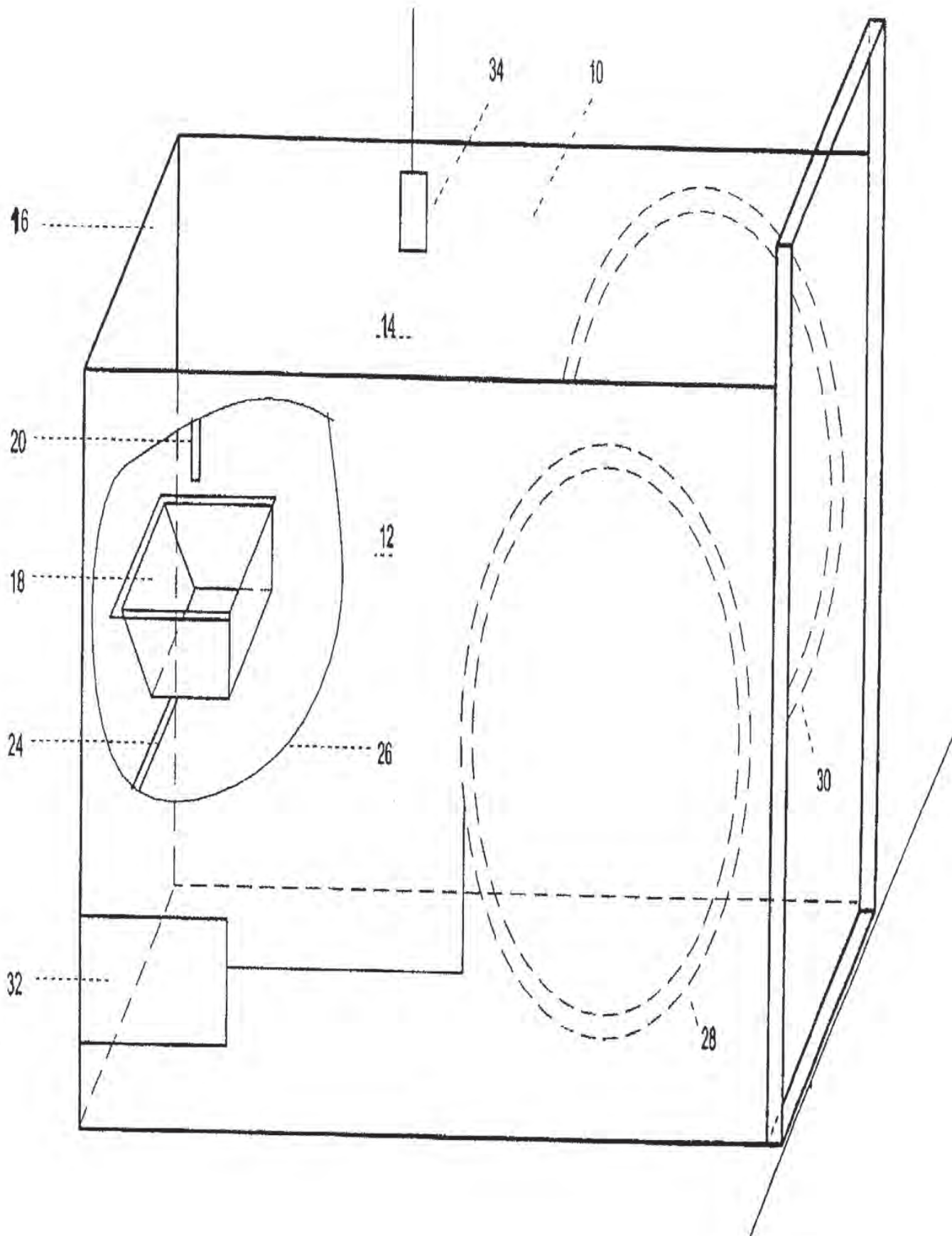
DRAWING:

TITLE- SYSTEM WIRELESS ENERGY DATA TRANSMISSION DETECT

TERMS: RECEIVE LEVEL REGULATE PRODUCE CONTROL SIGNAL SEND
TRANSMIT DEPEND

DERWENT-CLASS: U24 W02 W05

EPI-CODES: U24-E02; W02-G05A; W05-D06A1A; W05-D07G;





Patent Translate

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Description DE20016655

< Desc/ Clms Page number 1 >

EM| 1,1

[http://translationportal.epo.org/...16655&OPS=ops.epo.org&OPS=ops.epo.org&SRQLANG=de&TRGLANG=en&ENGINE=google\[9/30/2012 7:00:20 PM\]](http://translationportal.epo.org/...16655&OPS=ops.epo.org&OPS=ops.epo.org&SRQLANG=de&TRGLANG=en&ENGINE=google[9/30/2012 7:00:20 PM])

EMI 1.2

Energy and data transmission, and a transmitting / receiving device for use in such a system.

Numerous transponder systems are known that consist essentially of an interrogator and an implantable, for example in a human or animal body transponder.

Known transponder can consist of multiple actuators and sensors, run the commands and identify specific data.

The collected data are then transmitted from the transponder to the interrogator and evaluated there.

Such a transponder system is described for example in DE 195 382 13th

The power supply of a transponder can be performed using a separate battery, or in case of a battery-free transponder via an externally coupled supply energy.

Such a battery-free transponder for example disclosed in EP 0 442 390th

It describes batteryless transponder has a resonant circuit which is tuned to the frequency of the transmission signal of the interrogator.

Furthermore, an energy storage is provided which is charged by the light coming from the interrogator transmitter signal rectified.

The energy storage device provides in the charged state, the supply voltage for the transponder.

Further comprising a voltage-limiting means for limiting the voltage across the energy storage device is provided at a predetermined value.

With the known device and the query batteryless transponders it is not possible to

EMI 1.3

<Desc/Cims Page number 2>

to regulate from the interrogator provided for the transponder as a function of energy supply in the transponder determined and evaluated data.

The invention is therefore based on the object, a system for wireless power and data transmission as well as

EMI 2.1

to provide a supply of energy, which is regulated to a certain value, preferably for the operation of the battery-less transceiver required energy.

The gist of the invention is the fact that in the self-powered transceiver a manipulated variable is determined, which is used to a controllable

EMI 2.2

Receiving means to settle such that the wireless transceiver to the battery-less energy transferred substantially to the information required by the battery-free transmission / reception device energy quantity.

The above-mentioned technical problem is solved by the invention for one of the features of claim 1

For this purpose a system for wireless power and data transmission is provided, which preferably has a first and a second transceiver.

The first transceiver has a variable power supply means for providing a

EMI 2.3

and power transmission means for transmitting via a wireless data and.

The second, advantageously powered wireless transceiver comprises a receiving means for receiving from the first transmitting / receiving means wirelessly transmitted energy supply.

For rectifying the transmitted via an RF carrier signal energy of the receiving device is a rectifier, preferably associated with a bridge rectifier.

An energy storage device is used to the wirelessly transmitted and rectified supply energy

<Desc/Cims Page number 3>

EMI3.1

Amount of energy provided border energy quantity.

A regulating device is used to generate, in response to the output signal of the detection means a control signal for controlling the power supply means of the first transmitting / receiving device, wherein the control signal via a transmitting means is wireless to the first transmitting / receiving means transferable.

Advantageous developments are the subject of the dependent claims.

The detection device has, according to a first alternative embodiment of a series circuit comprising a voltage stabilizing means, and a current meter.

The detection means and the control means are able to compare the current flowing through the voltage-stabilizing device current with a predetermined current value.

The predetermined current value is preferably from the first transceiver to operate the required supply energy.

That is, the excess energy is preferably kept small.

According to a further embodiment, the detecting means to one of a load associated voltmeter. The falling of the load voltage in turn can be compared by means of the detection device or the control device with a predetermined voltage value, which in turn reflects the time required by the second transmitting / receiving device energy.

By the special design of the detection device according to the above-described alternatives, it is possible to regulate the power supply device of the first transmitter / receiver device such that the transmitted output power substantially corresponds to the energy that is required by the second battery-free transceiver. In this way it is possible to

EMI3.2

< Desc/Qms Page number 4>

Heat keeping in the second transceiver to a minimum.

In addition, during battery operation of the first transceiver can therefore its battery life can be extended, also, the transmission field strength can be reduced to the necessary degree.

Advantageously, the energy transfer takes place inductively, in which case the receiving means of the second transceiver for receiving said energy comprises a resonant circuit with a fixed resonant frequency.

The two transceivers used in the near field, a carrier frequency for the respective transmission means and a resonant frequency for the resonant circuit can be selected, which lie at around 130 kHz.

The second batteryless transceiver used for example as in a body implantable transponders, it is useful to measure with an implantable temperature sensor measures the temperature in the vicinity of the transponder, in order to avoid a critical heating of the environment.

For this purpose the control device is designed such that it can generate a control signal in dependence of the output signal of the detection device and the temperature sensor.

In this way it is possible, the transmit power to reduce by means of the variable power supply means in the first transmitting / receiving device, even when although the transmitted energy is not required by the second transmitting / receiving device of energy is exceeded, but the temperature in the vicinity of transponder reaches a critical value.

As mentioned, it may, at the second transmitting / receiving device, be an implantable transponder, and then the first transceiver advantageously acts as interrogator.

At this point it should be mentioned that the second transmitting / receiving device according to the various application

< Desc/Qms Page number 5>

May have actuators and sensors, with the exception of the integration of the temperature sensor are not the subject of the invention.

The above object is also achieved by a transmitting / receiving device, which can for example be designed as an implantable, batteryless transponder.

The essential features of the batteryless

EMI 5.1

that the characteristics are not repeated at this point.

The invention will now be described by way of example in more detail in conjunction with FIG.

In the present example as the first transmitting / receiving means comprises a retrieval means 10 is used, which communicates for example with a battery-less transponder 20 via a known inductive coupling.

Wherein said implantable batteryless transponder 20 may be a transponder to be used in medical inkorporalen nerve stimulation.

The interrogation device comprises in addition to a known transmission means 12, and receiving device 14 includes a variable power supply means 16, which provides the supply energy for the transponder 20. The wireless power and data transmission between the interrogator 10 and the transponder 20 via a carrier signal having a frequency of 130kHz for example.

The data can be transmitted, for example as a frequency-modulated signals via the transmitting means 12 for transponder 20.

For this purpose, the transponder 20 corresponding decoding and demodulation, which are not shown.

The transmitted RF signals are coupled via a resonant frequency circuit 30, which is constructed by a parallel circuit of a coil 32 and a capacitor 34.

The resonant frequency of the resonant circuit 30 is

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EMI 6.1

this example, 130 kHz. The injected HFSpannungen be rectified by a bridge rectifier 22, and then at least partially loading a charging capacitor 24.

The charging capacitor 24 is used as an energy storage in the power supply of the transponder 20th. A voltage-stabilizing or voltage limiting element 42, the voltage drop across the charging capacitor 24 voltage is stabilized and limited.

The voltage stabilizing element 42 may be realized for example as a Zener diode 42.

The Zener diode 42 in the present example is part of a detection device 40, further comprising a capacitor connected in series with the Zener diode 42 current blade 44.

The ammeter 44 of the detection device has the task to measure the effluent through the Zener diode 42 current.

The measured current is a measure of whether the transponder 20 is placed too much or too little power supply energy from the interrogation device 10 are available.

In a control device 50 of the measured current with a predetermined current value is compared to the required mapping of the transponder 20 supply energy.

In the control means 50 or alternatively, in the detection device 40 of the measured current from the current sensor 44 with the predetermined current value is compared.

From the comparison value, the control device 50 determines a control signal which is transmitted via a transmission device 60 to the interrogation device 10.

Increases as a function of the actuating signal, or lowers the controllable power supply device, the transmission power of the interrogation device 10

In other words, the transmission power of the interrogator 10 is increased, when the current flowing through the Zener diode 42 current falls below the predetermined current value, while the transmission power is lowered when the measured current exceeds the predetermined current value.

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Alternatively, the detection means comprise a voltage meter and a load, wherein the voltage drop is measured at the load from the voltage meter.

The measured voltage value is then compared with a predetermined voltage value, which in turn corresponds to the required by the transponder 20 supply energy.

This embodiment is not shown in the figure.

For example, the body temperature in the vicinity of the receiving means 30 and the transmitting means 60 of the transponder 20 can measure a temperature sensor 80 is provided.

To avoid that the skin is heated in a critical way, the measured temperature value is also supplied to the control means 50 which produces now both the measured temperature as well as from the current flowing through the Zener diode 42 power a control signal, which power supply means, the controllable 16 of the interrogator prompted to change the transmit power is such that on the one hand, the environment can not be heated in a critical manner and also ensure sufficient energy supply for the transponder.

The signal generated by the control means 50 in the extreme case the control signal can turn the interrogator in order to avoid damage to the body in the vicinity of the transponder.



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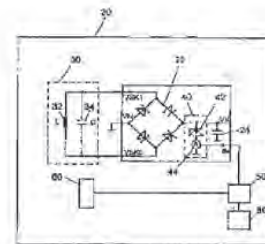
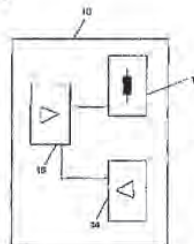
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54 **System zur drahtlosen Energie- und Datenübertragung**

51 System zur drahtlosen Energie- und Datenübertragung mit einer ersten Sende-/Empfangseinrichtung (10), die eine regelbare Energieversorgungseinrichtung (16) zur Bereitstellung einer Versorgungsenergie für eine zweite Sende-/Empfangseinrichtung (20) und eine Sendeeinrichtung (12) zur drahtlosen Daten- und Energieübertragung aufweist, wobei die zweite Sende-/Empfangseinrichtung (20) folgende Merkmale aufweist:
eine Empfangseinrichtung (30, 32, 34) zum Empfangen der von der ersten Sende-/Empfangseinrichtung (10) drahtlos übertragenen Versorgungsenergie,
einen der Empfangseinrichtung (30, 32, 34) zugeordneten Gleichrichter (22), einen Energiespeicher (24) zum wenigstens teilweisen Speichern der drahtlos übertragenen und gleichgerichteten Versorgungsenergie,
eine Detektionseinrichtung (40) zum Erfassen einer vorbestimmten Energiemenge überschreitende Energiemenge,
eine Regeleinrichtung (50), die in Abhängigkeit von dem Ausgangssignal der Detektionseinrichtung (40) eine Stellgröße zur Regelung der Energieversorgungseinrichtung (16) der ersten Sende-/Empfangseinrichtung (10) erzeugt und
eine Sendeeinrichtung (60) zum drahtlosen Übertragen der Stellgröße zur ersten Sende-/Empfangseinrichtung (10).



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System zur drahtlosen Energie- und Datenübertragung

Die Erfindung betrifft ein System zur drahtlosen
Energie- und Datenübertragung sowie eine Sende-/
5 Empfangseinrichtung zum Einsatz in einem solchen System.

Zahlreiche Transpondersysteme sind bekannt, die im
Wesentlichen aus einer Abfrageeinrichtung und einem
beispielsweise in einen menschlichen oder tierischen Körper
implantierbaren Transponder bestehen. Bekannte Transponder
10 können aus mehreren Aktoren und Sensoren bestehen, die
Befehle ausführen bzw. bestimmte Daten ermitteln. Die
ermittelten Daten werden dann vom Transponder zur
Abfrageeinrichtung übertragen und dort ausgewertet. Ein
solches Transpondersystem ist beispielsweise in der DE 195
15 382 13 beschrieben.

Die Energieversorgung eines Transponders kann mittels
einer eigenen Batterie oder im Falle eines batterielosen
Transponders über eine extern eingekoppelte
Versorgungsenergie erfolgen. Ein solcher batterieloser
20 Transponder ist beispielsweise Gegenstand der EP 0442 390.
Der darin beschriebene batterielose Transponder weist einen
Resonanzschwingkreis auf, der auf die Frequenz des
Sendesignals der Abfrageeinrichtung abgestimmt ist. Ferner
ist ein Energiespeicher vorgesehen, der durch das von der
25 Abfrageeinrichtung kommende gleichgerichtete Sendesignal
aufgeladen wird. Der Energiespeicher liefert im geladenen
Zustand die Versorgungsspannung für den Transponder. Ferner
ist eine Spannungs-begrenzende Einrichtung zum Begrenzen der
Spannung an dem Energiespeicher auf einen vorbestimmten Wert
30 vorgesehen. Mit der bekannten Abfrageeinrichtung und dem
batterielosen Transponder ist es jedoch nicht möglich, die

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von der Abfrageeinrichtung für den Transponder bereitgestellte Versorgungsenergie in Abhängigkeit von im Transponder ermittelten und ausgewerteten Daten zu regeln.

Der Erfindung liegt daher die Aufgabe zugrunde, ein
5 System zur drahtlosen Energie- und Datenübertragung sowie eine Sende-/Empfangseinrichtung zu schaffen, mit denen es möglich ist, eine batterie-lose Sende-/Empfangseinrichtung mit einer Versorgungsenergie zu versorgen, die auf einen bestimmten Wert, vorzugsweise auf die zum Betrieb der
10 batterie-losen Sende-/Empfangseinrichtung benötigte Energie geregelt wird.

Der Kerngedanke der Erfindung ist darin zu sehen, dass in der batterie-losen Sende-/Empfangseinrichtung eine Stellgröße ermittelt wird, die dazu dient, eine regelbare
15 Versorgungsenergie in der externen Sende-/Empfangseinrichtung derart zu regeln, dass die drahtlos zur batterie-losen Sende-/Empfangseinrichtung übertragene Energie im Wesentlichen der von der batterie-losen Sende-/Empfangseinrichtung benötigten Energiemenge entspricht.

20 Das oben genannte technische Problem löst die Erfindung zum einen mit den Merkmalen des Anspruchs 1.

Hierzu ist ein System zur drahtlosen Energie- und Datenübertragung vorgesehen, welches vorzugsweise eine erste und eine zweite Sende-/Empfangseinrichtung aufweist. Die
25 erste Sende-/Empfangseinrichtung verfügt über eine regelbare Energieversorgungseinrichtung zur Bereitstellung einer Versorgungsenergie für die zweite Sende-/Empfangseinrichtung und über eine Sendeeinrichtung zur drahtlosen Daten- und Energieübertragung. Die zweite, zweckmäßigerweise
30 batterie-lose Sende-/Empfangseinrichtung weist eine Empfangseinrichtung zum Empfangen der von der ersten Sende-/Empfangseinrichtung drahtlos übertragenen Versorgungsenergie auf. Zur Gleichrichtung der über ein HF-Trägersignal übertragenen Energie ist der Empfangseinrichtung ein
35 Gleichrichter, vorzugsweise ein Brückengleichrichter zugeordnet. Ein Energiespeicher dient dazu, die drahtlos übertragene und gleichgerichtete Versorgungsenergie

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wenigstens teilweise zu speichern. Ferner ist eine Detektionseinrichtung zum Erfassen einer vorbestimmten Energiemenge überschreitende Energiemenge vorgesehen. Eine Regeleinrichtung dient dazu, in Abhängigkeit von dem Ausgangssignal der Detektionseinrichtung ein Stellsignal zur Regelung der Energieversorgungseinrichtung der ersten Sende-/Empfangseinrichtung zu erzeugen, wobei das Stellsignal über eine Sendeeinrichtung drahtlos zur ersten Sende-/Empfangseinrichtung übertragbar ist.

Vorteilhafte Weiterbildungen sind Gegenstand der Unteransprüche.

Die Detektionseinrichtung weist gemäß einer ersten alternativen Ausführungsform eine Serienschaltung aus einer Spannungs-stabilisierenden Einrichtung und einem Strommessgerät auf. Die Detektionseinrichtung oder die Regeleinrichtung sind in der Lage, den durch die Spannung-stabilisierende Einrichtung fließenden Strom mit einem vorbestimmten Stromwert zu vergleichen. Der vorbestimmte Stromwert bildet vorzugsweise die zum Betrieb der ersten Sende-/Empfangseinrichtung benötigte Versorgungsenergie ab. Das heißt, die überschüssige Energie wird vorzugsweise klein gehalten.

Gemäß einer weiteren Ausführungsform weist die Detektionseinrichtung einen einer Last zugeordneten Spannungsmesser auf. Die an der Last abfallende Spannung kann wiederum mittels der Detektionseinrichtung oder der Regeleinrichtung mit einem vorbestimmten Spannungswert verglichen werden, der wiederum die von der zweiten Sende-/Empfangseinrichtung benötigte Energie abbildet.

Durch die spezielle Ausgestaltung der Detektionseinrichtung gemäß den oben beschriebenen Alternativen ist es möglich, die Energieversorgungseinrichtung der ersten Sende-/Empfangseinrichtung derart zu regeln, dass die übermittelte Sendeleistung im Wesentlichen der Energie entspricht, die von der zweiten, batterielosen Sende-/Empfangseinrichtung benötigt wird. Auf diese Weise ist es möglich, die

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Wärmeentwicklung in der zweiten Sende-/ Empfangseinrichtung
möglichst klein zu halten. Darüber hinaus kann bei
Batteriebetrieb der ersten Sende-/ Empfangseinrichtung
demzufolge deren Batterielebensdauer verlängert werden,
5 Ferner kann die Sendefeldstärke auf das notwendige Maß
reduziert werden.

Zweckmäßigerweise erfolgt die Energieübertragung
induktiv, wobei dann die Empfangseinrichtung der zweiten
Sende-/Empfangseinrichtung zum Empfang der Energie einen
10 Schwingkreis mit einer fest vorgegebenen Resonanzfrequenz
aufweist.

Werden die beiden Sende-/Empfangseinrichtungen im
Nahfeld benutzt, kann eine Trägerfrequenz für die jeweiligen
Sendeeinrichtungen und eine Resonanzfrequenz für den
15 Schwingkreis gewählt werden, die etwa bei 130 kHz liegen.
Wird die zweite batterie lose Sende-/Empfangseinrichtung
beispielsweise als in einem Körper implantierbarer
Transponder verwendet, ist es sinnvoll, mit einem
implantierbaren Temperatursensor die Temperatur in der
20 Umgebung des Transponders zu messen, um eine kritische
Erwärmung der Umgebung zu vermeiden. Hierzu ist die
Regeleinrichtung derart ausgebildet, dass sie ein Stellsignal
in Abhängigkeit des Ausgangssignals der Detektionseinrichtung
und des Temperatursensors erzeugen kann. Auf diese Weise ist
25 es möglich, die Sendeleistung mittels der regelbaren
Energieversorgungseinrichtung in der ersten Sende-/
Empfangseinrichtung auch dann zu reduzieren, wenn zwar die
übertragene Energie die von der zweiten Sende-/
Empfangseinrichtung benötigte Energie nicht überschritten,
30 aber die Temperatur in der Umgebung des Transponders einen
kritischen Wert erreicht hat.

Wie erwähnt, kann es sich bei der zweiten Sende-/
Empfangseinrichtung um einen implantierbaren Transponder
handeln, wobei dann die erste Sende-/Empfangseinrichtung
35 zweckmäßigerweise als Abfrageeinrichtung fungiert.

An dieser Stelle sei erwähnt, dass die zweite Sende-/
Empfangseinrichtung je nach Anwendungsfall verschiedene

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Aktoren und Sensoren aufweisen kann, die mit Ausnahme der Einbindung des Temperatursensors nicht Gegenstand der Erfindung sind.

Die oben genannte Aufgabe wird ferner durch eine Sende-
5 /Empfangseinrichtung gelöst, die beispielsweise als
implantierbarer, batterieloser Transponder ausgebildet sein
kann. Die wesentlichen Merkmale der batterielosen
Sende-/Empfangseinrichtung wurden obenstehend in Bezug auf
die zweite Sende-/Empfangseinrichtung näher ausgeführt, so
10 dass die Merkmale an dieser Stelle nicht mehr wiederholt
werden.

Die Erfindung wird nachstehend anhand eines
Ausführungsbeispiels in Verbindung mit einer Figur näher
erläutert.

15 In dem vorliegenden Beispiel wird als erste Sende-/
Empfangseinrichtung eine Abfrageeinrichtung 10 verwendet, die
beispielsweise mit einem batterielosen Transponder 20 über
eine an sich bekannte induktive Kopplung kommuniziert. Bei
dem implantierbaren batterielosen Transponder 20 kann es sich
20 um einen in der Medizintechnik einsetzbaren Transponder zur
inkorporalen Nervenstimulation handeln.

Die Abfrageeinrichtung weist neben einer an sich
bekannten Sendeeinrichtung 12 und Empfangseinrichtung 14 eine
regelbare Energieversorgungseinrichtung 16 auf, die die
25 Versorgungsenergie für den Transponder 20 liefert. Die
drahtlose Energie- und Datenübertragung zwischen der
Abfrageeinrichtung 10 und dem Transponder 20 erfolgt über ein
Trägersignal, welches beispielsweise eine Frequenz von 130kHz
aufweist. Die Daten können beispielsweise als
30 frequenzmodulierte Signale über die Sendeeinrichtung 12 zum
Transponder 20 übertragen werden. Hierzu weist der
Transponder 20 entsprechende Decodier- und
Demodulationseinrichtungen auf, die nicht dargestellt sind.
Die übertragenen HF-Signale werden über einen
35 Resonanzfrequenzkreis 30 eingekoppelt, der durch eine
Parallelschaltung aus einer Spule 32 und einem Kondensator 34
aufgebaut ist. Die Resonanzfrequenz des Schwingkreises 30 ist

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auf die Trägerfrequenz des Sendesignals der Abfrageeinrichtung abgestimmt und beträgt daher in dem vorliegenden Beispiel 130 kHz. Die eingekoppelten HF-Spannungen werden über einen Brückengleichrichter 22
5 gleichgerichtet und laden anschließend zumindest teilweise einen Ladekondensator 24 auf. Der Ladekondensator 24 dient als Energiespeicher bei der Energieversorgung des Transponders 20. Über ein Spannungs-stabilisierendes oder Spannungs-begrenzendes Element 42 wird die über den
10 Ladekondensator 24 abfallende Spannung stabilisiert und begrenzt. Das Spannungs-stabilisierende Element 42 kann beispielsweise als Zener-Diode 42 realisiert werden. Die Zener-Diode 42 ist im vorliegenden Beispiel Bestandteil einer Detektionseinrichtung 40, die ferner einen in Reihe zur
15 Zener-Diode 42 geschalteten Strommesser 44 aufweist. Der Strommesser 44 der Detektionseinrichtung hat die Aufgabe, den über die Zener-Diode 42 abfließenden Strom zu messen. Der gemessene Strom ist ein Maß dafür, ob dem Transponder 20 zu viel oder zu wenig Versorgungsenergie von der
20 Abfrageeinrichtung 10 zur Verfügung gestellt wird. In einer Regeleinrichtung 50 wird der gemessene Strom mit einem vorbestimmten Stromwert verglichen, der die von dem Transponder 20 benötigte Versorgungsenergie abbildet. In der Regeleinrichtung 50 oder alternativ auch in der
25 Detektionseinrichtung 40 wird der vom Strommesser 44 gemessene Strom mit dem vorbestimmten Stromwert verglichen. Aus dem Vergleichswert ermittelt die Regeleinrichtung 50 ein Stellsignal, welches über eine Sendeeinrichtung 60 zur Abfrageeinrichtung 10 übertragen wird. In Abhängigkeit des
30 Stellsignals erhöht oder erniedrigt die regelbare Energieversorgungseinrichtung die Sendeleistung der Abfrageeinrichtung 10. Mit anderen Worten wird die Sendeleistung der Abfrageeinrichtung 10 erhöht, wenn der durch die Zener-Diode 42 fließende Strom den vorbestimmten
35 Stromwert unterschreitet, während die Sendeleistung erniedrigt wird, wenn der gemessene Strom den vorbestimmten Stromwert überschreitet.

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Alternativ kann die Detektionseinrichtung einen Spannungsmesser und eine Last aufweisen, wobei der Spannungsabfall an der Last vom Spannungsmesser gemessen wird. Der gemessene Spannungswert wird dann mit einem
5 vorbestimmten Spannungswert verglichen, der wiederum der von dem Transponder 20 benötigten Versorgungsenergie entspricht. Dieses Ausführungsbeispiel ist jedoch nicht in der Figur dargestellt.

Um beispielsweise die Körpertemperatur in der Nähe der
10 Empfangseinrichtung 30 und der Sendeeinrichtung 60 des Transponders 20 messen zu können, ist ein Temperatursensor 80 vorgesehen. Um zu vermeiden, dass die Haut sich in kritischer Weise erwärmt, wird der gemessene Temperaturwert ebenfalls der Regeleinrichtung 50 zugeführt, die nunmehr sowohl aus der
15 gemessenen Temperatur als auch aus dem durch die Zener-Diode 42 fließenden Strom ein Stellsignal erzeugt, welches die regelbare Energieversorgungseinrichtung 16 der Abfrageeinrichtung veranlasst, die Sendeleistung derart zu ändern, dass zum einen die Umgebung sich nicht in kritischer
20 Weise erwärmt und andererseits eine ausreichende Energieversorgung für den Transponder gewährleistet ist. Das von der Regeleinrichtung 50 erzeugte Stellsignal kann im Extremfall die Abfrageeinrichtung deaktivieren, um Schädigungen des Körpers in der Nähe des Transponders zu
25 vermeiden.

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Schutzansprüche

1. System zur drahtlosen Energie- und Datenübertragung mit
5 einer ersten Sende-/Empfangseinrichtung (10), die eine
regelbare Energieversorgungseinrichtung (16) zur
Bereitstellung einer Versorgungsenergie für eine zweite
Sende-/Empfangseinrichtung (20) und eine Sendeeinrichtung
10 (12) zur drahtlosen Daten- und Energieübertragung
aufweist, wobei
die zweite Sende-/Empfangseinrichtung (20) folgende
Merkmale aufweist:
eine Empfangseinrichtung (30, 32, 34) zum Empfangen der
von der ersten Sende-/Empfangseinrichtung (10) drahtlos
15 übertragenen Versorgungsenergie,
einen der Empfangseinrichtung (30, 32, 34) zugeordneten
Gleichrichter (22), einen Energiespeicher (24) zum
wenigstens teilweisen Speichern der drahtlos übertragenen
und gleichgerichteten Versorgungsenergie,
20 eine Detektionseinrichtung (40) zum Erfassen einer eine
vorbestimmte Energiemenge überschreitende Energiemenge,
eine Regeleinrichtung (50), die in Abhängigkeit von dem
Ausgangssignal der Detektionseinrichtung (40) eine
Stellgröße zur Regelung der Energieversorgungseinrichtung
25 (16) der ersten Sende-/Empfangseinrichtung (10) erzeugt
und
eine Sendeeinrichtung (60) zum drahtlosen Übertragen der
Stellgröße zur ersten Sende-/Empfangseinrichtung (10).
- 30 2. System zur drahtlosen Energie- und Datenübertragung nach
Anspruch 1,
dadurch gekennzeichnet, dass
die Detektionseinrichtung (40) eine Serienschaltung aus

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einer Spannungs-stabilisierenden Einrichtung (42) und einem Strommessgerät (44) umfasst und den durch die Spannungs-stabilisierende Einrichtung (42) fließenden Strom mit einem vorbestimmten Stromwert vergleichen kann,

5

3. System zur drahtlosen Energie- und Datenübertragung nach Anspruch 1,

dadurch gekennzeichnet, dass die Detektionseinrichtung einen einer Last zugeordneten Spannungsmesser aufweist und die an der Last abfallende Spannung mit einem vorbestimmten Spannungswert vergleichen kann.

10

4. System zur drahtlosen Energie- und Datenübertragung nach einem der Ansprüche 1 bis 3,

15

dadurch gekennzeichnet, dass die Energieübertragung induktiv erfolgt und die Empfangseinrichtung der zweiten Sende-/Empfangseinrichtung (30) ein Schwingkreis (32, 34) mit einer fest vorgegebenen Resonanzfrequenz ist.

20

5. System zur drahtlosen Energie- und Datenübertragung nach Anspruch 4,

dadurch gekennzeichnet, dass die Trägerfrequenz der jeweiligen Sendeeinrichtungen (12, 60) und die Resonanzfrequenz des Schwingkreises (32, 34) bei etwa 130 kHz liegt.

25

6. System zur drahtlosen Energie- und Datenübertragung nach einem der Ansprüche 1 bis 5,

30

dadurch gekennzeichnet, dass die zweite Sende-/Empfangseinrichtung (20) einen Temperatursensor (80) aufweist, wobei die

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Regeleinrichtung (50) eine Stellgröße in Abhängigkeit des Ausgangssignals der Detektionseinrichtung (40) und des Temperatursensor (80) erzeugt.

- 5 7 System zur drahtlosen Energie- und Datenübertragung nach einem der Ansprüche 1 bis 6,
dadurch gekennzeichnet, dass die erste Sende-/
Empfangseinrichtung (10) eine Abfrageeinrichtung und die
zweite Sende-/Empfangseinrichtung (20) ein
10 implantierbarer Transponder ist.
8. Sende-/Empfangseinrichtung, insbesondere ein
implantierbarer Transponder zum Einsatz in einem System
zur drahtlosen Energie- und Datenübertragung nach einem
15 der Ansprüche 1 bis 7, umfassend
eine Empfangseinrichtung (30) zum Empfangen der von einer
entfernten Sende-/Empfangseinrichtung (10) drahtlos
übertragenen Versorgungsenergie,
einen der Empfangseinrichtung (30) zugeordneten
20 Gleichrichter (22), einen Energiespeicher (24) zum
wenigstens teilweise Speichern der drahtlos übertragenen
und gleichgerichteten Versorgungsenergie,
eine Detektionseinrichtung (40) zum Erfassen einer eine
vorbestimmte Energiemenge überschreitende Energiemenge,
25 eine Regeleinrichtung (50), die in Abhängigkeit von dem
Ausgangssignal der Detektionseinrichtung (40) eine
Stellgröße zur Regelung einer
Energieversorgungseinrichtung (16) der entfernten Sende-
/Empfangseinrichtung (10) erzeugt und
30 eine Sendeeinrichtung (60) zum drahtlosen Übertragen der
Stellgröße zur entfernten Sende-/Empfangseinrichtung.

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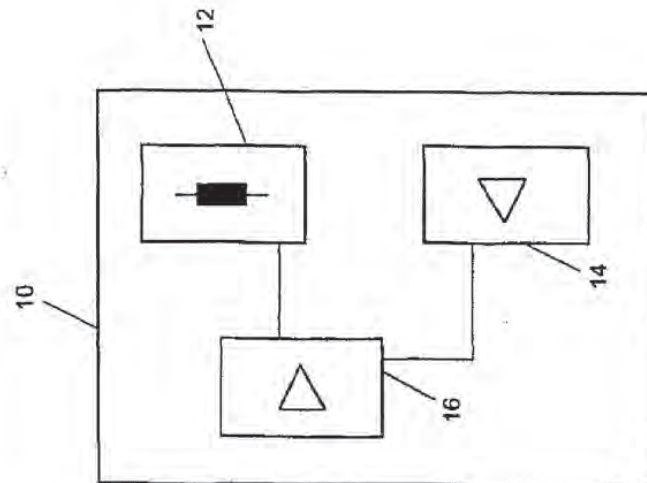
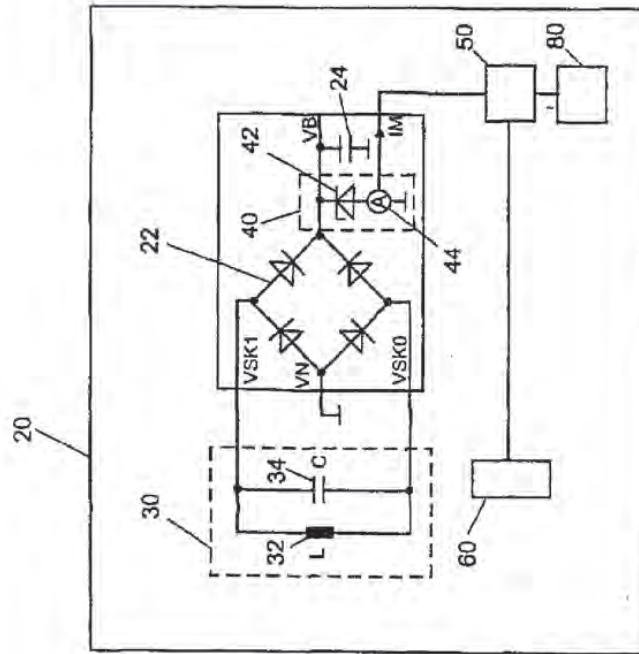
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11

9. Sende-/Empfangseinrichtung nach Anspruch 8
dadurch gekennzeichnet, dass
die Detektionseinrichtung (40) eine Serienschaltung aus
einer Spannungs-stabilisierenden Einrichtung (42) und
5 einem Strommessgerät (44) umfasst und den durch die
Spannungs-stabilisierende Einrichtung (42) fließenden
Strom mit einem vorbestimmten Stromwert vergleichen kann.
10. Sende-/Empfangseinrichtung nach Anspruch 8,
10 dadurch gekennzeichnet, dass
die Detektionseinrichtung einen einer Last zugeordneten
Spannungsmesser aufweist und die an der Last abfallende
Spannung mit einem vorbestimmten Spannungswert
vergleichen kann.
- 15 11. Sende-/Empfangseinrichtung nach Anspruch 8 oder 9,
dadurch gekennzeichnet, dass
die Energieübertragung induktiv erfolgt und die
Empfangseinrichtung (30) der zweiten Sende-/
20 Empfangseinrichtung (20) ein Schwingkreis (32, 34) mit
einer fest vorgegebenen Resonanzfrequenz ist.
12. Sende-/und Empfangseinrichtung nach einem der Ansprüche 8
bis 11,
25 dadurch gekennzeichnet, dass
die zweite Sende-/Empfangseinrichtung (20) einen
Temperatursensor (80) aufweist, wobei die
Regeleinrichtung (50) eine Stellgröße in Abhängigkeit des
Ausgangssignals der Detektionseinrichtung (40) und des
30 Temperatursensor (80) erzeugt.

DE 200 16 655 U1

28.09.00



DE 200 16 655 01

Electronic Acknowledgement Receipt	
EFS ID:	13986230
Application Number:	12649635
International Application Number:	
Confirmation Number:	5891
Title of Invention:	WIRELESS ENERGY TRANSFER TO A MOVING DEVICE BETWEEN HIGH-Q RESONATORS
First Named Inventor/Applicant Name:	John D. Joannopoulos
Customer Number:	26161
Filer:	Marc M. Wefers/Cheryl Forrest
Filer Authorized By:	Marc M. Wefers
Attorney Docket Number:	01997-0359015 / MIT 11757
Receipt Date:	15-OCT-2012
Filing Date:	30-DEC-2009
Time Stamp:	15:45:56
Application Type:	Utility under 35 USC 111(a)

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Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		359015IDS.pdf	58957	yes	2
			9818f942d568e3171826c734fc08bd9d26211dc		

	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Transmittal Letter		1	1	
	Information Disclosure Statement (IDS) Form (SB08)		2	2	
Warnings:					
Information:					
2	Foreign Reference	ART2.pdf	365566	no	14
			4b77a4ba15d95777a2d900188625c776/45d01		
Warnings:					
Information:					
3	Foreign Reference	ART3.pdf	635114	no	21
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Warnings:					
Information:					
4	Non Patent Literature	NPL4.pdf	2736619	no	41
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6	Non Patent Literature	NPL6.pdf	1056792	no	20
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9	Non Patent Literature	NPL9.pdf	1247130 (d) 11b0c8783(2866e1a27f041a811e1209f1c95f	no	26
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : John D. Joannopoulos et al. Art Unit : Unknown
Serial No. : 12/649,635 Examiner : Unknown
Filed : December 30, 2009 Conf. No. : 5891
Title : WIRELESS ENERGY TRANSFER TO A MOVING DEVICE BETWEEN HIGH-
Q RESONATORS

MAIL STOP AMENDMENT

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

INFORMATION DISCLOSURE STATEMENT

Please consider the references listed on the enclosed PTO-1449 form. Foreign patent documents and non-patent literature are enclosed; cited U.S. patents and patent application publications will be provided on request.

This statement is being filed within three months of the filing date of the application or before the receipt of a first Office Action on the merits. Please apply any necessary charges or credits to Deposit Account 06-1050, referencing the above attorney docket number.

Respectfully submitted,

Date: 10/15/12



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Substitute Form PTO-1449 (Modified)	U.S. Department of Commerce Patent and Trademark Office	Attorney Docket No. 01997-0359015	Application No. 12/649,635
Information Disclosure Statement by Applicant (Use several sheets if necessary) (37 CFR §1.98(b))		Applicant John D. Joannopoulos et al.	
		Filing Date December 30, 2009	Group Art Unit

U.S. Patent Documents							
Examiner Initial	Desig. ID	Document Number	Publication Date	Patentee	Class	Subclass	Filing Date If Appropriate
	1						

Foreign Patent Documents or Published Foreign Patent Applications								
Examiner Initial	Desig. ID	Document Number	Publication Date	Country or Patent Office	Class	Subclass	Translation	
							Yes	No
	2	2006-074848	3/16/2006	Japan	H02J	17/00	X	
	3	10-2007-0017804	2/13/2007	Korea	H02J	17/00	X	

Other Documents (include Author, Title, Date, and Place of Publication)		
Examiner Initial	Desig. ID	Document
	4	

Examiner Signature	Date Considered
EXAMINER: Initials citation considered. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.	

Substitute Disclosure Form (PTO-1449)

[Brief Translation]

**JAPANESE PATENT OFFICE
PATENT APPLICATION PUBLICATION (A)**

Application No.: 2004-251768
Applicant: HOKUSHIN DENKI KK,

Publication No.: JP 2006-074848 A

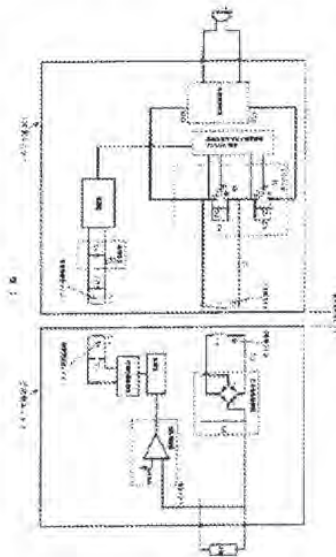
TITLE:

NON-CONTACT POWER TRANSMISSION SYSTEM

ABSTRACT:

PROBLEM TO BE SOLVED: To conduct the efficient stabilization control of a secondary output voltage and a current in a noncontact power transmission system.

SOLUTION: This non-contact power transmissions system can perform secondary stabilization control at high efficiency, in a small size, and at low cost, by transmitting a signal related to a secondary voltage and a current to a primary unit using a noncontact electromagnetic coupling coil, receiving a signal transmitted from the secondary side, and varying the drive frequency of a primary inverter. This reduces ineffective power consumption on the primary side by providing it with a means which controls the secondary output voltage and the current by shifting the drive frequency to a higher side at a light load or no-load and reducing the current of the primary coil of a coupling transformer thereby controlling the stabilization of the secondary output voltage and the current.



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特開2006-74848

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(22) 出願日	平成16年8月31日(2004.8.31)		北伸電機株式会社
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		Fターム(参考)	5H730 AA14 AS01 BB24 BB62 BB80
			CC01 DD04 DD41 EE04 EE07
			FD01 FF02 FF18 VV03

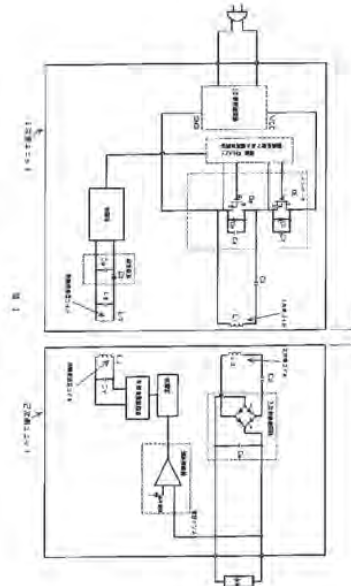
(54) 【発明の名称】 非接触電力伝送装置

(57) 【要約】 (修正有)

【課題】 非接触電力伝送装置における2次側出力電圧、電流の安定化制御を高効率で実現する。

【解決手段】 本発明の非接触電力伝送装置では、2次側における電圧および電流に関する信号を1次側ユニットへ非接触の電磁結合コイルを用いて1次側に送信し、1次側ユニットでは2次側から送られてきた信号を受信して、1次側のインバータの駆動周波数を可変させることにより高効率、小型、低コストで2次側の安定化制御を行う事が出来る。軽負荷時や無負荷時において駆動周波数を高い方に移動させ、結合トランスの1次側コイルの電流を減少させる事により2次側の出力電圧及び電流を安定化制御する手段を設ける事により、1次側の無効な消費電力が減少させる。

【選択図】 図1



【特許請求の範囲】

【請求項 1】

結合トランスの 1 次側と 2 次側を個別に収容して、相互に分離可能に構成してなる 1 次側ユニットと 2 次側ユニットを具備し、前記 1 次側ユニットから 2 次側ユニットへ電磁誘導作用を利用して非接触で電力を供給する非接触電力伝送装置において、前記 2 次側ユニットは、前記結合トランスの 2 次側における電圧および電流に関する信号を前記 2 次側ユニットから前記 1 次側ユニットへ制御用送信コイルを用いて送信する送信手段を備え、前記 1 次側ユニットは、前記制御用送信コイルと電磁結合された制御用受信コイルをもちいて 2 次側における電圧および電流に関する信号を受信して、結合トランスの 1 次側コイルの高周波電流を可変し 2 次側の出力電圧及び電流を安定化制御する手段を具備して構成したことを特徴とする非接触電力伝送装置。

10

【請求項 2】

結合トランスの 1 次側と 2 次側を個別に収容して、相互に分離可能に構成してなる 1 次側ユニットと 2 次側ユニットを具備した非接触電力伝送装置であって 1 次側直列共振回路の共振周波数と駆動周波数を離調させて設定し、前記 1 次側直列共振回路の共振周波数と駆動周波数の離調の程度により 1 次側直列共振回路の電流を制限すること及び 2 次側直列共振回路の共振周波数を 1 次側駆動周波数にほぼ等しくする様に 1 次と 2 次の直列共振回路の共振周波数を設定した状態において、1 次側の駆動周波数を可変することにより 2 次側出力電圧又は電流を可変する事を特徴とする非接触電力伝送装置。

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【発明の詳細な説明】

【技術分野】

【0001】

本発明は非接触電力伝送装置において 2 次側における電圧および電流を 1 次側にフィードバックし、2 次側出力電圧、電流を安定化制御する非接触電力伝送装置に関する。

【背景技術】

【0002】

非接触電力伝送装置において、2 次側の安定化を計る場合、2 次側に独立した安定化回路を設ける方法がある。（例えば、特許文献 1、2、3 参照。）。

【特許文献 1】特許公開 2002-354711 号 公報

【特許文献 2】特許公開 2004-120915 号 公報

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【特許文献 3】特許出願 2002-252511 号 公報

【0003】

2 つ目の方法として、2 次側共振回路の共振用コンデンサーの値を変える事により、共振周波数を変えて、2 次側で受電出来る電力を可変する方法を用い安定化する方法がある。（例えば、特許文献 4 参照。）。

【特許文献 4】特許公開 2004-72832 号 公報

【発明の開示】

【発明が解決しようとする課題】

【0004】

従来方式の課題として以下のものがあげられる。すなわち 2 次側に独立した安定化回路を設ける方法は 2 次側の安定化回路の損失が有り、全体の効率を下げてしまう。

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2 次側が軽負荷の場合においても、結合トランスの 1 次側コイルの電流は少なくならず 1 次側コイルの消費電力が低減しない。

【0005】

2 次側の共振回路の共振周波数を変える方法は、2 次側が軽負荷の場合においても、結合トランスの 1 次コイルの電流は小さくならず 1 次側コイルの消費電力が低減しない。

【0006】

以上に述べた従来の非接触電力伝送装置における 2 次側出力電圧、電流を安定化制御する方法では、全体の効率が悪い。また 2 次側負荷が軽負荷の場合における消費電力を低減出来ない。

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【0007】

本発明は非接触電力伝送装置における2次側出力電圧、電流の安定化制御を高効率で実現することを目的とするものである。

【課題を解決するための手段】

【0008】

上記目的を達成するため、本発明の非接触電力伝送装置は、2次側における電圧および電流に関する信号を1次側ユニットへ非接触の電磁結合コイルを用いて1次側に送信し、1次側ユニットでは2次側から送られてきた信号を受信して、1次側ユニットのインバータの駆動周波数を可変し2次側の出力電圧及び電流を安定化制御する手段を設けたものである。

10

【発明の効果】

【0009】

本発明の非接触電力伝送装置によれば、非接触で2次側の電圧電流情報を1次側に伝送しインバータの駆動周波数を変え出力電圧、電流を制御出来るため、閉磁路コアを用いたスイッチング電源と同じ安定化電源を実現出来る事にある。

このため2次側ユニットに独立した安定化のためのチョップ回路やシリーズレギュレータが不要であり、2次側の安定化回路の為の損失が無いので、高効率の非接触電力伝送装置が実現出来る。2次側ユニットに独立した安定化回路が不要なのでこの回路の実装面積も不要となり小型化が可能になりコストも低減する。

【0010】

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2次側負荷が軽負荷もしくは無負荷時において、インバータの駆動周波数を上げる制御を行う事により、駆動される結合トランスの1次側直列共振回路の共振周波数から離調するため1次側コイルの高周波電流も減る事になり、2次側負荷が軽負荷もしくは無負荷時において交流電源の消費電力を低減できる効果がある。

【発明を実施するための最良の形態】

【0011】

図1は非接触電源装置に応用した回路図である。

以下本発明の実施の形態を図1から図6に基づいて説明する。

【0012】

図1において1次側ユニットのインバータは1次側整流回路の直流出力を電源とする。前記インバータはハーフブリッジ接続され発振周波数可変2相発振器により駆動される。結合トランスの1次側コアに巻き線を巻き回し、1次側コイルを作る。この1次側コイルをL1とする。L1と直列に共振コンデンサC1を接続する。

30

一方、2次側ユニットでは、2次側コアに巻き線を巻き回し、2次側コイルを得る。この2次側コイルをL2とする。前記L2を用いてL1の磁力線から高周波電力を取り出す。L2にC2を直列に接続して2次側直列共振回路を得る。C2の後のブリッジ整流回路とC6から構成する2次側整流回路により整流した後、負荷に電力を供給する。

【0013】

図1のインバータは電界効果トランジスタQ1のドレインDを1次側整流回路のVCC側に接続し、Q1のソースSとQ2のドレインDを直列に接続し、Q2のソースSを1次側整流回路のGND側に接続する。

40

Q1のソースSとQ2のドレインDの接続点に、1次側直列共振回路のC1側を接続する。L1側をQ2のソースに接続する。

Q1のドレインDとソースSに並列にC3を、Q2のドレインDとソースSに並列にC4を接続する。

D1、D2は電界効果トランジスタで有るQ1、Q2のボディダイオードである。

【0014】

図1の発振周波数可変2相発振器は、Q1のG-S間及びQ2のG-S間にデットタイムを設けて交互に電圧駆動する発振周波数可変の発振器で有る。

【0015】

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図5のタイミングチャートにおいてQ1のG-S間を駆動する電圧をQ1 VGSと表し、Q2のG-S間を駆動する電圧をQ2 VGSと表して有る。
同様に図5のタイミングチャートにおいてQ1 VGSとQ2 VGS間のデットタイムをDtと表して有る。

【0016】

図4-Aは結合トランスの1次側直列共振回路の共振周波数と2次側直列共振回路の共振周波数対2次側負荷出力電圧の関係をグラフで表したもので有る。

縦軸は2次側負荷出力電圧を示し、横軸はインバータの駆動周波数を示す。

1次側直列共振回路の共振周波数を f_p に設定し、2次側直列共振回路の共振周波数を f_s に設定して有る。

$f_p < f_s$ の関係に設定する。

駆動周波数の使用範囲は図4-Aの f_s から f_1 までとする。

【0017】

図4-Bは駆動周波数対、1次側直列共振回路の共振周波数特性と2次側直列共振回路の共振周波数特性を合成した2次側整流電圧のカーブで有る。

【0018】

図4-Bのグラフにおいて、 f_s の点を使用範囲の最大出力電圧の点なるよう1次、2次の共振回路の共振周波数を設定しインバータの最低駆動周波数を f_s に設定する。

AC入力電圧の変動や負荷の変動に応じて駆動周波数の変化範囲を f_0 から f_1 の範囲に設定する。

負荷に最大出力電圧を供給できる駆動周波数は f_s の点になる。

定格負荷時は周波数を f_0 に設定し、AC入力電圧が低下した場合や、負荷が重たくなった場合など、周波数 f_s に設定する。AC入力電圧が高くなった場合や軽負荷時は、周波数を f_1 に設定する。

f_p 、 f_s 、 f_0 、 f_1 の各周波数の1例を下記に示す。

$f_p \approx 60 \text{ KHz}$ 、 $f_s \approx 74 \text{ KHz}$ 、 $f_0 \approx 77 \text{ KHz}$ 、 $f_1 \approx 100 \text{ KHz}$

【0019】

図4-Bのグラフからは、インバータの駆動周波数を変化させることで出力電圧を可変出来ることが判る。2次側出力電圧が設定より下回った場合その情報を、信号制御用送信コイルを用いて非接触で1次側ユニットに送り、1次側ユニットのインバータの駆動周波数を下げる方向でフィードバック制御を行う。また、軽負荷時等において、出力電圧が設定より上回った場合は、その情報を、制御用送信コイルを用いて非接触で1次側ユニットに送り、1次側ユニットのインバータの駆動周波数を上げる方向でフィードバック制御を行う。

【0020】

図1において2次側整流回路の出力電圧を誤差増幅器に接続し、この電圧と基準電圧を比較する。

誤差増幅器の出力を変調器に接続し変調器の出力を制御用発振回路に接続する。

制御用発振器はL4とC7の並列共振周波数で自励発振を行う。

【0021】

図1においてL3とC8の並列共振回路を検波回路に接続し、検波回路の出力を復調器に接続する。

復調回路の出力を発振周波数可変2相発振器に接続する。

【0022】

図3は誤差増幅器、変調器、制御用発振器、復調器、発振周波数可変2相発振器の具体例で有る。

出力電圧をR201とR202で分割しU202のオペアンプのインバータ端子（－端子）に接続する。

U202のオペアンプのノンインバータ端子（＋端子）には基準電圧を印可しておく。

U202の出力を、U201のコンパレータのインバータ端子（－端子）に接続する。

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三角波発振器の出力をU201のノンインバータ端子(+端子)に接続する。
三角波発振器の発信周波数を10KHz程度で有る。
制御用発振器はL4、C7の並列共振回路を用いたLC発振器で有り、8MHz程度の発振周波数である。L4は制御用送信コイルである。
U201の出力を制御用発振器に接続し、制御用発振器の発振を断続させる。

【0023】

一方1次側ユニットにおいて、L3はL4と電磁結合された制御用受信コイルで有る。L3、C8の並列共振回路は制御用発振器の発振周波数に同調させる値とする。
L3、C8の並列共振回路をD3、C9で構成された検波回路に接続する。
検波回路の出力をU101のコンパレータのノンインバータ端子(+端子)に接続する。
U101のコンパレータのインバータ端子(-端子)には、+12VをR103とR104で分割した電圧を印可する。
検波回路の出力をR103とR104で分割した電圧と比較しU101の出力とする。U101の出力をNPNトランジスタQ103のベースへ抵抗を介して接続する。
Q103のコレクタをPNPトランジスタQ102のベースへ抵抗を介して接続する。Q102のエミッタを+12V電源に接続する。
Q102のエミッタにD101、L101、C102から構成するパルス幅-電圧変換回路に接続する。
パルス幅-電圧変換回路の出力をNPNトランジスタQ101のベースへ抵抗を介して接続する。

Q101のエミッタにR102を接続し回路のGNDに接続する。
2相発振回路はC101とR101のCR発振器を構成して有る。
Q101のコレクタをR101に接続する。R101はR101とQ101のコレクター-エミッタを通して並列接続されている。
2相発振回路の出力はA相とB相の2出力を持ち、それぞれ逆相で出力される。
2相発振回路の出力をデッドタイム生成回路に接続し、A相とB相間に僅かなデッドタイムを設ける。
デッドタイム生成回路の出力をハーフブリッジドライバに接続する。
ハーフブリッジドライバに接続されているD101とC102はハイサイドスイッチのQ1の駆動電源を作る目的でブーストアップ回路を構成してある。
ハーフブリッジドライバの出力はQ1のゲート、ソース間とQ2のゲート、ソース間に接続する。
Q1とQ2のゲートソース間電圧波形は図5のQ1VGSとQ2VGSになる。

【0024】

図2にU字型コアを用いた結合トランスの一例をしめす。
1次側ユニットに設けたU字型コアの胴部に1次巻き線 L1を巻き回する。
2次側ユニットに設けたU字型コアの胴部に2次巻き線 L2を巻き回する。
結合トランスの1次2次間は、1次側ユニットの樹脂製外郭と2次側ユニットの樹脂製外郭で隔てられている。
結合トランスの1次側U字型コアの脚部の先端と2次側U字型コアの脚部の先端とは、数mmの間隔を隔てて対向している。
1次側U字コアの両脚の中央と1次側ユニットの樹脂製外郭の内側の境界面にL3を配置し、2次側U字コアの両脚の中央と2次側ユニットの樹脂製外郭の内側の境界面にL4を配置する。
L3、L4は空芯コイルを用いる。

【0025】

フィードバック制御の説明を図3、図4、図6を用いて説明する。
1次側ユニットから2次側ユニットへ非接触で電力を伝送している状態において2次側ユニットの出力電圧が設定値より高い場合、(図6の左側部分)オペアンプU202のインバータ端子(-端子)の電圧である、R201とR202で出力電圧を分割した電圧とノ

ンインバータ端子（＋端子）に接続してある基準電圧の比較でインバータ端子（－端子）の方が高いため、U202の出力電圧は低い方へ変化する。

U202の出力電圧はコンパレータのU201のインバータ端子（－端子）に接続してあり、U201のノンインバータ端子（＋端子）には三角波を印加してある為、三角波の振幅が、U201のインバータ端子より高い期間、Hiレベル出力電圧になる。三角波は固定周波数で有るためその周期も固定である。一定周期の期間においてU201の出力がU201のインバータ端子の電圧に応じてU201のパルス幅が変化する為、パルス幅変調の動作といえる。

2次側ユニットの出力電圧が設定値より高い場合、U201のON幅が広がる結果になる。

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【0026】

U201の出力で制御用発振器の発振を断続する制御を行う。

U201の出力がHiレベルの状態で制御用発振器が発振し、U201の出力がLowレベルの状態では制御用発振器の発振が停止する。

U201の出力がONの期間制御用発振器が発振し、出力がOFFの期間制御用発振器が発振を停止する。

2次側ユニットの出力電圧が設定値より高い場合、制御用発振器が発振している期間が長くなる。

【0027】

1次側ユニットに設けられたL3は2次側ユニットのL4と電磁結合しているためL3、C8の並列共振回路の高周波誘導電圧は、制御用発振器の発振の断続に応じて断続する。

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【0028】

L3、C8に接続された検波回路の出力はU201の出力がONの時ON、U201の出力がOFFの時、OFFとなり、検波回路のON幅は、U201の出力のON幅に同期する。

【0029】

復調器のU101は検波回路電圧を増幅する目的のコンパレータで有る。

検波回路の出力電圧をU101のノンインバータ端子（＋端子）に接続して有るためR103とR104で生成した基準電圧よりU101のインバータ端子（－端子）の電圧が高いと、U101の出力はON、NPNタイプのQ103がON、PNPタイプのQ102がONとなる。

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Q102のON幅はU201のON幅と同じになる。

【0030】

L201、D101、C102を用いたパルス幅－電圧変換回路はフィードフォワードタイプのスイッチング電源回路の2次側整流回路に用いられるものと同じ構成である。

従ってQ102のON幅に比例した出力電圧が得られる。

結果U201のON幅に比例した出力電圧が得られる。

以上から2次側ユニットの出力電圧が設定値より高い場合、パルス幅－電圧変換回路の出力電圧も高くなる。

【0031】

パルス幅－電圧変換回路の出力を、抵抗を介してNPNのQ101のベースに接続して有るため、パルス幅－電圧変換回路の出力電圧が高くなるとQ101のコレクタ電流が増える。

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Q101のコレクタ電流が増える事は、等価的にR101の抵抗値が減る事になる。

【0032】

2相発振器はCR発振器で構成されているため、R101の抵抗値が減ると2相発振器の発振周波数は高くなる。2相発振器の発振周波数が高くなるとインバータの駆動周波数が高くなる。図4-Bから駆動周波数が高くなると2次側ユニットの出力電圧が低くなる事が判る。

【0033】

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2次側ユニットの出力電圧が設定値より低い場合は図6の右側に示すとおりU201のコンパレータのON幅が狭まり、制御用発振器の発振幅が狭まりL4の高周波電流の発振幅が狭まる。

【0034】

制御用発振器の発振幅が狭まりL4の高周波電流の発振幅が狭まると、検波回路の出力のON幅が狭まり、パルス幅—電圧変換回路の出力電圧が低くなり、Q101のコレクタ電流が減る。Q101のコレクタ電流が減ると等価的にR101の抵抗値に近づく事になる。

【0035】

2相発振器はCR発振器で構成されているため、2相発振器の発振周波数は低くなる。2相発振器の発振周波数が低くなるとインバータの駆動周波数が低くなる。

図4-Bから駆動周波数が低くなると2次側ユニットの出力電圧が高くなる事が判る。

【0036】

以上の様に2次側電圧情報が1次側にフィードバックされ、インバータの駆動周波数を変え、2次側の出力電圧を安定化する。

【0037】

同様な手法を用いて2次側の電流情報を1次側にフィードバックされ、インバータの駆動周波数を変え、2次側の出力電流を安定化することが出来る。

【図面の簡単な説明】

【0038】

【図1】本発明の実施形態を示す、概略回路図である。

【図2】結合トランスの構造図。

【図3】フィードバック制御の為の詳細回路図。

【図4】駆動周波数対、1次側直列共振回路の共振周波数特性と2次側直列共振回路の共振周波数特性と2次側整流電圧の関係を表した説明図。

【図5】インバータ回路と結合トランスの動作を説明するタイムチャート。

【図6】フィードバック制御の動作を説明するタイムチャート。

【符号の説明】

【0039】

L1：結合トランスの1次側巻き線インダクタンス。

L2：結合トランスの2次側巻き線インダクタンス。

C1：1次側直列共振用コンデンサ。

C2：2次側直列共振用コンデンサ。

L3：制御用受信コイル。

L4：制御用送信コイル。

C7：L4の並列共振用コンデンサ。

C8：L3の並列共振用コンデンサ。

f_p：1次側直列共振回路の共振周波数。

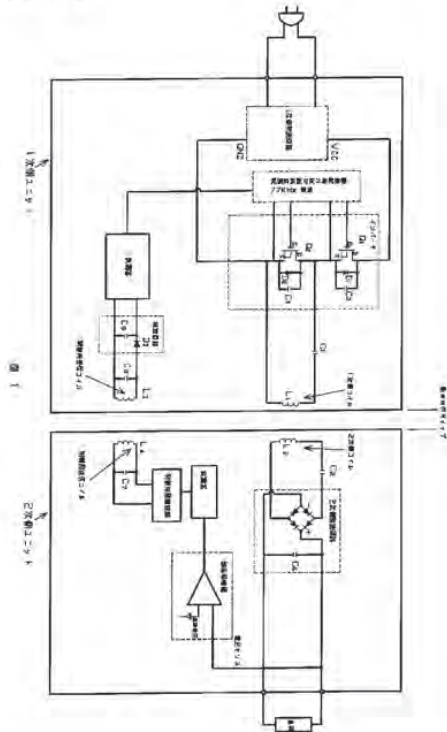
f_s：2次側共振回路の共振周波数。

f₁：定格負荷時のインバータ駆動周波数。

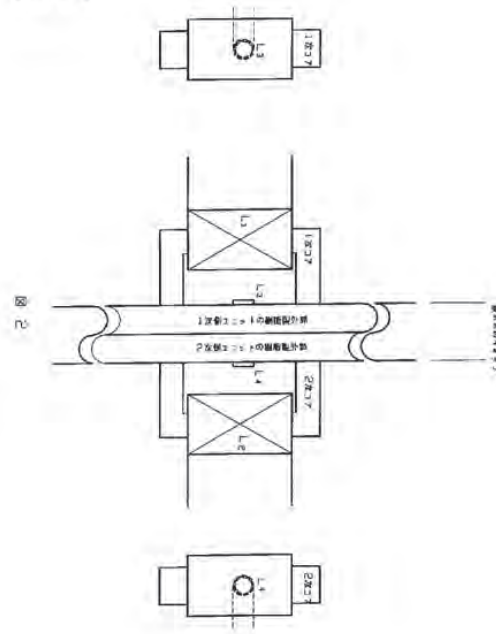
f₀：重負荷時のインバータ駆動周波数。

f₂：軽負荷時のインバータ駆動周波数。

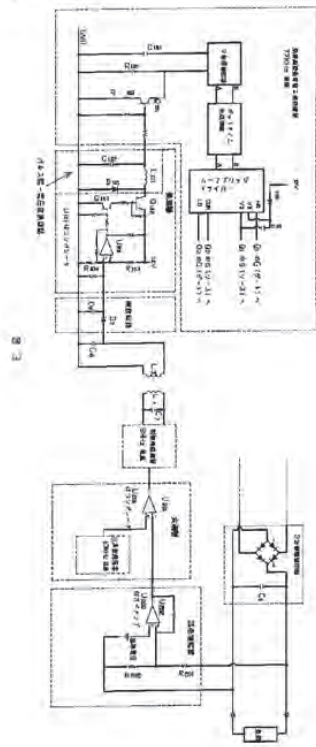
【図 1】



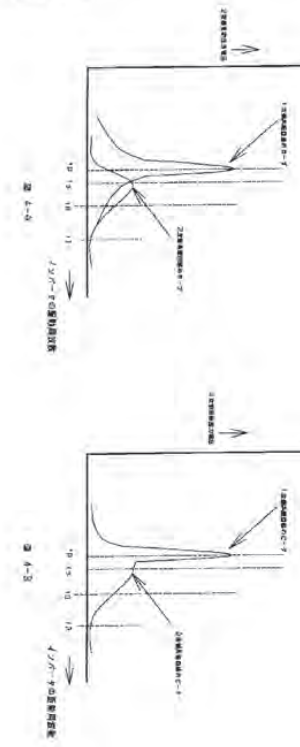
【図 2】



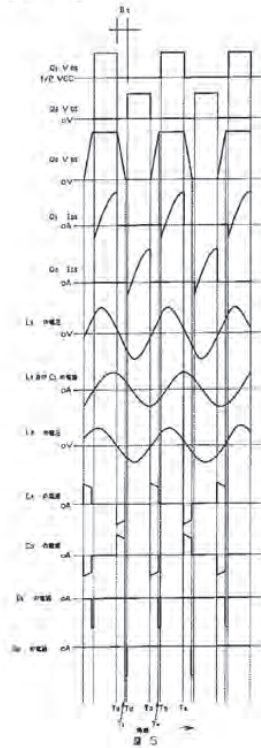
【図 3】



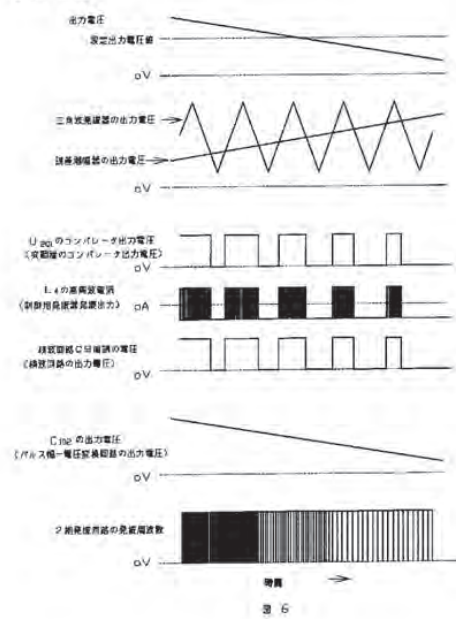
【図 4】



【図 5】



【図 6】



JP2006-074848 Machine Translation

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CLAIMS

[Claim(s)]

[Claim 1]

Accommodate a secondary individually a primary coupling transformer side, and a primary side unit and a secondary unit which are constituted disengageable mutually are provided, In non-contact transfer-of-power equipment which supplies electric power to a secondary unit by non-contact from the aforementioned primary side unit using an electromagnetic induction action, the aforementioned secondary unit, It has a transmitting means which transmits a signal about voltage and current in a secondary of the aforementioned coupling transformer to the aforementioned primary side unit using a transmission coil for control from the aforementioned secondary unit, The aforementioned primary side unit is with a receiver coil for control by which inductive coupling was carried out to the aforementioned transmission coil for control, and a signal about voltage and current in a secondary is received, Non-contact transfer-of-power equipment providing and constituting a means which changes high frequency current of a primary side coil of a coupling transformer, and carries out stabilization control of output voltage and current of a secondary.

[Claim 2]

Accommodate a secondary individually a primary coupling transformer side, and are non-contact transfer-of-power equipment possessing a primary side unit constituted disengageable and a secondary unit, and make resonance frequency and drive frequency of a primary side series resonant circuit detune mutually, and it sets to it, In the state where resonance frequency of the primary series resonant circuit [secondary] was set up so that resonance frequency of restricting current of a primary side series resonant circuit by a degree of detuning of resonance frequency and drive frequency of the aforementioned primary side series resonant circuit and a secondary series resonant circuit might be made substantially equal to primary side drive frequency, Non-contact transfer-of-power equipment changing secondary side output voltage or current by changing drive frequency by the side of primary.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[Field of the Invention]

[0001]

The present invention feeds back the voltage and current in a secondary to a primary side in non-contact transfer-of-power equipment, and relates to the non-contact transfer-of-power equipment which carries out stabilization control of secondary side output voltage and the current.

[Background of the Invention]

[0002]

In non-contact transfer-of-power equipment, when measuring stabilization of a secondary, there is the method of providing the stabilization circuit independent to the secondary. (For example, a Patent document 1, 2, three references.).

[Patent document 1] Patent public presentation No. 354711 [2002 to] Gazette

[Patent document 2] Patent public presentation No. 120915 [2004 to] Gazette

[Patent document 3] Patent application No. 252511 [2002 to] Gazette

[0003]

By changing the value of the capacitor for resonance of a secondary resonant circuit, resonance frequency is changed and the 2nd method includes a method stable using the method of changing the electric power which can receive transmitted electricity by a secondary. (For example, see Patent Document 4.).

[Patent document 4] Patent public presentation No. 72832 [2004 to] Gazette

[Description of the Invention]

[Problem to be solved by the invention]

[0004]

The following are raised as problem of a conventional system. That is, the method of providing the stabilization circuit independent to the secondary has the loss of the stabilization circuit of a secondary, and will lower the whole efficiency.

When a secondary is a light load, the current of the primary side coil of a coupling transformer does not decrease, and the power consumption of a primary side coil does not reduce it.

[0005]

When the secondary of the method of changing the resonance frequency of the resonant circuit of a secondary is a light load, the current of the primary coil of a coupling transformer does not become small, and the power consumption of a primary side coil does not reduce it.

[0006]

In the method of carrying out stabilization control of the secondary side output voltage in the conventional non-contact transfer-of-power equipment described above, and the current, the whole efficiency is bad. Power consumption in case secondary side load is a light load cannot be reduced.

[0007]

An object of the present invention is to be efficient and to realize stabilization control of the secondary side output voltage in non-contact transfer-of-power equipment, and current.

[Means for solving problem]

[0008]

In order to attain the above-mentioned purpose, the non-contact transfer-of-power equipment of the present invention, Transmit the signal about the voltage and current in a secondary to a primary side unit at a primary side using a non-contact electromagnetic coupling coil, and the signal sent from the secondary in the primary side unit is received, The means which changes the drive frequency of the inverter of a primary side unit, and carries out stabilization control of the output voltage and current of a secondary is provided.

[Effect of the Invention]

[0009]

Since according to the non-contact transfer-of-power equipment of the present invention the voltage current information on a secondary is transmitted to a primary side by non-contact, the drive frequency of an inverter is changed and output voltage and current can be controlled, it is in the same regulated power supply as the switching power supply using a closed magnetic circuit core being realizable.

For this reason, chopper circuits and the series regulator for the stabilization independent to the secondary unit are unnecessary, and since there is no loss for the stabilization circuit of a secondary, efficient non-contact transfer-of-power equipment is realizable. Since the stabilization circuit independent to the secondary unit is unnecessary, it becomes unnecessary [the packaging area of this circuit], and a miniaturization changes possible and also reduces cost.

[0010]

By performing control which raises the drive frequency of an inverter at a light load or the time of no-load, [secondary side load] In order to detune from the resonance frequency of the primary side series resonant circuit of the coupling transformer to drive, the high frequency current of a primary side coil will also decrease, and it is effective in the ability to reduce the power consumption of AC power supply at a light load or the time of no-load. [secondary side load]

[Best Mode of Carrying Out the Invention]

[0011]

Fig.1 is the circuit diagram applied to the non-contact electric power unit.

An embodiment of the invention is described based on Fig.6 from Fig.1 below.

[0012]

In Fig.1, the inverter of a primary side unit uses the dc output of a primary side rectification circuit as a power supply. Half bridge connection is made and the aforementioned inverter is driven with an oscillating frequency variable 2 phase oscillator. Winding is coiled around the primary side core of a coupling transformer about, and a primary side coil is made. This primary side coil is set to L1. The resonance capacitors C1 are connected with L1 in series.

On the other hand, in a secondary unit, winding is coiled around a secondary core about and a secondary side coil is obtained. This secondary side coil is set to L2. High-frequency power is taken out from the line of magnetic force of L1 using the above L2. C2 is connected to L2 in series, and a secondary series resonant circuit is obtained. After the bridge rectifier circuit after C2 and the secondary rectification circuit constituted from C6 rectify, electric power is supplied to load.

[0013]

The inverter of Fig.1 connects the drain D of the field effect transistor Q1 to the VCC side of a primary side rectification circuit, connects the drain D of the sources S and Q2 of Q1 in series, and connects the source S of Q2 to the GND side of a primary side rectification circuit.

C1 side of a primary side series resonant circuit is connected at the node of the drain D of the sources S and Q2 of Q1. L1 side is connected to the source of Q2.

C4 is connected for C3 in parallel with the drain D and the source S of Q2 in parallel with the drain D and the source S of Q1.

D1 and D2 are body diodes of Q1 and Q2 which exist by a field effect transistor.

[0014]

The oscillating frequency variable 2 phase oscillator of Fig.1 is G-S of Q1. Between and G-S of Q2 It is with the oscillator with variable oscillating frequency which provides a DETTO time and carries out a voltage drive alternately in between.

[0015]

The voltage which drives G-S Hazama of Q1 in the timing chart of Fig.5 is expressed as Q1 VGS, and it is G-S of Q2. The voltage which drives between is expressed as Q2 VGS. They are [in / similarly / the timing chart of Fig.5] Q1 VGS and Q2 VGS. The DETTO time of a between is expressed as Dt.

[0016]

Fig.4-A is what expressed the resonance frequency of the primary side series resonant circuit of a coupling transformer, and the relation of resonance frequency versus secondary load output voltage of the secondary series resonant circuit with Graf, and there is.

A vertical axis shows secondary load output voltage, and a horizontal axis shows the drive frequency of an inverter.

The resonance frequency of a primary side series resonant circuit is set as f_p , and the resonance frequency of a secondary in-series series resonant circuit is set as f_s .

It sets to the relation of $f_p < f_s$.

The use range of drive frequency is carried out to from f_s of Fig.4-A to f_l .

[0017]

There is Fig.4-B in the curve of the secondary rectified voltage which synthesized the resonance frequency characteristic of a drive frequency pair and a primary side series resonant circuit, and the resonance frequency characteristic of the secondary series resonant circuit.

[0018]

in the graph of Fig.4-B -- the point of f_s -- the maximum output voltage of the use range -- a point -- it needs -- the resonance frequency of the primary resonant circuit [secondary] is set up, and the minimum drive frequency of an inverter is set as f_s .

According to change of AC input voltage, or change of load, the variability region of drive frequency is set as the range of f_0 to f_l .

The drive frequency which can supply maximum output voltage to load becomes a point of f_s .

At the time of rated load, frequency is set as f_0 , and when AC input voltage was deteriorated, or when load becomes heavy, it is set as the frequency f_s . At the case where AC input voltage becomes high, or the time of a light load, frequency is set up f_l .

One example of each frequency of f_p , f_s , f_0 , and f_l is shown below.

f_p nearly equal to 60kHz, f_s nearly equal to 74kHz, f_0 nearly-equal-to 77kHz, f_l nearly-equal-to 100kHz

[0019]

Graf of Fig.4-B shows changing output voltage by changing the drive frequency of an inverter.

When secondary side output voltage is less from setting out, the information is sent to a primary side unit by non-contact using the transmission coil for signal controls, and feedback control is performed towards lowering the drive frequency of the inverter of a primary side unit. In the time of a light load, etc., when output voltage exceeds from setting out, the information is sent to a primary side unit by non-contact using the transmission coil for control, and feedback control is performed towards raising the drive frequency of the inverter of a primary side unit.

[0020]

The output voltage of a secondary rectification circuit is connected to an error amplifier in Fig.1, and this voltage and reference voltage are measured.

The output of an error amplifier is connected to a modulator and the output of a modulator is connected to the oscillating circuit for control.

The oscillator for control performs self-oscillation with the parallel resonance frequency of L4 and C7.

[0021]

In Fig.1, the parallel resonant circuit of L3 and C8 is connected to a detector circuit, and the output of a detector circuit is connected to a demodulator.

The output of a demodulator circuit is connected to an oscillating frequency variable 2 phase oscillator.

[0022]

There is Fig.3 by the example of an error amplifier, a modulator, the oscillator for control, a demodulator, and an oscillating frequency variable 2 phase oscillator.

Output voltage is divided by R201 and R202, and it connects with the inverter terminal (- terminal) of the operational amplifier of U202.

The seal of approval of the reference voltage is carried out to the non inverter terminal (+ terminal) of the operational amplifier of U202.

The output of U202 is connected to the inverter terminal (- terminal) of the comparator of U201.

The output of a triangular wave oscillator is connected to the non inverter terminal (+ terminal) of U201.

It is at about 10 kHz about the dispatch frequency of a triangular wave oscillator.

There is an oscillator for control with the LC oscillator which used the parallel resonant circuit of L4 and C7, and it is the oscillating frequency of a 8MHz degree. L4 is a transmission coil for control.

The output of U201 is connected to the oscillator for control, and the oscillation of the oscillator for control is made intermittent.

[0023]

On the other hand in a primary side unit, there is L3 with the receiver coil for control by which inductive coupling was carried out to L4. Let the parallel resonant circuit of L3 and C8 be a value aligned with the oscillating frequency of the oscillator for control.

The parallel resonant circuit of L3 and C8 is connected to the detector circuit which comprised D3 and C9.

The output of a detector circuit is connected to the non inverter terminal (+ terminal) of the comparator of U101. The seal of approval of the voltage which divided +12V by R103 and R104 is carried out to the inverter terminal (- terminal) of the comparator of U101.

The output of a detector circuit is considered as the output of U101 as compared with the voltage divided by R103 and R104. The output of U101 is connected to the base of NPN transistor Q103 via resistance.

The collector of Q103 is connected to the base of PNP transistor Q102 via resistance. The emitter of Q102 is connected to +12V power supply.

It connects with the emitter of Q102 in D101, L101, and the pulse width-voltage conversion circuit constituted from C102.

The output of a pulse width-voltage conversion circuit is connected to the base of NPN transistor Q101 via resistance.

R102 is connected to the emitter of Q101, and it connects with GND of a circuit.

2 phase oscillating circuit constitutes the CR oscillator of C101 and R101.

The collector of Q101 is connected to R101. Multiple connection of R101 is carried out through the collector emitter of R101 and Q101.

The output of 2 phase oscillating circuit has two outputs of an A phase and a B phase, and is outputted by an opposite phase, respectively.

The output of 2 phase oscillating circuit is connected to a DETTO time generating circuit, and few dead times are provided to an A phase and B interphase.

The output of a DETTO time generating circuit is connected to a half bridge driver.

D101 and C102 which are connected to the half bridge driver constitute the boost rise circuit in order to make the drive power source of Q1 of a high side switch.

The output of a half bridge driver is connected between the gate of Q1, between sources and the gate of Q2, and a source.

The voltage waveform between gate sources of Q1 and Q2 is set to Q1VGS and Q2VGS of Fig.5.

[0024]

An example of a coupling transformer which used U shape core for Fig.2 is shown.

The winding time of primary winding L1 is carried out to the drum section of U shape core provided to the primary side unit.

The winding time of secondary winding L2 is carried out to the drum section of U shape core provided to the secondary unit.

Between [of the coupling transformer / per order] secondary, it is separated in the outline made of resin of a primary side unit, and the outline made of resin of the secondary unit.

The tip of the leg of the primary side U shape core of a coupling transformer and the tip of the leg of a secondary U shape core separate a several millimeters interval, and are opposing.

L3 is arranged at the center of the biped of a primary side U character core, and the interface inside the outline made of resin of a primary side unit, and L4 is arranged at the center of the biped of a secondary U character core, and the interface inside the outline made of resin of a secondary unit.

L3 and L4 use an air-core coil.

[0025]

The description of feedback control is described using Fig.3, Fig.4, and Fig.6.

When the output voltage of a secondary unit is higher than a preset value in the state where electric power is transmitted to the secondary unit by non-contact from the primary side unit,

(Left part of Fig.6) It is the voltage of the inverter terminal (- terminal) of the operational amplifier U202, By comparison of the reference voltage linked to the voltage which divided output voltage by R201 and R202, and a non inverter terminal (+ terminal), since the inverter terminal (- terminal) is more expensive, the output voltage of U202 changes to the lower one.

Since the output voltage of U202 is connected to the inverter terminal of U201 of a comparator (- terminal) and the triangular wave is applied to the non inverter terminal (+ terminal) of U201, the amplitude of a triangular wave becomes Hi level output voltage during the period higher than the inverter terminal of U201. Since there is a triangular wave with fixed frequency, the cycle is also fixing. Since the pulse width of U201 changes according to the voltage of the inverter terminal of U201 in the period of a constant period, the output of U201 can call it operation of Pulse Density Modulation.

When the output voltage of a secondary unit is higher than a preset value, a result in which the ON width of U201 spreads is brought.

[0026]

Control which is intermittent in the oscillation of the oscillator for control with the output of U201 is performed.

In the output of U201, the oscillator for control oscillates in the state of Hi level, and, in the output of U201, the oscillation of the oscillator for control stops in the state of a Low level. The oscillator for period control of ON of the output of U201 oscillates, and the oscillator for period control of OFF of an output suspends an oscillation.

When the output voltage of a secondary unit is higher than a preset value, the period which the oscillator for control is oscillating becomes long.

[0027]

Since L3 provided by the primary side unit is carrying out inductive coupling to L4 of the secondary unit, the high-frequency-induction voltage of the parallel resonant circuit of L3 and C8 is intermittent according to intermittence of an oscillation of the oscillator for control.

[0028]

The output of the detector circuit connected to L3 and C8 serves as OFF, when the output of U201 is ON and the output of ON and U201 is OFF, and the ON width of a detector circuit synchronizes with the ON width of the output of U201.

[0029]

There is U101 of a demodulator with a comparator to amplify detector circuit voltage.

Since the output voltage of a detector circuit is connected to the non inverter terminal (+ terminal) of U101 and it is, if the voltage of the inverter terminal (- terminal) of U101 is higher than the reference voltage generated by R103 and R104, As for the output of U101, ON and PNP type Q102 is set to ON by ON and NPN type Q103.

The ON width of Q102 becomes the same as the ON width of U201.

[0030]

The pulse width-voltage conversion circuit using L201, D101, and C102 is the same composition as what is used for the secondary rectification circuit of the switching power supply circuit of a feedforward type.

Therefore, the output voltage proportional to the ON width of Q102 is obtained.

The output voltage proportional to the ON width of the result U201 is obtained.

As mentioned above, when the output voltage of a secondary unit is higher than a preset value, the output voltage of a pulse width-voltage conversion circuit also becomes high.

[0031]

Since the output of a pulse width-voltage conversion circuit is connected to the base of Q101 of NPN via resistance and it is, if the output voltage of a pulse width-voltage conversion circuit becomes high, the collector current of Q101 will increase.

The resistance of increase [the collector current of Q101] of R101 will decrease equivalent.

[0032]

Since 2 phase oscillator comprises a CR oscillator, if the resistance of R101 decreases, the oscillating frequency of 2 phase oscillator will become high. If the oscillating frequency of 2 phase oscillator becomes high, the drive frequency of an inverter will become high. Fig.4 - B shows that the output voltage of a secondary unit becomes low, when drive frequency becomes high.

[0033]

The output voltage of a secondary unit is lower than a preset value, and as for a case, in the oscillation width of narrowing and the oscillator for control, the oscillation width of the high

frequency current of the narrowing L4 narrows [the ON width of the comparator of U201] as shown in the right-hand side of Fig.6,

[0034]

If the oscillation width of the high frequency current of the narrowing L4 narrows in the oscillation width of the oscillator for control, in the ON width of the output of a detector circuit, the output voltage of narrowing and a pulse width-voltage conversion circuit will become low, and the collector current of Q101 will decrease. When the collector current of Q101 decreases, the resistance of R101 will be approached equivalent.

[0035]

Since 2 phase oscillator comprises a CR oscillator, the oscillating frequency of 2 phase oscillator becomes low. If the oscillating frequency of 2 phase oscillator becomes low, the drive frequency of an inverter will become low.

Fig.4 - B shows that the output voltage of a secondary unit becomes high, when drive frequency becomes low.

[0036]

As mentioned above, secondary voltage information is fed back to a primary side, changes the drive frequency of an inverter, and stabilizes the output voltage of a secondary.

[0037]

The current information of a secondary can be fed back at a primary side using the same technique, the drive frequency of an inverter can be changed, and the output current of a secondary can be stabilized.

[Brief Description of the Drawings]

[0038]

[Drawing 1] It is an outline circuit diagram showing the embodiment of the present invention.

[Drawing 2] Structural drawing of a coupling transformer.

[Drawing 3] The detail circuit diagram for feedback control.

[Drawing 4] The explanatory view showing the resonance frequency characteristic of a drive frequency pair and a primary side series resonant circuit, the resonance frequency characteristic of a secondary series resonant circuit, and the relation of secondary rectified voltage.

[Drawing 5] The time chart which describes operation of an inverter circuit and a coupling transformer.

[Drawing 6] The time chart which describes operation of feedback control.

[Explanations of letters or numerals]

[0039]

L1: The primary side winding inductance of a coupling transformer.

L2: The secondary winding inductance of a coupling transformer.

The capacitor for the C 1:1st side series resonance.

The capacitor for the C 2:2nd side series resonance.

L3: The receiver coil for control.

L4: The transmission coil for control.

C7: The capacitor for parallel resonance of L4.

C8: The capacitor for parallel resonance of L3.

fp: Resonance frequency of a primary side series resonant circuit.

fs : resonance frequency of a secondary resonant circuit.

f1 : Inverter drive frequency at the time of rated load.

f0: Inverter drive frequency at the time of heavy loading.

f2: Inverter drive frequency at the time of a light load.

TECHNICAL FIELD

[Field of the Invention]

[0001]

The present invention feeds back the voltage and current in a secondary to a primary side in non-contact transfer-of-power equipment, and relates to the non-contact transfer-of-power equipment which carries out stabilization control of secondary side output voltage and the current.

PRIOR ART

[Background of the Invention]

[0002]

In non-contact transfer-of-power equipment, when measuring stabilization of a secondary, there is the method of providing the stabilization circuit independent to the secondary. (For example, a Patent document 1, 2, three references.).

[Patent document 1] Patent public presentation No. 354711 [2002 to] Gazette

[Patent document 2] Patent public presentation No. 120915 [2004 to] Gazette

[Patent document 3] Patent application No. 252511 [2002 to] Gazette

[0003]

By changing the value of the capacitor for resonance of a secondary resonant circuit, resonance frequency is changed and the 2nd method includes a method stable using the method of changing the electric power which can receive transmitted electricity by a secondary. (For example, see Patent Document 4.).

[Patent document 4] Patent public presentation No. 72832 [2004 to] Gazette

EFFECT OF THE INVENTION

[Effect of the Invention]

[0009]

Since according to the non-contact transfer-of-power equipment of the present invention the voltage current information on a secondary is transmitted to a primary side by non-contact, the drive frequency of an inverter is changed and output voltage and current can be controlled, it is in the same regulated power supply as the switching power supply using a closed magnetic circuit core being realizable.

For this reason, chopper circuits and the series regulator for the stabilization independent to the secondary unit are unnecessary, and since there is no loss for the stabilization circuit of a secondary, efficient non-contact transfer-of-power equipment is realizable. Since the stabilization circuit independent to the secondary unit is unnecessary, it becomes unnecessary [the packaging area of this circuit], and a miniaturization changes possible and also reduces cost.

[0010]

By performing control which raises the drive frequency of an inverter at a light load or the time of no-load, [secondary side load] In order to detune from the resonance frequency of the primary side series resonant circuit of the coupling transformer to drive, the high frequency current of a primary side coil will also decrease, and it is effective in the ability to reduce the power consumption of AC power supply at a light load or the time of no-load. [secondary side load]

TECHNICAL PROBLEM

[Problem to be solved by the invention]

[0004]

The following are raised as problem of a conventional system. That is, the method of providing the stabilization circuit independent to the secondary has the loss of the stabilization circuit of a secondary, and will lower the whole efficiency.

When a secondary is a light load, the current of the primary side coil of a coupling transformer does not decrease, and the power consumption of a primary side coil does not reduce it.

[0005]

When the secondary of the method of changing the resonance frequency of the resonant circuit of a secondary is a light load, the current of the primary coil of a coupling transformer does not become small, and the power consumption of a primary side coil does not reduce it.

[0006]

In the method of carrying out stabilization control of the secondary side output voltage in the conventional non-contact transfer-of-power equipment described above, and the current, the whole efficiency is bad. Power consumption in case secondary side load is a light load cannot be reduced.

[0007]

An object of the present invention is to be efficient and to realize stabilization control of the secondary side output voltage in non-contact transfer-of-power equipment, and current.

MEANS

[Means for solving problem]

[0008]

In order to attain the above-mentioned purpose, the non-contact transfer-of-power equipment of the present invention, Transmit the signal about the voltage and current in a secondary to a primary side unit at a primary side using a non-contact electromagnetic coupling coil, and the signal sent from the secondary in the primary side unit is received, The means which changes the drive frequency of the inverter of a primary side unit, and carries out stabilization control of the output voltage and current of a secondary is provided.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[0038]

[Drawing 1] It is an outline circuit diagram showing the embodiment of the present invention.

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[Drawing 5] The time chart which describes operation of an inverter circuit and a coupling transformer.

[Drawing 6] The time chart which describes operation of feedback control.

[Brief Translation]

**KOREAN INTELLECTUAL PROPERTY OFFICE
PATENT APPLICATION PUBLICATION (A)**

Application No.: 10-2005-0072402
Applicant: JC PROTEK CO., LTD.

Publication No.: KR 10-2007-0017804 A

TITLE:

SMALL AND LIGHT WIRELESS POWER TRANSCIVING DEVICE, CAPABLE OF PREVENTING ACCIDENT CAUSED BY DISCONNECTION OF CABLE AND ELECTRIC LEAKAGE AND CONVENIENTLY ANSWERING CALLS IN CHARGING PROCESS WITH SIMPLE INSTALLATION

ABSTRACT:

OBJECTIVE: A small and light wireless power transceiving device is provided to charge a battery of various electric devices quickly on one transmitting pad in a noncontact and wireless method.

CONSTITUTION: In a small and light wireless power transceiving device, a signal control unit includes a noise removing filter to remove a noise included in power inputted with AC 220V/110V or various types and a rectifying circuit rectifying an AC signal whose noise is removed, and transforms the rectified DC power to an electrical signal having a frequency in a range of several tens kHz to several hundreds kHz and the predetermined output by using a switching circuit. A transmitting output control unit includes a transformer transforming the electric signal generated from the signal control unit to a required voltage and a rectifying circuit rectifying the transformed power, and transmits the transformed signal as a constant-voltage source with the predetermined frequency and output to a transmission coil so as to control the frequency and the output. A transmitting pad (13) receives the signal from the transmission output control unit and generates an induced magnetic field of an electromagnetic wave to a solenoid or spiral type transmission coil.



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(54) 소형·경량의 무선 전력 송수신 장치

(57) 요약

본 발명은 전자파의 유도 자기장을 발생하는 송신패드 및 충전용 전자기기의 내외장형 수신용 모듈을 사용하여 핸드폰, 리모콘, MP3, PMP, PDA 및 배터리 충전이 필요한 다양한 전자기기들의 전원충전을 위하여 송신패드위에서 자유롭게 무접점·무선으로 동시에 여러 가지 전자기기들의 배터리에 전원을 충전할 수 있는 어댑터 및 송신패드로 구성된 송신모듈과, 송신모듈 및 수신모듈을 구비한 소형·경량의 무선 전력 송수신 장치에 관한 것이다. 보다 구체적으로 본 발명은 다양한 전자기기 내외장용 수신용 모듈의 사용하여 핸드폰, MP3 및 PDA등의 배터리 충전을 위하여 송신패드위에서 무접점·무선으로 충전할 수 있는 소형·경량의 무선 전력 송수신 장치에 있어서, 콘센트로부터 나오는 일반적인 교류전원을 AC 어댑터를 경유하여 수십㎸내지 수백㎸의 교류 정전압 신호로 변환한 후 높은 에너지 효율로 전력을 송신할 수 있도록 구성된 송신코일을 구비하고 전자파의 유도 자기장을 발생하는 송신패드와, 상기 송신패드에서 발생한 전자파의 유도 자기장을 수신하기 위하여 솔레노이드 혹은 스파이럴구조의 수신코일과, 수신코일을 통해서 수신된 전기 에너지를 극대화하기 위한 공진회로와, 공진회로를 거쳐서 나온 신호를 정류하는 정류 회로와, 정류된 소정 전류와 전압을 가진 전기에너지를 충전하는 충전회로 및 보호회로로 구성된 수신모듈을 구비하고 최대 유도 수신전력 변환 및 전력 전송으로 핸드폰, 리모콘, MP3, PMP, PDA 및 충전이 필요한 다양한 전자기기의 배터리에 전원을 충전함으로써 전선의 단선 및 누전에 의한 안전사고를 예방할 수 있고 소형·경량으로 취급이 용이하게 하는데 그 특징이 있다.

대표도

도 1

특허청구의 범위

청구항 1.

전자기와 유도자기장을 발생하기 위한 송신모듈에 있어서,

교류 220V/110V 또는 다양한 형태로 입력되는 전원에 포함된 노이즈를 제거하는 노이즈제거필터와, 노이즈가 제거된 교류신호를 정류하는 정류회로(33)와, 정류된 DC전원을 스위칭 회로를 사용하여 수십㎍내지 수백㎍ 주파수와 소정의 출력을 가진 전기신호로 변환하는 신호제어부와,

상기 신호제어부(34)에서 소정의 출력과 주파수를 가진 전기신호를 필요한 전압으로 변환하는 트랜스포머(35)와, 이를 정류하는 정류회로(36)를 거쳐서 필요한 정전압원으로 변환한 후 소정의 주파수와 출력을 가진 신호로 송신코일(39)로 전송하여 주파수 및 출력을 제어하는 송신 출력제어부와,

상기 송신 출력제어부로부터 전송된 신호를 수신하여 솔레노이드 혹은 스파이럴형태의 송신코일로 전자파의 유도 자기장을 발생하는 송신페드로 구성된 전자파의 유도 자기장을 발생하는 송신모듈.

청구항 2.

청구항1에 있어서,

상기 신호제어부와 출력제어부를 하나로 묶어서 어댑터를 구성하고, 서로 유선으로 연결되되 분리하여 송신페드를 구성하며, 상기 어댑터는 송신페드에서 떨어져 공급전원과 인접하여 위치시키거나 송신페드 가까이 위치시키는 구성으로 이루어진 전자파의 유도 자기장을 발생하는 송신모듈.

청구항 3.

청구항1 또는 청구항2에 있어서,

상기 송신페드는 소정의 외경과 내경을 가지고 소정의 회수로 감은 스파이럴 형태의 중계코일과, 상기 중계코일과 공진회로를 형성하기 위한 커패시터로 구성된 중계기와,

상기 중계기를 형성하고 있는 스파이럴코일 내부에 위치하며, 서로 유선으로 연결되지 않으면서 소정의 외경과 내경을 가지고 소정의 회수로 감은 스파이럴형태의 송신코일로 구성된 전자파의 유도 자기장을 발생하는 송신모듈.

청구항 4.

무접점·무선으로 다양한 전자기기를 충전할 수 있는 소형·경량의 무선 전력 송수신장치에 있어서,

소정의 전원을 사용하여 소정의 주파수와 출력을 가진 신호로 변환하여 출력신호를 발생하는 출력제어부와, 상기 출력제어부로부터 전송된 전기신호를 전송받아서 전자파의 유도자기장을 발생하는 송신코일로 구성된 송신모듈과,

상기 송신모듈에서 발생한 전자파의 유도 자기장을 수신하는 수신코일과, 수신코일에 유입된 유도기전력을 이용하여 충전에 필요한 소정의 직류전기에너지로 변환하는 수신모듈로 구성된 소형·경량의 무선 전력 송수신장치.

청구항 5.

무접점·무선으로 다양한 전자기기를 충전할 수 있는 소형·경량의 무선 전력 송수신장치에 있어서,

소정의 전원과 체결되며, 정류회로, 스위칭 회로 및 피드백회로를 사용하여 소정의 주파수와 출력을 가진 전기신호로 변환하여 출력신호를 발생하는 출력제어부를 가진 어댑터와, 상기 출력제어부에서 전송된 전기신호에 기초하여 전자파의 유도 자기장을 발생하는 송신코일을 내장한 송신페드를 구비한 송신모듈과,

상기 송신페드에서 발생한 전자파의 유도자기장을 수신하는 수신코일과, 상기 수신코일과 병렬로 연결되어 수신코일과 공진회로를 구성하면서 출력단으로 최대전력 전송을 위한 임피던스 매칭용 가변커패시터와, 상기 가변커패시터를 거쳐서 나온 신호를 직류전원으로 정류하는 정류회로와, 상기 정류회로를 거쳐서 나온 직류전원을 핸드폰, 리모콘, PMP, MP3 및 PDA 중에 어느 하나를 선택하여 충전용 접점에 맞도록 접속단자를 구성한 수신모듈을 구비한 소형·경량의 무선 전력 송수신장치.

청구항 6.

청구항4 또는 청구항5에 있어서,

상기 송신페드는 스파이럴 코일과, 전자파의 유도자기장을 중계하는 중계코일 및 상기 중계코일과 공진회로를 형성하기 위한 커패시터로 구성된 중계기와 상기 중계기와 유선으로 연결되지 않으면서 소정의 거리를 두고 설치된 스파이럴 코일과 결합한 구성과, 자성체 코어에 소정회수의 유도코일을 감은 솔레노이드 코일과, 하나의 자성체코어에 중계코일을 감고 중계코일과 공진회로를 형성하기 위한 커패시터로 이루어진 중계기와 상기 중계기와 유선으로 연결되지 않으면서 소정회수의 송신용 유도코일과 결합한 구성 중 어느 하나를 선택하여 구성한 소형·경량의 무선 전력 송수신장치.

청구항 7.

청구항4 또는 청구항5에 있어서,

상기 수신용 코일은 자성체 코어에 소정회수의 유도코일을 감은 솔레노이드코일과, 하나의 자성체코어에 소정회수의 수신코일과 상기 수신코일과 유선으로 연결되지 않으면서 전자파의 유도자기장을 강화하는 중계코일을 감고 중계코일과 공진회로를 형성하는 커패시터로 이루어진 중계기가 결합된 구성과, 스파이럴 코일과, 스파이럴코일과 상기 스파이럴코일과 유선으로 연결되지 않으면서 전자파의 유도자기장을 중계하는 중계코일과 상기 중계코일과 공진회로를 형성하는 커패시터로 구성된 중계기가 결합된 구성 중 어느 하나를 선택하여 구성한 소형·경량의 무선 전력 송수신장치.

청구항 8.

청구항4에 있어서,

상기 수신모듈은 상기 수신코일과 병렬로 연결되어 수신코일과 공진회로를 구성하면서 출력단으로 최대전력 전송을 위한 임피던스 매칭용 가변커패시터와,

상기 가변커패시터를 거쳐서 나온 신호를 직류전원으로 정류하는 정류회로 및 평활회로와,

상기 정류회로 및 평활회로를 거쳐서 나온 직류전원을 전기에너지의 충전을 필요로 하는 전자기기의 충전용 접점에 맞는 접속단자를 구비한 소형·경량의 무선 전력 송수신장치.

청구항 9.

청구항4 또는 청구항8에 있어서,

상기 수신모듈내부에는 충전용 배터리가 방전되어 작동되지 않을 경우에 사용할 수 있도록 충전용 배터리를 더 구비한 소형·경량의 무선 전력 송수신장치.

청구항 10.

청구항4, 청구항5 및 청구항8 중 어느 한 항에 있어서,

상기 수신모듈은 핸드폰, 리모콘, PMP, MP3 및 PDA 중에 어느 하나를 선택하여 충전용 접점에 맞는 접속단자를 구비하고 외부기와 체결되는 구성이나 핸드폰, 리모콘, PMP, MP3 및 PDA 중 어느 하나를 선택하여 내부에 내장시키는 구성으로 이루어진 소형·경량의 무선 전력 송수신장치.

명세서

발명의 상세한 설명

발명의 목적

발명이 속하는 기술 및 그 분야의 종래기술

본 발명은 소정의 전원을 공급받아서 전자파의 유도 자기장을 발생하는 송신패드 및 충전용 전자기기의 배터리 충전용 내외장형 수신용 모듈을 사용하여 핸드폰, 리모콘, MP3, PMP, PDA 및 배터리의 충전이 필요한 다양한 전자기기들의 전원 충전을 위하여 송신패드에 위치시켜 무접점·무선으로 동시에 충전할 수 있도록 어댑터 및 송신패드로 구성된 송신모듈과, 송신모듈 및 수신모듈을 구비한 소형·경량의 무선 전력 송수신 장치에 관한 것이다.

종래기술로는 전기에너지를 공급하는 전선들의 접촉에 의하여 전력이 전달되도록 구성된 핸드폰, MP3 및 PDA 등의 배터리를 충전하기 위하여는 각각의 기종에 맞는 배터리 충전기가 필요하며 유선에 의한 충전 시 충전기의 접점단자의 접촉을 확인하여야 하는 번거로움과, 접점단자들이 대기 중에 노출되어 절연물질의 적층 및 부식에 의하여 사용할 수 없는 경우가 발생하거나 습기에 노출되어 충전 시 접점을 통한 감전의 위험성 및 방전이 발생하는 등의 문제점과 이외에 동시에 다양한 기종 및 다양한 전기기기들의 충전이 불가능한 문제점과, 부피가 비교적 크고 무거우며 충전 시 걸려온 전화를 받기가 불편하고, 핸드폰 배터리 방전시 일시적 충전을 위해 일회용 배터리 충전기를 사용하나 재충전이 불가능하다는 문제점이 있다.

발명이 이루고자 하는 기술적 과제

본 발명이 이루고자 하는 기술적 과제는 상기와 같은 종래기술의 문제점을 인식하고 창안된 것으로, 노이즈필터, 정류회로, 주파수 변환회로, 정전압 회로 및 다양한 크기와 출력의 전자파의 유도 자기장을 발생할 수 있도록 전기신호를 제어하는 출력제어부로 구성된 AC어댑터와 AC어댑터에서 전송된 전기신호로 전자파의 유도 자기장을 발생하는 송신코일로 이루어진 송신패드로 구성된 송신모듈을 구비하며, 상기 송신패드에서 발생한 전자파의 유도 자기장을 수신하기 위하여 솔레노이드 혹은 스파이럴구조의 수신코일과 수신된 전기에너지를 높은 효율로 출력단으로 전송하기 위한 공진 및 임피던스 매칭용 가변커패시터를 거쳐서 나온 신호를 정류하는 정류 회로와 정류되어 소정의 전류와 전압을 가진 전기에너지를 충전하는 충전회로 및 보호회로로 구성된 수신모듈을 구비하고 최대 유도 무선 전력 송수신 장치를 구현하여 핸드폰, 리모콘, MP3, PMP, PDA 및 충전이 필요한 전기기기의 배터리에 전원을 충전함으로써 전선의 단선, 및 누전에 의한 안전사고를 예방할 수 있고 소형·경량으로 설치가 간단하고 충전 시 걸려온 전화를 용이하게 받을 수 있도록 하는데 그 목적이 있다.

발명의 또 다른 목적은 AC어댑터와 송신용 유도 코일과 상기 유도코일과 공진을 이루기 위한 커패시터를 구비하고 최대한 효율이 높은 전자파의 유도 자기장을 발생하는 송신패드로 구성된 송신모듈과, 수신용 유도코일과 공진회로를 형성하면서 출력단과는 임피던스 매칭을 위한 가변커패시터를 구성하여 최대한 높은 효율로 수신 전기에너지를 얻을 수 있으면서 소형·경량으로 설계 제작되어 핸드폰, 리모콘, MP3, PMP, PDA 및 충전이 필요한 전기기기들의 충전용 접점단자에 맞는 내외장형 수신모듈을 제공함으로써 하나의 송신패드위에서 무접점·무선으로 다양한 전기기기들의 충전용 배터리를 효율적으로 신속하게 충전할 수 있고 유선충전 시 발생할 수 있는 여러 가지 불편을 모두 해결하는데 있다.

발명의 또 다른 목적은 충전시 수신모듈내의 용량이 작은 충전용 배터리와 핸드폰등 전자기기내의 충전용 배터리를 동시에 충전하여 수신모듈은 무선전력 변환 기능 외에 전자기기내 배터리의 방전시 응급시 짧은 시간 동안 전자기기내 전원공급을 할 수 있는 용도로도 사용되어질 수 있도록 하는데 있다.

발명의 구성

본 발명은 소정의 전원 공급하여 전자파의 유도 자기장을 발생시키는 송신페드 및 충전용 전자기기의 내외장형 수신용 모듈을 사용하여 핸드폰, 리모콘, MP3, PMP, PDA 및 배터리의 충전을 필요로 하는 다양한 전자기기들의 전원충전을 위하여 송신페드위에서 무접점·무선으로 동시에 여러 대의 충전용 전자기기들을 배터리를 충전할 수 있는 송신페드로 구성된 송신모듈과 상기 송신모듈 및 수신모듈을 구비한 소형·경량의 무선 전력 송수신 장치에 관한 것이다.

종래기술로는 전기에너지를 공급하는 전선들의 접촉에 의하여 전력이 전달되도록 구성된 핸드폰, MP3 및 PDA 등의 배터리를 충전하기 위하여서는 각각의 기종에 맞는 배터리 충전기가 필요하며 유선에 의한 충전 시 충전기의 접점단자의 접촉을 확인하여야 하는 번거로움과, 접점단자들이 대기 중에 노출되어 절연물질의 적층 및 부식에 의하여 사용할 수 없는 경우가 발생하거나 습기에 노출되어 충전 시 접점을 통한 감전의 위험성 및 방전이 발생하는 등의 문제점과 이외에 동시에 다양한 기종 및 다양한 전기기기들의 충전이 불가능한 문제점과, 부피가 비교적 크고 무거우며 충전 시 걸려온 전화를 받기가 불편하고, 핸드폰 배터리 방전시 일시적 충전을 위해 일회용 배터리 충전기를 사용하나 재충전이 불가능하다는 문제점이 있다.

본 발명은 상기와 같은 종래기술의 문제점을 해결하기 위하여 창출된 것이다. 본 발명의 용이하게 이해할 수 있도록 하는 도면에 대하여 살펴본다. 도1은 본 발명에 따른 AC 어댑터와 송신페드로 구성된 송신모듈과 수신모듈로 구성된 소형·경량의 무선 전력 송수신장치의 개략도이며, 도2는 본 발명에 따른 AC 어댑터와 송신페드에 내장된 회로의 블록다이아그램과 수신모듈에 내장된 회로의 블록다이아그램을 나타낸 것이다. 도3은 본 발명의 실시 예를 위하여 설계 제작된 스파이럴 송신코일을 나타낸 것이고, 도4는 본 발명의 실시 예를 위하여 설계 제작된 스파이럴 코일로 구성된 중계코일과, 중계코일과 공진회로를 형성하기 위한 공진커패시터 구성의 중계기 및 소정거리의 스파이럴 코일로 구성된 송신코일을 보여주고 있다. 도5는 본 발명의 실시 예를 위하여 설계 제작된 스파이럴 코일로 구성된 중계코일과, 중계코일과 공진회로를 형성하기 위한 공진커패시터와, 상기 중계코일 내부에 스파이럴 코일로 구성된 송신코일을 보여주고 있으며, 도6은 본 발명의 실시 예를 위하여 설계 제작된 하나의 자성체 코어에 유도코일을 감은 수신코일을 나타낸 것이다. 도7은 본 발명의 실시 예를 위하여 설계 제작된 하나의 자성체를 공통코어로 사용하여 수신코일과 중계코일을 감아서 구성한 수신코일을 나타낸 것이며, 도8은 일반적인 스파이럴 코일로 구성된 수신코일을 보여주고 있다. 도9는 본 발명의 실시 예를 위하여 설계 제작된 도5의 송신코일과 동일한 구조로 형성한 수신코일을 나타낸 것이며, 도10은 본 발명에 따라 설계 제작된 수신모듈의 회로도이다.

본 발명에 따른 구성수단들을 구체적으로 살펴본다. 본 발명은 무선으로 전력을 수신할 수 있도록 전자파의 유도 자기장을 발생하기 위하여 설계 제작된 AC 어댑터(15)와 송신페드(13)로 구성된 송신모듈과, 상기 송신모듈에서 발생한 전자파의 유도 자기장을 수신하여 유도기전력을 발생시키는 수신코일(71)과, 수신된 유도기전력을 극대화하여 출력단으로 전송하기 위하여 수신코일(71)과 병렬로 체결된 공진 및 임피던스 매칭을 위하여 사용되는 가변커패시터(72)와, 가변커패시터(72)를 거쳐서 나온 신호를 다이오드로 정류하는 정류회로(73)와, 정류된 전압을 평활하여 DC전원으로 변환하는 평활콘덴서(74)로 이루어진 수신모듈로 크게 2가지로 구성된 소형·경량의 무선 전력 송수신장치이다. 상기 송신모듈은 핸드폰, 리모콘, MP3, PMP, PDA 및 배터리의 충전이 필요한 다양한 전기기기들의 전원충전을 위하여 수신모듈이 필요로 하는 전자파의 유도자기장을 발생시키는 장치로서 가정 또는 산업용으로 사용되는 일반적인 전원 AC 220V/110V로부터 입력되는 전원에 포함된 노이즈를 제거하는 노이즈제거필터(32)와, 노이즈가 제거된 교류전원(신호)을 정류하는 1차 정류회로(33)와, 정류된 DC전원을 스위칭 회로를 사용하여 수십kHz 내지 수백kHz 출력의 주파수를 가진 전기신호로 변환하는 신호제어부(34)와, 신호제어부에서 소정의 출력과 주파수를 가진 전기신호를 필요한 전압으로 변환하는 트랜스포머(35)와 이를 정류하는 2차 정류회로를 거쳐서 필요한 정전압 전원으로 만든 후 필요한 출력과 주파수를 가진 전기신호로 변환하여 송신코일로 전송하는 주파수 및 출력을 제어하는 출력제어부(37)와, 출력제어부(37)를 거쳐서 나온 신호를 전송받아서 전자파의 유도 자기장을 발생시키는 송신코일로 구성되어 있다. 상기 출력제어부는 다양한 충전용전자(전기)기기에 필요한 전기에너지를 고려하여 송신출력을 제어할 수 있도록 구성되어 있다. 상기 출력제어부에서 출력되는 신호의 출력을 일정하게 유지하기 위하여 출력신호를 감지하여 신호제어부로 피드백시켜 출력제어부에서 송신코일로 전송되는 전기신호의 출력이 증가하면 감소시키고 출력이 감소하면 증가시켜 일정한 송신출력을 유지시켜주는 피드백회로를 가진다. 상기 어댑터에서 발생한 소정의 주파수 및 출력전압을 일정하게 발생하는 신호에 기초하여 충전에 필요한 전자파의 유도 자기장을 높은 효율로 발생하도록 유도코일과 커패시터를 체결시켜 구성한 송신페드가 설계 제작된다. 상기 AC어댑터(15)와 송신페드(13)로 구성되어 전자파의 유도 자기장을 발생시키는 송신부를 송신모듈이라 한다. 상기 AC어댑터와 송신페드는 필요에 따라 일체형 또는 다소 거리를 두고 분리하는 분리형으로 설계 제작할 수 있다. 상기 송신모듈에서 발생한 전자파의 유도 자기장을 수신하기 위하여 솔레노이드 혹은 스파이럴구조의 수신코일과 수신된 전기에너지를 높은 효율로 출력단으로 전송하기 위하여 공진회로 및 전자파의 유도 자기장을 중계하는 중계코일이 부가로 연결되며, 상기 공진회로 및 중계코일을 거쳐서 나온 신호를 정류하는 정류회로와 정류되어 소정의 전류와 전압을 가진 전기에너지를 충전하는 충전회로와, 핸드폰, 리모콘, MP3, PMP, PDA 및 배터리의 충전이 필요한 다양한 전자(또는 전기)기기들의 전원충전을 위하여 각각의 전자기기에 전원을 충전하기 위하여 형성된 접점들과 결합되는 접속단자를 구비한 수신모듈(12)로 구성되어 있다. 상기 수신코일, 증폭중계기

(상기 중계코일에 해당함) 및 이들의 구성회로에 대하여서는 본원 출원인이 출원한 출원번호 10-2004-0093696호 및 10-2005-0059562호에 자세하게 기재되어 있다. 본 발명에 따른 송신모듈의 출력전압, 주파수 및 출력전력을 제어하여 필요한 송신출력으로 전자파의 유도자기장을 송신파드를 통해서 송신하고, 수신모듈의 접속단자를 충전을 원하는 다양한 전자기기에 형성되어 있는 접점에 맞추어 설계 제작할 경우에 핸드폰(11), MP3, 및 PDA 뿐만 아니라 충전이 필요한 대부분의 전자기기에 내장시키거나 외부의 접점에 수신모듈(12)에 형성된 접속단자를 체결하여 충전할 수 있다. 본 발명의 송신파드와 AC어댑터는 필요에 따라 일체형 또는 도1에서와 같이 분리형으로 설계 제작할 수 있다. 본 발명에 따른 송신파드와 수신모듈을 구비한 소형·경량의 무선 전력 송수신 장치에 관한 구체적이고 다양한 실시 예를 살펴본다.

[실시 예]

본 발명에 따른 구체적인 실시 예를 도면에 기초하여 살펴본다. 먼저 본 발명에 따른 송신모듈에 대하여 살펴본다. 송신모듈은 일반적인 전원 AC 220V 또는 다양한 형태로 제공되는 전원에서부터 입력되는 전원에 포함된 노이즈를 제거하는 노이즈제거필터와 노이즈가 제거된 교류전원(신호)을 정류하는 정류회로(33)와, 정류된 DC전원을 스위칭 회로를 사용하여 수십㎍내지 수백㎍ 출력의 주파수를 가진 전기신호로 변환하는 신호제어부(34)와, 신호제어부(34)에서 소정의 출력과 주파수를 가진 전기신호를 필요한 전압으로 변환하는 트랜스포머(35)와, 이를 정류하는 정류회로(36)를 거쳐서 필요한 정전압 전원으로 만든 후 필요한 출력으로 공급하면서 소정의 주파수와 전압을 가진 신호를 송신코일(39)로 전송하는 주파수 및 출력을 제어하는 송신 출력제어부와, 송신 출력제어부(37)를 거쳐서 나온 신호를 전자파의 유도 자기장을 발생시키는 송신코일로 구성되어 다양한 충전용전자기기에 필요한 전기에너지를 고려하여 송신출력을 제어하여 공급하는 구성들을 구비한다. 상기 출력제어부에서 출력되는 전기신호의 출력을 일정하게 유지하기 위하여 송신파드로 전송되는 출력신호를 감지하여 신호제어부로 피드백시켜 출력제어부에서 송신코일로 전송되는 전기신호의 출력이 증가하면 감소시키고 출력이 감소하면 증가시켜 항상 일정한 송신출력을 유지시켜주는 피드백회로를 가진다. 상기 송신모듈에서 유도코일이 내장된 송신파드의 앞단에 설치되는 AC어댑터(15)는 다양한 방법에 설계 제작하여 안정된 출력을 가지면서 소정의 주파수와 AC 출력전압을 발생시킬 수 있도록 구성되어야 한다. 본 발명에 따른 송신파드에 내장된 송신코일의 구성은 수신모듈(12)에 내장된 수신코일에서 최대한 많은 전기에너지가 유도될 수 있도록 전자파의 유도자기장을 발생할 수 있도록 다양하게 형성할 수 있다. 표1은 도3에서 구성한 스파이럴 코일의 직경, 감은 수, 내경 및 외경을 나타낸 것이며, 본 발명의 실시 예에서 사용된 송신코일의 샘플1에 해당한다.

표1. 도3의 스파이럴 코일의 직경, 감은 수, 내경 및 외경(송신샘플1)

도3	내경(mm)	외경(mm)	코일종류(mm)	감은 수
송신표일	24	80	0.2*8	34

표2는 도4와 같이 설계 제작된 스파이럴 코일로 전자파의 유도자기장을 중계를 위한 중계코일과, 중계코일과 공진을 형성하기 위해 공진커패시터를 연결 구성한 스파이럴형 중계기와 소정거리의 스파이럴 송신코일의 직경, 감은 수, 내경 및 외경을 나타낸 것이며, 본 발명의 실시 예에서 사용된 송신코일의 샘플2에 해당한다.

표2 :도4의 중계코일 및 송신코일의 직경, 감은 수, 내경 및 외경(송신샘플2)

도4	내경(mm)	외경(mm)	코일종류(mm)	감은 수
중계코일	24	80	0.2*8	34
송신표일	24	80	0.2*6	34

표3은 도5와 같이 설계 제작된 스파이럴 코일로 전자파의 유도 자기장의 중계를 위한 중계코일과, 중계코일과 공진회로를 형성하기 위한 커패시터로 구성되어진 중계기와 상기 전자파의 유도자기장의 강화를 위한 중계코일 내부에 스파이럴 코일로 송신코일을 구성한 송신코일의 샘플에 대한 중계코일 및 송신코일의 직경, 감은 수, 내경 및 외경을 나타낸 것이며, 본 발명의 실시 예에서 사용된 송신코일의 샘플3에 해당한다. 송신코일과 중계기는 유선으로 연결되어 있지 않으며, 패드의 크기와 형태에 따라 중계코일 및 송신코일을 감은 수, 외경 및 내경 등을 다르게 수정할 수 있다.

표3 :도5의 중계코일 및 송신코일의 직경, 감은 수, 내경 및 외경(송신샘플3)

도5	내경(mm)	외경(mm)	코일종류(mm)	감은 수
송신코일	20	30	0.2*8	9
중계코일	30	80	0.2*8	29

본 발명에 따라 설계 제작되는 송신코일은 상기 샘플1, 샘플2 및 샘플3에서 설계 제작된 스파이럴로 구성된 송신코일 대신에 본 발명의 특허 출원인 2005년 출원한 출원번호 10-2005-0059562호에 기재된 자성체 코어와 코일을 이용하여 송신코일과 중계코일(상기 특허출원에서는 전자파의 유도자기장 증폭중계기라고 기재되어 있습니다)을 구성할 수 있다.

다음은 본 발명에 따라 설계 제작된 수신코일에 대하여 구체적으로 살펴본다. 핸드폰, MP3 및 PDA 등에 채용될 수 있는 내외장형 수신모듈에 삽입되도록 설계 제작된 소형·경량의 수신코일의 샘플구조들을 살펴본다. 도6은 자성체 코어에 유도코일을 감은 솔레노이드 코일로 구성된 수신코일이며, 표4는 수신 솔레노이드 코일의 직경, 높이, 코일종류 및 감은 수를 나타낸 것으로 수신코일 샘플1이다.

표4. 수신코일의 직경, 높이, 코일종류 및 감은 수(수신샘플1)

도6	직경(mm)	높이(mm)	코일종류(mm)	감은 수
수신코일	10	7	0.1*30	10

도7은 하나의 자성체(페라이트)를 공통코어로 사용하여 수신코일과 전자파의 유도자기장을 중계하는 중계코일을 감아서 구성한 수신코일이며, 표5는 수신코일 및 중계코일의 직경, 높이, 코일규격 및 감은 수를 표시한 것으로 수신코일샘플2에 해당한다.

표5. 수신코일 및 중계코일의 직경, 높이, 코일규격 및 감은 수(수신샘플2)

도7	내경(mm)	외경(mm)	코일규격(mm)	감은 수
수신코일	5	20	0.2*8	9
중계코일	20	40	0.43*1	21

도8은 일반적인 스파이럴 코일로 구성된 수신코일이며, 표6은 코일의 직경, 감은 수, 내경 및 외경을 나타낸 것으로 수신코일샘플3에 해당한다.

표6. 스파이럴 코일의 직경, 감은 수, 내경 및 외경(수신샘플3)

도8	내경(mm)	외경(mm)	코일종류(mm)	감은 수
수신코일	10	25	0.2*8	8

도9는 도5의 송신코일과 동일한 구조로 외부에는 스파이럴 중계코일과 공진회로 구성을 위한 커패시터를 사용하여 전자파의 유도 자기장을 강화하는 중계기를 구성하고, 내부에 스파이럴 수신코일로 결합된 구조로 수신코일 샘플4에 해당한다. 표7은 상기 수신코일 샘플4에 사용된 중계코일 및 수신코일의 직경, 감은 수, 내경 및 외경을 나타낸 것이다.

표7. 중계코일 및 수신코일의 직경, 감은 수, 내경 및 외경(수신샘플4)

도9	내경(mm)	외경(mm)	코일규격(mm)	감은 수
수신코일	5	20	0.2*8	9
중계코일	20	40	0.43*1	21

상기 도3내지 도9 및 표1내지 표7에서와 같이 구성된 송신코일 및 수신코일로 설계 제작된 송수신코일의 샘플들을 조합하여 핸드폰, MP3 및 PDA 등에 채용될 수 있는 내외장형 수신모듈에 삽입되어 소형·경량의 무선 송수신장치를 얻기 위한 샘플구조에 있어서, 상기 송신모듈의 출력제어부에 송신출력을 10W, AC 100kHz 주파수로 송신하여 전자파의 유도자기장을 발생시키고, 상기 수신코일 샘플1내지 4에서 설계 제작한 다양한 수신 샘플코일들을 사용하여 수신모듈의 충전 회로도를 구성하여 출력단에서 DC 전력이 3.7V 전자기기(핸드폰) 충전용 배터리에 전기에너지를 충전 시에 수신전압, 전류 및 전력 값을 측정한다. 수신모듈은 핸드폰 등의 전자기기에 필요한 전기에너지를 충전하는 수단만 내장시키거나 소정의 용량을 가진 충전용 배터리를 상기 충전수단과 동시에 내장시켜 병렬로 동시에 충전되도록 구성할 수 있다. 상기 수신코일샘플 1내지 4의 뒷단에 높은 효율로 전기에너지를 전송하기 위하여 공진 및 임피던스 매칭용 가변 커패시터가 체결되고, 커패시터를 거쳐서 나온 전기신호를 다이오드를 이용하여 직류신호로 변환하기 위한 정류회로와, 정류된 신호를 평활하기 위한 커패시터로 구성되어 충전을 필요로 하는 전자기기의 배터리에 전기에너지를 충전하게 된다. 즉, 도10의 수신모듈은 수신코일에서 수신된 유도자기전력을 출력단으로 높은 효율로 전기에너지를 전송하기 위하여 공진 및 임피던스 매칭용 가변 커패시터를 수신코일과 병렬로 체결 구성하고, 공진 및 임피던스 매칭용 가변 커패시터를 거쳐서 전송된 신호를 정류 다이오드와 평활커패시터를 거쳐서 정전압 및 보호회로를 거친 후, 수신모듈 내에 내장된 소정용량의 3V내지 4V 충전용 배터리와 전자기기내의 3내지 4V 충전용 배터리에만 충전할 수 있도록 수신모듈로 구성할 수 있다. 표8은 상기 본 발명의 실시 예에서 설계 제작한 송신코일의 샘플1내지 샘플3 각각에 대하여 상기 수신코일의 샘플1내지 샘플4에 대한 각각의 수신회로를 구성하여 출력단 전자기기의 충전배터리에서 측정한 충전하는 수신전압, 전류 및 전력 값을 나타낸 것이다. 표8을 통해서 알 수 있듯이 전자파의 유도 자기장을 중계하는 중계코일을 결합한 송신코일과 전자파의 유도 자기장을 중계하는 중계코일을 결합한 수신코일로 전자파의 유도자기장을 발생하고 발생한 전자파 자기장을 수신하는 구조가 전자기기의 충전배터리에 전기에너지를 신속하고 높은 효율로 충전할 수 있는 높은 출력전력을 얻을 수 있다. 즉, 스파이럴코일 외부에 중계코일과 송신코일을 결합한 구성인 송신코일샘플3으로 송신파드를 구성하고, 수신코일 샘플2 구조인 하나의 페라이트 코어에 중계코일과 수신코일을 결합하여 구성한 수신모듈로 전자파의 유도 자기장을 송수신할 경우에 가장 큰 충전 수신전류인 1.32A와 충전전력 5.41W를 얻을 수 있었다. 상기 중계코일을 포함하지 않는 일반 송신코일 샘플1을 사용하여 송신코일로 구성하고, 중계코일을 사용하지 않은 일반 솔레노이드로 구성된 수신코일 샘플1과 스파이럴 수신코일인 샘플3의 구조에서는 아주 낮은 0.24W, 0.28W의 충전전력을 얻었다.

표8. 본 발명의 실시 예에서 설계 제작한 송신코일의 샘플1내지 샘플3 각각에 대하여 수신코일의 샘플1내지 샘플4에 대하여 수신모듈의 출력단 전자기기내 충전 배터리 에서 측정한 수신전압, 전류, 전력값

송신	수신			
송신샘플	수신샘플	수신전압(V)	수신전류(A)	수신전력(W)
송신샘플1	수신샘플1	4.1	0.06	0.24
	수신샘플2	4.1	0.2	0.82
	수신샘플3	4.1	0.37	0.26
	수신샘플4	4.1	0.18	0.73
송신샘플2	수신샘플1	4.1	0.17	0.89
	수신샘플2	4.1	0.4	1.64
	수신샘플3	4.1	0.20	0.82
	수신샘플4	4.1	0.37	1.51
송신샘플3	수신샘플1	4.1	0.74	3.03
	수신샘플2	4.1	1.32	5.41
	수신샘플3	4.1	0.81	3.32
	수신샘플4	4.1	1.13	4.63

본 발명에 따라 구성되는 전자파 유도자기장 발생을 위한 송신페드를 구성하는 송신코일은 상기 실시 예에서 설계 제작한 다양한 종류의 송신코일 외에 본 발명의 특허 출원인 2005년 출원한 출원번호 10-2005-0059562호에 기재된 자성체 코어와 유도코일을 사용하여 구성된 송신코일과 중계증폭기(본 발명의 중계코일에 해당한다) 등을 사용하여 다양하게 구성할 수 있으며, 수신코일 또한 상기 실시 예에서 설계 제작한 다양한 종류의 수신코일 외에 본 발명의 특허 출원인 2005년 출원한 출원번호 10-2005-0059562호에 기재된 자성체 코어, 유도코일 및 가변커패시터를 사용하여 구성된 수신코일과 중계증폭기(본 발명의 중계코일에 해당한다) 등을 사용하여 다양하게 구성할 수 있다. 본 발명에 따른 송신모듈의 출력전압, 주파수 및 출력전력을 제어하여 송신출력을 제어하여 송신하고, 수신모듈의 접속단자를 충전을 원하는 다양한 전자기기에 형성되어 있는 집적에 맞추어 설계 제작할 경우에 핸드폰, 리모콘, MP3, PMP, PDA 뿐만 아니라 충전이나 전원공급이 필요한 대부분의 전자기기들에 내장 또는 외장형으로 설계 제작하여 배터리 충전에 적용할 수 있다. 본 발명의 송신패드와 AC어댑터는 필요에 따라 일체형 또는 도1에서와 같이 분리형으로 설계 제작할 수 있다.

발명의 효과

본 발명은 노이즈필터, 정류회로, 주파수 변환회로, 정전압 회로 및 다양한 크기와 출력의 전자파의 유도 자기장을 발생시킬 수 있도록 전기신호를 제어하는 출력제어부로 구성된 AC 어댑터와, 어댑터에서 전송된 전기신호의 연결된 송신코일로 전자파의 유도 자기장을 발생시키는 송신페드로 구성된 송신모듈과, 상기 송신모듈에서 발생한 전자파의 유도 자기장을 수신하기 위하여 수신코일과 수신된 전기에너지를 극대화하기 위한 공진 및 임피던스 매칭 회로와 충전용 DC전원으로 변환하는 정류회로로 구성된 수신모듈을 구비하고 최대 유도 무선 전력 송수신 장치를 구현하여 핸드폰, 리모콘, MP3, PMP, PDA 및 충전이 필요한 기기의 배터리로 전원을 충전함으로써 전선의 단선 및 누전에 의한 안전사고를 예방할 수 있고 소형·경량으로 설치가 간단하고 충전 시 걸려온 전화를 용이하게 받을 수 있는 작용효과가 있다.

발명의 또 다른 효과는 AC어댑터와 송신용 유도 코일과 상기 유도코일과 공진을 이루기 위한 커패시터를 구비하고 최대한 효율이 높은 전자파의 유도 자기장을 발생시키는 송신페드로, 수신용 유도코일과 공진회로를 형성하면서 출력단과는 임피던스 매칭을 위한 가변커패시터를 구성하여 최대한 높은 효율로 수신 전기에너지를 수신모듈내 소형 충전 배터리와 전자기기내 충전 배터리에 공급하면서 소형·경량으로 설계 제작되어 핸드폰, 리모콘, MP3, PMP, PDA 및 충전이 필요한 전자기기들의 충전용 집적단자에 맞는 내외장형 수신모듈을 제공함으로써 하나의 송신패드위에서 무접점·무선으로 다양한 전자기기들의 충전용 배터리를 효율적으로 신속하게 충전할 수 있고 유선충전 시 발생할 수 있는 여러 가지 불편을 모두 해결하고 수신모듈내 소정 크기의 충전용 배터리를 이용하여 전자기기내 충전 배터리의 방전시 응급용 전자기기내 전원 공급으로도 사용할 수 있도록 하는데 있다.

도면의 간단한 설명

도1: 본 발명에 따른 AC 어댑터를 구비한 송신페드로 구성된 소형·경량의 무선 전력 송수신장치의 개략도

도2: 본 발명에 따른 AC 어댑터와 송신페드에 내장된 회로의 블록다이아그램과 수신모듈의 블록다이아그램

도3: 스파이럴 송신코일

도4: 스파이럴 코일로 구성된 중계코일과, 중계코일과 공진회로를 형성하기 위한 공진커패시터 구성의 중계기 및 소정거리의 스파이럴 코일로 구성된 송신코일

도5: 스파이럴 코일로 설계 제작된 중계코일과, 상기 중계코일과 공진회로를 형성하기 위한 공진커패시터와, 상기 중계코일 내부에 스파이럴 코일로 구성된 송신코일

도6: 자성체 코어에 유도코일을 감은 솔레노이드 구조 수신코일

도7: 자성체를 공통코어로 하여 수신코일과 중계코일을 감아서 구성한 수신코일

도8: 일반적인 스파이럴 구조로 구성한 수신코일

도9: 도5의 송신코일과 동일한 구조로 형성한 수신코일

도10: 본 발명에 따라 설계 제작된 수신모듈의 회로도

<도면부호의 간단한 설명>

11; 충전 대상인 핸드폰 12; 수신모듈

13; 송신패드 14; 접속단자

15; AC어댑터 16; 콘센트

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