

Receipt date: 12/10/2013

12639963 - GAU: 2836

Sheet 1 of 3

Substitute Disclosure Form	U.S. Department of Commerce Patent and Trademark Office	Attorney Docket No. 01997-0359009	Application No. 12/639,963
Information Disclosure Statement by Applicant (Use several sheets if necessary) (37 CFR §1.98(b))		Applicant John D. Joannopoulos et al.	
		Filing Date December 16, 2009	Group Art Unit 2836

U.S. Patent Documents							
Examiner Initial	Desig. ID	Document Number	Publication Date	Patentee	Class	Subclass	Filing Date If Appropriate
	I	2005/0135122	6/23/2005	Cheng 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
	2	EP 1 524 010	4/20/2005	EPO	A61N	1/372	

Other Documents (include Author, Title, Date, and Place of Publication)		
Examiner Initial	Desig. ID	Document
	3	Australian Office Action, Application No. 2007349874; mailed April 27, 2011; Applicant: Massachusetts Institute of Technology; 3 pages
	4	Australian Office Action, Application No. 2011232776; mailed December 2, 2011; Applicant: Massachusetts Institute of Technology; 2 pages
	5	Australian Office Action, Application No. 2011232776; mailed February 15, 2013; Applicant: Massachusetts Institute of Technology; 3 pages
	6	Australian Office Action, Application No. 2006269374; mailed September 18, 2008; Applicant: Massachusetts Institute of Technology; 3 pages
	7	Australian Office Action, Application No. 2010200044; mailed May 16, 2011; Applicant: Massachusetts Institute of Technology; 2 pages
	8	Australian Office Action, Application No. 2011203137; mailed April 18, 2013; Applicant: Massachusetts Institute of Technology; 3 pages
	9	Australian Office Action, Application No. 2009246310; mailed June 13, 2013; Applicant: Massachusetts Institute of Technology; 2 pages
	10	Canadian Office Action, Application No. 2,615,123; mailed November 15, 2012; Applicant: Massachusetts Institute of Technology; 4 pages
	11	Chinese Office Action, Application No. 200780053126.3; mailed October 27, 2011; Applicant: Massachusetts Institute of Technology; 6 pages
	12	Chinese Office Action, Application No. 200780053126.3; mailed August 6, 2012; Applicant: Massachusetts Institute of Technology; 11 pages
	13	Chinese Office Action, Application No. 200780053126.3; mailed December 19, 2012; Applicant: Massachusetts Institute of Technology; 8 pages
	14	Chinese Office Action, Application No. 201110311000.X; mailed June 18, 2013; Applicant: Massachusetts Institute of Technology; 20 pages
	15	Chinese Office Action, Application No. 200680032299.2; mailed January 22, 2010; Applicant: Massachusetts Institute of Technology; 5 pages
	16	Chinese Office Action, Application No. 200680032299.2; mailed October 17, 2011; Applicant: Massachusetts Institute of Technology; 9 pages
	17	Chinese Office Action, Application No. 200680032299.2; mailed June 4, 2012; Applicant: Massachusetts Institute of Technology; 5 pages

Examiner Signature /Fritz Fleming/ (02/24/2014)	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

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /F.F./

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Sheet 2 of 3

Substitute Disclosure Form	U.S. Department of Commerce Patent and Trademark Office	Attorney Docket No.: 01997-0359009	Application No. 12/639,963
Information Disclosure Statement by Applicant (Use several sheets if necessary)		Applicant John D. Joannopoulos et al.	
		Filing Date December 16, 2009	Group Art Unit 2836
(37 CFR §1.98(b))			

Other Documents (include Author, Title, Date, and Place of Publication)		
Examiner Initial	Desig. ID	Document
	18	Chinese Office Action, Application No. 201010214681.3; mailed January 26, 2011; Applicant: Massachusetts Institute of Technology; 7 pages
	19	Chinese Office Action, Application No. 201010214681.3; mailed November 2, 2011; Applicant: Massachusetts Institute of Technology; 7 pages
	20	Chinese Office Action, Application No. 201010214681.3; mailed February 13, 2012; Applicant: Massachusetts Institute of Technology; 4 pages
	21	Chinese Office Action, Application No. 201010214681.3; mailed May 29, 2012; Applicant: Massachusetts Institute of Technology; 4 pages
	22	Chinese Office Action, Application No. 201010214681.3; mailed October 10, 2012; Applicant: Massachusetts Institute of Technology; 3 pages
	23	Chinese Office Action, Application No. 201110185992.6; mailed April 11, 2012; Applicant: Massachusetts Institute of Technology; 5 pages
	24	Chinese Office Action, Application No. 201110185992.6; mailed January 4, 2013; Applicant: Massachusetts Institute of Technology; 10 pages
	25	Chinese Office Action, Application No. 200980127634.0; mailed April 2, 2013; Applicant: Massachusetts Institute of Technology; 11 pages
	26	European Office Action, Application No. 06 786 588.1; mailed January 15, 2009; Applicant: Massachusetts Institute of Technology; 5 pages
	27	European Office Action, Application No. 06 786 588.1; mailed April 24, 2013; Applicant: Massachusetts Institute of Technology; 4 pages
	28	European Office Action, Application No. 06 786 588.1; mailed December 3, 2013; Applicant: Massachusetts Institute of Technology; 6 pages
	29	Japanese Office Action, Application No. 2010-500897; mailed May 29, 2012; Applicant: Massachusetts Institute of Technology; 7 pages
	30	Japanese Office Action, Application No. 2011-256729; mailed May 28, 2013; Applicant: Massachusetts Institute of Technology; 7 pages
	31	Japanese Office Action, Application No. 2011-509705; mailed July 16, 2013; Applicant: Massachusetts Institute of Technology; 10 pages
	32	Japanese Office Action, Application No. 2008-521453; mailed January 4, 2011; Applicant: Massachusetts Institute of Technology; 3 pages
	33	Japanese Office Action, Application No. 2011-083009; mailed July 2, 2013; Applicant: Massachusetts Institute of Technology; 5 pages
	34	Korean Office Action, Application No. 10-2009-7022442; mailed October 18, 2012; Applicant: Massachusetts Institute of Technology; 5 pages
	35	Korean Office Action, Application No. 10-2009-7022442; mailed January 31, 2013; Applicant: Massachusetts Institute of Technology; 6 pages
	36	Korean Office Action, Application No. 10-2011-7023643; mailed October 23, 2012; Applicant: Massachusetts Institute of Technology; 5 pages
	37	Korean Office Action, Application No. 10-2011-7023643; mailed January 31, 2013; Applicant: Massachusetts Institute of Technology; 3 pages
	38	Korean Office Action, Application No. 10-2013-7013521; mailed August 8, 2013; Applicant: Massachusetts Institute of Technology; 2 pages

Examiner Signature /Fritz Fleming/ (02/24/2014)	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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Sheet 3 of 3

Substitute Disclosure Form	U.S. Department of Commerce Patent and Trademark Office	Attorney Docket No. 01997-0359009	Application No. 12/639,963
Information Disclosure Statement by Applicant (Use several sheets if necessary) (37 CFR §1.98(b))		Applicant John D. Joannopoulos et al.	
		Filing Date December 16, 2009	Group Art Unit 2836

Other Documents (include Author, Title, Date, and Place of Publication)		
Examiner Initial	Desig. ID	Document
	39	Korean Office Action, Application No. 10-2008-7003376; mailed March 7, 2011; Applicant: Massachusetts Institute of Technology; 3 pages
	40	Korean Office Action, Application No. 10-2011-7013029; mailed August 9, 2011; Applicant: Massachusetts Institute of Technology; 4 pages

Examiner Signature /Fritz Fleming/ (02/24/2014)	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

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UNITED STATES PATENT AND TRADEMARK OFFICE

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

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY-DOCKET NO.	CONFIRMATION NO.
12/639,963	12/16/2009	John D. Joannopoulos	01997-0359009 / MIT 11757	7811
26161 7590 04/14/2014 FISH & RICHARDSON P.C. (BO) P.O. BOX 1022 MINNEAPOLIS, MN 55440-1022			EXAMINER FLEMING, FRITZ M	
			ART UNIT 2836	PAPER NUMBER
			NOTIFICATION DATE 04/14/2014	DELIVERY MODE ELECTRONIC

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

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

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

PATDOCTC@fr.com

Applicant-Initiated Interview Summary	Application No.	Applicant(s)	
	12/639,963	JOANNOPOULOS ET AL.	
	Examiner	Art Unit	
	FRITZ M. FLEMING	2836	

All participants (applicant, applicant's representative, PTO personnel):

(1) FRITZ M. FLEMING. (3) _____

(2) Dr. Wefers, of record. (4) _____

Date of interview: 08 April 2014.

Type: ☒ Telephonic ☐ Video Conference
☐ Personal [copy given to: ☐ applicant ☐ applicant's representative]

Exhibit shown or demonstration conducted: ☐ Yes ☒ No.
If Yes, brief description: _____.

Issues Discussed ☐ 101 ☐ 112 ☐ 102 ☐ 103 ☒ Others
(For each of the checked box(es) above, please describe below the issue and detailed description of the discussion.)

Claim(s) discussed: 1 and 2.

Identification of prior art discussed: N/A.

Substance of Interview
(For each issue discussed, provide a detailed description and indicate if agreement was reached. Some topics may include: identification or clarification of a reference or a portion thereof, claim interpretation, proposed amendments, arguments of any applied references etc...)

Dr. Wefers proposed to amend the claims 1 and 2 to include the "objected to" language of claims 17 and 39, which would place the claims into condition for allowance. We also discussed the language of [0036] and the resonant modes of high Q for low intrinsic loss rates and evanescent tails significantly longer than the characteristic sizes for strong coupling rate over large distances. When the response is formally submitted, an update search as well as consideration of any outstanding IDSs will be performed.

Applicant recordation instructions: The formal written reply to the last Office action must include the substance of the interview. (See MPEP section 713.04). If a reply to the last Office action has already been filed, applicant is given a non-extendable period of the longer of one month or thirty days from this interview date, or the mailing date of this interview summary form, whichever is later, to file a statement of the substance of the interview

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

☐ Attachment

/FRITZ M FLEMING/ Primary Examiner, Art Unit 2836	
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Summary of Record of Interview Requirements

Manual of Patent Examining Procedure (MPEP), Section 713.04, Substance of Interview Must be Made of Record

A complete written statement as to the substance of any face-to-face, video conference, or telephone interview with regard to an application must be made of record in the application whether or not an agreement with the examiner was reached at the interview.

Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews

Paragraph (b)

In every instance where reconsideration is requested in view of an interview with an examiner, a complete written statement of the reasons presented at the interview as warranting favorable action must be filed by the applicant. An interview does not remove the necessity for reply to Office action as specified in §§ 1.111, 1.135. (35 U.S.C. 132)

37 CFR §1.2 Business to be transacted in writing.

All business with the Patent and Trademark Office should be transacted in writing. The personal attendance of applicants or their attorneys or agents at the Patent and Trademark Office is unnecessary. The action of the Patent and Trademark Office will be based exclusively on the written record in the Office. No attention will be paid to any alleged oral promise, stipulation, or understanding in relation to which there is disagreement or doubt.

The action of the Patent and Trademark Office cannot be based exclusively on the written record in the Office if that record is itself incomplete through the failure to record the substance of interviews.

It is the responsibility of the applicant or the attorney or agent to make the substance of an interview of record in the application file, unless the examiner indicates he or she will do so. It is the examiner's responsibility to see that such a record is made and to correct material inaccuracies which bear directly on the question of patentability.

Examiners must complete an Interview Summary Form for each interview held where a matter of substance has been discussed during the interview by checking the appropriate boxes and filling in the blanks. Discussions regarding only procedural matters, directed solely to restriction requirements for which interview recordation is otherwise provided for in Section 812.01 of the Manual of Patent Examining Procedure, or pointing out typographical errors or unreadable script in Office actions or the like, are excluded from the interview recordation procedures below. Where the substance of an interview is completely recorded in an Examiners Amendment, no separate Interview Summary Record is required.

The Interview Summary Form shall be given an appropriate Paper No., placed in the right hand portion of the file, and listed on the "Contents" section of the file wrapper. In a personal interview, a duplicate of the Form is given to the applicant (or attorney or agent) at the conclusion of the interview. In the case of a telephone or video-conference interview, the copy is mailed to the applicant's correspondence address either with or prior to the next official communication. If additional correspondence from the examiner is not likely before an allowance or if other circumstances dictate, the Form should be mailed promptly after the interview rather than with the next official communication.

The Form provides for recordation of the following information:

- Application Number (Series Code and Serial Number)
- Name of applicant
- Name of examiner
- Date of interview
- Type of interview (telephonic, video-conference, or personal)
- Name of participant(s) (applicant, attorney or agent, examiner, other PTO personnel, etc.)
- An indication whether or not an exhibit was shown or a demonstration conducted
- An identification of the specific prior art discussed
- An indication whether an agreement was reached and if so, a description of the general nature of the agreement (may be by attachment of a copy of amendments or claims agreed as being allowable). Note: Agreement as to allowability is tentative and does not restrict further action by the examiner to the contrary.
- The signature of the examiner who conducted the interview (if Form is not an attachment to a signed Office action)

It is desirable that the examiner orally remind the applicant of his or her obligation to record the substance of the interview of each case. It should be noted, however, that the Interview Summary Form will not normally be considered a complete and proper recordation of the interview unless it includes, or is supplemented by the applicant or the examiner to include, all of the applicable items required below concerning the substance of the interview.

A complete and proper recordation of the substance of any interview should include at least the following applicable items:

- 1) A brief description of the nature of any exhibit shown or any demonstration conducted,
- 2) an identification of the claims discussed,
- 3) an identification of the specific prior art discussed,
- 4) an identification of the principal proposed amendments of a substantive nature discussed, unless these are already described on the Interview Summary Form completed by the Examiner,
- 5) a brief identification of the general thrust of the principal arguments presented to the examiner.
(The identification of arguments need not be lengthy or elaborate. A verbatim or highly detailed description of the arguments is not required. The identification of the arguments is sufficient if the general nature or thrust of the principal arguments made to the examiner can be understood in the context of the application file. Of course, the applicant may desire to emphasize and fully describe those arguments which he or she feels were or might be persuasive to the examiner.)
- 6) a general indication of any other pertinent matters discussed, and
- 7) if appropriate, the general results or outcome of the interview unless already described in the Interview Summary Form completed by the examiner.

Examiners are expected to carefully review the applicant's record of the substance of an interview. If the record is not complete and accurate, the examiner will give the applicant an extendable one month time period to correct the record.

Examiner to Check for Accuracy

If the claims are allowable for other reasons of record, the examiner should send a letter setting forth the examiner's version of the statement attributed to him or her. If the record is complete and accurate, the examiner should place the indication, "Interview Record OK" on the paper recording the substance of the interview along with the date and the examiner's initials.

Doc Code: DIST.E.FILE Document Description: Electronic Terminal Disclaimer - Filed		PTO/SB/25 U.S. Patent and Trademark Office Department of Commerce
Electronic Petition Request	TERMINAL DISCLAIMER TO OBIATE A PROVISIONAL DOUBLE PATENTING REJECTION OVER A PENDING "REFERENCE" APPLICATION	
Application Number	12639963	
Filing Date	16-Dec-2009	
First Named Inventor	John Joannopoulos	
Attorney Docket Number	01997-0359009 / MIT 11757	
Title of Invention	WIRELESS ENERGY TRANSFER WITH HIGH-Q TO MORE THAN ONE DEVICE	
☒ Filing of terminal disclaimer does not obviate requirement for response under 37 CFR 1.111 to outstanding Office Action ☒ This electronic Terminal Disclaimer is not being used for a Joint Research Agreement.		
Owner	Percent Interest	
Massachusetts Institute of Technology	100%	
The owner(s) of percent interest listed above in the instant application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the instant application which would extend beyond the expiration date of the full statutory term of any patent granted on pending reference Application Number(s)		
12649852 filed on 12/30/2009 as the term of any patent granted on said reference application may be shortened by any terminal disclaimer filed prior to the grant of any patent on the pending reference application. The owner hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and any patent granted on the reference application are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns. In making the above disclaimer, the owner does not disclaim the terminal part of any patent granted on the instant application that would extend to the expiration date of the full statutory term of any patent granted on said reference application, "as the term of any patent granted on said reference application may be shortened by any terminal disclaimer filed prior to the grant of any patent on the pending reference application," in the event that any such patent granted on the pending reference application: expires for failure to pay a maintenance fee, is held unenforceable, is found invalid by a court of competent jurisdiction, is statutorily disclaimed in whole or terminally disclaimed under 37 CFR 1.321, has all claims canceled by a reexamination certificate, is reissued, or is in any manner terminated prior to the expiration of its full statutory term as shortened by any terminal disclaimer filed prior to its grant.		
☒ Terminal disclaimer fee under 37 CFR 1.20(d) is included with Electronic Terminal Disclaimer request.		

☐ I certify, in accordance with 37 CFR 1.4(d)(4), that the terminal disclaimer fee under 37 CFR 1.20(d) required for this terminal disclaimer has already been paid in the above-identified application.	
Applicant claims the following fee status:	
☐ Small Entity ☐ Micro Entity ☒ Regular Undiscounted	
I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.	
THIS PORTION MUST BE COMPLETED BY THE SIGNATORY OR SIGNATORIES	
I certify, in accordance with 37 CFR 1.4(d)(4) that I am:	
☒ An attorney or agent registered to practice before the Patent and Trademark Office who is of record in this application Registration Number <u>56842</u>	
☐ A sole inventor	
☐ A joint inventor; I certify that I am authorized to sign this submission on behalf of all of the inventors as evidenced by the power of attorney in the application	
☐ A joint inventor; all of whom are signing this request	
Signature	/Marc Wefers/
Name	Marc Wefers

*Statement under 37 CFR 3.73(b) is required if terminal disclaimer is signed by the assignee (owner).
 Form PTO/SB/96 may be used for making this certification. See MPEP § 324.

Electronic Patent Application Fee Transmittal				
Application Number:		12639963		
Filing Date:		16-Dec-2009		
Title of Invention:		WIRELESS ENERGY TRANSFER WITH HIGH-Q TO MORE THAN ONE DEVICE		
First Named Inventor/Applicant Name:		John D. Joannopoulos		
Filer:		Marc M. Wefers		
Attorney Docket Number:		01997-0359009 / MIT 11757		
Filed as Large Entity				
Utility under 35 USC 111(a) Filing Fees				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Statutory or Terminal Disclaimer	1814	1	160	160
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Miscellaneous:				
Total in USD (\$)				160

Doc Code: DISQ.E.FILE
Document Description: Electronic Terminal Disclaimer – Approved

Application No.: 12639963

Filing Date: 16-Dec-2009

Applicant/Patent under Reexamination: Joannopoulos et al.

Electronic Terminal Disclaimer filed on April 16, 2014

☒ APPROVED

This patent is subject to a terminal disclaimer

☐ DISAPPROVED

Approved/Disapproved by: Electronic Terminal Disclaimer automatically approved by EFS-Web

U.S. Patent and Trademark Office

Electronic Acknowledgement Receipt	
EFS ID:	18774380
Application Number:	12639963
International Application Number:	
Confirmation Number:	7811
Title of Invention:	WIRELESS ENERGY TRANSFER WITH HIGH-Q TO MORE THAN ONE DEVICE
First Named Inventor/Applicant Name:	John D. Joannopoulos
Customer Number:	26161
Filer:	Marc M. Wefers
Filer Authorized By:	
Attorney Docket Number:	01997-0359009 / MIT 11757
Receipt Date:	16-APR-2014
Filing Date:	16-DEC-2009
Time Stamp:	09:42:05
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	\$ 160
RAM confirmation Number	8044
Deposit Account	061050
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. Section 1.20 (Post Issuance fees)	

File Listing:					
Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Electronic Terminal Disclaimer-Filed	eTerminal-Disclaimer.pdf	34190 5b74a9d9e297e0c311c2e0b8ba071210 142c	no	2
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30476 eb13f4282580bd50cc2d4b0b0e0e3077A93 62271	no	2
Warnings:					
Information:					
Total Files Size (in bytes):			64666		
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 : 2836
Serial No. : 12/639,963 Examiner : Fritz Fleming
Filed : December 16, 2009 Conf. No. : 7811
Title : WIRELESS ENERGY TRANSFER WITH HIGH-Q TO MORE THAN ONE
DEVICE

Mail Stop Amendment

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

REPLY TO ACTION OF FEBRUARY 27, 2014

Please consider the following reply.

List of claims (replacing prior versions).

1. (Currently Amended) A system, comprising:

a source resonator having a resonant frequency ω_1 , an intrinsic loss rate Γ_1 , and capable of storing electromagnetic energy with a high intrinsic quality factor $Q_1 = \omega_1 / (2\Gamma_1)$, the source resonator configured to be coupled to an energy source;

a second resonator having a resonant frequency ω_2 , an intrinsic loss rate Γ_2 , and capable of storing electromagnetic energy with a high intrinsic quality factor $Q_2 = \omega_2 / (2\Gamma_2)$, the second resonator located a distance from the source resonator; and

a third resonator having a resonant frequency ω_3 , an intrinsic loss rate Γ_3 , and capable of storing electromagnetic energy with a high intrinsic quality factor $Q_3 = \omega_3 / (2\Gamma_3)$, the third resonator located a distance from the source resonator,

wherein the source resonator and at least one of the second resonator and third resonator are configured to be coupled to wirelessly transfer electromagnetic energy from said source resonator to said at least one of the second resonator and third resonator when the source resonator is coupled to the energy source, and

wherein $Q_1 > 100$ and $Q_2 > 100$,

wherein the resonators are movable relative to one another and wherein the wireless energy transfer occurs over a range of distances, and

wherein $\kappa / \sqrt{\Gamma_1 \Gamma_2} > 0.2$ over the range of distances, wherein κ is the wireless energy transfer rate.

2. (Currently Amended) A method, comprising:

providing a source resonator having a resonant frequency ω_1 , an intrinsic loss rate Γ_1 , and capable of storing electromagnetic energy with a high intrinsic quality factor $Q_1 = \omega_1 / (2\Gamma_1)$, the source resonator configured to be coupled to an energy source;

providing a second resonator having a resonant frequency ω_2 , an intrinsic loss rate Γ_2 , and capable of storing electromagnetic energy with a high intrinsic quality factor $Q_2 = \omega_2 / (2\Gamma_2)$, the second resonator located a distance from the source resonator; and

providing a third resonator having a resonant frequency ω_3 , an intrinsic loss rate Γ_3 , and capable of storing electromagnetic energy with a high intrinsic quality factor $Q_3 = \omega_3 / (2\Gamma_3)$, the third resonator located a distance from the source resonator,

wherein the source resonator and at least one of the second resonator and third resonator are configured to be coupled to wirelessly transfer electromagnetic energy from said source resonator to said at least one of the second resonator and third resonator when the source resonator is coupled to the energy source, ~~and~~

wherein $Q_1 > 100$ and $Q_2 > 100$,

wherein the resonators are movable relative to one another and wherein the wireless energy transfer occurs over a range of distances, and

wherein $\kappa / \sqrt{\Gamma_1 \Gamma_2} > 0.2$ over the range of distances, wherein κ is the wireless energy transfer rate.

3. (Previously Presented) The system of claim 1, further comprising the energy source coupled to the source resonator.

4. (Previously Presented) The system of claim 1, further comprising an energy drain configured to be coupled to the second resonator and an energy drain configured to be coupled to the third resonator.

5. (Previously Presented) The system of claim 4, wherein at least one of the energy drains comprises a robot, vehicle, computer, cell phone, or a portable electronic device.

6. (Previously Presented) The system of claim 5, wherein the at least one of the second resonator and third resonator is configured to provide useful power to the energy drain based on wirelessly transferred electromagnetic energy.

7. (Previously Presented) The system of claim 1, wherein each intrinsic loss rate comprises a resistive component and a radiative component.

8. (Previously Presented) The system of claim 1, wherein the source resonator is electromagnetically coupled to each of the second and third resonators.

9. (Previously Presented) The system of claim 8, wherein the source resonator is configured to wirelessly transfer electromagnetic energy from the source resonator to each of the second and third resonators.

10. (Previously Presented) The system of claim 1, wherein $Q_3 > 100$.

11. Canceled.

12. (Previously Presented) The system of claim 1, wherein at least one of the resonators is tunable.

13. Canceled.

14. (Currently Amended) The system of claim [[13]] 1, wherein the range of distances includes 5 cm.

15. (Previously Presented) The system of claim [[13]] 1, wherein the range of distances includes 10 cm.

16. (Previously Presented) The system of claim [[13]] 1, wherein the range of distances includes 30 cm.

17. Canceled.

18. (Currently Amended) The system of claim [[17]] 1, wherein $\kappa/\sqrt{\Gamma_1\Gamma_2} > 0.5$ over the range of distances.

19. (Currently Amended) The system of claim [[17]] 1, wherein $\kappa/\sqrt{\Gamma_1\Gamma_2} > 1$ over the range of distances.

20. (Currently Amended) The system of claim [[13]] 1, wherein the efficiency of the wireless energy transfer is at least 20% over the range of distances.

21. (Previously Presented) The system of claim 1, wherein frequencies $f_1 = \omega_1/2\pi$, $f_2 = \omega_2/2\pi$, and $f_3 = \omega_3/2\pi$ of the resonators are each at least 5 MHz.

22. (Previously Presented) The system of claim 1, further comprising a feedback mechanism coupled to at least one of the resonators to correct for detuning to correct for detuning of the resonant frequencies.

23. (Previously Presented) The system of claim 1, wherein the energy source is coupled to the source resonator, an energy drain is coupled to the second resonator, and the source resonator is electromagnetically coupled to the second resonator, and wherein the energy source and energy drain are configured to be driven to increase the ratio of useful-to-lost power for varying wireless energy transfer rates κ between the source resonator and the second resonator.

24. (Previously Presented) The system of claim 1, wherein the source resonator is electromagnetically coupled to the second resonator, and wherein the source resonator and second resonator are configured to be adjustably tuned to increase the ratio of useful-to-lost power for varying wireless energy transfer rates κ between the source resonator and the second resonator.

25. (Previously Presented) The method of claim 2, wherein the energy source is coupled to the source resonator.

26. (Previously Presented) The method of claim 2, wherein an energy drain is coupled to the second resonator and an energy drain is coupled to the third resonator.

27. (Previously Presented) The method of claim 26, wherein at least one of the energy drains comprises a robot, vehicle, computer, cell phone, or a portable electronic device.

28. (Previously Presented) The method of claim 26, wherein the at least one of the second resonator and third resonator is configured to provide useful power to the energy drain based on wirelessly transferred electromagnetic energy.

29. (Previously Presented) The method of claim 2, wherein wherein each intrinsic loss rate comprises a resistive component and a radiative component.

30. (Previously Presented) The method of claim 2, wherein the source resonator is electromagnetically coupled to each of the second and third resonators.

31. (Previously Presented) The method of claim 30, wherein the source resonator is configured to wirelessly transfer electromagnetic energy from the source resonator to each of the second and third resonators.

32. (Previously Presented) The method of claim 2, wherein $Q_3 > 100$.

33. Canceled.

34. (Previously Presented) The method of claim 2, wherein at least one of the resonators is tunable.

35. Canceled.

36. (Currently Amended) The method of claim [[35]] 2, wherein the range of distances includes 5 cm.

37. (Currently Amended) The method of claim [[35]] 2, wherein the range of distances includes 10 cm.

38. (Currently Amended) The method of claim [[35]] 2, wherein the range of distances includes 30 cm.

39. Canceled.

40. (Currently Amended) The method of claim [[39]] 2, wherein $\kappa/\sqrt{\Gamma_1\Gamma_2} > 0.5$ over the range of distances.

41. (Currently Amended) The method of claim [[39]] 2, wherein $\kappa/\sqrt{\Gamma_1\Gamma_2} > 1$ over the range of distances.

42. (Currently Amended) The method of claim [[35]] 2, wherein the efficiency of the wireless energy transfer is at least 20% over the range of distances.

43. (Previously Presented) The method of claim 2, wherein frequencies $f_1 = \omega_1/2\pi$, $f_2 = \omega_2/2\pi$, and $f_3 = \omega_3/2\pi$ of the resonators are each at least 5 MHz.

44. (Previously Presented) The method of claim 2, wherein a feedback mechanism is coupled to at least one of the resonators to correct for detuning of the resonant frequencies.

45. (Previously Presented) The method of claim 2, wherein the energy source is coupled to the source resonator, an energy drain is coupled to the second resonator, and the source resonator is electromagnetically coupled to the second resonator, and wherein the energy source and energy drain is driven to increase the ratio of useful-to-lost power for varying wireless energy transfer rates κ between the source resonator and the second resonator.

46. (Previously Presented) The method of claim 2, wherein the source resonator is electromagnetically coupled to the second resonator, and wherein the source resonator and second resonator are adjustably tuned to increase the ratio of useful-to-lost power for varying wireless energy transfer rates κ between the source resonator and the second resonator.

47. (Previously Presented) The system of claim 1, wherein the source resonator and the second resonator have different characteristic sizes.

48. (Previously Presented) The method of claim 2, wherein the source resonator and the second resonator have different characteristic sizes.

49. (Previously Presented) The system of claim 1, wherein $f_1 = \omega_1 / (2\pi)$, $f_2 = \omega_2 / (2\pi)$, and $f_3 = \omega_3 / (2\pi)$, and each of f_1 , f_2 , and f_3 is between about 5 MHz and 380 MHz.

50. (Previously Presented) The method of claim 2, wherein $f_1 = \omega_1 / (2\pi)$, $f_2 = \omega_2 / (2\pi)$, and $f_3 = \omega_3 / (2\pi)$, and each of f_1 , f_2 , and f_3 is between about 5 MHz and 380 MHz.

REMARKS

We thank the Examiner for taking the time to discuss the present application, and related applications 12/649,635, 12/649,777, 12/649,813, 12/649,852, and 12/649,904, with Marc Wefers on April 8, 2014. With respect to the present Office Action, it was agreed that Applicants would amend the independent claims to take the allowable subject matter identified in the Action, as explained in greater detail below.

The Action states that claims 17-19, 23, 24, 39-41, 45, and 46 would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

To expedite allowance, and without conceding the substantive merits of the rejections, independent claims 1 and 2 have been amended to include the limitations of allowable dependent claims 17 and 39 (and intervening claims 13 and 35), respectively, except that definitions for Γ_1 and Γ_2 in dependent claims 17 and 39 have not been included because they are redundant in view of the definitions for Γ_1 and Γ_2 already present in independent claims 1 and 2. All of the remaining claims depend from independent claim 1 or independent claim 2. Accordingly, every claim includes the subject matter of allowable claims 17 and 39.

A Terminal Disclaimer has been e-filed today to moot the obviousness-type double patent rejection.

Conclusion

In view of the above, allowance is requested.

Canceled claims, if any, have been canceled without prejudice or disclaimer.

Any circumstance in which the applicant has (a) addressed certain comments of the examiner does not mean that the applicant concedes other comments of the examiner, (b) made arguments for the patentability of some claims does not mean that there are not other good reasons for patentability of those claims and other claims, or (c) amended or canceled a claim does not mean that the applicant concedes any of the examiner's positions with respect to that claim or other claims.

Applicant : John D. Joannopoulos et al.
Serial No. : 12/639,963
Filed : December 16, 2009
Page : 10 of 10

Attorney's Docket No.: 01997-0359009 / MIT Case
No. 11757

The applicant respectfully requests consideration of all filed IDSs not previously considered, by initialing and returning each Form PTO-1449.

Please apply any necessary charges or credits to Deposit Account 06-1050, referencing the above attorney docket number.

Respectfully submitted,

Date: April 16, 2014

/Marc M. Wefers Reg. No. 56,842/

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23171642.doc

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : John D. Joannopoulos et al. Art Unit : 2836
Serial No. : 12/639,963 Examiner : Fritz Fleming
Filed : December 16, 2009 Conf. No. : 7811
Title : WIRELESS ENERGY TRANSFER WITH HIGH-Q TO MORE THAN ONE
DEVICE

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-SB-08 or Disclosure 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 after a first Office action on the merits, but before receipt of
a final Office action or a Notice of Allowance. The fees in the amount of \$180 in payment of the
late submission fee of 37 CFR §1.17(p) are being paid concurrently herewith. In addition, please
apply any other necessary charges or credits to Deposit Account 06-1050, referencing the above
attorney docket number.

Respectfully submitted,

Date: April 16, 2014

/Marc M. Wefers Reg. No. 56,842/

Marc M. Wefers
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Substitute Disclosure Form U.S. Department of Commerce Patent and Trademark Office Information Disclosure Statement by Applicant (Use several sheets if necessary) (37 CFR §1.98(b))	Attorney Docket No.: 01997-0359009	Application No.: 12/639,963
	First Named Inventor John D. Joannopoulos	
	Filing Date December 16, 2009	Group Art Unit 2836

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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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		Filing Date December 16, 2009	Group Art Unit 2836

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	First Named Inventor John D. Joannopoulos	
	Filing Date December 16, 2009	Group Art Unit 2836

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							Yes	No
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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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Substitute Disclosure Form	U.S. Department of Commerce Patent and Trademark Office	Attorney Docket No. 01997-0359009	Application No. 12/639,963
Information Disclosure Statement by Applicant (Use several sheets if necessary) (37 CFR §1.98(b))		First Named Inventor John D. Joannopoulos	
		Filing Date December 16, 2009	Group Art Unit 2836

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Examiner Initial	Desig. ID	Document Number	Publication Date	Country or Patent Office	Class	Subclass	Translation	
							Yes	No
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Friday, April 11 2014

THOMSON INNOVATION

Patent/Publication: JP4265875A**Bibliography****DWPI Title**

Superconducting quantum interference device uses superconductor thin-film bonding pads for interconnecting superconducting coils

Original Title

PLANE TYPE GRADIOMETER

Assignee/ApplicantStandardized: **SEIKO INSTR INC**

Original: SEIKO INSTR INC

DWPI Assignee/Applicant

SEIKO INSTR INC (DASE-C)

Inventor

CHIBA TOKUO, SHIMIZU NOBUHIRO, NAKAYAMA SATORU,

DWPI Inventor

CHIBA T; NAKAYAMA S; SHIMIZU N

Publication Date (Kind Code)

1992-09-22 (A)

DWPI Accession / Update

1992-362729 / 199244

Application Number / Date

JP199127508A / 1991-02-21

Priority Number / Date / Country

JP199127508A / 1991-02-21 / JP

Abstract**DWPI Abstract**

(JP4265875A_)

Abstract

PURPOSE: To enable production time to be reduced and yield to be improved by allowing a method for forming a cross portion of a detection coil to be simplified.

<https://www.thomsoninnovation.com/tip-innovation/printRecView.do?ResultSetId=69744...> 4/11/2014

CONSTITUTION: A detection coil cross portion 5 consists of a bonding wire 1 and a bonding pad 2. A detection coil portion 3, a bonding pad 2, and a pad for wiring 4 are formed simultaneously by a same-layer superconductive thin-film deposition and patterning process and the coil cross portion 5 is formed only by the process for performing wire bonding of the superconductive wire 1 to the bonding pad 2.

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Classes/Indexing

IPC

IPC Code(1-7) **G01R 33/035** H01L 39/22

(7)

Current IPC	Invention	Version	Additional	Version
Full	G01R 33/035 H01L 39/22	20060101 20060101	-	-
Main Group	-	-	-	-
Subclass	-	-	-	-

JP FI Codes

G01R 33/035 (ZAA); H01L 39/22 D (ZAA)

JP F Terms

2G017: AA11; AB02; AC08; AD31; BA10

4M113: AC06; AC44; AD02; AD52; AD56; AD58; AD61; AD62; AD63; CA13; CA17; CA19

DWPI Class

S01 U14

DWPI Manual Codes

DWPI Manual Codes

EPI Manual Codes: S01-E01A1; U14-F02B

DWPI Chemistry Resource Numbers

DWPI Chemistry Resource Numbers

-

DWPI Registry Numbers

DWPI Registry Numbers

-

Plasdoc Punch Codes

<https://www.thomsoninnovation.com/tip-innovation/printRecView.do?ResultSetId=69744...> 4/11/2014

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Chemical Fragment Codes

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Legal Status

INPADOC Legal Status

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INPADOC Family (1)

Publication Number	Publication Date	Inventor	Assignee/Applicant	Title
JP4265875A	1992-09-22	CHIBA TOKUO	SEIKO INSTR INC	PLANE TYPE GRADIOMETER

DWPI Family (1); Countries (1)

Publication	DWPI Update	Publication Date	IPC Code	Language
JP4265875A	199244	1992-09-22	G01R0033035	Japanese
Local Applications: JP199127508A filed 1991-02-21				

Claims

No Claims exist for this Record

Description

Drawing Description

Drawing Description

Description

Description

Citations

Citation Record level

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Cited Patents (0)

Cited Non-patents (0)

DPCI Citation Patent family level

DPCI Citing Patents (1)

Publication Number	Accession Number	Publication Date	Application Date	DWPI Family Member(s)	Relevance	Source
WO2013036947A2	2013-D66147	2013-03-14	2012-09-10	JP4265875A	A	0 (Examiner)
DWPI Title: System for detecting e.g. foreign object debris in wireless energy transfer system has readout						

<https://www.thomsoninnovation.com/tip-innovation/printRecView.do?ResultSetId=69744...> 4/11/2014

circuit for measuring electrical parameters of magnetic field sensor where sensor is positioned within magnetic field of energy transfer system

DWPI Assignee/Applicant: WITRICITY CORP (WITR-N)

DWPI Inventor: HALL K; HALL K L; KESLER M P; LOU H T; VERGHESE S

DPCI Cited Patents (0)

DPCI Cited Non-patents (0)

DPCI Citation Counts

DPCI Citations	Total	Examiner	Inventor	Opposition	3rd party	Undefined
Citing Patents	1	1	0	0	0	0
Cited Patents	0	0	0	0	0	0
Citing Authorities	1	1	0	0	0	0
Cited Authorities	0	0	0	0	0	0
Citing Accession Numbers	1	1	0	0	0	0
Cited Accession Numbers	0	0	0	0	0	0
Cited Non-patents	0	0	0	0	0	0

DPCI Field of Search

-

DPCI Citing Patents Country

WO

DPCI Cited Patents Country

-

Other

DWPI Title Terms

SUPERCONDUCTING QUANTUM INTERFERENCE DEVICE THIN FILM BOND PAD INTERCONNECT COIL

DWPI Related Accession Numbers

-

Custom Fields

Test

-

Relevance

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Product Name

-
Docket number

-
Notes

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(19) 日本国特許庁 (J P)

(12) 公開特許公報 (A)

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特開平4-265875

(43) 公開日 平成4年(1992)9月22日

(51) Int.Cl. ³	識別記号	序内整理番号	F 1	技術表示箇所
G 0 1 R 33/035	Z A A	8203-2G		
H 0 1 L 39/22	Z A A D	8728-4M		

審査請求 未請求 請求項の数 4 (全 3 頁)

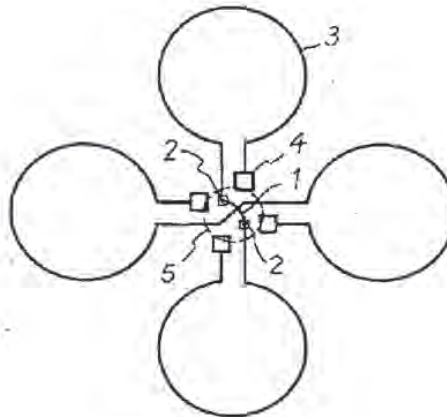
(21) 出願番号	特願平3-27508	(71) 出願人	000002325 セイコー電子工業株式会社 東京都江東区亀戸6丁目31番1号
(22) 出願日	平成3年(1991)2月21日	(72) 発明者	千葉 徳男 東京都江東区亀戸6丁目31番1号 セイコー電子工業株式会社内
		(72) 発明者	清水 信宏 東京都江東区亀戸6丁目31番1号 セイコー電子工業株式会社内
		(72) 発明者	中山 哲 東京都江東区亀戸6丁目31番1号 セイコー電子工業株式会社内
		(74) 代理人	弁理士 林 敬之助

(54) 【発明の名称】 平面型ラジオメータ

(57) 【要約】

【目的】 直交型の平面型ラジオメータにおいて、検出コイルの交差部の形成方法を簡単にし、製造時間の短縮および歩留りの向上を可能とする。

【構成】 検出コイル交差部5はボンディングワイヤー1とボンディングパッド2で構成する。検出コイル部3、ボンディングパッド2、配線用パッド4を薄膜プロセスにおいて同一層の超伝導薄膜堆積、パターニングの工程で同時に形成し、コイル交差部5は超伝導ボンディングワイヤー1をボンディングパッド2にワイヤーボンディングする工程のみで形成する。



【特許請求の範囲】

【請求項1】 同一平面上に構成され、ベースライン（検出コイルの中心間距離）の中心軸で互いに直交する2組の検出コイルを有する平面型グラジオメータにおいて、前記2組の検出コイルの交差部をボンディングワイヤーにより構成したことを特徴とする平面型グラジオメータ。

【請求項2】 前記ボンディングワイヤーは超伝導体で構成されていることを特徴とする請求項1記載の平面型グラジオメータ。

【請求項3】 前記ボンディングワイヤーの両端のコンタクト部は超伝導コンタクトで形成されていることを特徴とする請求項1記載の平面型グラジオメータ。

【請求項4】 前記2組の検出コイルは超伝導薄膜で形成されていることを特徴とする請求項1記載の平面型グラジオメータ。

【発明の詳細な説明】

【0001】

【産業上の利用分野】 この発明は高感度磁気センサ、電流計、変位計、または高周波信号増幅器などに応用する超伝導量子干渉素子（Superconducting Quantum Interference Device：SQUIDと略す）に関するものである。

【0002】

【従来の技術】 SQUID磁束計は高感度な磁場検出器として利用されている。例えば1次積分型平面型グラジオメータは2組の検出コイルを逆方向に直列に接続して構成され、地磁気などの一様磁場を消去し、1次磁場勾配を検出することができる。図2は従来例を示す直交型平面型グラジオメータの平面図である。2組の平面型グラジオメータをベースライン（検出コイルの中心間距離）の中心軸で互いに直交させて配置した構造である。平面型グラジオメータによる磁場測定は、同一点で直交する2方向の磁場勾配を測定することが必要であり、図2に示した平面型グラジオメータの構造は同一点で直交する2方向の磁場勾配を正確に検出することができる。従来、2組の検出コイルの交差部6はすべて薄膜で形成されていた。

【0003】

【発明が解決しようとする課題】 従来の2組の検出コイルの交差部6を薄膜プロセスによって形成するためには、半導体などの製造プロセスなどで公知の通り多くの工程が必要である。少なくとも下部配線堆積、下部配線パターニング、層間絶縁膜堆積、コンタクトホール形成、上部配線堆積、上部配線パターニングの工程が必要であり、工程が複雑で製造時間がかかり、歩留まりが低下する問題があった。

【0004】

【課題を解決するための手段】 本発明は、上記の課題を解決するため、同一平面上に構成され、ベースラインの

中心軸で互いに直交する2組の検出コイルを有する直交型の平面型グラジオメータにおいて、前記2組の検出コイルの交差部をボンディングワイヤーにより構成した。

【0005】

【作用】 上記のような構造によれば、平面型グラジオメータを製造するための薄膜プロセスはコイルパターンを形成するための1層の工程のみであり、2組の検出コイルの交差部はワイヤーボンディングという簡単な工程で形成することができ、製造工程を少なくして簡単に直交型の平面型グラジオメータを形成することができる。

【0006】

【実施例】 以下に本発明の実施例について図面を参照して説明する。図1は本発明の実施例を示す平面型グラジオメータの平面図である。1はボンディングワイヤー、2はボンディングパッド、3は検出コイル部、4は配線用パッド、5の点線で囲んだ部分はコイル交差部である。ボンディングワイヤー1の材料としては、例えば鉛インジウム金（Pb-In-Au）合金（Pb80%、In16%、Au4%）、鉛インジウム（Pb-In）合金（Pb80%、In20%）などが用いられるが、ボンディング可能な超伝導材料であれば他の材料でも良い。検出コイル部3、ボンディングパッド2、配線用パッド4の材料としては、例えばニオブ（Nb）、窒化ニオブ（NbN）、鉛（Pb）、Pb-Inなどの超伝導材料が用いられるが、他の超伝導材料を用いても良い。また、ボンディングパッド2の表面にはバッファ層として金（Au）薄膜が付加されることもある。ボンディングパッド2及びボンディングワイヤー1は超伝導材料で構成されるので、ボンディングワイヤー1の両端のコンタクト部は超伝導コンタクトとすることができる。

【0007】 上記のような平面型グラジオメータの構造によれば、検出コイル部3、ボンディングパッド2、配線用パッド4は薄膜プロセスにおいて同一層の薄膜堆積、パターニングの工程で同時に形成することができ、コイル交差部5はボンディングワイヤー1をボンディングパッド2にワイヤーボンディングする工程のみで形成することができる。従って、平面型グラジオメータの製造工程数が少なくなり、製造時間の短縮及び歩留まりの向上が可能となる。

【0008】

【発明の効果】 以上説明したように本発明によれば、直交型の平面型グラジオメータにおいて2組の検出コイルの交差部をボンディングワイヤーにより構成することによってその製造工程数を簡単にすることができ、製造時間の短縮及び歩留まりの向上が可能となる。

【図面の簡単な説明】

【図1】 本発明の実施例を示す平面型グラジオメータの平面図である。

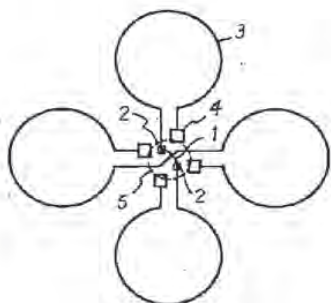
【図2】 従来例を示す平面型グラジオメータの平面図で

ある。

【符号の説明】

- 1・・・ボンディングワイヤー
2・・・ボンディングパッド

【図1】



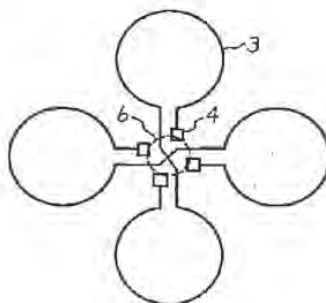
(3)

特開平4-265875

4

- 3・・・検出コイル部
4・・・配線用パッド
5・・・本発明の実施例によるコイル交差部
6・・・従来例によるコイル交差部

【図2】



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Friday, April 11 2014

THOMSON INNOVATION

Patent/Publication: JP9298847A

Working...

Bibliography**DWPI Title**

Non-contacting battery charger for electronic device, communication apparatus e.g. cordless telephone set such as cellular phone has feedback circuit that converts AC voltage from leakage magnetic flux pick-up coil to DC voltage and feeds it to constant voltage circuit NE SYSTEM

Original Title

NON-CONTACT CHARGER

Assignee/ApplicantStandardized: **SONY CORP**

Original: SONY CORP

DWPI Assignee/Applicant

SONY CORP (SONY-C)

Inventor

CHIBA YOJI,

DWPI Inventor

CHIBA Y

Publication Date (Kind Code)

1997-11-18 (A)

DWPI Accession / Update

2009-K39892 / 200940

Application Number / Date

JP1996132646A / 1996-04-30

Priority Number / Date / Country

JP1996132646A / 1996-04-30 / JP

Abstract**DWPI Abstract**

(JP9298847A_)

Novelty

The battery charger (1) includes an inverter (4) which converts a DC voltage obtained from a constant voltage circuit (3) into high frequency AC power, according to control signal from controller (5). The output

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of the inverter is given to a magnetic field generation coil (L1). EMF is induced in coupling coil (L2) of mobile unit (10) due to the magnetic field generated by coil. A rectifier (11) rectifies the AC voltage output from coupling coil and supplies DC voltage to a charging circuit (12) which charges a battery (13). A pick-up coil (L3) picks up the leakage flux between the magnetic field generation coil and coupling coil. A feedback circuit (6) converts the AC voltage from pick-up coil to DC voltage and feeds it to the constant voltage circuit for turning on a LED.

Advantage

Improves AC-DC transformation efficiency.Reduces maximum allowable current value and loss.

Abstract

PROBLEM TO BE SOLVED: To provide a non-contact charger whereby its conversion efficiency from an AC power into a DC power can be improved and both the maximum allowable current of its element and its loss can be reduced.

SOLUTION: In a non-contact charger 1, an inverter 4 converts a DC voltage fed from a constant-voltage circuit 3 into a high-frequency voltage according to the control of a control circuit 5 to generate a magnetic line of force by a magnetic-force generating coil L1. On the other hand, in a slave machine 10, a coupling coil L2 takes out a high-frequency power from the magnetic line of force of the foregoing magnetic-force generating coil L1 by an electromagnetic induction, and after rectifying the high-frequency power by a rectification circuit 11, a rectified DC voltage is fed to a charging circuit 12 to charge a battery 13 by the rectified DC voltage. Also, a pickup coil L3 takes out the leakage magnetic flux generated between the magnetic-force generating coil L1 and the coupling coil L2 to feed it to a feedback circuit 6. After the high-frequency power in response to the foregoing leakage magnetic flux is converted into a DC voltage, the feedback circuit 6 feeds back it to the constant-voltage circuit 3. A light emitting diode LED is lit by the DC voltage obtained from the leakage magnetic flux to indicating that the battery 13 is being charged.

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Classes/Indexing

IPC

IPC Code(1-7) **H02J 7/10** H01M 10/44 H01M 10/46 H02J 7/00 H02J 7/02 H02J 17/00 H04M 1/00
(6)

Current IPC	Invention	Version	Additional	Version
Full	H02J 7/02	20060101		
	H01M 10/44	20060101		
	H01M 10/46	20060101		
	H02J 7/00	20060101	-	-
	H02J 7/10	20060101		
	H02J 17/00	20060101		
	H04M 1/00	20060101		
Main Group	-	-	-	-
Subclass	-	-	-	-

ECLA

Y02E 60/12 Y02E 70/44

JP FI Codes

H01M 10/44 Q; H01M 10/46 ; H02J 7/00 301 D; H02J 7/02 U; H02J 7/10 R; H02J 17/00 B; H04M 1/00 N

JP F Terms

5G003; AA01; BA01; CA12; DA04; EA01; GB06; GB08

5G063

5G503; AA01; BA01; BB01; DA16; GB06; GB08

5H030; AA01; AA07; AS11; AS18; BB09; DD18; FF51

5K027; AA12; GG04

DWPI Class

U24 W01 X16

DWPI Manual Codes

DWPI Manual Codes

EPI Manual Codes: U24-H; W01-C01D1A; W01-C01E5A; X16-G

DWPI Chemistry Resource Numbers

DWPI Chemistry Resource Numbers

-

DWPI Registry Numbers

DWPI Registry Numbers

-

Plasdoc Punch Codes

Plasdoc Punch Codes

-

Plasdoc Key Serial Codes

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Enhanced Polymer Indexing

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Chemical Fragment Codes

Chemical Fragment Codes

Legal Status**INPADOC Legal Status**

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Family**Family**

INPADOC Family (1)

Publication Number	Publication Date	Inventor	Assignee/Applicant	Title
JP9298847A	1997-11-18	CHIBA YOJI	SONY CORP	NON-CONTACT CHARGER

DWPI Family (1); Countries (1)

Publication	DWPI Update	Publication Date	IPC Code	Language
JP9298847A	200940	1997-11-18	H02J000710	Japanese
Local Applications: JP1996132646A filed 1996-04-30				

Claims

No Claims exist for this Record

Description**Drawing Description**

Drawing Description

Description

Description

Citations**Citation** Record level

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US8542018B2	2013-09-24	2010-03-15	YOSHIKAWA HIROYASU	Power transmitting apparatus
US8587153B2	2013-11-19	2009-12-14	SCHATZ DAVID A	Wireless energy transfer using high Q resonators for lighting applications
US8618696B2	2013-12-31	2013-02-21	WITRICITY CORP	Wireless energy transfer systems
US8629578B2	2014-01-14	2013-02-21	WITRICITY CORP	Wireless energy transfer systems
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US8667452B2	2014-03-04	2012-11-05	WITRICITY CORP	Wireless energy transfer modeling tool
US8669676B2	2014-03-11	2009-12-30	KARALIS ARISTEIDIS	Wireless energy transfer across variable distances using field shaping with magnetic materials to improve the coupling factor
US8692412B2	2014-04-08	2010-03-30	WiTricity Corporation	Temperature compensation in a wireless transfer system
WO2013020138A2	2013-02-07	2012-08-06	WITRICITY CORP	TUNABLE WIRELESS POWER ARCHITECTURES

Cited Patents (0)

Cited Non-patents (0)

DPCI Citation Patent family level

DPCI Citing Patents (4)

Publication Number	Accession Number	Publication Date	Application Date	DWPI Family Member(s)	Relevance	Source
EP2267864A2	2011-A11920	2010-12-29	2010-06-22	JP9298847A	-	1 (Applicant)
DWPI Title: Non-contact charger for charging rechargeable battery of e.g. handle portion of electric toothbrush has notification block utilizing power						

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transmitted through electromagnetic induction between primary and auxiliary coils to activate LED						
DWPI Assignee/Applicant: MATSUSHITA ELECTRIC WORKS LTD (MATW-C); PANASONIC ELECTRIC WORKS CO LTD (MATU-C)						
DWPI Inventor: KATSURA Y						
EP2267865A2	2011-A11835	2010-12-29	2010-06-22	JP9298847A	-	1 (Applicant)
DWPI Title: Chargeable electric device e.g. electric toothbrush handle portion has transistor that obstructs normal resonance in synchronism with control performed by other transistor to suppress charging current						
DWPI Assignee/Applicant: MATSUSHITA DENKI SANGYO KK (MATU-C); MATSUSHITA ELECTRIC WORKS LTD (MATW-C); PANASONIC CORP (MATU-C); PANASONIC ELECTRIC WORKS CO LTD (MATU-C)						
DWPI Inventor: ASAKAWA K; ATSUSHI T; KATSURA Y; KOJI A; MIKIHIRO Y; SHIKI K; TAKAHASHI A; YAMASHITA M; YOSHINORI K						
US8542018B2	2010-M65432	2013-09-24	2010-03-15	JP9298847A	-	0 (Examiner)
DWPI Title: Power transmitting apparatus has power switching circuit selects either power accepted by power extracting coil or power transmitted from main power supply and transmits selected power to power supply coil						
DWPI Assignee/Applicant: FUJITSU LTD (FUIT-C)						
DWPI Inventor: YOSHIKAWA H						
WO2013020138A2	2013-B83908	2013-02-07	2012-08-06	JP9298847A	A	0 (Examiner)
DWPI Title: Tunable wireless system for transferring electrical energy between power supply and vehicle battery has rectifier control controlling switching characteristic and amplifier control providing fixed switching frequency to switching elements						
DWPI Assignee/Applicant: WITRICITY CORP (WITR-N)						
DWPI Inventor: HALL K L; KARALIS A; KESLER M P; PALLO N A						

DPCI Cited Patents (0)

DPCI Cited Non-patents (0)

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DPCI Citing Patents Country

WO; EP; US

DPCI Cited Patents Country

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Other**DWPI Title Terms**

NON CONTACT BATTERY CHARGE ELECTRONIC DEVICE COMMUNICATE APPARATUS CORD TELEPHONE SET
CELLULAR FEEDBACK CIRCUIT CONVERT AC VOLTAGE LEAK MAGNETIC FLUX PICK UP COIL DC FEED
CONSTANT SYSTEM

Custom Fields**Test**

-

Relevance

-

Product Name

-

Docket number

-

Notes

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特開平9-298847

(43) 公開日 平成9年(1997)11月18日

(51) Int.Cl. ⁸	識別記号	庁内整理番号	F I	技術表示箇所
H 0 2 J	7/10		H 0 2 J 7/10	R
H 0 1 M	10/44		H 0 1 M 10/44	Q
	10/46		10/46	
H 0 2 J	7/00	3 0 1	H 0 2 J 7/00	3 0 1 D
	7/02		7/02	U
審査請求 未請求 請求項の数 3 F D (全 4 頁) 最終頁に続く				

(21) 出願番号 特願平8-132646

(22) 出願日 平成8年(1996)4月30日

(71) 出願人 000002185

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東京都品川区北品川6丁目7番35号

(72) 発明者 千葉 洋治

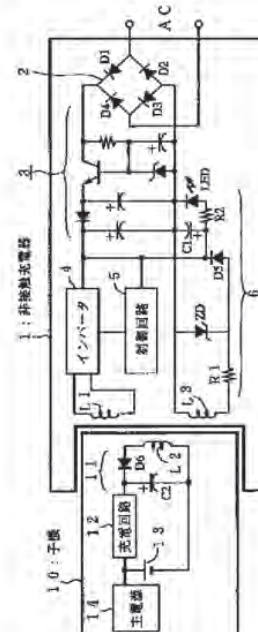
東京都品川区北品川6丁目7番35号 ソニー株式会社内

(54) 【発明の名称】 非接触充電器

(57) 【要約】

【課題】 交流→直流への変換効率を向上でき、また、素子の最大許容電流値や損失を低減できる非接触充電器を提供する。

【解決手段】 非接触充電器1では、インバータ4が定電圧回路3からの直流電圧を、制御回路5の制御に従って高周波に変換し、磁力発生コイルL1で磁力線を発生させる。一方、子機10では、結合コイルL2が電磁誘導により上記磁力発生コイルL1の磁力線から高周波電力を取り出し、整流回路11により整流した後、充電回路12に供給する。充電回路12は、整流された直流電圧によりバッテリー13を充電する。また、ビックアップコイルL3は、磁力発生コイルL1と結合コイルL2間における漏洩磁束を取り出し、フィードバック回路6に供給する。フィードバック回路6は、上記漏洩磁束に応じた高周波電力を直流電圧に変換した後、定電圧回路3にフィードバックする。発光ダイオードLEDは、漏洩磁束から得られた直流電圧によって点灯し、充電中であることを表示する。



【特許請求の範囲】

【請求項1】 電子機器のバッテリーを充電する充電器であって、電子機器側に設けられた結合コイルに高周波電力を誘導する磁力発生コイルを有し、前記磁力発生コイルと前記結合コイル間の電磁誘導によって非接触で前記電子機器に充電電力を供給する非接触充電器において、前記磁力発生コイル近傍に配置され、前記磁力発生コイルと前記結合コイル間における漏洩磁束による高周波電力を取り出すピックアップコイルと、前記ピックアップコイルによって取り出した高周波電力を定電圧制御回路系の電源としてフィードバックするフィードバック手段とを具備することを特徴とする非接触充電器。

【請求項2】 前記ピックアップコイルによって取り出した高周波電力によって点灯する表示手段を具備することを特徴とする請求項1記載の非接触充電器。

【請求項3】 前記フィードバック手段は、前記高周波電力を直流に変換する整流手段を具備することを特徴とする請求項1記載の非接触充電器。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、コードレス電話機の子機等に内蔵されたバッテリーを充電する通信機用非接触充電器に関する。

【0002】

【従来の技術】近年、PHSやセルラ、または家庭で用いられるコードレス電話機等では、その使用環境から防水性が必須となっている。そこで、機構面で考えた場合、問題となるのが、充電用に設けられた、筐体外部に露出する充電器とのコンタクト用端子部であり、これを回避し、全体の防水性能を向上させるために、非接触充電方式が普及してきた。

【0003】上記非接触充電器では、充電器側のインバータ回路で発生した高周波電力を磁力発生コイル(L1)に供給し、充電される電話機側に内蔵された結合用コイル(L2)によって上記高周波電力を電磁誘導により取り出し、整流した直流電圧によりバッテリーを充電するようになっている。

【0004】

【発明が解決しようとする課題】しかしながら、従来の非接触充電器では、磁力発生コイル(L1)と結合用コイル(L2)の結合係数kがかなり小さいため、所定の電流で電話機側のバッテリーを充電するためには、損失分も含めて、充電器で多大な電力が必要となり、商用交流電源から見た場合の交流→直流の変換効率を悪化させている。仮に、充電器にACアダプタを接続するタイプであっても、直流電流をかなり必要とするため、アダプタそれ自体の定格容量をアップしなければならず、コストアップにつながるという問題があった。

【0005】また、上述したように、充電器における電

流が大となるため、電圧レギュレータを含めた制御素子の電流定格値を大きくしなければならず、コストアップにつながるという問題があった。また、ほとんどの充電器には、充電/非充電をユーザに認知させるために、例えば、スイッチング素子等によって制御されるLED等の点灯装置が設けられているが、回路構成が複雑になるとともに、部品点数が増えるため、コストアップにつながるという問題があった。

【0006】そこで本発明は、交流→直流への変換効率を向上させることができ、また、素子の最大許容電流値や損失を低減することができ、さらに、特別な回路を用いることなく、充電/非充電を表示できる非接触充電器を提供することを目的としている。

【0007】

【課題を解決するための手段】上記目的を達成するため、この発明による非接触充電器は、電子機器のバッテリーを充電する充電器であって、電子機器側に設けられた結合コイルに高周波電力を誘導する磁力発生コイルを有し、前記磁力発生コイルと前記結合コイル間の電磁誘導によって非接触で前記電子機器に充電電力を供給する非接触充電器において、前記磁力発生コイル近傍に配置され、前記磁力発生コイルと前記結合コイル間における漏洩磁束による高周波電力を取り出すピックアップコイルと、前記ピックアップコイルによって取り出した高周波電力を定電圧制御回路系の電源としてフィードバックするフィードバック手段とを具備することを特徴とする。

【0008】

【発明の実施の形態】以下、本発明の実施の形態を図面を参照して説明する。

【0009】A. 実施の形態

A-1. 実施の形態の構成

図1は本発明の実施の形態による非接触充電器と該非接触充電器で充電される電話機の子機の略構成を示す回路図であり、図2は、非接触充電器の断面図である。図において、非接触充電器1は、整流回路2、定電圧回路3、インバータ回路4、制御回路5、磁力発生コイルL1、ピックアップコイルL3、およびフィードバック回路6から構成されている。整流回路2は、ダイオードD1～D4からなるブリッジ回路より構成され、商用電源ACを整流し、定電圧回路(レギュレータ)3に供給する。

【0010】定電圧回路3は、整流された直流電圧を平滑化するとともに、所定電圧となるように制御し、インバータ回路4に供給する。インバータ回路4は、上記直流電圧を高周波に変換し、磁力発生コイルL1によって、磁力線を発生させる。制御回路5は、上記インバータ回路4を制御し、所定高周波を発生させる。ピックアップコイルL3は、磁力発生コイルL1と後述する子機側の結合コイルL1とによって電磁結合されなかった漏洩磁束を取り出し、フィードバック回路6に供給する。

【0011】フィードバック回路6は、抵抗器R1、ツェナーダイオードZD、ダイオードD5、コンデンサC1、抵抗器R2、発光ダイオードLEDから構成されており、上記漏洩磁束をダイオードD5により直流電圧に変換した後、コンデンサC1により平滑化し、定電圧回路3にフィードバックするとともに、抵抗器R2、発光ダイオードLEDを点灯させる。したがって、充電中の間は、ピックアップコイルL3によって漏洩磁束が取り出されるので、発光ダイオードLEDが点灯することになる。また、漏洩した分の電力は、直流電圧源に供給することで、交流（AC）→直流（DC）への変換効率を向上させることができる。

【0012】一方、子機（ハンドセット）10は、結合コイルL2、整流回路11、充電回路12、バッテリー13、主電源回路14を備えている。結合コイルL2は、上記非接触充電器1の磁力発生コイルL1に対して電磁誘導により結合し、高周波電力を取り出し、整流回路11に供給する。整流回路11は、ダイオードD6およびコンデンサC2から構成されており、ダイオードD6により上記高周波電力を整流し、コンデンサC2で平滑化した後、充電回路12に供給する。充電回路12は、上記直流電圧によりバッテリー13を充電する。主電源回路14は、バッテリー13の出力電圧から図示しない通信関連の回路を駆動するための駆動電圧を生成し、各部に供給する。

【0013】上述した磁力発生コイルL1およびピックアップコイルL3は、図2に示すように、子機10が充電時に非接触充電器1に載置される面の内側に同心円状に配置されている。また、結合コイルL2も同様に、図2に示すように、上記磁力発生コイルL1に対向するように、同心円状に配置されている。

【0014】B. 実施の形態の動作

次に、上述した非接触充電器の動作について説明する。非接触充電器1では、商用電力ACが整流回路2により直流電圧に変換され、定電圧回路3により所定電圧に制御された後、インバータ4に供給される。該直流電圧は、インバータ4により、制御回路5の制御の従って高周波に変換され、磁力発生コイルL1に供給される。この結果、磁力発生コイルL1からは磁力線が発生する。一方、子機10では、結合コイルL2によって電磁誘導により上記磁力発生コイルL1の磁力線から高周波電力が取り出される。該高周波電力は、整流回路11により整流された後、充電回路12に供給される。充電回路12では、整流された直流電圧によりバッテリー13が充電される。

【0015】上記充電動作において、磁力発生コイルL1と結合コイルL2間で結合しなかった漏洩磁束がピックアップコイルL3によって取り出され、フィードバック回路6に供給される。上記漏洩磁束に応じた高周波電力は、フィードバック回路6のダイオードD5によ

て整流され、コンデンサC1により平滑化されて、定電圧回路3にフィードバックされる。このとき、発光ダイオードLEDが点灯することで、充電中であることが表示される。

【0016】このように、上述した実施の形態では、非接触充電器1にピックアップコイルL3を設け、該ピックアップコイルL3で取り出した漏洩磁束に応じた高周波電力を、フィードバック回路6によって直流電圧に変換した後、直流電圧源にフィードバックすることにより、非接触充電器1における交流（AC）→直流（DC）への変換効率を向上させることができる。また、ピックアップコイルL3によって取り出され、漏洩磁束に応じた直流電圧によって点灯する発光ダイオードLEDを設けることにより、特別なスイッチング素子を用いることなく、充電中であることを表示することができる。また、漏洩磁束に応じた電力を直流電圧源にフィードバックすることにより、例えば、定電圧回路の素子の供給電流を削減することができるので、同一電源で同等の磁力線が発生させる場合、素子の最大許容電流値や損失を低めに設定でき、コストダウンを図ることができる。

【0017】

【発明の効果】以上説明したように、この発明によれば、電子機器のバッテリーを充電する充電器であって、電子機器側に設けられた結合コイルに高周波電力を誘導する磁力発生コイルを有し、前記磁力発生コイルと前記結合コイル間の電磁誘導によって非接触で前記電子機器に充電電力を供給する非接触充電器において、前記磁力発生コイル近傍に配置され、前記磁力発生コイルと前記結合コイル間における漏洩磁束による高周波電力を取り出すピックアップコイルと、前記ピックアップコイルによって取り出した高周波電力を定電圧制御回路系の電源としてフィードバックするフィードバック手段とを具備するようにしたことにより、交流→直流への変換効率を向上させることができ、また、素子の最大許容電流値や損失を低減することができるという利点が得られる。

【図面の簡単な説明】

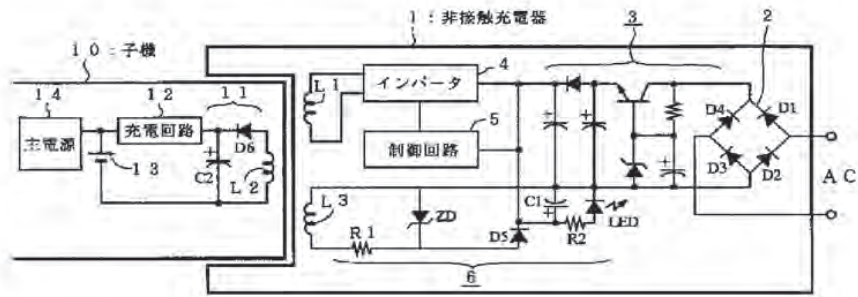
【図1】本発明の実施の形態による非接触充電器と該非接触充電器により充電される子機（ハンドセット）の略構成を示す回路図である。

【図2】非接触充電器と該非接触充電器により充電される子機（ハンドセット）の断面図である。

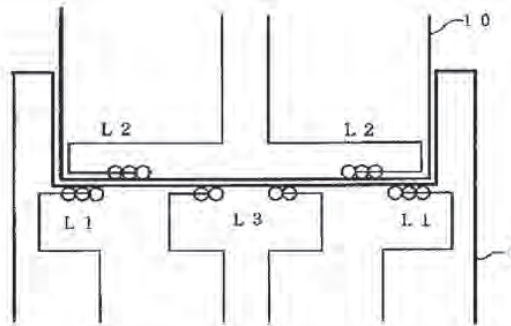
【符号の説明】

1……非接触充電器、2……整流回路、3……定電圧回路、4……インバータ回路、5……制御回路、6……フィードバック回路（フィードバック手段）、10……子機、11……整流回路、12……充電回路、13……バッテリー、14……主電源回路、L1……磁力発生コイル、L2……結合コイル、L3……ピックアップコイル、D5……ダイオード（整流手段）、LED……発光ダイオード（表示手段）。

【図 1】



【図 2】



フロントページの続き

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H 0 4 M 1/00

識別記号

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F 1

H 0 2 J 17/00

H 0 4 M 1/00

技術表示箇所

B

N

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Friday, April 11 2014

THOMSON INNOVATION

Patent/Publication: JP10164837A**Bibliography****DWPI Title**

Power supply for personal computer uses two MOSFETs, connected to ends of secondary-side coils of transformer for conversion, to perform synchronous voltage rectification in side of secondary-side coil of transformer

Original Title

POWER SUPPLY

Assignee/ApplicantStandardized: **SONY CORP**

Original: SONY CORP

DWPI Assignee/Applicant

SONY CORP (SONY-C)

Inventor

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DWPI Inventor

KIKUCHI A; TAKAHAMA M

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1998-405789 / 199835

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JP1996315049A / 1996-11-26

Priority Number / Date / Country

JP1996315049A / 1996-11-26 / JP

Abstract**DWPI Abstract**

(JP10164837A_)

Novelty

The power supply includes two transistors (1, 2) whose collector and emitter are respectively connected to an input DC source (100). A transformer (5) for conversion and a resonance capacitor (4) are provided in

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the middle point of two transistors. The middle point of two transistors is connected to one end of the primary-side coil (5A) of the transformer for conversion through the coil a supersaturation reactor transformer (3) and the resonance capacitor. The ends of the secondary-side coil (5B) of the transformer for conversion are connected to a pair of MOSFETs (19, 20) which performs synchronous voltage rectification in the side of the secondary-side coil of the transformer for conversion. A smoothing capacitor (21) is connected in parallel to the secondary-side coil of the transformer for conversion.

Advantage

Reduces voltage loss by providing MOSFETs for secondary-side rectification. Attains efficient switch-mode power supply.

Abstract

PROBLEM TO BE SOLVED: To significantly reduce loss by using MOS-FETs for secondary-side rectification.

SOLUTION: The positive end of a direct current 100 obtained by rectifying an AC input is connected with the negative end through the collectors and emitters of switching transistors 1, 2. The middle point is connected with one end of the primary-side coil 5A of voltage changing transformer 5 through the coil 3A of a saturable reactor transformer 3 and a resonance capacitor 4. One and the other ends of the secondary-side coil 5B of the voltage changing transformer 5 are connected with each other through the sources and drains of N-channel MOS-FETs 19, 20, respectively. A capacitor 21 for smoothing is connected between the connecting point and the middle tap of the secondary- side coil 5B. The MOS-FETs 19, 20 are on/off-controlled by drive circuits 24, 25, respectively, and synchronously controlled, so that they will be on only when current flows from the capacitor 21 side to the coil 5B, for example.

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Classes/Indexing

IPC

IPC Code(1-7) **H02M 3/28** H02M 3/335

(6)

Current IPC	Invention	Version	Additional	Version
Full	H02M 3/28 H02M 3/335	20060101 20060101	-	-
Main Group	-	-	-	-
Subclass	-	-	-	-

Original IPC	Invention	Version	Additional	Version
Advanced/Full	H02M 3/28 H02M 3/335	20060101 20060101	-	-
Core/Main Group	H02M 3/24	20060101	-	-
Subclass	-	-	-	-

ECLA

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Y02B 70/14F4

JP FI Codes

H02M 3/28 F; H02M 3/28 Q; H02M 3/335 F

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5H730: AA14; AS01; BB26; BB52; BB57; BB62; DD02; DD23; EE03; EE07; EE14; FD01; FD31; FG07

DWPI Class

T01 U24

DWPI Manual Codes

DWPI Manual Codes

EPI Manual Codes: T01-L01; T01-M06A; U24-D02B3

DWPI Chemistry Resource Numbers

DWPI Chemistry Resource Numbers

DWPI Registry Numbers

DWPI Registry Numbers

Plasdoc Punch Codes

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Enhanced Polymer Indexing

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Chemical Fragment Codes

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Legal Status**INPADOC Legal Status**

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INPADOC Family (1)

Publication Number	Publication Date	Inventor	Assignee/Applicant	Title
JP10164837A	1998-06-19	KIKUCHI AKIHIKO	SONY CORP	POWER SUPPLY

DWPI Family (1); Countries (1)

Publication	DWPI Update	Publication Date	IPC Code	Language
JP10164837A	199835	1998-06-19	H02M000328	Japanese
Local Applications: JP1996315049A filed 1996-11-26				

Claims

No Claims exist for this Record

Description**Drawing Description**

Drawing Description

Description

Description

Citations**Citation** Record level

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Cited Non-patents (0)

DPCI Citation Patent family level
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DPCI Citing Patents (10)

Publication Number	Accession Number	Publication Date	Application Date	DWPI Family Member(s)	Relevance	Source
EP1415386A2	2003-329862	2004-05-06	2002-07-02	JP10164837A	A	0 (Examiner)
DWPI Title: Isolated voltage switching regulator for supplying power to microprocessor has error amplifier connected between capacitor and one of resistors that are connected between load and transformer connected to rectifier switches DWPI Assignee/Applicant: DI (DT INC/DIDT-N); POWER-ONE INC (POWE-N); BRKOVIC M S (BRKO-I) DWPI Inventor: BRKOVIC M; BRKOVIC M S						
EP1415386B1	2003-329862	2012-09-05	2002-07-02	JP10164837A	-	0 (Examiner)
DWPI Title: Isolated voltage switching regulator for supplying power to microprocessor has error amplifier connected between capacitor and one of resistors that are connected between load and transformer connected to rectifier switches DWPI Assignee/Applicant: DI (DT INC/DIDT-N); POWER-ONE INC (POWE-N); BRKOVIC M S (BRKO-I) DWPI Inventor: BRKOVIC M; BRKOVIC M S						
JP03405241B2	2000-487573	2003-05-12	1998-12-18	JP10164837A	-	0 (Examiner)
DWPI Title: Power supply system for printer of copier has comparator to evaluate voltage drop with reference voltage to operate MOSFET to output charge stored in capacitor to load DWPI Assignee/Applicant: FUJI XEROX CO LTD (XERF-C) DWPI Inventor: MIKAMI H						
JP04140169B2	2003-734362	2008-08-27	2000-04-25	JP10164837A	-	0 (Examiner)
DWPI Title: Non-contact power transfer apparatus has current detector that detects flow of rectified current to transistor in order to output to signal generator for switching ON/OFF of transistor element DWPI Assignee/Applicant: MATSUSHITA ELECTRIC WORKS LTD (MATW-C) DWPI Inventor: ABE H; MUTO M						
JP04149915B2	2003-329862	2008-09-17	2002-06-28	JP10164837A	-	0 (Examiner)
DWPI Title: Isolated voltage switching regulator for supplying power to microprocessor has error amplifier connected between capacitor and one of resistors that are connected between load and transformer connected to rectifier switches						

DWPI Assignee/Applicant: DI (DT INC/DIDT-N); POWER-ONE INC (POWE-N); BRKOVIC M S (BRKO-I)						
DWPI Inventor: BRKOVIC M; BRKOVIC M S						
JP04367611B2	2005-209388	2009-11-18	2003-08-22	JP10164837A	-	-
DWPI Title: Switching power supply circuit for electronic devices has inductors inserted between positive terminal of smoothing capacitor with respect to synchronous rectifier circuit at secondary windings of insulation converter transformer						
DWPI Assignee/Applicant: SONY CORP (SONY-C)						
DWPI Inventor: YASUMURA M						
JP04449461B2	2005-537002	2010-04-14	2004-01-08	JP10164837A	-	0 (Examiner)
DWPI Title: Switching power supply apparatus for current resonance type converter has control circuit generating control signal for controlling synchronizing rectifiers so that ON period of rectifiers is less than ON period of switching elements						
DWPI Assignee/Applicant: SANKEN DENKI KK (SANK-N)						
DWPI Inventor: FUKUMOTO S; OSAKA S						
WO2012049911A1	2012-E49626	2012-04-19	2011-08-26	JP10164837A	Y	0 (Examiner)
DWPI Title: Charge and discharge circuit of electric power supply system has center switching circuit that blocks/connects path to carry out power conversion by power inverter circuit and charges secondary battery						
DWPI Assignee/Applicant: SANYO ELECTRIC CO LTD (SAOL-C)						
DWPI Inventor: IKE T; NAKASHIMA T						
WO2012153799A1	2012-P93129	2012-11-15	2012-05-10	JP10164837A	A	0 (Examiner)
DWPI Title: Switched-mode power supply apparatus of half-bridge type has control unit which controls specific switch elements while performing pulse frequency modulation (PFM) control according to output voltage						
DWPI Assignee/Applicant: MURATA MFG CO LTD (MURA-C)						
DWPI Inventor: HARA T; SHIJI H						
WO2013020138A2	2013-B83908	2013-02-07	2012-08-06	JP10164837A	A	0 (Examiner)
DWPI Title: Tunable wireless system for transferring electrical energy between power supply and vehicle battery has rectifier control controlling switching characteristic and amplifier control providing fixed switching frequency to switching elements						

DWPI Assignee/Applicant: WITRICITY CORP (WITR-N)**DWPI Inventor:** HALL K L; KARALIS A; KESLER M
P; PALLO N A

DPCI Cited Patents (0)

DPCI Cited Non-patents (0)

DPCI Citation Counts

DPCI Citations	Total	Examiner	Inventor	Opposition	3rd party	Undefined
Citing Patents	10	9	0	0	0	1
Cited Patents	0	0	0	0	0	0
Citing Authorities	3	3	0	0	0	1
Cited Authorities	0	0	0	0	0	0
Citing Accession Numbers	8	7	0	0	0	1
Cited Accession Numbers	0	0	0	0	0	0
Cited Non-patents	0	0	0	0	0	0

DPCI Field of Search

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DPCI Citing Patents Country

WO; JP; EP

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Other**DWPI Title Terms**POWER SUPPLY PERSON COMPUTER TWO MOSFET CONNECT END SECONDARY SIDE COIL TRANSFORMER
CONVERT PERFORMANCE SYNCHRONOUS VOLTAGE RECTIFY**DWPI Related Accession Numbers**

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Relevance

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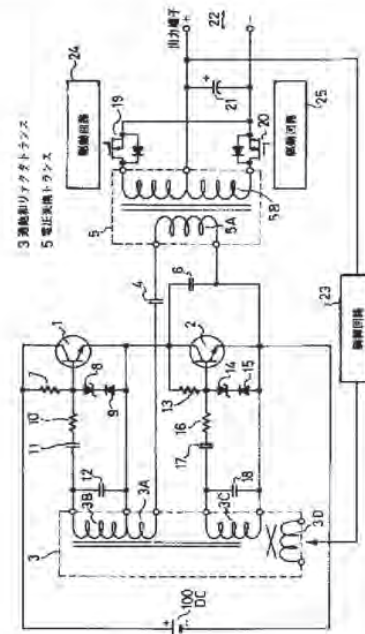
(74) 代理人 弁理士 松隈 秀盛

(54) 【発明の名称】 電源装置

(57) 【要約】

【課題】 2次側整流にMOS-FETを用いて損失を大幅に減少させる。

【解決手段】 AC入力を整流したDC100の+端がスイッチングトランジスタ1、2のコレクタ・エミッタ間を通じて一端に接続され、中点が過飽和リアクタランス3のコイル3A、共振コンデンサ4を通じて電圧変換トランス5の1次側コイル5Aの一端に接続される。また電圧変換トランス5の2次側コイル5Bの一端及び他端が、それぞれNチャンネルのMOS-FET19、20のソース・ドレイン間を通じて互いに接続され、この接続点と2次側コイル5Bの中間タップとの間に平滑用のコンデンサ21が接続される。さらにMOS-FET19、20はそれぞれ駆動回路24、25によってオンオフが制御され、例えば図示の例ではコンデンサ21側からコイル5Bに向かって電流が流れている期間にのみオンされるように同期制御される。



【特許請求の範囲】

【請求項1】 スイッチング素子を2石用いたハーフブリッジ構成を有し、

上記2石のスイッチング素子の midpoint に共振コンデンサと電圧変換用トランスが設けられると共に、
上記電圧変換用トランスの2次側整流としてMOS-FETを用いて同期整流を行うことを特徴とする電源装置。

【請求項2】 請求項1記載の電源装置において、
上記2次側整流用のMOS-FETの駆動信号として上記MOS-FETを流れる電流を検出した信号を用いることを特徴とする電源装置。

【請求項3】 請求項2記載の電源装置において、
上記MOS-FETに直列に電流検出トランスを接続して上記MOS-FETを流れる電流を検出することを特徴とする電源装置。

【請求項4】 請求項2記載の電源装置において、
上記MOS-FETに直列に電流検出抵抗を接続してその電圧降下により上記MOS-FETを流れる電流を検出することを特徴とする電源装置。

【請求項5】 請求項2記載の電源装置において、
上記MOS-FETのオン抵抗による電圧降下により上記MOS-FETを流れる電流を検出することを特徴とする電源装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、例えばAC入力を整流したDCで駆動されるパーソナルコンピュータの電源等を使用して好適な電源装置に関するものである。

【0002】

【従来の技術】例えばAC入力を整流したDCで駆動されるパーソナルコンピュータの電源においては、内部で必要な駆動電圧を得るために、いわゆるDC-DCコンバータ等の電源装置が用いられている。すなわち図9には、そのような電源装置の一例の構成を示す。

【0003】この図9において、DC70の+端が、直列に接続された2石のスイッチングトランジスタ71、72のコレクタ・エミッタ間を通じてDC70の一端に接続される。これらのトランジスタ71、72の midpoint が過飽和リアクタランス73のコイル3A、共振コンデンサ74を通じて電圧変換トランス75の1次側コイル5Aの一端に接続される。またこの1次側コイル5Aの他端がDC70の一端に接続される。さらにトランジスタ71、72の midpoint がコンデンサ76を通じてDC70の一端に接続される。

【0004】また、トランジスタ71のコレクタが抵抗器77を通じてトランジスタ71のベースに接続され、このトランジスタ71のベースが順方向のツェナーダイオード78と逆方向のダイオード79の直列回路を通じてトランジスタ71のエミッタに接続される。さらにト

ランジスタ71のベースが抵抗器80、コンデンサ81と、過飽和リアクタランス73のコイル3B及びコンデンサ82の並列回路との直列回路を通じてトランジスタ71のエミッタに接続される。

【0005】さらにトランジスタ72のコレクタが抵抗器83を通じてトランジスタ72のベースに接続され、このトランジスタ72のベースが順方向のツェナーダイオード84と逆方向のダイオード85の直列回路を通じてトランジスタ72のエミッタに接続される。さらにトランジスタ72のベースが抵抗器86、コンデンサ87と、過飽和リアクタランス73のコイル3C及びコンデンサ88の並列回路との直列回路を通じてトランジスタ72のエミッタに接続される。

【0006】また、上述の電圧変換トランス75の2次側コイル5Bの一端及び他端が、それぞれ整流用の順方向のダイオード89、90を通じて互いに接続される。さらにこの接続点と2次側コイル5Bの中間タップとの間に平滑用のコンデンサ91が接続される。そしてこのコンデンサ91の両端から出力端子92の+端及び一端が導出される。さらにこの出力端子92の+端がエラーアンプ93を通じて過飽和リアクタランス73の制御コイル3Dに接続される。

【0007】そしてこの装置において、上述のスイッチングトランジスタ71、72が自励発振によって交互にオンオフされることによって、電圧変換トランス75の1次側コイル5Aには略正弦波の電流が流れ、2次側コイル5Bには所望の電圧が取り出される。さらにこの取り出された電圧がダイオード89、90を通じて両波整流され、整流された電圧がコンデンサ91で平滑されて出力端子92に取り出される。

【0008】また、出力端子92の+端に取り出された電圧の、所望の電圧からの変動分がエラーアンプ93で検出され、この変動分が過飽和リアクタランス73の制御コイル3Dに供給される。これによってこの過飽和リアクタランス73のコイル3A～3Cに取り出される信号の波形が変化され、トランジスタ71、72のスイッチング周波数が変化されて、出力端子92の+端に取り出される電圧が所望の電圧に等しくなるように制御が行われる。

【0009】このようにして、上述の装置において、安定化された所望の電圧を出力端子92に取り出すことができる。そしてこの取り出された電圧は、例えばDCで駆動されるパーソナルコンピュータの電源として使用されるものである。

【0010】

【発明が解決しようとする課題】ところが上述の電源装置において、電圧変換トランス75の2次側整流用のダイオード89、90の順方向降下電圧V_fによって損失が発生する。すなわちこのようなダイオードの順方向降下電圧V_fは、一般的0.45V程度であるが、この順

方向降下電圧 V_f によって上述の装置では、

$1.11 \times I_o \times V_f$ [W] (但し、 I_o は出力電流 [A])

の損失が発生する。

【0011】そしてこのような2次側整流用のダイオード89、90による損失が、例えば出力電流 I_o が10 [A] では5 [W]、20 [A] では10 [W] にもなってしまう、特にパーソナルコンピュータのように低電圧、大電流が要求される電源では、出力に対する損失の割合が大きくなってしまふものである。

【0012】この出願はこのような点に鑑みて成されたものであって、解決しようとする問題点は、従来の装置では、特にパーソナルコンピュータのように低電圧、大電流の電源が要求される場合に、2次側整流用ダイオードの順方向降下電圧によって、出力に対する損失の割合が大きくなってしまふというものである。

【0013】

【課題を解決するための手段】このため本発明においては、電圧変換用トランスの2次側整流としてMOS-FETを用いて同期整流を行うようにしたものであって、これによれば、特に低オン抵抗のMOS-FETを用いることで、2次側整流での損失を大幅に減少させることができる。

【0014】

【発明の実施の形態】すなわち本発明においては、スイッチング素子を2石用いたハーフブリッジ構成を有し、2石のスイッチング素子の中点に共振コンデンサと電圧変換用トランスが設けられると共に、電圧変換用トランスの2次側整流としてMOS-FETを用いて同期整流を行うものである。以下、図面を参照して本発明を説明するに、図1は本発明を適用した電源装置の一例の構成を示すブロック図である。

【0015】この図1において、AC入力を整流したDC100の+端が、直列に接続された2石のスイッチングトランジスタ1、2のコレクタ・エミッタ間を通じてDC100の一端に接続される。これらのトランジスタ1、2の中点が過飽和リアクタランス3のコイル3A、共振コンデンサ4を通じて電圧変換トランス5の1次側コイル5Aの一端に接続される。またこの1次側コイル5Aの他端がDC100の一端に接続される。さらにトランジスタ1、2の中点がコンデンサ6を通じてDC100の一端に接続される。

【0016】また、トランジスタ1のコレクタが抵抗器7を通じてトランジスタ1のベースに接続され、このトランジスタ1のベースが順方向のツェナーダイオード8と逆方向のダイオード9の直列回路を通じてトランジスタ1のエミッタに接続される。さらにトランジスタ1のベースが抵抗器10、コンデンサ11と、過飽和リアクタランス3のコイル3B及びコンデンサ12の並列回路との直列回路を通じてトランジスタ1のエミッタに接

続される。

【0017】さらにトランジスタ2のコレクタが抵抗器13を通じてトランジスタ2のベースに接続され、このトランジスタ2のベースが順方向のツェナーダイオード14と逆方向のダイオード15の直列回路を通じてトランジスタ2のエミッタに接続される。さらにトランジスタ2のベースが抵抗器16、コンデンサ17と、過飽和リアクタランス3のコイル3C及びコンデンサ18の並列回路との直列回路を通じてトランジスタ2のエミッタに接続される。

【0018】また、上述の電圧変換トランス5の2次側コイル5Bの一端及び他端が、それぞれNチャンネルのMOS-FET19、20のソース・ドレイン間を通じて互いに接続される。さらにこの接続点と2次側コイル5Bの中間タップとの間に平滑用のコンデンサ21が接続される。そしてこのコンデンサ21の両端から出力端子22の+端及び-端が導出される。さらにこの出力端子22の+端が制御回路23を通じて過飽和リアクタランス3の制御コイル3Dに接続される。

【0019】そしてこの装置において、上述のスイッチングトランジスタ1、2が自励発振によって交互にオンオフされることによって、電圧変換トランス5の1次側コイル5Aには略正弦波の電流が流れ、2次側コイル5Bには所望の電圧が取り出される。さらにこの取り出された電圧が、MOS-FET19、20を通じて互いに接続される。

【0020】ここでこれらのMOS-FET19、20はそれぞれ駆動回路24、25によってオンオフが制御され、例えば図示の例ではコンデンサ21側からコイル5Bに向かって電流が流れている期間にのみオンされるように同期制御される。これによって2次側コイル5Bに取り出された電圧が両波整流され、整流された電圧がコンデンサ21で平滑されて出力端子22に取り出される。

【0021】また、出力端子22の+端に取り出された電圧の、所望の電圧からの変動分が制御回路23で検出され、この変動分が過飽和リアクタランス3の制御コイル3Dに供給される。これによってこの過飽和リアクタランス3のコイル3A～3Cに取り出される信号の波形が変化され、トランジスタ1、2のスイッチング周波数が変化されて、出力端子22の+端に取り出される電圧が所望の電圧に等しくなるように制御が行われる。

【0022】このようにして、上述の装置において、安定化された所望の電圧を出力端子22に取り出すことができる。さらにこの取り出された電圧は、例えばDCで駆動されるパーソナルコンピュータの電源として使用されるものである。

【0023】そして上述の装置において、電圧変換トランス5の2次側の整流が、MOS-FET19、20のそれぞれ同期制御による同期整流によって行われてい

る。従ってこの場合には、2次側整流用のMOS-FET 19、20のオン抵抗 R_{on} によって損失が発生する。

【0024】すなわちこのようなオン抵抗 R_{on} は、例えば低オン抵抗のMOS-FETでは7mΩ程度である。そしてこのオン抵抗 R_{on} によって上述の装置では、 $1.11 \times I_o \times 1.11 \times I_o \times R_{on}$ [W]の損失が発生する。

【0025】そしてこのような2次側整流用のMOS-FET 19、20による損失は、例えば出力電流 I_o が10 [A]では約0.86 [W]、20 [A]では約3.45 [W]に留めることができ、特にパーソナルコンピュータのように低電圧、大電流が要求される電源で、出力に対する損失の割合を大幅に削減することができるものである。

【0026】すなわち図2において、直線Aは、従来の2次側整流用の素子に例えば順方向降下電圧 $V_f = 0.45$ Vのダイオードを用いた場合の、電流 [A] に対する損失 [W] の発生の状況を示す。また、曲線Bは、2次側整流用の素子に例えばオン抵抗 $R_{on} = 7$ mΩのMOS-FETを用いた場合の、電流 [A] に対する損失 [W] の発生の状況を示している。

【0027】従ってこの装置において、電圧変換用トランスの2次側整流としてMOS-FETを用いて同期整流を行うことによって、特に低オン抵抗のMOS-FETを用いることで、2次側整流での損失を大幅に減少させることができる。

【0028】これによって、従来の装置では、2次側整流用ダイオードの順方向降下電圧によって、出力に対する損失の割合が大きくなっていたものを、本発明によれば、特にパーソナルコンピュータのように低電圧、大電流の電源が要求される場合に、2次側整流での損失を大幅に減少させ、効率の良いスイッチング電源を実現することができるものである。

【0029】ところで上述の装置において、2次側整流素子は、本来は電圧変換用トランス5の2次側コイル5Bから平滑用コンデンサ21を充電する方向のみに電流を流さなければならない。ところが上述の装置において、MOS-FETは、ゲートにオン電圧が印加されるとドレイン・ソース間は抵抗体と同等になるため、電流は双方向に流れることができる。

【0030】従って上述の装置において、MOS-FETのゲートにオン電圧を印加するタイミングを悪くすると、コンデンサ21から2次側コイル5Bへ放電電流が流れ、負荷側にエネルギーを有効に伝達できないばかりか、逆電流によるMOS-FETの発熱やノイズの発生、1次側スイッチング損失の増大にもつながる恐れがある。

【0031】そこで、このようなMOS-FETのゲートにオン電圧を印加するタイミングを正確に制御するために、例えば図3に示すような回路が用いられる。なお

以下の説明では、2次側整流用のMOS-FET 19、20の下側の片方の回路についてのみ示すが、上下両方のMOS-FETについての回路構成、及びその作用動作は同じである。

【0032】この図3において、MOS-FET 20に直列に電流検出用トランス31の1次側コイル31Aが設けられる。そしてこの電流検出用トランス31の2次側コイル31Bの両端間に検出用の抵抗器32が接続され、この抵抗器32の電圧がコンパレータ33で検出される。

【0033】すなわち上述の抵抗器32の一端が電圧源34に接続され、この電圧源34の電圧と抵抗器32の他端の電圧がコンパレータ33で比較されて、他端の電圧が所定値以上になったときに検出が行われる。そしてこの検出信号がバッファ回路35を通じてMOS-FET 20のゲートに供給される。

【0034】従ってこの回路において、例えば上述の1次側のトランジスタ1のコレクタ電流 I_c が、図4のAに示すようであった場合には、電圧変換用トランス5の2次側コイル5Bには図4のBの電圧が誘起される。そしてこの電圧がコンデンサ21の充電電圧より大きくなると、MOS-FET 20の寄生ダイオード20Aを通じてコンデンサ21に充電電流が流される。

【0035】さらにこの充電電流が電流検出用トランス31の1次側コイル31Aを流れることによって、2次側コイル31Bには電圧が誘起される。そしてこの出力電圧がコンパレータ33で検出され、この出力電圧が所定値以上になると、即座にバッファ回路35を通じて例えば図4のCに示すようなゲート電圧 V_{gs} がMOS-FET 20に印加される。

【0036】また、上述の充電電流が減少すると、コンパレータ33の出力が反転され、バッファ回路35を通じてMOS-FET 20のゲート容量が放電されて、MOS-FET 20がオフされる。なおこの時点でコンデンサ21の充電電流はゼロにはなっていないが、この電流はMOS-FET 20の寄生ダイオード20Aを通じて流される。

【0037】これによって、MOS-FET 20には、例えば図4のDに示すようなドレイン電流 I_D が流される。すなわちこのMOS-FET 20は、コンデンサ21への充電電流が流れ始めた後でオンされ、充電電流がゼロになる前にオフされる。そしてこのMOS-FET 20がオンされている期間に、低オン抵抗を介して損失の少ない充電が行われるものである。

【0038】なお、上述のMOS-FET 19においても作用動作は全く同じに行われる。すなわち例えば図5のA、Bに示すMOS-FET 20の動作に反転した形で、図5のC、Dに示すようにMOS-FET 19の動作が行われる。そしてこの場合も、MOS-FET 19は、コンデンサ21への充電電流が流れ始めた後でオン

され、充電電流がゼロになる前にオフされるものである。

【0039】従ってこの回路において、MOS-FETは充電電流がゼロになる前にオフされるので、例えばターンオフのタイミングが遅れて逆電流が流されるようなことがない。これにより、いかなる動作条件でもMOS-FETのオン期間が充電電流の方向のみの電流だけ流せるようにでき、逆電流の発生による不具合を解消することができる。

【0040】さらに図6、図7は、MOS-FETのゲートにオン電圧を印加するタイミングを正確に制御するための回路の他の例を示す。すなわち図6は充電電流の検出方法として検出抵抗41を用いる場合であって、この検出抵抗41で検出された電圧をコンパレータ42で電圧源43の電圧と比較し、この比較出力をバッファ回路44を通じてMOS-FET20のゲートに印加している。

【0041】また、図7は検出抵抗としてMOS-FET20のオン抵抗を用いるものである。すなわちこの例では、MOS-FET20のオン抵抗で検出された電圧をコンパレータ51で電圧源52の電圧と比較し、この比較出力をバッファ回路53を通じてMOS-FET20のゲートに印加している。なおこの図7の回路は、もっとも損失が少なくなる構成である。

【0042】こうして上述の電源装置によれば、スイッチング素子を2石用いたハーフブリッジ構成を有し、2石のスイッチング素子の midpoint に共振コンデンサと電圧変換用トランスが設けられると共に、電圧変換用トランスの2次側整流としてMOS-FETを用いて同期整流を行うことにより、2次側整流での損失を大幅に減少させ、効率の良いスイッチング電源を実現することができるものである。

【0043】なお、上述の説明では、いずれも2次側整流用のMOS-FET19、20を電圧変換トランス5の2次側コイル5Bの一侧に設ける場合について行ったが、例えば従来の装置で述べたダイオードのように+側に設けても同様の作用効果を得ることができる。ただし、一侧に設けた方がMOS-FETの駆動には適正である。

【0044】また、例えば図8に示すように1次側のスイッチング素子が他励発振によってオンオフ駆動される場合においても本発明を適用することができる。すなわち図8においては、コントロール回路60からの制御信号がドライブ回路61、62を通じてそれぞれスイッチング素子63、64に供給され、これらのスイッチング素子63、64がオンオフ駆動されて、上述の電圧変換トランス5の1次側コイル5Aに略正弦波の電流が流される。

【0045】さらにこの装置において、出力端子22の+端に取り出された電圧の、所望の電圧からの変動分が

フィードバック回路65を通じてコントロール回路60に供給され、これによってスイッチング素子63、64のスイッチング周波数が変化されて、出力端子22の+端に取り出される電圧が所望の電圧に等しくなるように制御が行われる。

【0046】そしてさらにこの装置においても、電圧変換用トランスの2次側整流としてMOS-FETを用いて同期整流を行うことによって、特に低オン抵抗のMOS-FETを用いることで、2次側整流での損失を大幅に減少させることができ、効率の良いスイッチング電源を実現することができるものである。

【0047】

【発明の効果】この発明によれば、電圧変換用トランスの2次側整流としてMOS-FETを用いて同期整流を行うことによって、特に低オン抵抗のMOS-FETを用いることで、2次側整流での損失を大幅に減少させることができるようになった。

【0048】これによって、従来の装置では、2次側整流用ダイオードの順方向降下電圧によって、出力に対する損失の割合が大きくなっていったものを、本発明によれば、特にパーソナルコンピュータのように低電圧、大電流の電源が要求される場合に、2次側整流での損失を大幅に減少させ、効率の良いスイッチング電源を実現することができるものである。

【図面の簡単な説明】

【図1】本発明の適用される電源装置の一例の構成図である。

【図2】その説明のための図である。

【図3】本発明の適用される電源装置の要部の一例の構成図である。

【図4】その動作の説明のための図である。

【図5】その動作の説明のための図である。

【図6】本発明の適用される電源装置の要部の他の例の構成図である。

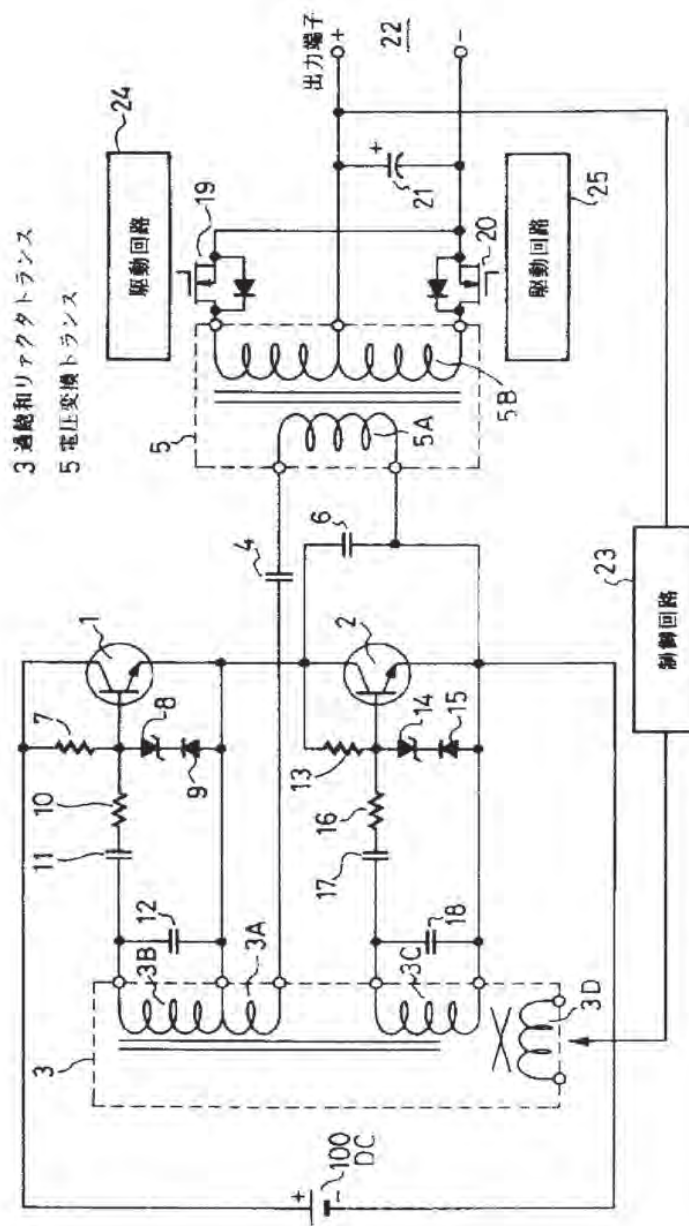
【図7】本発明の適用される電源装置の要部の他の例の構成図である。

【図8】本発明の適用される電源装置の他の例の構成図である。

【図9】従来の電源装置の構成図である。

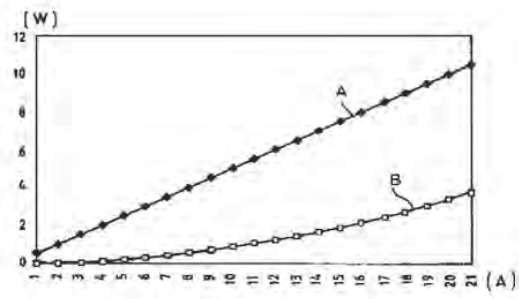
【符号の説明】

100 AC入力、1 整流したDC、2 スwitchングトランジスタ、3 過飽和リアクタランス、4 共振コンデンサ、5 電圧変換トランス、6 コンデンサ、7 抵抗器、8 ツェナーダイオード、9 ダイオード、10 抵抗器、11、12 コンデンサ、13 抵抗器、14 ツェナーダイオード、15 ダイオード、16 抵抗器、17、18 コンデンサ、19、20 MOS-FET、21 コンデンサ、22 出力端子、23 制御回路、24、25 駆動回路

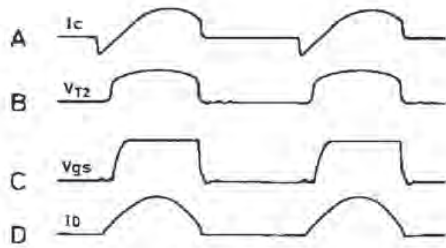


【図 1】

【図 2】

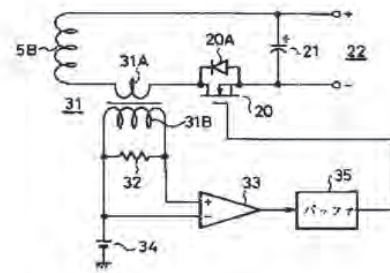


【図 4】

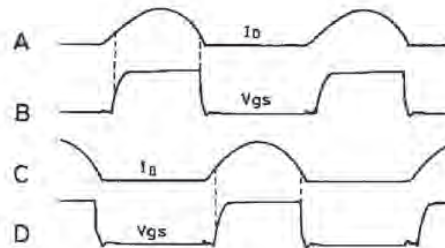


【図 6】

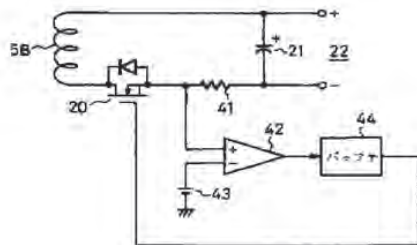
【図 3】



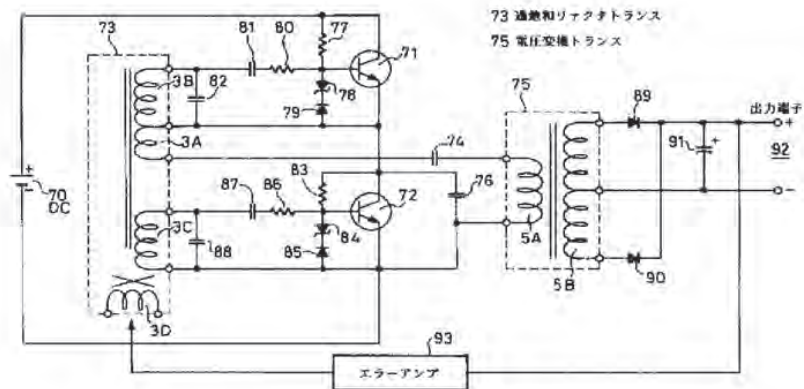
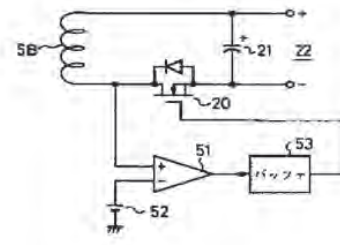
【図 5】

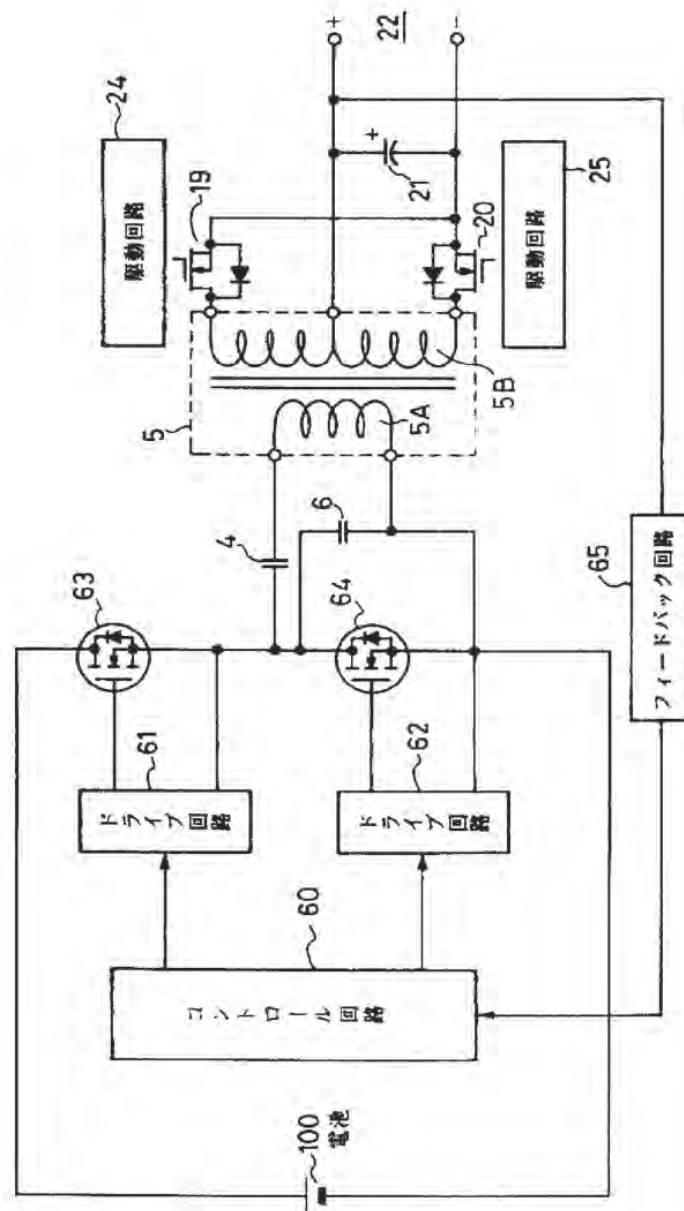


【図 7】



【図 9】





【図8】

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Friday, April 11 2014

THOMSON INNOVATION

Patent/Publication: JP2001309580A**Bibliography****DWPI Title**

Non-contact power transfer apparatus has current detector that detects flow of rectified current to transistor, in order to output to signal generator for switching ON/OFF of transistor element

Original Title

NON-CONTACT POWER TRANSFER APPARATUS

Non-contact power transmission apparatus (*Translation from Thomson Reuters*)**English Title**

NON-CONTACT POWER TRANSFER APPARATUS

Assignee/ApplicantStandardized: **MATSUSHITA ELECTRIC WORKS LTD**

Original: MATSUSHITA ELECTRIC WORKS LTD

DWPI Assignee/Applicant

MATSUSHITA ELECTRIC WORKS LTD (MATW-C)

Inventor

MUTO MOTOHARU, ABE HIDEAKI,

DWPI Inventor

ABE H; MUTO M

Publication Date (Kind Code)

2001-11-02 (A)

DWPI Accession / Update

2003-734362 / 200370

Application Number / Date

JP2000124565A / 2000-04-25

Priority Number / Date / Country

JP2000124565A / 2000-04-25 / JP

Abstract**DWPI Abstract**<https://www.thomsoninnovation.com/tip-innovation/printRecView.do?ResultSetId=69744...> 4/11/2014

(JP2001309580A_)

Novelty

A current detector (H1) connected in series with field effect transistor (FET) (Q1), detects rectified current of secondary coil (L2) of transformer (T1), flowing into Q1, to output a signal for a drive signal generator (E1). When the detected signal is greater than threshold value, E1 outputs drive signal to turn ON the FET element (P1), else E1 outputs signal to turn OFF the FET element.

Use

Non-contact power transfer apparatus.

Advantage

The efficiency of secondary side circuit is improved.

Drawing Description

The figure shows the circuit diagram of the non-contact power transfer apparatus. (Drawing includes non-English language text).

H1 - current detector.

L1, L2 - primary and secondary coils.

P1 - FET element.

Q1 - FET.

T - transformer.

Abstract

PROBLEM TO BE SOLVED: To provide a non-contact power transfer apparatus which has improved the rectifying efficiency of a secondary side circuit.

SOLUTION: A power supply section A supplies a DC power to an inverter section B, the DC power is converted to a high frequency power in the inverter section B, and the high frequency power is supplied to a primary coil L1 of a transformer T1. A secondary coil L2 of the transformer T1 receives the power from the primary coil L1 through electro-magnetic coupling, the voltage across the secondary coil L2 is half-wave rectified with FETQ1, and the half-wave rectified voltage is smoothed in a smoothing section F to output a DC voltage. A current detecting section H1connected in series to FETQ1 detects a current flowing into the FETQ1 and outputs the detected signal to a drive signal generating section E1. The drive signal generating section E1outputs a drive signal to turn ON the FET element P1when the detected signal from the current detecting section H1is the predetermined threshold value or higher, and also outputs a drive signal to turn OFF the FET element P1 when the signal from the current detecting section H1is a predetermined threshold or lower.

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SUBJECT of the InventionThe non-contact power transmission apparatus which raised the

rectification|straightening efficiency of the secondary side circuit is provided.

PROBLEM to be solvedThe power supply part A supplies direct-current power to the inverter part B, it converts into high frequency electric power in the inverter part B, and the said high frequency electric power is supplied to the primary coil L1 of the trans|transformer T1.

The secondary coil L2 of the trans|transformer T1 power-receives electric power from the primary coil L1 by electromagnetically coupling,

The half wave rectification of the voltage of secondary coil L2 both ends is carried out by FETQ1, and the voltage by which the half wave rectification was carried out is smoothed out by the smooth section F, and outputs a DC voltage.

The electric current detection part H1 connected in series by FETQ1 detects the electric current which flows into FETQ1, and outputs the said detection signal to the drive signal production|generation part E1.

The drive signal production|generation part E1 will output the drive signal which turns ON the FET element P1, if the detection signal from the electric current detection part H1 is more than a predetermined threshold value,

If the signal from the electric current detection part H1 is below a predetermined threshold value, the drive signal which turns OFF the FET element P1 will be output.

[MAT_IMAGE 000002]

(Translation from Thomson Reuters)

Classes/Indexing

IPC

IPC Code(1-7) **H02J 17/00** H02M 3/28 H02M 7/12 H02M 7/21

(7)

Current IPC	Invention	Version	Additional	Version
Full	H02J 17/00	20060101	-	-
	H02M 3/28	20060101		
	H02M 7/12	20060101		
	H02M 7/21	20060101		
Main Group	-	-	-	-
Subclass	-	-	-	-

Original IPC	Invention	Version	Additional	Version
Advanced/Full	H02J 17/00	20060101	-	-
	H02M 3/28	20060101		
	H02M 7/12	20060101		
	H02M 7/21	20060101		
Core/Main Group	H02J 17/00	20060101	-	-
	H02M 3/24	20060101		
	H02M 7/12	20060101		
	H02M 7/21	20060101		
Subclass	-	-	-	-

JP FI Codes

<https://www.thomsoninnovation.com/tip-innovation/printRecView.do?ResultSetId=69744...> 4/11/2014

H02J 17/00 B; H02M 3/28 F; H02M 7/12 A; H02M 7/21 A

JP F Terms

5G063

5H006: CA02; CB01; CB07; CC01; DB03; DC02; HA09

5H730: BB25; BB26; CC01; DD04; DD21; EE02; EE03; EE13; FD31

DWPI Class

U21 U24

DWPI Manual Codes

DWPI Manual Codes

EPI Manual Codes: U21-B01B; U21-B05C; U24-D01A3; U24-D02B; U24-H

DWPI Chemistry Resource Numbers

DWPI Chemistry Resource Numbers

-

DWPI Registry Numbers

DWPI Registry Numbers

-

Plasdoc Punch Codes

Plasdoc Punch Codes

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Plasdoc Key Serial Codes

Plasdoc Key Serial Codes

-

Enhanced Polymer Indexing

Enhanced Polymer Indexing

-

Chemical Fragment Codes

Chemical Fragment Codes

-

<https://www.thomsoninnovation.com/tip-innovation/printRecView.do?ResultSetId=69744...> 4/11/2014

Legal Status**INPADOC Legal Status**

Gazette Date	Code	Description
2012-06-05	FPAY +	RENEWAL FEE PAYMENT (PRS DATE IS RENEWAL DATE OF DATABASE) PAYMENT UNTIL: 20130620
2012-05-31	FPAY +	RENEWAL FEE PAYMENT (PRS DATE IS RENEWAL DATE OF DATABASE) PAYMENT UNTIL: 20120620
2011-05-31	FPAY +	RENEWAL FEE PAYMENT (PRS DATE IS RENEWAL DATE OF DATABASE) PAYMENT UNTIL: 20120620
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2008-12-04	FPAY +	RENEWAL FEE PAYMENT (PRS DATE IS RENEWAL DATE OF DATABASE) PAYMENT UNTIL: 20110620
2008-11-26	S533	WRITTEN REQUEST FOR REGISTRATION OF CHANGE OF NAME JAPANESE INTERMEDIATE CODE: R313533
2008-06-23	FPAY +	RENEWAL FEE PAYMENT (PRS DATE IS RENEWAL DATE OF DATABASE) PAYMENT UNTIL: 20110620
2008-06-20	FPAY +	RENEWAL FEE PAYMENT (PRS DATE IS RENEWAL DATE OF DATABASE) PAYMENT UNTIL: 20110620
2008-06-19	A61 +	FIRST PAYMENT OF ANNUAL FEES (DURING GRANT PROCEDURE) JAPANESE INTERMEDIATE CODE: A61 2008-06-02
2008-05-22	A01 +	WRITTEN DECISION TO GRANT A PATENT OR TO GRANT A REGISTRATION (UTILITY MODEL) JAPANESE INTERMEDIATE CODE: A01
2008-05-21	A01 +	WRITTEN DECISION TO GRANT A PATENT OR TO GRANT A REGISTRATION (UTILITY MODEL) JAPANESE INTERMEDIATE CODE: A01 2008-05-20
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Get Family Legal Status

Family**Family**

INPADOC Family (2)

Publication Number	Publication Date	Inventor	Assignee/Applicant	Title
JP2001309580A	2001-11-02	MUTO MOTOHARU	MATSUSHITA ELECTRIC WORKS LTD	NON-CONTACT POWER TRANSFER APPARATUS
JP04140169B2	2008-08-27	-	MATSUSHITA ELECTRIC WORKS LTD	-

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DWPI Family (2); Countries (1)

Publication	DWPI Update	Publication Date	IPC Code	Language
JP2001309580A	200370	2001-11-02	H02J001700	Japanese
Local Applications: JP2000124565A filed 2000-04-25				
JP04140169B2	200858	2008-08-27	H02J001700	Japanese
Local Applications: JP2000124565A filed 2000-04-25				

Claims

Claims

All Claims (13)

Claims (English)

1. The power supply part which supplies DC power supply,
The inverter part which converts the said DC power supply into a high frequency electric-power,
The primary side circuit comprised with the said primary coil of the trans|transformer which can isolate|separate the primary coil to which high frequency electric power is supplied, and the secondary coil which outputs the electric power power-received from the primary coil from the said inverter part,
The said secondary coil,
The non-contact electric power transmission apparatus which has a secondary side circuit comprised in the rectification|straightening part which rectifies|straightens the output voltage of the capacitor|condenser for a load adjustment parallelly connected to the said secondary coil, and the said secondary coil
WHEREIN:
The said rectification|straightening part that connected in series the synchronous rectification element consisting of the diode parallelly reversely connected by the switching element and the said switching element in the said secondary coil, and was comprised,
It consists of an electric current detection part which detects the electric current which flows into the said synchronous rectification element, and a drive signal production|generation part which produces|generates the drive signal of the switching element of the said synchronous rectification element based on the detection signal of the said electric current detection part.
The non-contact electric power transmission apparatus characterized by the above-mentioned.
2. The secondary coil of the said trans|transformer is provided with a center tap, and the said rectification|straightening part,
Each other end which have not been connected to the secondary coil of the said trans|transformer of the said synchronous rectification element of the 1st and 2nd in series and mutually connected to both the output terminals that are not the center taps of the secondary coil of the said trans|transformer at a reverse direction is connected, and a full wave rectification part is comprised.
The non-contact electric power transmission apparatus of Claim 1 characterized by the above-mentioned.
3. The drive signal of the switching element of the said 1st synchronous rectification element is produced|generated from the detection signal of one said electric current detection part,
The drive signal of the switching element of the said 2nd synchronous rectification element is taken as the inversion signal of the drive signal of the switching element of the said 1st synchronous rectification element.
The non-contact electric power transmission apparatus of Claim 2 characterized by the above-mentioned.
4. The said electric current detection part consists of resistance for an electric current detection connected in series to the said synchronous rectification element, and produces|generates the drive signal of the switching element of the said synchronous rectification element in the said drive signal production|generation part based on the voltage generate|occur|produced at the both ends of the said resistance for an electric current detection.
The non-contact electric power transmission apparatus in any one of the Claims 1 to 3 characterized by the above-mentioned.

<https://www.thomsoninnovation.com/tip-innovation/printRecView.do?ResultSetId=69744...> 4/11/2014

5. The resistance value of the said resistance for an electric current detection is resistance value which becomes the minimum voltage that the voltage of the both ends of the said resistance for an electric current detection generate|occur|produced with respect to the electric current which flows into the said resistance for an electric current detection can amplify even to the voltage which can drive the switching element of the said synchronous rectification element in the said drive signal production|generation part. The non-contact electric power transmission apparatus of Claim 4 characterized by the above-mentioned.

6. The said electric current detection part is a current trans|transformer consisting of the primary coil and secondary coil which were connected in series to the said synchronous rectification element, Resistance parallelly connected to the both ends of the secondary coil of the said current trans|transformer, Since the voltage between the both ends of the said resistance is rectified|straightened, it is comprised from the rectifier diode connected in series in the secondary coil of the said current trans|transformer, Based on the output of the said electric current detection part output from the said rectifier diode, the drive signal of the switching element of the said synchronous rectification element is produced|generated in a drive signal production|generation part. The non-contact electric power transmission apparatus in any one of the Claims 1 to 3 characterized by the above-mentioned.

7. The said drive signal production|generation part compares the output and reference voltage of the said electric current detection part, and produces|generates the drive signal of the switching element of the said synchronous rectification element based on the said comparison result. The non-contact electric power transmission apparatus in any one of the Claims 1 to 6 characterized by the above-mentioned.

8. The electric current value which flows through the said 1st synchronous rectification element that conducts previously and is complete|finishing rectification|straightening in the non-contact electric power transmission apparatus which has multiple said synchronous rectification elements, The 1st drive signal production|generation part which outputs the drive signal which turns OFF the switching element of the said 1st synchronous rectification element to the time when the electric current value which begins to flow into the diode of the said 2nd synchronous rectification element that should conduct for the next rectification|straightening becomes equivalent, It has a 2nd drive signal production|generation part which outputs the drive signal which turns ON the switching element of the said 2nd synchronous rectification element. The non-contact electric power transmission apparatus in any one of the Claims 2 to 7 characterized by the above-mentioned.

9. The electric current value which flows through the 1st synchronous rectification element which conducts previously the said, 1st and 2nd drive signal production|generation part, and is complete|finishing rectification|straightening, The output voltage of the said electric current detection part in the time when the electric current value which begins to flow into the diode of the 2nd synchronous rectification element which should conduct for the next rectification|straightening becomes equivalent, and the reference voltage which is the same voltages, The detection signal of the said electric current detection part is compared, Based on the said comparison result, the drive signal of the switching element of the said synchronous rectification element is produced|generated. The non-contact electric power transmission apparatus of Claim 8 characterized by the above-mentioned.

10. The electric current value which flows through the 1st synchronous rectification element which conducts the said 2nd drive signal production|generation part previously, and is complete|finishing rectification|straightening, The drive signal which amplified the switching element of the said 2nd synchronous rectification element even to the voltage which can turn ON is output to the time when the electric current value which begins to flow into the diode of the 2nd synchronous rectification element which should conduct for the next rectification|straightening becomes equivalent. The non-contact electric power transmission apparatus of Claim 8 characterized by the above-mentioned.

11. The said rectification|straightening part comprises the half wave rectification part which connected one of the said synchronous rectification elements to the secondary coil of the said trans|transformer in series,

The said drive signal production|generation part consists of a comparator which compares the detection signal and reference voltage of the said electric current detection circuit, and makes the said comparison output the drive signal of the switching element of the said synchronous rectification element, and the said reference voltage,

It is a voltage through which the electric current of the same direction as the forward-current direction of the diode parallelly reversely connected by the switching element of the said synchronous rectification element at the said switching element flows through the maximum time, and the forward current of the said diode and the electric current of a reverse direction do not flow into the switching element of an initial period synchronous rectification element.

The non-contact electric power transmission apparatus of Claim 7 characterized by the above-mentioned.

12. The said rectification|straightening part comprises the half wave rectification part which connected one of the said synchronous rectification elements to the secondary coil of the said trans|transformer in series,

The said drive signal production|generation part has a drive signal production|generation part which outputs the drive signal which amplified the switching element of the said synchronous rectification element even to the voltage which can turn ON to the time when a forward current begins to flow into the diode of the said synchronous rectification element.

The non-contact electric power transmission apparatus in any one of Claim 1, 4, 5, 6 characterized by the above-mentioned.

13. The said inverter part consists of an inverter of the half bridge which has a switching element, and the said switching element performs zero volt|bolt switching.

The non-contact electric power transmission apparatus in any one of the Claims 1 to 12 characterized by the above-mentioned.

(Translation from Thomson Reuters)

Description

DWPI Drawing Description

The figure shows the circuit diagram of the non-contact power transfer apparatus. (Drawing includes non-English language text).

H1 - current detector.

L1, L2 - primary and secondary coils.

P1 - FET element.

Q1 - FET.

T - transformer.

Drawing Description

Drawing Description

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Description

Description

TECHNICAL FIELD of the Invention

This invention relates to a non-contact power transmission apparatus.

PRIOR ART

The examples utilized by applying a non-contact electric power technique are charging applications, such as a shaver and an electric toothbrush, and were restricted to about several watts low output. And the diode rectification|straightening system has been used as a rectification|straightening system of a secondary side circuit.

PROBLEM to be solved by the Invention

The electric power transmission technique of non-contact and a non-contact in which the magnetic induction by an isolation|separation detachable trans|transformer was utilized can take the fundamental measures against an electric shock according to the characteristic of the metal contact less,

From this, the application as a power supply of the circumference of water is attracting attention.

It was safe, and while the output voltage was a low voltage, the efficiency of the apparatus did not fall, either, but it is an about

[12V]

power supply which already has a performance in the object for vehicles, and high-outputting beyond 50W is needed, in order to use it as a power supply about which he can feel easy so that various apparatuses can be used.

However,

Output current also became large as it made high-powered by the low voltage, by the diode rectification|straightening system currently used conventionally in the secondary side circuit of non-contact electric power supply, rectification|straightening loss became large and the problem that the size of heat sinks, such as a diode, also became large and was not stored in practical size generate|occur|produced.

Then, it examined applying the synchronous rectification technique currently used for loss reduction of the rectification|straightening part of the switched-mode power supply whose output voltage is conventionally 5 V or less to a non-contact power transmission apparatus.

With the synchronous rectification technique, the switching element of FET and the parasitic diode of FET are used as a switching element for synchronous rectification,

It is the technique of reducing the loss of a rectification|straightening part using the low ON-resistance of FET by switching the switching element of FET according to the rectifying|straightening cycle, and sending a rectified current via the switching element of FET.

Of course, instead of FET which incorporates the parasitic diode, even if it connects the diode of a reverse direction to a switching element and a switching element parallelly, the same operation|movement is carried out.

The power supply part to which a non-contact power transmission apparatus supplies DC power supply, and the inverter part which converts DC power supply into a high frequency electric-power,

The primary side circuit comprised with the primary coil of the isolation|separation detachable trans|transformer which can isolate|separate the primary coil to which high frequency electric power is supplied, and the secondary coil which outputs the electric power power-received from the primary coil from an inverter part,

It consists of a secondary side circuit comprised in the rectification|straightening part which rectifies|straightens the output voltage of a secondary coil, and the capacitor|condenser for a load adjustment parallelly connected to a secondary coil and a secondary coil.

In order to make into the maximum active power which can be taken out to a secondary side at this time, to raise the efficiency of the whole circuit and to achieve size reduction of an isolation|separation detachable trans|transformer,

The power factor of the whole circuit is improved by the capacitor|condenser for a load adjustment parallelly connected to the leakage inductance and secondary coil by a leakage flux between the primary coil of an isolation|separation detachable trans|transformer, and a secondary coil.

However, when the load adjustment by the said capacitor|condenser for a load adjustment is performed, Since [the] the output waveform of the said secondary coil turns into a sine wave-form and also a perverted waveform unlike the secondary coil output waveform of a switched-mode power supply,

Since the ON time of the switching element for synchronous rectification was short, rectification|straightening efficiency was bad, and efficiency was not able to be raised by the drive signal production|generation system of the conventional switching element for synchronous rectification using

the voltage between coil|windings, or an auxiliary|assistant coil|winding from a diode rectification|straightening system.

This invention is made in view of the said reason,

The objective is to provide the non-contact power transmission apparatus which raised the rectification|straightening efficiency of the secondary side circuit.

MEANS to solve the Problem

Invention of Claim 1 is a power supply part which supplies DC power supply,

The inverter part which converts the said DC power supply into a high frequency electric-power,

The primary side circuit comprised with the said primary coil of the trans|transformer which can isolate|separate the primary coil to which high frequency electric power is supplied, and the secondary coil which outputs the electric power power-received from the primary coil from the said inverter part,

The said secondary coil,

The non-contact electric power transmission apparatus which has a secondary side circuit comprised in the rectification|straightening part which rectifies|straightens the output voltage of the capacitor|condenser for a load adjustment parallelly connected to the said secondary coil, and the said secondary coil

WHEREIN:

The said rectification|straightening part that connected in series the synchronous rectification element consisting of the diode parallelly reversely connected by the switching element and the said switching element in the said secondary coil, and was comprised,

It consists of an electric current detection part which detects the electric current which flows into the said synchronous rectification element, and a drive signal production|generation part which produces|generates the drive signal of the switching element of the said synchronous rectification element based on the detection signal of the said electric current detection part,

It is characterized by the above-mentioned, the rectification|straightening loss of a secondary side circuit is reduced, the size of the heat sink of a rectification|straightening part can be made small, and the efficiency of the whole circuit can be raised.

In invention of Claim 1, invention of Claim 2 is provided with the secondary coil of the said trans|transformer, and a center tap the said rectification|straightening part,

Each other end which have not been connected to the secondary coil of the said trans|transformer of the said synchronous rectification element of the 1st and 2nd in series and mutually connected to both the output terminals that are not the center taps of the secondary coil of the said trans|transformer at a reverse direction is connected, and a full wave rectification part is comprised,

Loss can perform little efficient rectification|straightening rather than a half wave rectification by being characterized by the above-mentioned and carrying out a full wave rectification.

Invention of Claim 3 produces|generates the drive signal of the switching element of the said 1st synchronous rectification element from the detection signal of one said electric current detection part in invention of Claim 2,

The drive signal of the switching element of the said 2nd synchronous rectification element is taken as the inversion signal of the drive signal of the switching element of the said 1st synchronous rectification element,

It can be characterized by the above-mentioned, simplification of a drive signal production|generation part can be achieved, and cost reduction and size reduction can be performed.

In the invention in any one of Claims 1 to 3, invention of Claim 4 the said electric current detection part, It consists of resistance for an electric current detection connected in series to the said synchronous rectification element, and the drive signal of the switching element of the said synchronous rectification element is produced|generated in the said drive signal production|generation part based on the voltage generate|occur|produced at the both ends of the said resistance for an electric current detection,

It is characterized by the above-mentioned and an electric current detection part can be comprised by easy circuit structure.

In invention of Claim 4, invention of Claim 5 the resistance value of the said resistance for an electric current detection,

The voltage of the both ends of the said resistance for an electric current detection generate|occur|produced with respect to the electric current which flows into the said resistance for an electric current detection is the resistance value which becomes the minimum voltage that can be amplified even to the voltage which can drive the switching element of the said synchronous rectification

element in the said drive signal production|generation part,
It can be characterized by the above-mentioned and the loss in an electric current detection part can be reduced.

Invention of Claim 6 is a current trans|transformer consisting of the primary coil and secondary coil which connected the said electric current detection part in series to the said synchronous rectification element in the invention in any one of Claims 1 to 3,
Resistance parallelly connected to the both ends of the secondary coil of the said current trans|transformer,
Since the voltage between the both ends of the said resistance is rectified|straightened, it is comprised from the rectifier diode connected in series in the secondary coil of the said current trans|transformer,
Based on the output of the said electric current detection part output from the said rectifier diode, the drive signal of the switching element of the said synchronous rectification element is produced|generated in a drive signal production|generation part,
It can be characterized by the above-mentioned and the rectification|straightening loss of a secondary side circuit can be reduced.

In the invention in any one of Claims 1 to 6, as for invention of Claim 7, the said drive signal production|generation part compares the output and reference voltage of the said electric current detection part,
Based on the said comparison result, the drive signal of the switching element of the said synchronous rectification element is produced|generated,
It is characterized by the above-mentioned, the rectification|straightening loss of a secondary side circuit is reduced, the size of the heat sink of a rectification|straightening part can be made small, and the efficiency of the whole circuit can be raised.

Invention of Claim 8 is a non-contact electric power transmission apparatus which has multiple said synchronous rectification elements in the invention in any one of Claims 2 to 7.

WHEREIN:

The electric current value which flows through the said 1st synchronous rectification element that conducts previously and is complete|finishing rectification|straightening,
The 1st drive signal production|generation part which outputs the drive signal which turns OFF the switching element of the said 1st synchronous rectification element to the time when the electric current value which begins to flow into the diode of the said 2nd synchronous rectification element that should conduct for the next rectification|straightening becomes equivalent,
It is characterized by having a 2nd drive signal production|generation part which outputs the drive signal which turns ON the switching element of the said 2nd synchronous rectification element,
The rectification|straightening loss of a secondary side circuit is reduced,
The size of the heat sink of a rectification|straightening part can be made small, and the efficiency of the whole circuit can be raised.

In invention of Claim 8, invention of Claim 9 the said, 1st and 2nd drive signal production|generation part,
The output voltage of the said electric current detection part in the time when the electric current value which flows through the 1st synchronous rectification element which conducts previously and is complete|finishing rectification|straightening, and the electric current value which begins to flow into the diode of the 2nd synchronous rectification element which should conduct for the next rectification|straightening become equivalent, and the reference voltage which is the same voltages,
The detection signal of the said electric current detection part is compared,
Based on the said comparison result, the drive signal of the switching element of the said synchronous rectification element is produced|generated,
It is characterized by the above-mentioned, the rectification|straightening loss of a secondary side circuit is reduced, the size of the heat sink of a rectification|straightening part can be made small, and the efficiency of the whole circuit can be raised.

In invention of Claim 8, invention of Claim 10 the said 2nd drive signal production|generation part,
The electric current value which flows through the 1st synchronous rectification element which conducts previously and is complete|finishing rectification|straightening,
The drive signal which amplified the switching element of the said 2nd synchronous rectification element even to the voltage which can turn ON is output to the time when the electric current value which begins to flow into the diode of the 2nd synchronous rectification element which should conduct for the next rectification|straightening becomes equivalent,
It is characterized by the above-mentioned, the rectification|straightening loss of a secondary side circuit

is reduced, the size of the heat sink of a rectification|straightening part can be made small, and the efficiency of the whole circuit can be raised.

Invention of Claim 11 comprises the half wave rectification part in which the said rectification|straightening part connected one of the said synchronous rectification elements to the secondary coil of the said trans|transformer in series in invention of Claim 7,

The said drive signal production|generation part consists of a comparator which compares the detection signal and reference voltage of the said electric current detection circuit, and makes the said comparison output the drive signal of the switching element of the said synchronous rectification element, and the said reference voltage,

It is a voltage through which the electric current of the same direction as the forward-current direction of the diode parallelly reversely connected by the switching element of the said synchronous rectification element at the said switching element flows through the maximum time, and the forward current of the said diode and the electric current of a reverse direction do not flow into the switching element of an initial period synchronous rectification element,

It is characterized by the above-mentioned,

The rectification|straightening loss of a secondary side circuit is reduced, the size of the heat sink of a rectification|straightening part can be made small, and the efficiency of the whole circuit can be raised.

Invention of Claim 12 comprises the half wave rectification part in which the said rectification|straightening part connected one of the said synchronous rectification elements to the secondary coil of the said trans|transformer in series in the invention in any one of a Claim 1, 4, 5, 6,

The said drive signal production|generation part has a drive signal production|generation part which outputs the drive signal which amplified the switching element of the said synchronous rectification element even to the voltage which can turn ON to the time when a forward current begins to flow into the diode of the said synchronous rectification element,

It is characterized by the above-mentioned, the rectification|straightening loss of a secondary side circuit is reduced, the size of the heat sink of a rectification|straightening part can be made small, and the efficiency of the whole circuit can be raised.

Invention of Claim 13 consists of an inverter of a half bridge with which the said inverter part has a switching element in the invention in any one of Claims 1 to 12, and it is characterized by the said switching element performing zero volt|bolt switching,

The rectification|straightening loss of a secondary side circuit is reduced,

The size of the heat sink of a rectification|straightening part can be made small, and the efficiency of the whole circuit can be raised.

EMBODIMENT of the Invention

Hereafter, embodiment of this invention is described based on drawing.

(Embodiment 1)

FIG. 1 shows the circuit structure of Embodiment 1.

The primary side circuit G1 is comprised with the power supply part A, the inverter part B, and the primary coil L1 of the trans|transformer T1,

The secondary circuit G2 is comprised by FETQ1 and the electric current detection part H1 which comprise the secondary coil L2, the capacitor|condenser C1 for a load adjustment, and the synchronous rectification element of the trans|transformer T1, the drive signal production|generation part E1, and the smooth section F.

The power supply part A supplies direct-current power to the inverter part B, it converts into high frequency electric power in the inverter part B, and the said high frequency electric power is supplied to the primary coil L1 of the trans|transformer T1.

The secondary coil L2 of the trans|transformer T1 power-receives electric power from the primary coil L1 by electromagnetically coupling,

The half wave rectification of the voltage of secondary coil L2 both ends is carried out by FETQ1, and the voltage by which the half wave rectification was carried out is smoothed out by the smooth section F, and outputs a DC voltage.

Only predetermined gap length spaces apart mutually the primary coil L1 and the secondary coil L2 of the trans|transformer T1 with an insulator, and they have become the structure which can carry out the isolation|separation removal|desorption.

The capacitor|condenser C1 parallelly connected to the secondary coil L2 is an object for a load adjustment, makes the maximum active power which can be taken out in the secondary side circuit G2, and is raising the efficiency of the power transmission to the secondary side circuit G2 from the primary side circuit G1.

Next, the synchronous rectification operation|movement of this Embodiment 1 is demonstrated.

FETQ1 consists of the parasitic diode D1 parallelly connected to the FET element P1 and the FET element P1 at the reverse direction.

The electric current detection part H1 connected in series by FETQ1 detects the electric current which flows into FETQ1, and outputs the said detection signal to the drive signal production|generation part E1. The drive signal production|generation part E1 will output the drive signal which turns ON the FET element P1, if the detection signal from the electric current detection part H1 is more than a predetermined threshold value,

If the signal from the electric current detection part H1 is below a predetermined threshold value, the drive signal which turns OFF the FET element P1 will be output.

When the polarity of the electromotive force induced|guided|derived to the secondary coil L2 from the primary coil L1 by the electromagnetic induction agree|coincides with the forward direction of the parasitic diode D1 of FETQ1, a forward current flows into the parasitic diode D1,

The said forward current is detected in the electric current detection part H1,

If the detection signal from the electric current detection part H1 exceeds the said threshold value, the drive signal production|generation part E1 outputs an ON signal to the FET element P1, and turns ON the FET element P1.

If the FET element P1 turns ON, since resistance is small compared with the parasitic diode D1, the way of the FET element P1 will flow into a drain direction through the electric current which was flowing through the parasitic diode D1 at the beginning from the source|saue of FETQ1 via the ON-resistance of the FET element P1.

At this time, the way which lengthened ON time of the FET element as much as possible in the cycle through which a rectified current flows into FETQ1 can make loss of FETQ1 small, and can reduce rectification|straightening loss.

The detection signal which will be output from the electric current detection part H1 if the electromotive force which the electromotive force induced|guided|derived to the secondary coil L2 changes from the primary coil L1, and is induced|guided|derived to the secondary coil L2 by an electromagnetic induction becomes small also becomes small,

If the detection signal from the electric current detection part H1 falls from the said threshold value, the drive signal production|generation part E1 outputs an OFF signal to the FET element P1, and turns off the FET element P1.

Furthermore, since the voltage of a reverse direction will be built over the parasitic diode D1 of the FET element P1 if the polarity of the electromotive force induced|guided|derived to the secondary coil L2 is reversed,

An electric current does not flow into the parasitic diode D1 until the polarity of the electromotive force again induced|guided|derived to the secondary coil L2 is reversed, but the input of the smooth section F becomes a half wave rectification waveform.

A half wave rectification output is smoothed out by the smooth section F.

FIG. 2 shows current waveform S1 which flows into FETQ1 of this Embodiment 1, and said current waveform S1 becomes a waveform which stood|started up gentle and was distorted.

The loss at the time of this synchronous rectification,

Said current waveform S1 one|on threshold value K of the FET element P1.

Time to exceed and set the FET element P1 to ON from OFF.

The ON-resistance of t3 and the FET element P1 at the time of the said synchronous rectification for the time when t2 and said current waveform S1 are set to zero in time for t1 and said current waveform S1 to fall from one|on threshold value K of the FET element P1, and for the FET element P1 become from ON to OFF Ron,

In the electric current which flows through FETQ1, when I and the forward direction voltage of the parasitic diode D1 are set to Vf, the gross loss W in one period is represented like [with the one following].

[EQUATION 1]
[MAT_IMAGE 000003]

Thus, the electric current which flows into FETQ1 is detected,
If the FET element P1 is driven by the signal in sync with the said detection signal, time for an electric current to flow into the parasitic diode D1 of FETQ1 can be shortened, and the loss of FETQ1 can be reduced.

As a result, since the size of a heat sink can be made small, the secondary side circuit G2 can be reduced in size.

(Embodiment 2)

FIG. 3 shows the circuit structure of Embodiment 2.

Since the structure of the primary side circuit G1 which consists of the power supply part A, the inverter part B, and the primary coil L1 of the trans|transformer T1, and an operation|movement are similar to Embodiment 1, they are abbreviate|omitted.

The secondary coil L2 of the trans|transformer T1 becomes a center tap system with three output terminals,

It has the terminals 1 and 3 of secondary coil L2 both ends, and a 3 terminal of the center tap terminal 2,

The capacitor|condenser C1 for a load adjustment is parallelly connected between the terminal 1 cathode terminals 3 of the secondary coil L2.

The drain of FETQ1 which comprises the synchronous rectification element via the electric current detection part H1 in series is connected to the terminal 1 of the secondary coil L2,

The drain of FETQ2 which comprises the synchronous rectification element via the electric current detection part H3 in series is connected to the terminal 3 of the secondary coil L2.

Each source|saue of FETQ1 and Q2 is mutually connected, it connects with the negative electrode side of the smoothing capacitor C8, and the terminal 3 of the secondary coil L2 is connected to the positive electrode side of the smoothing capacitor C8 via the choke coil L3.

Next, the operation|movement of this Embodiment 2 is demonstrated.

FETQ1 consists of the parasitic diode D1 by which the reverse direction was parallelly connected to the FET element P1 and the FET element P1.

The electric current detection part H1 connected in series by FETQ1 detects the electric current which flows into FETQ1, and outputs the said detection signal to the drive signal production|generation part E1. The drive signal production|generation part E1 will output the drive signal which turns ON the FET element P1, if the detection signal from the electric current detection part H1 is more than a predetermined threshold value,

If the signal from the electric current detection part H1 is below a predetermined threshold value, the drive signal which turns OFF the FET element P1 will be output.

FETQ2 is the FET element P2 and the FET element P2 from the connection れた parasitic diode D2 of the reverse direction parallelly in a similar manner.

The electric current detection part H2 connected in series by FETQ2 detects the electric current which flows into FETQ2, and outputs the said detection signal to the drive signal production|generation part E2. The drive signal production|generation part E2 will output the drive signal which turns ON the FET element P2, if the detection signal from the electric current detection part H2 is more than a predetermined threshold value,

If the signal from the electric current detection part H2 is below a predetermined threshold value, the drive signal which turns OFF the FET element P2 will be output.

When the polarity of the electromotive force induced|guided|derived by an electromagnetic induction between the terminals 2-1 of the primary coil L1 to the secondary coil L2 agree|coincides with the forward direction of the parasitic diode D1 of FETQ1, a forward current flows into the parasitic diode D1, The said forward current is detected in the electric current detection part H1,

If the detection signal of the electric current detection part H1 exceeds the said threshold value, the drive signal production|generation part E1 outputs an ON signal to the FET element P1, and turns ON the FET element P1.

If the FET element P1 turns ON, since resistance is small compared with the parasitic diode D1, the way of the FET element P1 will flow into a drain direction through the electric current which was flowing through the parasitic diode D1 at the beginning from the source|saue of FETQ1 via the ON-resistance of the FET element P1.

At this time, the way which lengthened ON time of the FET element as much as possible like

Embodiment 1 in the cycle through which a rectified current flows into FETQ1 can make loss of FETQ1 small, and can reduce rectification|straightening loss.

The detection signal which will be output from the electric current detection part H1 if the electromotive force which the electromotive force induced|guided|derived to the secondary coil L2 changes from the primary coil L1, and is induced|guided|derived to the secondary coil L2 by an electromagnetic induction becomes small also becomes small,

If the detection signal from the electric current detection part H1 falls from the said threshold value, the drive signal production|generation part E1 outputs an OFF signal to the FET element P1, and turns off the FET element P1.

Furthermore, since the voltage of a reverse direction will be built over the parasitic diode D1 of the FET element P1 if the polarity of the electromotive force induced|guided|derived to the secondary coil L2 is reversed, an electric current does not flow into the parasitic diode D1 until the polarity of the electromotive force again induced|guided|derived to the secondary coil L2 is reversed.

On the other hand, the polarity of the electromotive force induced|guided|derived by the electromagnetic induction between the terminals 2-3 of the primary coil L1 to the secondary coil L2 at this time,

Since it is agree|coinciding with the forward direction of the parasitic diode D2 of FETQ2, a forward current flows into the parasitic diode D2,

FETQ2, the FET element P2, the parasitic diode D2, the electric current detection part H2, and the drive signal production|generation part E2 perform the same, said operation|movement as FETQ1 [said], the FET element P1, the parasitic diode D1, the electric current detection part H1, and the drive signal production|generation part E1.

The said operation|movement is repeated, the voltage by which the full wave rectification was carried out to the voltage between the source|sauce of FETQ1 and Q2 and the terminal 2 of the secondary coil L2 arises, and it smooths out with the choke coil L3 and the smoothing capacitor C8.

FIG. 4 has shown induced electromotive force waveform S2 between the terminals 1-3 of the secondary coil L2, current waveform S3 which flows through the secondary coil L2, and one|on threshold value K of FETQ1 and Q2.

Under the influence of the capacitor|condenser C1 for a load adjustment, current waveform S3 of the secondary coil L2 becomes the perverted waveform,

Voltage waveform S2 induced between the terminals 1-3 of the secondary coil L2 becomes a waveform which vibrated to positive/negative across the area which is the fixed area 0V.

Therefore, in the drive system of FET using the conventional auxiliary|assistant coil|winding or the voltage between secondary coils, if one|on threshold value K of FETQ1 and Q2 is compared with said voltage waveform S2, the drive signal of FET will become like waveform S4,

Since time to turn ON FETQ1 and Q2 is short, rectification|straightening efficiency does not increase.

However,

Current waveform S5 which flows through FETQ1 as shown in FIG. 5 is compared with one|on threshold value K of FETQ1 and Q2,

Moreover, the drive signal of FETQ1 and Q2 becomes like waveform S7 and S8 respectively by comparing with one|on threshold value K of FETQ1 and Q2 current waveform S6 which flows through FETQ2,

Compared with waveform S4 of FIG. 4, the FET element P1 of FETQ1 and Q2 and the ON time of P2 become long.

Therefore, the FET element P1 and time for a rectified current to flow into P2 become long, and rectification|straightening efficiency increases.

Moreover, if the secondary coil shown in this Embodiment 2 compares the full wave rectifier circuit using the trans|transformer T1 which is a center tap system with the half wave rectifier circuit shown in Embodiment 1, when sending the same output current, the full wave rectifier circuit can make small the maximum value of the electric current sent through FET compared with a half wave rectifier circuit.

Since loss is proportional to the square of an electric current when the FET element P1 and P2 turn ON, in this Embodiment 2, the FET element P1 and the electric current sent through P2 can be made small compared with a half wave rectifier circuit, and loss can be reduced.

In addition, the capacitor|condenser C1 for a load adjustment is parallelly connected between the terminal 1 cathode terminals 2 of the secondary coil L2 like the circuit structure shown in FIG. 6,

Also when the capacitor|condenser C9 for a load adjustment is parallelly connected between the terminal 2 cathode terminals 3 of the secondary coil L2, the same effect as the capacitor|condenser C1 for a load adjustment of FIG. 4 is acquired.

Furthermore, the same effect is acquired, even if the said capacitor|condenser C1 is parallelly connected to FETQ1 and it connects the said capacitor|condenser C9 to FETQ2 parallel.

In addition, the same effect is acquired even if it connects the capacitor|condenser C1 for a load adjustment to FETQ1 parallelly in FIG. 1.

(Embodiment 3)

FIG. 7 shows the circuit structure of Embodiment 3,

The inverter part B which converts into a high frequency electric-power the direct current|flow input from the power supply part A which converts AC power supply into DC power supply, and the power supply part A.

From the control circuit J of the inverter part B, and the primary coil L1 of the trans|transformer T1 to which a high frequency electric-power is supplied from the inverter part B, the primary side circuit G1 is comprised and The secondary center tap-type coil L2 of the trans|transformer T1,

It consists of the secondary side circuit G2 comprised with the capacitor|condenser C1 for a load adjustment, the electric current detection part H1 and H2, the drive signal production|generation part E1 and E2, FETQ1 and Q2, the choke coil L3, and the smoothing capacitor C8.

Since the structure of the secondary side circuit G2 and an operation|movement are similar to FIG. 3 of Embodiment 2, description is abbreviate|omitted.

The structure of the primary side circuit G1 and an operation|movement are demonstrated.

The capacitor|condenser C2 by which the power supply part A was comprised from the rectifier D3 which carries out the full wave rectification of AC power supply Vs and AC power supply Vs, and the inverter part B was parallelly connected to the output terminal of the rectifier D3, and the series circuit of C3, The switching element Q3 parallelly connected to the output terminal of the rectifier D3, and the series circuit of Q4,

It is comprised in the switching element Q3, the capacitor|condenser C4 respectively connected to Q4 parallelly, and the half bridge inverter circuit which consists of C5,

The control circuit J is comprised from the electronic circuit for controlling the switching element Q3 and the switch operation of Q4, and the end of the primary coil L1 of the trans|transformer T1 is connected to the capacitor|condenser C1 and the middle point of C2,

An other end is connected to the switching element Q1 and the middle point of Q2.

The voltage by which the full wave rectification was carried out with the rectifier D3 is voltage-divided by the capacitor|condenser C2 and C3, and the switching element Q3 and Q4 are alternately turned on/off by a drive signal with the fixed dead time from the control circuit J, and they apply high frequency voltage to the primary coil L1.

Moreover, by the switching element Q3, the capacitor|condenser C4 parallelly connected to Q4, and C5, the switching element Q3 and the switch operation of Q4 can be made into a null voltage switch operation, and the switching loss of the switching element Q3 and Q4 can be decreased.

Moreover, the switching element Q3 and the drive signal of Q4 have fixed dead time,

Therefore

Since the voltage between the terminal 1 cathode terminals 3 of the secondary coil L2 of the trans|transformer T1 becomes like waveform S2 of FIG. 4,

If synchronous rectification by FETQ1 and Q2 is performed like Embodiment 2 by the electric current detection circuit H1 and the drive signal produced|generated from the detection signal of H2, the rectification|straightening loss of the secondary side circuit G2 as well as Embodiment 2 can reduce.

Moreover, as well as the circuit of FIG. 7 when the capacitor|condenser C4 is parallelly connected to the primary coil L1 of the trans|transformer T1 like the circuit structure shown in FIG. 8, null voltage switching can be performed.

Since the structure of the circuit of FIG. 8 except for the above and an operation|movement are similar to the structure of the circuit of FIG. 7, and an operation|movement, description is abbreviate|omitted.

Thus, according to this Embodiment 3, the loss not only in the secondary side circuit G2 but the primary side circuit G1 is reduced, the efficiency of the whole circuit is raised, and size reduction of the whole circuit can be performed.

(Embodiment 4)

FIG. 9 shows the circuit structure of Embodiment 4.

A fundamental circuit structure and an operation|movement are the same as that of FIG. 7 of Embodiment 3, and differ from the circuit structure which the point which made the signal which reversed the drive signal of the drive signal production|generation part E1 of the FET element P1 via inversion device INV1 the drive signal of the FET element P2 shows in FIG. 7.

Since it is similar to FIG. 7 of Embodiment 3 about a circuit structure except for the above and an operation|movement, it abbreviate|omits.

As shown in the circuit block diagram shown in FIG. 9, in the synchronous rectification circuit which used the center tap system for the secondary coil L2 of the trans|transformer T1,

In order to control the drive signal of FETQ1 and Q2 so that an electric current flows into FETQ1 and Q2 alternately, each drive signal of FETQ1 and Q2 turns into an inversion signal of one drive signal.

Then, by driving FETQ2 for the signal which reversed the drive signal of the drive signal production|generation part E1 of FETQ1 via inversion device INV1 as a drive signal of FETQ2, simplification of the drive circuit of FETQ2 can be achieved and cost reduction and size reduction can be performed.

In addition, also when the forward system using synchronous rectification as a rectifier circuit of the secondary side circuit G2 is employ|adopted, it can apply similarly to two rectification|straightening and the switching element for commutations.

(Embodiment 5)

FIG. 10 shows the circuit block diagram of Embodiment 5.

A fundamental circuit structure and an operation|movement are as substantially the same as FIG. 7 of Embodiment 3, and the electric current detection part H3 which consists of resistance R1, R2 which connected in series respectively the electric current detection part H1 of FIG. 7 and H2 to FETQ1 and Q2 differs from the point replaced with H4 in FIG. 10.

Since it is similar to FIG. 7 of Embodiment 3 about a circuit structure except for the above and an operation|movement, it abbreviate|omits.

In this Embodiment 5, the voltage proportional to the electric current which flows into FETQ1 and Q2 respectively generate|occur|produces in the both ends of resistance R1, R2 respectively connected in series by FETQ1 and Q2.

Each both-ends voltage of said resistance R1, R2 is respectively inputted into the drive signal production|generation part E1 and E2,

The drive signal production|generation part E1 and E2 will output the FET element P1 and the drive signal which turns ON P2 respectively, if each both-ends voltage of resistance R1, R2 is more than a predetermined threshold value,

If each both-ends voltage of resistance R1, R2 is below a predetermined threshold value, the FET element P1 and the drive signal which turns OFF P2 respectively will be output.

Thus, according to this Embodiment 5, the electric current of FETQ1 and Q2 is detectable by an easy method,

The FET element P1 and P2 have been turned ON as much as possible for a long time in each rectification|straightening cycle through which an electric current flows into FETQ1 and Q2 like Embodiment 2 by producing|generating the drive signal of FETQ1 and Q2 using the said detection signal, Rectification|straightening loss can be reduced.

(Embodiment 6)

FIG. 11 shows the circuit block diagram of this Embodiment 6,

A fundamental circuit structure and an operation|movement are the same as that of FIG. 10 of Embodiment 5, and in FIG. 11,

The points which substituted resistance R1, R2 of FIG. 10 to the electric current detection part H5 and H6 which consist of resistance R3, R4 which has micro resistance value (for example, 10m(ohm)) respectively, and substituted the drive signal production|generation part E1 and E2 to the drive signal production|generation part E3 which consists of operational amplifier OP1 and OP2 respectively, and E4 differ.

Since it is similar to FIG. 10 of Embodiment 5 about a circuit structure except for the above and an operation|movement, it abbreviate|omits.

In this Embodiment 5, the loss in resistance R3, R4 is reduced compared with Embodiment 5 by making into micro resistance value (for example, 10m(ohm)) resistance value of resistance R3, R4 respectively

connected in series by FETQ1 and Q2.

However, since the voltage of resistance R3, R4 both ends also becomes small by having diminished the resistance value of resistance R3, R4, the voltage of resistance R3, R4 both ends is respectively inputted into the inverting input terminal and non-inverting input terminal of operational amplifier OP1 and OP2, Differential amplification of each both-ends voltage of resistance R3, R4 is carried out even to the voltage which can drive FETQ1 and Q2 enough by operational amplifier OP1 and OP2,

Let the outputs of operational amplifier OP1 [said] that carried out differential amplification, and OP2 be the FET element P1 and a drive signal of P2.

Thus, in this Embodiment 6, the loss of the electric current detection part H5 and H6 can be lowered|hung.

(Embodiment 7)

FIG. 12 shows the circuit block diagram of Embodiment 7.

A fundamental circuit structure and an operation|movement are as substantially the same as FIG. 7 of Embodiment 3, and resistance R5, R6 is parallelly connected to the secondary coil L6 of current trans|transformer CT1 which consists respectively the electric current detection part H1 of FIG. 7, and H2 of the primary coil L4, L5 and the secondary coil L6, and L7, and CT2, and L7 respectively in FIG. 12, The diode D3 and D4 are respectively connected to the said secondary coil L6 and L7 in series,

The point which substituted the capacitor|condenser C6, C7, resistance R7, R8 and constant voltage diode ZD1, and ZD2 to resistance R5, R6 parallelly via the diode D3 and D4 the respectively connected electric current detection part H7 and H8,

Amplifier AMP1 which connected in series respectively the drive signal production|generation part E1 of FIG. 7 and E2 to the diode D3 and D4, and the drive signal production|generation part E5 which consists of AMP2 differ from the point replaced with E6.

Since it is similar to FIG. 7 of Embodiment 3 about a circuit structure except for the above and an operation|movement, it abbreviate|omits.

The each primary coil L4 of current trans|transformer CT1 and CT2 and the electric current which flows into L5 are detected by the each secondary coil L6 of current trans|transformer CT1 and CT2, and L7, The both ends of resistance R5, R6 are made to generate|occur|produce a voltage respectively.

The half wave rectification of the said voltage is respectively carried out by the diode D3 and D4.

The capacitor|condenser C6 and C7 are the objects for noise cut, and resistance R7, R8 discharge|releases the capacitor|condenser C6 and the electric charge accumulate|stored in C7, and makes falling of the input signal of AMP1 and 2 sudden increase.

Moreover, constant voltage diode ZD1 and ZD2 clamp the voltage which carried out the half wave rectification so that the voltage which exceeded the rated voltage of amplifier AMP1 and 2 to the input of amplifier AMP1 and 2 might not be inputted with a fixed voltage.

And since the secondary coil L6 of current trans|transformer CT1 and CT2 and the output current of L7 are small and the FET element P1 and P2 cannot be driven, it amplifies by amplifier AMP1 and AMP2, FETQ1 and Q2 are driven by the amplified said drive signal.

Thus, according to this Embodiment 7, the electric current which flows through FETQ1 and Q2 can be detected, and the FET element P1 and P2 have been turned ON as much as possible for a long time in each rectification|straightening cycle through which an electric current flows into FETQ1 and Q2 like Embodiment 2 by producing|generating the drive signal of FETQ1 and Q2 using the said detection signal, Rectification|straightening loss can be reduced.

(Embodiment 8)

Embodiment 8 is demonstrated using the circuit block diagram of FIG. 13.

A fundamental circuit structure and an operation|movement are as substantially the same as FIG. 12 of Embodiment 7, and the points which substituted amplifier AMP1 of FIG. 12 and AMP2 to the comparison circuit which connected the reference voltage source E1 and E2 to the inverting input terminal of comparator CP1, CP2, and comparator CP1 and CP2 respectively differ in FIG. 13.

Since it is similar to FIG. 12 of Embodiment 7 about a circuit structure except for the above and an operation|movement, it abbreviate|omits.

In the present Example 8, the each secondary coil L6 of current trans|transformer CT1 by which the half wave rectification was carried out by the diode D3 and D4, and CT2, and the output of L7 are respectively connected to the non-inverting input terminal of comparator CP1 and CP2,

The reference voltage source E1 and E2 are respectively connected to the inverting input terminal of comparator CP1 and CP2,

The FET element P1 and P2 have been turned ON as much as possible for a long time in each rectification|straightening cycle through which an electric current flows into FETQ1 and Q2 by setting appropriately the reference voltage source E1 and the reference voltage of E2, Rectification|straightening loss can be reduced.

FIG. 14 has shown current waveform S9 which flows through FETQ1 in this Embodiment 8, the reference voltage M1 of the reference voltage source E1, and output waveform S10 of comparator CP1, If said waveform S9 exceeds the said reference voltage M1, said waveform S10 will become H level, and if said waveform S9 falls from the said reference voltage M1, said waveform S10 will become L level. Therefore, output waveform S10 of comparator CP1 can make wide the area which is H level by setting the reference voltage M1 appropriately. The same may be said of FETQ2.

That is, the FET element P1 and P2 have been turned ON as much as possible for a long time in each rectification|straightening cycle through which an electric current flows into FETQ1 and Q2, and rectification|straightening loss can be reduced.

(Embodiment 9)

Embodiment 9 is demonstrated using the circuit block diagram of FIG. 13.

Since it is similar to Embodiment 8 about a fundamental circuit structure and an operation|movement, it abbreviate|omits.

According to the induced electromotive force which generate|occur|produces the electric current of FETQ1 which has the FET element P1 turned ON in order to synchronously rectificate in the secondary coil L2 for the capacitor|condenser C6 for a load adjustment, the electric current value reduces smoothly.

Moreover, in order to synchronously rectificate following half cycle, before the electric current through which FETQ2 which has the FET element P2 to turn ON flows into FETQ1 similarly for the capacitor|condenser C6 becomes zero, an electric current begins to flow via the parasitic diode D2.

Therefore, the FET element P1 and P2 may turn ON simultaneously, and rectification|straightening is no longer performed.

So, in this Embodiment 9, when each electric current which flows into FETQ1 and Q2 becomes equal, the drive signal which turns OFF the FET element P1 turned ON till then is output from comparator CP1, The drive signal which turns ON the FET element P2 turned off till then is output from comparator CP2. Moreover, when each electric current through which reverse half cycle flows into FETQ1 and Q2 similarly becomes equal, the drive signal which turns OFF the FET element P2 turned ON till then is output from comparator CP2, The drive signal which turns ON the FET element P1 turned off till then is output from comparator CP1.

Thus, according to this Embodiment 9, it is lose|eliminated that the FET element P1 and P2 turn ON simultaneously, and the secondary side circuit G2 which can reduce rectification|straightening loss and contains a heat sink can be reduced in size.

(Embodiment 10)

Embodiment 10 is demonstrated using the circuit block diagram of FIG. 13.

Since it is similar to Embodiment 9 about a fundamental circuit structure and an operation|movement, it abbreviate|omits.

As Embodiment 9 demonstrated, when each electric current which flows into FETQ1 and Q2 becomes equal, the drive signal which turns OFF the FET element P1 turned ON till then is output from comparator CP1,

The drive signal which turns ON the FET element P2 turned off till then is output from comparator CP2. Moreover, when each electric current through which reverse half cycle flows into FETQ1 and Q2 similarly becomes equal, the drive signal which turns OFF the FET element P2 turned ON till then is output from comparator CP2,

If the drive signal which turns ON the FET element P1 turned off till then is output from comparator CP1, it will become without the FET element P1 and P2 turning ON simultaneously, Rectification|straightening loss can be reduced.

So, in this Embodiment 10, each output voltage of the output voltage which carried out the half wave rectification of each detection signal detected by current trans|transformer CT1 and CT2 in the circuit structure of FIG. 13 by the diode D3 and D4, i.e., constant voltage diode ZD1, and ZD2 is inputted into the non-inverting input terminal of comparator CP1 and CP2,

The reference voltage source E1 and E2 which make a reference voltage each output voltage of constant voltage diode ZD1 when each electric current which flows into FETQ1 and Q2 becomes equal, and ZD2 are respectively connected to the inverting input terminal of comparator CP1 and CP2 at an input, It is lost/eliminated by making the output of comparator CP1 and CP2 into each drive signal of FET element P1 and P2 that the FET element P1 and P2 turn ON simultaneously, The secondary side circuit G2 which can reduce rectification/straightening loss and contains a heat sink can be reduced in size.

FIG. 15 shows the reference voltage M3 of current waveform S13 which flows through the reference voltage M2 of current waveform S11 which flows through FETQ1 in this Embodiment 10, and the reference voltage source E1, output waveform S12 of comparator CP1, and FETQ2, and the reference voltage source E2, and output waveform S14 of comparator CP2.

The output of comparator CP1 is set to L in the time t4 for the magnitude/size of current waveform S11 which flows through FETQ1, and the magnitude/size of current waveform S13 which flows through FETQ2 to become equal, and the FET element P1 is turned OFF, It is lost/eliminated that the FET element P1 and P2 turn ON simultaneously by setting the output of comparator CP2 to H and turning ON the FET element P2, The secondary side circuit G2 which can reduce rectification/straightening loss and contains a heat sink can be reduced in size.

(Embodiment 11)

Embodiment 11 is demonstrated using the circuit block diagram of FIG. 12.

Since it is similar to Embodiment 7 about a fundamental circuit structure and an operation/movement, it abbreviate/omits.

As Embodiment 9 demonstrated, when each electric current which flows into FETQ1 and Q2 becomes equal, the drive signal which turns OFF FETQ1 turned ON till then is output from comparator CP1,

The drive signal which turns ON FETQ2 turned off till then is output from comparator CP2.

Moreover, when each electric current through which reverse half cycle flows into FETQ1 and Q2 similarly becomes equal, the drive signal which turns OFF FETQ2 turned ON till then is output from comparator CP2,

If the drive signal which turns ON FETQ1 turned off till then is output from comparator CP1, it will be lost/eliminated that FETQ1 and Q2 turn ON simultaneously, Rectification/straightening loss can be reduced.

Then, when the electric current which flows into FETQ1 and Q2 in the circuit structure of FIG. 12 in this Embodiment 11 becomes equal,

The output voltage which carried out the half wave rectification of each detection signal detected by current trans/transformer CT1 and CT2 by the diode D3 and D4,

Namely, so that each drive signal of FET element P1 and P2 which amplified respectively each output voltage of constant voltage diode ZD1 and ZD2 by amplifier AMP1 and 2 may become the FET element P1 and a voltage which can turn ON P2 enough.

Coil/winding ratio of the primary coil L4 of current trans/transformer CT1 and the secondary coil L6 and coil/winding ratio of the primary coil L5 of current trans/transformer CT2 and the secondary coil L7 are set.

Current waveform S16 into which FIG. 16 flows through drive signal waveform S15 of the FET element P1 in this Embodiment 11, and FETQ1, and the clamp voltage N1 of constant voltage diode ZD1,

Drive signal waveform S17 of the FET element P2, current waveform S18 which flows through FETQ2, the clamp voltage N2 of constant voltage diode ZD2, and the FET element P1 and the voltage K which can turn ON P2 enough are shown.

In the time t5 for the magnitude/size of current waveform S16 which flows through FETQ1, and the magnitude/size of current waveform S18 which flows through FETQ2 to become equal, drive signal waveform S15 of the FET element P1 falls from the FET element P1 and the voltage K which can turn ON P2 enough, and the FET element P1 is come by off,

It is lost/eliminated exceeding the voltage K in which drive signal waveform S17 of the FET element P2 can turn ON the FET element P1 and P2 enough that the FET element P1 and P2 turn ON of the FET element P2 simultaneously by being set to ON,

The secondary side circuit G2 which can reduce rectification/straightening loss and contains a heat sink can be reduced in size.

In addition, said waveform S15 and S17 are clamped by the clamp voltage N1 of constant-voltage voltage diode ZD1 and ZD2, and N2.

(Embodiment 12)

As shown in the circuit block diagram shown in FIG. 1, when performing a half wave rectification using FETQ1 for one synchronous rectification, in order to diminish the rectification|straightening loss of FETQ1, the FET element P1 of FETQ1 needs to be turned ON as much as possible for a long time in the rectification|straightening cycle through which an electric current flows into FETQ1.

The electric current detection part H1 and the drive signal production|generation part E1 of FIG. 1 are respectively substituted to the electric current detection part H9 and the drive signal production|generation part E7 of FIG. 13,

By making the reference voltage of the reference voltage source E1 linked to the inverting input terminal of comparator CP1 of the drive signal production|generation part E7 into 0V vicinity, comparator CP1 outputs the drive signal which has turned ON the FET element P1 as much as possible for a long time in the said rectification|straightening cycle,

The secondary side circuit G2 which can reduce the rectification|straightening loss of FETQ1 and contains a heat sink can be reduced in size.

About the circuit structure of that excepting the above, and an operation|movement, since Embodiment 1 and 8 demonstrates, it abbreviate|omits.

(Embodiment 13)

As shown in the circuit block diagram shown in FIG. 1, when performing a half wave rectification using FETQ1 for one synchronous rectification, in order to diminish the rectification|straightening loss of FETQ1, the FET element P1 of FETQ1 needs to be turned ON as much as possible for a long time in the rectification|straightening cycle through which an electric current flows into FETQ1.

The electric current detection part H1 and the drive signal production|generation part E1 of FIG. 1 are respectively substituted to the electric current detection part H7 and the drive signal production|generation part E5 of FIG. 12,

By enlarging, the turns ratio of the primary coil L4 of current trans|transformer CT1 of the electric current detection part H7, and the secondary coil L5,

Even when the electric current which flows into the primary coil L4 of current trans|transformer CT1 is small, the induced voltage of the secondary coil L5 becomes large, and the drive signal which can turn ON the FET element P1 of FETQ1 is output from amplifier AMP1.

Therefore, the rectifier P1 has been set as much as possible to ON in the said rectification|straightening cycle for a long time, and can reduce in size the secondary side circuit G2 which can reduce the rectification|straightening loss of FETQ1 and contains a heat sink.

About the circuit structure of that excepting the above, and an operation|movement, since Embodiment 1 and 7 demonstrates, it abbreviate|omits.

ADVANTAGE of the Invention

Invention of Claim 1 is a power supply part which supplies DC power supply,

The inverter part which converts the said DC power supply into a high frequency electric-power,

The primary side circuit comprised with the said primary coil of the trans|transformer which can isolate|separate the primary coil to which high frequency electric power is supplied, and the secondary coil which outputs the electric power power-received from the primary coil from the said inverter part,

The said secondary coil,

The non-contact electric power transmission apparatus which has a secondary side circuit comprised in the rectification|straightening part which rectifies|straightens the output voltage of the capacitor|condenser for a load adjustment parallelly connected to the said secondary coil, and the said secondary coil

WHEREIN:

The said rectification|straightening part that connected in series the synchronous rectification element consisting of the diode parallelly reversely connected by the switching element and the said switching element in the said secondary coil, and was comprised,

It consists of an electric current detection part which detects the electric current which flows into the said synchronous rectification element, and a drive signal production|generation part which produces|generates the drive signal of the switching element of the said synchronous rectification element based on the detection signal of the said electric current detection part,

It is characterized by the above-mentioned, the rectification|straightening loss of a secondary side circuit

is reduced, the size of the heat sink of a rectification|straightening part can be made small, and it is effective in the ability to raise the efficiency of the whole circuit.

In invention of Claim 1, invention of Claim 2 is provided with the secondary coil of the said trans|transformer, and a center tap the said rectification|straightening part, Each other end which have not been connected to the secondary coil of the said trans|transformer of the said synchronous rectification element of the 1st and 2nd in series and mutually connected to both the output terminals that are not the center taps of the secondary coil of the said trans|transformer at a reverse direction is connected, and a full wave rectification part is comprised, It is characterized by the above-mentioned and is effective in the ability of loss to perform little efficient rectification|straightening rather than a half wave rectification by carrying out a full wave rectification.

Invention of Claim 3 produces|generates the drive signal of the switching element of the said 1st synchronous rectification element from the detection signal of one said electric current detection part in invention of Claim 2,

The drive signal of the switching element of the said 2nd synchronous rectification element is taken as the inversion signal of the drive signal of the switching element of the said 1st synchronous rectification element,

It can be characterized by the above-mentioned, simplification of a drive signal production|generation part can be achieved, and it is effective in the ability to perform cost reduction and size reduction.

In the invention in any one of Claims 1 to 3, invention of Claim 4 the said electric current detection part, It consists of resistance for an electric current detection connected in series to the said synchronous rectification element, and the drive signal of the switching element of the said synchronous rectification element is produced|generated in the said drive signal production|generation part based on the voltage generate|occur|produced at the both ends of the said resistance for an electric current detection, It is characterized by the above-mentioned and is effective in the ability to comprise an electric current detection part by easy circuit structure.

In invention of Claim 4, invention of Claim 5 the resistance value of the said resistance for an electric current detection,

The voltage of the both ends of the said resistance for an electric current detection generate|occur|produced with respect to the electric current which flows into the said resistance for an electric current detection is the resistance value which becomes the minimum voltage that can be amplified even to the voltage which can drive the switching element of the said synchronous rectification element in the said drive signal production|generation part,

It is characterized by the above-mentioned and is effective in the ability to reduce the loss in an electric current detection part.

Invention of Claim 6 is a current trans|transformer consisting of the primary coil and secondary coil which connected the said electric current detection part in series to the said synchronous rectification element in the invention in any one of Claims 1 to 3,

Resistance parallelly connected to the both ends of the secondary coil of the said current trans|transformer,

Since the voltage between the both ends of the said resistance is rectified|straightened, it is comprised from the rectifier diode connected in series in the secondary coil of the said current trans|transformer,

Based on the output of the said electric current detection part output from the said rectifier diode, the drive signal of the switching element of the said synchronous rectification element is produced|generated in a drive signal production|generation part,

It is characterized by the above-mentioned and is effective in the ability to reduce the rectification|straightening loss of a secondary side circuit.

In the invention in any one of Claims 1 to 6, as for invention of Claim 7, the said drive signal production|generation part compares the output and reference voltage of the said electric current detection part,

Based on the said comparison result, the drive signal of the switching element of the said synchronous rectification element is produced|generated,

It is characterized by the above-mentioned, the rectification|straightening loss of a secondary side circuit is reduced, the size of the heat sink of a rectification|straightening part can be made small, and it is effective in the ability to raise the efficiency of the whole circuit.

Invention of Claim 8 is a non-contact electric power transmission apparatus which has multiple said synchronous rectification elements in the invention in any one of Claims 2 to 7.

WHEREIN:

The electric current value which flows through the said 1st synchronous rectification element that conducts previously and is complete|finishing rectification|straightening,

The 1st drive signal production|generation part which outputs the drive signal which turns OFF the switching element of the said 1st synchronous rectification element to the time when the electric current value which begins to flow into the diode of the said 2nd synchronous rectification element that should conduct for the next rectification|straightening becomes equivalent,

It is characterized by having a 2nd drive signal production|generation part which outputs the drive signal which turns ON the switching element of the said 2nd synchronous rectification element,

The rectification|straightening loss of a secondary side circuit is reduced,

The size of the heat sink of a rectification|straightening part can be made small, and it is effective in the ability to raise the efficiency of the whole circuit.

In invention of Claim 8, invention of Claim 9 the said, 1st and 2nd drive signal production|generation part,

The output voltage of the said electric current detection part in the time when the electric current value which flows through the 1st synchronous rectification element which conducts previously and is complete|finishing rectification|straightening, and the electric current value which begins to flow into the diode of the 2nd synchronous rectification element which should conduct for the next rectification|straightening become equivalent, and the reference voltage which is the same voltages,

The detection signal of the said electric current detection part is compared,

Based on the said comparison result, the drive signal of the switching element of the said synchronous rectification element is produced|generated,

It is characterized by the above-mentioned, the rectification|straightening loss of a secondary side circuit is reduced, the size of the heat sink of a rectification|straightening part can be made small, and it is effective in the ability to raise the efficiency of the whole circuit.

In invention of Claim 8, invention of Claim 10 the said 2nd drive signal production|generation part,

The electric current value which flows through the 1st synchronous rectification element which conducts previously and is complete|finishing rectification|straightening,

The drive signal which amplified the switching element of the said 2nd synchronous rectification element even to the voltage which can turn ON is output to the time when the electric current value which begins to flow into the diode of the 2nd synchronous rectification element which should conduct for the next rectification|straightening becomes equivalent,

It is characterized by the above-mentioned, the rectification|straightening loss of a secondary side circuit is reduced, the size of the heat sink of a rectification|straightening part can be made small, and it is effective in the ability to raise the efficiency of the whole circuit.

Invention of Claim 11 comprises the half wave rectification part in which the said rectification|straightening part connected one of the said synchronous rectification elements to the secondary coil of the said trans|transformer in series in invention of Claim 7,

The said drive signal production|generation part consists of a comparator which compares the detection signal and reference voltage of the said electric current detection circuit, and makes the said comparison output the drive signal of the switching element of the said synchronous rectification element, and the said reference voltage,

It is a voltage through which the electric current of the same direction as the forward-current direction of the diode parallelly reversely connected by the switching element of the said synchronous rectification element at the said switching element flows through the maximum time, and the forward current of the said diode and the electric current of a reverse direction do not flow into the switching element of an initial period synchronous rectification element,

It is characterized by the above-mentioned,

The rectification|straightening loss of a secondary side circuit is reduced, the size of the heat sink of a rectification|straightening part can be made small, and it is effective in the ability to raise the efficiency of the whole circuit.

Invention of Claim 12 comprises the half wave rectification part in which the said rectification|straightening part connected one of the said synchronous rectification elements to the secondary coil of the said trans|transformer in series in the invention in any one of a Claim 1, 4, 5, 6,

The said drive signal production|generation part has a drive signal production|generation part which outputs the drive signal which amplified the switching element of the said synchronous rectification element even to the voltage which can turn ON to the time when a forward current begins to flow into the diode of the said synchronous rectification element,

It is characterized by the above-mentioned, the rectification|straightening loss of a secondary side circuit

is reduced, the size of the heat sink of a rectification|straightening part can be made small, and it is effective in the ability to raise the efficiency of the whole circuit.

Invention of Claim 13 consists of an inverter of a half bridge with which the said inverter part has a switching element in the invention in any one of Claims 1 to 12, and it is characterized by the said switching element performing zero volt|bolt switching,
The rectification|straightening loss of a secondary side circuit is reduced,
The size of the heat sink of a rectification|straightening part can be made small, and it is effective in the ability to raise the efficiency of the whole circuit.

BRIEF DESCRIPTION OF THE DRAWINGS

[FIG. 1]

It is a figure which shows Embodiment 1, 12 of this invention, and the circuit structure of 13.

[FIG. 2]

It is a figure which shows the current waveform which flows into FET of Embodiment 1 of this invention.

[FIG. 3]

It is a figure which shows the circuit structure of Embodiment 2 of this invention.

[FIG. 4]

It is a figure which shows the circuit operation|movement of Embodiment 2 of this invention.

[FIG. 5]

It is a figure which shows the switch operation of the FET element of Embodiment 2 of this invention.

[FIG. 6]

It is a figure which shows the circuit structure of Embodiment 2 of this invention.

[FIG. 7]

It is a figure which shows the circuit structure of Embodiment 3 of this invention.

[FIG. 8]

It is a figure which shows the circuit structure of Embodiment 3 of this invention.

[FIG. 9]

It is a figure which shows the circuit structure of Embodiment 4 of this invention.

[FIG. 10]

It is a figure which shows the circuit structure of Embodiment 5 of this invention.

[FIG. 11]

It is a figure which shows the circuit structure of Embodiment 6 of this invention.

[FIG. 12]

It is a figure which shows the circuit structure of Embodiment 7, 11 of this invention.

[FIG. 13]

It is a figure which shows Embodiment 8, 9 of this invention, and the circuit structure of 10.

[FIG. 14]

It is a figure which shows the switch operation of Embodiment 8 of this invention.

[FIG. 15]

It is a figure which shows the switch operation of Embodiment 10 of this invention.

[FIG. 16]

It is a figure which shows the switch operation of Embodiment 11 of this invention.

Description of Symbols

A Power supply part

B Inverter part

C1 Capacitor|condenser

D1 Parasitic diode

E1 Drive signal production|generation part

F Smooth section

G1 Primary side circuit

G2 Secondary side circuit

H1 Electric current detection part

L1 Primary coil

L2 Secondary coil

P1 FET element

Q1 FET

T1 Trans|transformer

[FIG. 1]

[MAT_IMAGE 000004]

[FIG. 2]
 [MAT_IMAGE 000005]
 [FIG. 3]
 [MAT_IMAGE 000006]
 [FIG. 4]
 [MAT_IMAGE 000007]
 [FIG. 5]
 [MAT_IMAGE 000008]
 [FIG. 6]
 [MAT_IMAGE 000009]
 [FIG. 7]
 [MAT_IMAGE 000010]
 [FIG. 8]
 [MAT_IMAGE 000011]
 [FIG. 14]
 [MAT_IMAGE 000017]
 [FIG. 15]
 [MAT_IMAGE 000018]
 [FIG. 9]
 [MAT_IMAGE 000012]
 [FIG. 10]
 [MAT_IMAGE 000013]
 [FIG. 16]
 [MAT_IMAGE 000019]
 [FIG. 11]
 [MAT_IMAGE 000014]
 [FIG. 12]
 [MAT_IMAGE 000015]
 [FIG. 13]
 [MAT_IMAGE 000016]

(Translation from Thomson Reuters)

Citations

Citation Record level

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Expand Cited Patents (5)

Cited Non-patents (0)

DPCI Citation Patent family level

DPCI Citing Patents (6)

Publication Number	Accession Number	Publication Date	Application Date	DWPI Family Member(s)	Relevance	Source
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DPCI Citations	Total	Examiner	Inventor	Opposition	3rd party	Undefined
Citing Patents	6	6	0	0	0	0
Cited Patents	5	5	0	0	0	0
Citing Authorities	3	3	0	0	0	0
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Cited Non-patents	0	0	0	0	0	0

DPCI Field of Search

-

DPCI Citing Patents Country

WO; JP; KR

DPCI Cited Patents Country

JP

Other

DWPI Title Terms

NON CONTACT POWER TRANSFER APPARATUS CURRENT DETECT FLOW RECTIFY TRANSISTOR ORDER
 OUTPUT SIGNAL GENERATOR SWITCH ELEMENT

DWPI Related Accession Numbers

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Custom Fields

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	7/21		7/21	A	

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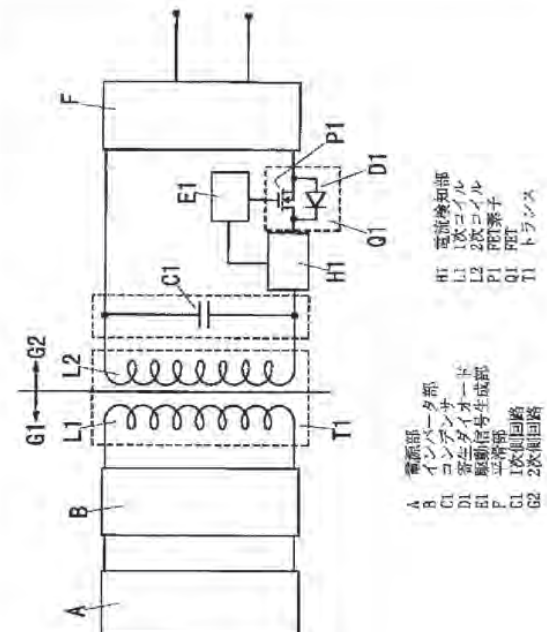
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(54) 【発明の名称】 非接触電力伝達装置

(57) 【要約】

【課題】 2次側回路の整流効率を上げた非接触電力伝達装置を提供する。

【解決手段】 電源部Aは直流電力をインバータ部Bに供給し、インバータ部Bで高周波電力に変換され、前記高周波電力はトランスT1の1次コイルL1に供給される。トランスT1の2次コイルL2は、電磁結合により1次コイルL1より電力を受電し、2次コイルL2両端の電圧はFETQ1で半波整流され、半波整流された電圧は平滑部Fで平滑されて直流電圧を出力する。FETQ1に直列に接続された電流検知部H1はFETQ1に流れる電流を検出し、前記検出信号を駆動信号生成部E1に出力する。駆動信号生成部E1は、電流検知部H1からの検出信号が所定のしきい値以上であればFET素子P1をオンにする駆動信号を出力し、電流検知部H1からの信号が所定のしきい値以下であればFET素子P1をオフにする駆動信号を出力する。



【特許請求の範囲】

【請求項1】 直流電源を供給する電源部と、前記直流電源を高周波電源に変換するインバータ部と、前記インバータ部から高周波電力を供給される1次コイルと1次コイルから受電した電力を出力する2次コイルとが分離可能なトランスの前記1次コイルとで構成される1次側回路と、前記2次コイルと、前記2次コイルに並列に接続される負荷整合用コンデンサ及び前記2次コイルの出力電圧を整流する整流部とで構成される2次側回路とを有する非接触電力伝送装置において、スイッチング素子及び前記スイッチング素子に並列に逆接続されたダイオードとからなる同期整流要素を前記2次コイルに直列に接続して構成された前記整流部と、前記同期整流要素に流れる電流を検出する電流検知部と、前記電流検知部の検出信号に基づいて前記同期整流要素のスイッチング素子の駆動信号を生成する駆動信号生成部とからなることを特徴とする非接触電力伝送装置。

【請求項2】 前記トランスの2次コイルはセンタータップを備え、前記整流部は、前記トランスの2次コイルのセンタータップではない両出力端に直列に且つ互いに逆方向に接続する第1及び第2の前記同期整流要素の前記トランスの2次コイルに接続していない各他端同士を接続して全波整流部を構成することを特徴とする請求項1記載の非接触電力伝送装置。

【請求項3】 一つの前記電流検知部の検出信号より前記第1の同期整流要素のスイッチング素子の駆動信号を生成し、前記第2の同期整流要素のスイッチング素子の駆動信号は前記第1の同期整流要素のスイッチング素子の駆動信号の反転信号とすることを特徴とする請求項2記載の非接触電力伝送装置。

【請求項4】 前記電流検知部は、前記同期整流要素に直列に接続した電流検出用抵抗からなり、前記電流検出用抵抗の両端に発生する電圧に基づいて前記駆動信号生成部にて前記同期整流要素のスイッチング素子の駆動信号を生成することを特徴とする請求項1乃至3いずれか記載の非接触電力伝送装置。

【請求項5】 前記電流検出用抵抗の抵抗値は、前記電流検出用抵抗に流れる電流に対して発生する前記電流検出用抵抗の両端の電圧が前記駆動信号生成部にて前記同期整流要素のスイッチング素子を駆動できる電圧にまで増幅できる最小の電圧になる抵抗値であることを特徴とする請求項4記載の非接触電力伝送装置。

【請求項6】 前記電流検知部は、前記同期整流要素に直列に接続した1次コイル及び2次コイルとからなるカレントトランスと、前記カレントトランスの2次コイルの両端に並列に接続した抵抗と、前記抵抗の両端間の電圧を整流するために前記カレントトランスの2次コイルに直列に接続した整流ダイオードとから構成され、前記整流ダイオードから出力される前記電流検知部の出力に基づいて駆動信号生成部にて前記同期整流要素のスイッ

チング素子の駆動信号を生成することを特徴とする請求項1乃至3いずれか記載の非接触電力伝送装置。

【請求項7】 前記駆動信号生成部は、前記電流検知部の出力と基準電圧とを比較し、前記比較結果に基づいて前記同期整流要素のスイッチング素子の駆動信号を生成することを特徴とする請求項1乃至6いずれか記載の非接触電力伝送装置。

【請求項8】 前記同期整流要素を複数有する非接触電力伝送装置において、先に導通し整流を終了しつつある前記第1の同期整流要素を流れる電流値と、次の整流のために導通を行うべき前記第2の同期整流要素のダイオードに流れ始める電流値とが相等しくなる時刻に、前記第1の同期整流要素のスイッチング素子をオフにする駆動信号を出力する第1の駆動信号生成部と、前記第2の同期整流要素のスイッチング素子をオンにする駆動信号を出力する第2の駆動信号生成部とを有することを特徴とする請求項2乃至7いずれか記載の非接触電力伝送装置。

【請求項9】 前記第1及び第2の駆動信号生成部は、先に導通し整流を終了しつつある第1の同期整流要素を流れる電流値と、次の整流のために導通を行うべき第2の同期整流要素のダイオードに流れ始める電流値とが相等しくなる時刻における前記電流検知部の出力電圧と同じ電圧である基準電圧と、前記電流検知部の検出信号とを比較し、前記比較結果に基づいて前記同期整流要素のスイッチング素子の駆動信号を生成することを特徴とする請求項8記載の非接触電力伝送装置。

【請求項10】 前記第2の駆動信号生成部は、先に導通し整流を終了しつつある第1の同期整流要素を流れる電流値と、次の整流のために導通を行うべき第2の同期整流要素のダイオードに流れ始める電流値とが相等しくなる時刻に、前記第2の同期整流要素のスイッチング素子をオンにできる電圧にまで増幅した駆動信号を出力することを特徴とする請求項8記載の非接触電力伝送装置。

【請求項11】 前記整流部は前記同期整流要素を前記トランスの2次コイルに直列に1つ接続した半波整流部を構成し、前記駆動信号生成部は前記電流検知回路の検出信号と基準電圧とを比較して前記比較出力を前記同期整流要素のスイッチング素子の駆動信号とする比較器からなり、前記基準電圧は、前記同期整流要素のスイッチング素子に前記スイッチング素子に並列に逆接続されたダイオードの順電流方向と同じ方向の電流が最大時間流れ且つ前記同期整流要素のスイッチング素子に前記ダイオードの順電流と逆方向の電流が流れない電圧であることを特徴とする請求項7記載の非接触電力伝送装置。

【請求項12】 前記整流部は前記同期整流要素を前記トランスの2次コイルに直列に1つ接続した半波整流部を構成し、前記駆動信号生成部は前記同期整流要素のダイオードに順電流が流れ始める時刻に、前記同期整流要

素のスイッチング素子をオンにできる電圧にまで増幅した駆動信号を出力する駆動信号生成部を有することを特徴とする請求項1、4、5、6いずれか記載の非接触電力伝送装置。

【請求項13】 前記インバータ部は、スイッチング素子を有するハーフブリッジのインバータからなり、前記スイッチング素子はゼロボルトスイッチングを行うことを特徴とする請求項1乃至12いずれか記載の非接触電力伝送装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、非接触電力伝送装置に関するものである。

【0002】

【従来の技術】非接触電力技術を応用して実用化されている例は、シェーパや電動歯ブラシ等の充電用途であり、数W程度の低出力に限られていた。そして、2次側回路の整流方式としては、ダイオード整流方式が用いられてきた。

【0003】

【発明が解決しようとする課題】分離着脱式トランスによる磁気誘導を利用した非接触・無接点の電力伝送技術は、その金属接点レスという特徴により感電の根本的対策を施せることから、水まわりの電源としての用途が注目されつつある。安全で安心できる電源として使用するために、出力電圧が低電圧であるとともに機器の効率も低下せず、車用において既に実績のある12V程度の電源でなおかつ、いろいろな機器が使用できるよう50W以上の高出力化が必要となった。しかし、低電圧で高出力化を行うに従い出力電流も大きくなり、従来非接触給電装置の2次側回路で使用されているダイオード整流方式では整流損失が大きくなりダイオード等の放熱板のサイズも大きくなり実用的なサイズに収められないという問題が発生した。

【0004】そこで従来から出力電圧が5V以下のスイッチング電源の整流部の損失低減に使用されている同期整流技術を非接触電力伝送装置に適用することを検討した。同期整流技術とは、同期整流用スイッチング素子としてFETのスイッチング素子とFETの寄生ダイオードを使い、整流するサイクルに応じてFETのスイッチング素子をスイッチングさせてFETのスイッチング素子を介して整流電流を流すことで、FETの低いオン抵抗を利用して整流部の損失を低減させる技術である。勿論、寄生ダイオードを内蔵しているFETの代わりに、スイッチング素子とスイッチング素子に並列に逆方向のダイオードを接続しても同じ動作をする。

【0005】非接触電力伝送装置は、直流電源を供給する電源部と、直流電源を高周波電源に変換するインバータ部と、インバータ部から高周波電力を供給される1次コイルと1次コイルから受電した電力を出力する2次コ

イルとが分離可能な分離着脱式トランスの1次コイルとで構成される1次側回路と、2次コイルと、2次コイルに並列に接続される負荷整合用コンデンサ及び2次コイルの出力電圧を整流する整流部とで構成される2次側回路とからなっている。この時2次側に取り出せる有効電力を最大にして回路全体の効率を上げ、分離着脱式トランスの小型化を図るために、分離着脱式トランスの1次コイルと2次コイルとの間の漏れ磁束による漏れインダクタンスと2次コイルに並列に接続する負荷整合用コンデンサとにより回路全体の力率を改善している。

【0006】ところが、前記負荷整合用コンデンサによる負荷整合を行うと、前記2次コイルの出力波形はスイッチング電源の2次コイル出力波形とは異なり、正弦波状あるいはさらに歪んだ波形となる、そのために、巻線間電圧あるいは補助巻線を利用した従来の同期整流用スイッチング素子の駆動信号生成方式では同期整流用スイッチング素子のオン時間が短いため整流効率が悪く、ダイオード整流方式より効率を上げることができなかった。

【0007】本発明は、上記事由に鑑みてなされたものであり、その目的は、2次側回路の整流効率を上げた非接触電力伝送装置を提供することにある。

【0008】

【課題を解決するための手段】請求項1の発明は、直流電源を供給する電源部と、前記直流電源を高周波電源に変換するインバータ部と、前記インバータ部から高周波電力を供給される1次コイルと1次コイルから受電した電力を出力する2次コイルとが分離可能なトランスの前記1次コイルとで構成される1次側回路と、前記2次コイルと、前記2次コイルに並列に接続される負荷整合用コンデンサ及び前記2次コイルの出力電圧を整流する整流部とで構成される2次側回路とを有する非接触電力伝送装置において、スイッチング素子及び前記スイッチング素子に並列に逆接続されたダイオードとからなる同期整流要素を前記2次コイルに直列に接続して構成された前記整流部と、前記同期整流要素に流れる電流を検出する電流検知部と、前記電流検知部の検出信号に基づいて前記同期整流要素のスイッチング素子の駆動信号を生成する駆動信号生成部とからなることを特徴とし、2次側回路の整流損失を減らして、整流部の放熱板のサイズを小さくでき、回路全体の効率を上げることができる。

【0009】請求項2の発明は、請求項1の発明において、前記トランスの2次コイルはセンタータップを備え、前記整流部は、前記トランスの2次コイルのセンタータップではない両出力端に直列に且つ互いに逆方向に接続する第1及び第2の前記同期整流要素の前記トランスの2次コイルに接続していない各他端同士を接続して全波整流部を構成することを特徴とし、全波整流することで半波整流よりも損失が少なく効率の良い整流を行える。

【0010】請求項3の発明は、請求項2の発明において、一つの前記電流検知部の検出信号より前記第1の同期整流要素のスイッチング素子の駆動信号を生成し、前記第2の同期整流要素のスイッチング素子の駆動信号は前記第1の同期整流要素のスイッチング素子の駆動信号の反転信号とすることを特徴とし、駆動信号生成部の簡素化を図ることができ、低コスト化、小型化ができる。

【0011】請求項4の発明は、請求項1乃至3のいずれかの発明において、前記電流検知部は、前記同期整流要素に直列に接続した電流検出用抵抗からなり、前記電流検出用抵抗の両端に発生する電圧に基づいて前記駆動信号生成部にて前記同期整流要素のスイッチング素子の駆動信号を生成することを特徴とし、簡単な回路構成で電流検知部を構成できる。

【0012】請求項5の発明は、請求項4の発明において、前記電流検出用抵抗の抵抗値は、前記電流検出用抵抗に流れる電流に対して発生する前記電流検出用抵抗の両端の電圧が前記駆動信号生成部にて前記同期整流要素のスイッチング素子を駆動できる電圧にまで増幅できる最小の電圧になる抵抗値であることを特徴とし、電流検知部での損失を減らすことができる。

【0013】請求項6の発明は、請求項1乃至3いずれかの発明において、前記電流検知部は、前記同期整流要素に直列に接続した1次コイル及び2次コイルとからなるカレントトランスと、前記カレントトランスの2次コイルの両端に並列に接続した抵抗と、前記抵抗の両端間の電圧を整流するために前記カレントトランスの2次コイルに直列に接続した整流ダイオードとから構成され、前記整流ダイオードから出力される前記電流検知部の出力に基づいて駆動信号生成部にて前記同期整流要素のスイッチング素子の駆動信号を生成することを特徴とし、2次側回路の整流損失を減らすことができる。

【0014】請求項7の発明は、請求項1乃至6いずれかの発明において、前記駆動信号生成部は、前記電流検知部の出力と基準電圧とを比較し、前記比較結果に基づいて前記同期整流要素のスイッチング素子の駆動信号を生成することを特徴とし、2次側回路の整流損失を減らして、整流部の放熱板のサイズを小さくでき、回路全体の効率を上げることができる。

【0015】請求項8の発明は、請求項2乃至7いずれかの発明において、前記同期整流要素を複数有する非接触電力伝送装置において、先に導通し整流を終了しつつある前記第1の同期整流要素を流れる電流値と、次の整流のために導通を行うべき前記第2の同期整流要素のダイオードに流れ始める電流値とが相等しくなる時刻に、前記第1の同期整流要素のスイッチング素子をオフにする駆動信号を出力する第1の駆動信号生成部と、前記第2の同期整流要素のスイッチング素子をオンにする駆動信号を出力する第2の駆動信号生成部とを有することを特徴とし、2次側回路の整流損失を減らして、整流部の

放熱板のサイズを小さくでき、回路全体の効率を上げることができる。

【0016】請求項9の発明は、請求項8記載の発明において、前記第1及び第2の駆動信号生成部は、先に導通し整流を終了しつつある第1の同期整流要素を流れる電流値と、次の整流のために導通を行うべき第2の同期整流要素のダイオードに流れ始める電流値とが相等しくなる時刻における前記電流検知部の出力電圧と同じ電圧である基準電圧と、前記電流検知部の検出信号とを比較し、前記比較結果に基づいて前記同期整流要素のスイッチング素子の駆動信号を生成することを特徴とし、2次側回路の整流損失を減らして、整流部の放熱板のサイズを小さくでき、回路全体の効率を上げることができる。

【0017】請求項10の発明は、請求項8記載の発明において、前記第2の駆動信号生成部は、先に導通し整流を終了しつつある第1の同期整流要素を流れる電流値と、次の整流のために導通を行うべき第2の同期整流要素のダイオードに流れ始める電流値とが相等しくなる時刻に、前記第2の同期整流要素のスイッチング素子をオンにできる電圧にまで増幅した駆動信号を出力することを特徴とし、2次側回路の整流損失を減らして、整流部の放熱板のサイズを小さくでき、回路全体の効率を上げることができる。

【0018】請求項11の発明は、請求項7記載の発明において、前記整流部は前記同期整流要素を前記トランスの2次コイルに直列に1つ接続した半波整流部を構成し、前記駆動信号生成部は前記電流検知回路の検出信号と基準電圧とを比較して前記比較出力を前記同期整流要素のスイッチング素子の駆動信号とする比較器からなり、前記基準電圧は、前記同期整流要素のスイッチング素子に前記スイッチング素子に並列に逆接続されたダイオードの順電流方向と同じ方向の電流が最大時間流れ且つ前記同期整流要素のスイッチング素子に前記ダイオードの順電流と逆方向の電流が流れない電圧であることを特徴とし、2次側回路の整流損失を減らして、整流部の放熱板のサイズを小さくでき、回路全体の効率を上げることができる。

【0019】請求項12の発明は、請求項1、4、5、6いずれか記載の発明において、前記整流部は前記同期整流要素を前記トランスの2次コイルに直列に1つ接続した半波整流部を構成し、前記駆動信号生成部は前記同期整流要素のダイオードに順電流が流れ始める時刻に、前記同期整流要素のスイッチング素子をオンにできる電圧にまで増幅した駆動信号を出力する駆動信号生成部を有することを特徴とし、2次側回路の整流損失を減らして、整流部の放熱板のサイズを小さくでき、回路全体の効率を上げることができる。

【0020】請求項13の発明は、請求項1乃至12いずれか記載の発明において、前記インバータ部は、スイッチング素子を有するハーフブリッジのインバータから

なり、前記スイッチング素子はゼロボルトスイッチングを行うことを特徴とし、2次側回路の整流損失を減らし、整流部の放熱板のサイズを小さくでき、回路全体の効率を上げることができる。

【0021】

【発明の実施の形態】以下、本発明の実施の形態を図面に基づいて説明する。

【0022】（実施形態1）図1は実施形態1の回路構成を示す。電源部Aとインバータ部BとトランスT1の1次コイルL1とで1次側回路G1を構成し、トランスT1の2次コイルL2と負荷整合用コンデンサC1と同期整流要素を構成するFET素子P1と電流検知部H1と駆動信号生成部E1と平滑部Fとで2次側回路G2を構成する。

【0023】電源部Aは直流電力をインバータ部Bに供給し、インバータ部Bで高周波電力に変換され、前記高周波電力はトランスT1の1次コイルL1に供給される。トランスT1の2次コイルL2は、電磁結合により1次コイルL1より電力を受電し、2次コイルL2両端の電圧はFET素子P1で半波整流され、半波整流された電圧は平滑部Fで平滑されて直流電圧を出力する。

【0024】トランスT1の1次コイルL1と2次コイルL2とはお互いに絶縁物により所定のギャップ長だけ離間し、分離脱着できる構成になっている。

【0025】2次コイルL2に並列に接続されるコンデンサC1は負荷整合用であり、2次側回路G2で取り出せる有効電力を最大にして1次側回路G1から2次側回路G2への電力伝達の効率を上げている。

【0026】次に本実施形態1の同期整流動作について説明する。

【0027】FETQ1は、FET素子P1とFET素子P1に並列に逆方向に接続された寄生ダイオードD1とからなっている。FETQ1に直列に接続された電流検知部H1はFETQ1に流れる電流を検出し、前記検出信号を駆動信号生成部E1に出力する。駆動信号生成部E1は、電流検知部H1からの検出信号が所定のしきい値以上であればFET素子P1をオンにする駆動信号を出力し、電流検知部H1からの信号が所定のしきい値以下であればFET素子P1をオフにする駆動信号を出力する。

【0028】電磁誘導によって1次コイルL1から2次コイルL2に誘導される起電力の極性が、FETQ1の寄生ダイオードD1の順方向と合致した時に寄生ダイオードD1には順方向電流が流れ、前記順方向電流を電流検知部H1で検出し、駆動信号生成部E1は電流検知部H1からの検出信号が前記しきい値を超えるとFET素子P1にオン信号を出力してFET素子P1はオンする。

【0029】FET素子P1がオンすると当初寄生ダイオードD1を流れていた電流は寄生ダイオードD1に比

べてFET素子P1のほうが抵抗が小さいので、FET素子P1のオン抵抗を介してFETQ1のソースからドレイン方向に流れる。この時、FETQ1に整流電流が流れるサイクル中にFET素子のオン時間をできるだけ長くしたほうが、FETQ1での損失を小さくでき、整流損失を減らすことができる。

【0030】電磁誘導によって1次コイルL1から2次コイルL2に誘導される起電力が変化して2次コイルL2に誘導される起電力が小さくなると電流検知部H1から出力される検出信号も小さくなり、駆動信号生成部E1は電流検知部H1からの検出信号が前記しきい値より下がるとFET素子P1にオフ信号を出力してFET素子P1はオフする。

【0031】さらに、2次コイルL2に誘導される起電力の極性が反転するとFET素子P1の寄生ダイオードD1には逆方向の電圧がかかるため、再び2次コイルL2に誘導された起電力の極性が反転するまでは寄生ダイオードD1には電流は流れず、平滑部Fの入力は半波整流波形となる。半波整流出力は平滑部Fで平滑される。

【0032】図2は、本実施形態1のFETQ1に流れる電流波形S1を示し、前記電流波形S1はなだらかに立ち上がり歪んだ波形となる。

【0033】この同期整流時の損失は、前記電流波形S1がFET素子P1のオンしきい値Kを超えてFET素子P1がオフからオンになる時間を t_1 、前記電流波形S1がFET素子P1のオンしきい値Kより下がりFET素子P1がオンからオフになる時間を t_2 、前記電流波形S1が0になる時間を t_3 、前記同期整流時のFET素子P1のオン抵抗を R_{on} 、FETQ1を流れる電流を I 、寄生ダイオードD1の順方向電圧を V_f とすると、一周期での総損失Wは、下記数1のように表される。

【0034】

【数1】

$$W = \int_0^{t_1} I \cdot V_f dt + \int_{t_1}^{t_2} I^2 \cdot R_{on} dt + \int_{t_2}^{t_3} I \cdot V_f dt$$

【0035】このように、FETQ1に流れる電流を検出し、前記検出信号に同期した信号でFET素子P1を駆動すれば、FETQ1の寄生ダイオードD1に電流が流れる時間を短くすることができ、FETQ1での損失を低減できる。その結果、放熱板のサイズを小さくできるため、2次側回路G2を小型化できる。

【0036】（実施形態2）図3は実施形態2の回路構成を示す。電源部A、インバータ部B、トランスT1の1次コイルL1からなる1次側回路G1の構成、動作は実施形態1と同様なので省略する。

【0037】トランスT1の2次コイルL2は出力端子が3つあるセンタータップ方式となっており、2次コイルL2両端の端子1及び3とセンタータップ端子2の3つの端子を有し、2次コイルL2の端子1—端子3間に

並列に負荷整合用のコンデンサC1を接続する。2次コイルL2の端子1に直列に電流検知部H1を介して同期整流要素を構成するFETQ1のドレインを接続し、2次コイルL2の端子3に直列に電流検知部H3を介して同期整流要素を構成するFETQ2のドレインを接続する。FETQ1、Q2の各ソースは互いに接続し、平滑コンデンサC8の負極側に接続し、2次コイルL2の端子3は、チョークコイルL3を介して平滑コンデンサC8の正極側に接続する。

【0038】次に、本実施形態2の動作について説明する。FETQ1は、FET素子P1とFET素子P1に並列に逆方向の接続された寄生ダイオードD1とからなっている。FETQ1に直列に接続された電流検知部H1はFETQ1に流れる電流を検出し、前記検出信号を駆動信号生成部E1に出力する。駆動信号生成部E1は、電流検知部H1からの検出信号が所定のしきい値以上であればFET素子P1をオンにする駆動信号を出力し、電流検知部H1からの信号が所定のしきい値以下であればFET素子P1をオフにする駆動信号を出力する。

【0039】同様にFETQ2は、FET素子P2とFET素子P2に並列に逆方向の接続された寄生ダイオードD2とからなっている。FETQ2に直列に接続された電流検知部H2はFETQ2に流れる電流を検出し、前記検出信号を駆動信号生成部E2に出力する。駆動信号生成部E2は、電流検知部H2からの検出信号が所定のしきい値以上であればFET素子P2をオンにする駆動信号を出力し、電流検知部H2からの信号が所定のしきい値以下であればFET素子P2をオフにする駆動信号を出力する。

【0040】電磁誘導によって1次コイルL1から2次コイルL2の端子2-1間に誘導される起電力の極性が、FETQ1の寄生ダイオードD1の順方向と合致した時に寄生ダイオードD1に順方向電流が流れ、前記順方向電流を電流検知部H1にて検出し、駆動信号生成部E1は電流検知部H1の検出信号が前記しきい値を超えるとFET素子P1にオン信号を出力してFET素子P1はオンする。FET素子P1がオンすると当初寄生ダイオードD1を流れていた電流は寄生ダイオードD1に比べてFET素子P1のほうが抵抗が小さいので、FET素子P1のオン抵抗を介してFETQ1のソースからドレイン方向に流れる。この時、実施形態1同様、FETQ1に整流電流が流れるサイクル中にFET素子のオン時間をできるだけ長くしたほうが、FETQ1での損失を小さくでき、整流損失を減らすことができる。

【0041】電磁誘導によって1次コイルL1から2次コイルL2に誘導される起電力が変化して2次コイルL2に誘導される起電力が小さくなると電流検知部H1から出力される検出信号も小さくなり、駆動信号生成部E1は電流検知部H1からの検出信号が前記しきい値より

下がるとFET素子P1にオフ信号を出力してFET素子P1はオフする。

【0042】さらに、2次コイルL2に誘導された起電力の極性が反転するとFET素子P1の寄生ダイオードD1には逆方向の電圧がかかるため、再び2次コイルL2に誘導された起電力の極性が反転するまで寄生ダイオードD1には電流は流れない。

【0043】一方この時、電磁誘導によって1次コイルL1から2次コイルL2の端子2-3間に誘導された起電力の極性は、FETQ2の寄生ダイオードD2の順方向と合致しているため、寄生ダイオードD2に順方向電流が流れ、FETQ2、FET素子P2、寄生ダイオードD2、電流検知部H2、駆動信号生成部E2は前記FETQ1、FET素子P1、寄生ダイオードD1、電流検知部H1、駆動信号生成部E1と同様の前記動作を行う。

【0044】前記動作を繰り返して、FETQ1、Q2のソースと2次コイルL2の端子2間の電圧には全波整流された電圧が生じ、チョークコイルL3と平滑コンデンサC8とで平滑される。

【0045】図4は、2次コイルL2の端子1-3間の誘導起電力波形S2と、2次コイルL2を流れる電流波形S3と、FETQ1、Q2のオンしきい値Kとを示している。負荷整合用のコンデンサC1の影響で、2次コイルL2の電流波形S3は歪んだ波形になり、2次コイルL2の端子1-3間に誘起する電圧波形S2は一定区間0Vである区間を挟んで正負に振動した波形となる。そのため、従来の補助巻線や2次コイル間電圧を利用したFETの駆動方式ではFETQ1、Q2のオンしきい値Kと前記電圧波形S2とを比較すると、FETの駆動信号は波形S4のようになり、FETQ1及びQ2をオンする時間が短いため整流効率が上がらない。

【0046】しかし、図5に示す様にFETQ1を流れる電流波形S5とFETQ1、Q2のオンしきい値Kとを比較し、またFETQ2を流れる電流波形S6とFETQ1、Q2のオンしきい値Kとを比較することで、FETQ1、Q2の駆動信号は各々波形S7、S8のようになり、図4の波形S4に比べてFETQ1、Q2のFET素子P1、P2のオン時間が長くなる。したがって、FET素子P1、P2に整流電流が流れる時間が長くなり、整流効率が上がる。

【0047】また本実施形態2に示す2次コイルがセンタタップ方式であるトランスT1を用いた全波整流回路と実施形態1に示す半波整流回路とを比較すると、同じ出力電流を流す場合、全波整流回路は半波整流回路に比べてFETに流す電流の最大値を小さくできる。FET素子P1、P2がオンした時の損失は電流の2乗に比例するので、本実施形態2では、FET素子P1、P2に流す電流を半波整流回路に比べて小さくでき、損失を減らすことができる。

【0048】なお、図6に示す回路構成の様に、負荷整合用のコンデンサC1を2次コイルL2の端子1-端子2間に並列に接続し、負荷整合用のコンデンサC9を2次コイルL2の端子2-端子3間に並列に接続した場合も図4の負荷整合用のコンデンサC1と同様の効果が得られる。さらに、前記コンデンサC1をFETQ1に並列に接続し、前記コンデンサC9をFETQ2並列に接続しても同様の効果が得られる。

【0049】なお、図1において負荷整合用コンデンサC1をFETQ1に並列に接続しても同様の効果が得られる。

【0050】（実施形態3）図7は実施形態3の回路構成を示し、交流電源を直流電源に変換する電源部Aと電源部Aからの直流入力を高周波電源に変換するインバータ部Bと、インバータ部Bの制御回路Jと、インバータ部Bから高周波電源を供給されるトランスT1の1次コイルL1とから1次側回路G1は構成され、トランスT1のセンタータップ式の2次コイルL2と、負荷整合用コンデンサC1と、電流検知部H1、H2と、駆動信号生成部E1、E2と、FETQ1、Q2とチョークコイルL3と、平滑コンデンサC8とで構成される2次側回路G2とからなっている。

【0051】2次側回路G2の構成、動作は実施形態2の図3と同様なので説明は省略する。

【0052】1次側回路G1の構成、動作について説明する。電源部Aは、交流電源Vsと交流電源Vsを全波整流する整流器D3とから構成され、インバータ部Bは整流器D3の出力端に並列に接続されたコンデンサC2、C3の直列回路と、整流器D3の出力端に並列に接続されたスイッチング素子Q3、Q4の直列回路と、スイッチング素子Q3、Q4に各々並列に接続されたコンデンサC4、C5とからなるハーフブリッジインバータ回路で構成され、制御回路Jはスイッチング素子Q3、Q4のスイッチング動作を制御するための電子回路から構成され、トランスT1の1次コイルL1の一端はコンデンサC1、C2の中点に接続され、他端はスイッチング素子Q1、Q2の中点に接続される。

【0053】整流器D3で全波整流された電圧はコンデンサC2、C3で分圧され、スイッチング素子Q3、Q4は制御回路Jからの一定のデッドタイムを持った駆動信号により交互にオン・オフして1次コイルL1に高周波電圧を印加する。

【0054】また、スイッチング素子Q3、Q4に並列に接続されたコンデンサC4、C5により、スイッチング素子Q3、Q4のスイッチング動作をゼロ電圧スイッチング動作とすることができ、スイッチング素子Q3、Q4でのスイッチング損失を減少させることができる。

【0055】またスイッチング素子Q3、Q4の駆動信号は一定のデッドタイムを持っているので、トランスT1の2次コイルL2の端子1-端子3間の電圧は図4の

波形S2のようになるため、実施形態2と同様に電流検出回路H1、H2の検出信号から生成した駆動信号でFETQ1、Q2による同期整流を行えば、実施形態2同様に2次側回路G2の整流損失も減少できる。

【0056】また、図8に示す回路構成のようにトランスT1の1次コイルL1に並列にコンデンサC4を接続した場合も、図7の回路同様にゼロ電圧スイッチングを行える。前記以外の図8の回路の構成、動作は図7の回路の構成、動作と同様なので説明は省略する。

【0057】このように本実施形態3によれば、2次側回路G2だけでなく、1次側回路G1での損失を減らして、回路全体の効率を上げて回路全体の小型化ができる。

【0058】（実施形態4）図9は実施形態4の回路構成を示す。基本的な回路構成、動作は実施形態3の図7と同様で、FET素子P1の駆動信号生成部E1の駆動信号を反転器INV1を介して反転させた信号をFET素子P2の駆動信号とした点が図7に示す回路構成と異なる。前記以外の回路構成、動作については実施形態3の図7と同様なので省略する。

【0059】図9に示す回路構成図のように、トランスT1の2次コイルL2にセンタータップ方式を用いた同期整流回路では、FETQ1、Q2に交互に電流が流れるようにFETQ1、Q2の駆動信号を制御するため、FETQ1、Q2の各駆動信号は、一方の駆動信号の反転信号となる。そこで、FETQ1の駆動信号生成部E1の駆動信号を反転器INV1を介して反転させた信号をFETQ2の駆動信号としてFETQ2を駆動することで、FETQ2の駆動回路の簡素化を図ることができ、低コスト化、小型化ができる。

【0060】なお、2次側回路G2の整流回路として、同期整流を用いたフォワード方式を採用した場合にも、2つの整流及び転流用スイッチング素子にたいしても同様に応用できる。

【0061】（実施形態5）図10は実施形態5の回路構成図を示す。基本的な回路構成、動作は実施形態3の図7とほぼ同様で、図10では、図7の電流検知部H1、H2を、各々FETQ1、Q2に直列に接続した抵抗R1、R2からなる電流検知部H3、H4に置き換えた点が異なる。前記以外の回路構成、動作については実施形態3の図7と同様なので省略する。

【0062】本実施形態5では、FETQ1、Q2に各々直列に接続された抵抗R1、R2の両端には各々FETQ1、Q2に流れる電流に比例した電圧が発生する。前記抵抗R1、R2の各両端電圧を駆動信号生成部E1、E2に各々入力し、駆動信号生成部E1、E2は、抵抗R1、R2の各両端電圧が所定のしきい値以上であればFET素子P1、P2を各々オンにする駆動信号を出力し、抵抗R1、R2の各両端電圧が所定のしきい値以下であればFET素子P1、P2を各々オフにする駆

動信号を出力する。

【0063】このように本実施形態5によれば、簡単な方法でFETQ1、Q2の電流を検出でき、前記検出信号を用いてFETQ1、Q2の駆動信号を生成することで実施形態2同様にFETQ1、Q2に電流が流れる各整流サイクル中にできるだけ長い間FET素子P1、P2をオンにして、整流損失を減らすことができる。

【0064】（実施形態6）図11は本実施形態6の回路構成図を示し、基本的な回路構成、動作は実施形態5の図10と同様で、図11では、図10の抵抗R1、R2を各々微小な抵抗値（例えば10mΩ）を有する抵抗R3、R4からなる電流検出部H5、H6に置き換え、駆動信号生成部E1、E2を各々オペアンプOP1、OP2からなる駆動信号生成部E3、E4に置き換えた点異なる。前記以外の回路構成、動作については実施形態5の図10と同様なので省略する。

【0065】本実施形態5では、FETQ1、Q2に各々直列に接続された抵抗R3、R4の抵抗値を微小な抵抗値（例えば10mΩ）とすることで、実施形態5に比べて抵抗R3、R4での損失を減らしている。しかし抵抗R3、R4の抵抗値を小さくしたことで抵抗R3、R4両端の電圧も小さくなるため、抵抗R3、R4両端の電圧を各々オペアンプOP1、OP2の反転入力端子と非反転入力端子とに入力し、オペアンプOP1、OP2で抵抗R3、R4の各両端電圧を、FETQ1、Q2を十分駆動できる電圧にまで差動増幅し、前記差動増幅したオペアンプOP1、OP2の出力をFET素子P1、P2の駆動信号とする。

【0066】このように本実施形態6では、電流検知部H5、H6での損失を下げるができる。

【0067】（実施形態7）図12は実施形態7の回路構成図を示す。基本的な回路構成、動作は実施形態3の図7とほぼ同様で、図12では図7の電流検知部H1、H2を各々、1次コイルL4、L5と2次コイルL6、L7からなるカレントトランスCT1、CT2の2次コイルL6、L7に並列に抵抗R5、R6を各々接続し、前記2次コイルL6、L7に直列にダイオードD3、D4を各々接続し、ダイオードD3、D4を介して抵抗R5、R6に並列にコンデンサC6、C7、抵抗R7、R8及び定電圧ダイオードZD1、ZD2を各々接続した電流検知部H7、H8に置き換えた点と、図7の駆動信号生成部E1、E2を各々ダイオードD3、D4に直列に接続した増幅器AMP1、AMP2からなる駆動信号生成部E5、E6に置き換えた点とが異なる。前記以外の回路構成、動作については実施形態3の図7と同様なので省略する。

【0068】カレントトランスCT1、CT2の各1次コイルL4、L5に流れる電流をカレントトランスCT1、CT2の各2次コイルL6、L7で検出し、抵抗R5、R6の両端に各々電圧を発生させ、前記電圧はダイ

オードD3、D4で各々半波整流される。コンデンサC6、C7はノイズカット用であり、抵抗R7、R8はコンデンサC6、C7に蓄積された電荷を放出してAMP1、2の入力信号の立下りを急峻にする。また、定電圧ダイオードZD1、ZD2は増幅器AMP1、2の入力に増幅器AMP1、2の定格電圧を超えた電圧が入力されないように半波整流した電圧を一定電圧でクランプする。

【0069】そして、カレントトランスCT1、CT2の2次コイルL6、L7の出力電流は小さいためにFET素子P1、P2を駆動できないので、増幅器AMP1、AMP2で増幅し、前記増幅した駆動信号でFETQ1、Q2を駆動する。

【0070】このように本実施形態7によれば、FETQ1、Q2を流れる電流を検出でき、前記検出信号を用いてFETQ1、Q2の駆動信号を生成することで実施形態2同様にFETQ1、Q2に電流が流れる各整流サイクル中にできるだけ長い間FET素子P1、P2をオンにして、整流損失を減らすことができる。

【0071】（実施形態8）図13の回路構成図を用いて実施形態8を説明する。基本的な回路構成、動作は実施形態7の図12とほぼ同様で、図13では、図12の増幅器AMP1、AMP2を、比較器CP1、CP2と比較器CP1、CP2の反転入力端子に基準電圧源E1、E2を各々接続した比較回路に置き換えた点異なる。前記以外の回路構成、動作については実施形態7の図12と同様なので省略する。

【0072】本実施例8では、ダイオードD3、D4で半波整流されたカレントトランスCT1、CT2の各2次コイルL6、L7の出力を各々比較器CP1、CP2の非反転入力端子に接続し、基準電圧源E1、E2を各々比較器CP1、CP2の反転入力端子に接続して、基準電圧源E1、E2の基準電圧を適切に設定することで、FETQ1、Q2に電流が流れる各整流サイクル中にできるだけ長い間FET素子P1、P2をオンにして、整流損失を減らすことができる。

【0073】図14は、本実施形態8におけるFETQ1を流れる電流波形S9と、基準電圧源E1の基準電圧M1と、比較器CP1の出力波形S10を示しており、前記波形S9が前記基準電圧M1を超えると前記波形S10はHレベルとなり、前記波形S9が前記基準電圧M1より下がると前記波形S10はLレベルとなる。したがって、基準電圧M1を適切に設定することで比較器CP1の出力波形S10がHレベルの区間を広くできる。FETQ2についても同様である。

【0074】即ちFETQ1、Q2に電流が流れる各整流サイクル中にできるだけ長い間FET素子P1、P2をオンにして、整流損失を減らすことができる。

【0075】（実施形態9）図13の回路構成図を用いて実施形態9を説明する。基本的な回路構成、動作につ

いては実施形態8と同様なので省略する。

【0076】同期整流を行うためにオンしていたFET素子P1を有するFETQ1の電流は、負荷整合用コンデンサC6のために2次コイルL2に発生する誘導起電力に応じてなめらかに電流値が減少していく。また次の半サイクルの同期整流を行うためにオンするFET素子P2を有するFETQ2も同様にコンデンサC6のために、FETQ1に流れる電流がゼロになる前に寄生ダイオードD2を介して電流が流れ始める。そのため、FET素子P1、P2が同時にオンする可能性があり、整流が行われなくなる可能性がある。

【0077】そこで本実施形態9では、FETQ1、Q2に流れる各電流が等しくなった時にそれまでオンしていたFET素子P1をオフにする駆動信号を比較器CP1から出力し、それまでオフしていたFET素子P2をオンにする駆動信号を比較器CP2から出力する。また、逆の半サイクルも同様にFETQ1、Q2に流れる各電流が等しくなった時にそれまでオンしていたFET素子P2をオフにする駆動信号を比較器CP2から出力し、それまでオフしていたFET素子P1をオンにする駆動信号を比較器CP1から出力する。

【0078】このように、本実施形態9によれば、FET素子P1、P2が同時にオンすることがなくなり、整流損失を減らせて放熱板を含む2次側回路G2を小型化できる。

【0079】（実施形態10）図13の回路構成図を用いて実施形態10を説明する。基本的な回路構成、動作については実施形態9と同様なので省略する。

【0080】実施形態9で説明したように、FETQ1、Q2に流れる各電流が等しくなった時にそれまでオンしていたFET素子P1をオフにする駆動信号を比較器CP1から出力し、それまでオフしていたFET素子P2をオンにする駆動信号を比較器CP2から出力する。また、逆の半サイクルも同様にFETQ1、Q2に流れる各電流が等しくなった時にそれまでオンしていたFET素子P2をオフにする駆動信号を比較器CP2から出力し、それまでオフしていたFET素子P1をオンにする駆動信号を比較器CP1から出力すれば、FET素子P1、P2が同時にオンすることなくなり、整流損失を減らせる。

【0081】そこで、本実施形態10では図13の回路構成においてカレントトランスCT1、CT2で検出した各検出信号をダイオードD3、D4で半波整流した出力電圧、即ち定電圧ダイオードZD1、ZD2の各出力電圧を比較器CP1、CP2の非反転入力端子に入力し、FETQ1、Q2に流れる各電流が等しくなった時の定電圧ダイオードZD1、ZD2の各出力電圧を基準電圧とする基準電圧源E1、E2を比較器CP1、CP2の反転入力端子に入力に各々接続して、比較器CP1、CP2の出力をFET素子P1、P2の各駆動信号

とすることで、FET素子P1、P2が同時にオンすることがなくなり、整流損失を減らせて放熱板を含む2次側回路G2を小型化できる。

【0082】図15は、本実施形態10におけるFETQ1を流れる電流波形S11、基準電圧源E1の基準電圧M2、比較器CP1の出力波形S12と、FETQ2を流れる電流波形S13、基準電圧源E2の基準電圧M3、比較器CP2の出力波形S14とを示す。FETQ1を流れる電流波形S11の大きさとFETQ2を流れる電流波形S13の大きさが等しくなる時間t4において比較器CP1の出力をLにしてFET素子P1をオフにし、比較器CP2の出力をHにしてFET素子P2をオンにすることでFET素子P1、P2が同時にオンすることがなくなり、整流損失を減らせて放熱板を含む2次側回路G2を小型化できる。

【0083】（実施形態11）図12の回路構成図を用いて実施形態11を説明する。基本的な回路構成、動作については実施形態7と同様なので省略する。

【0084】実施形態9で説明したように、FETQ1、Q2に流れる各電流が等しくなった時にそれまでオンしていたFETQ1をオフにする駆動信号を比較器CP1から出力し、それまでオフしていたFETQ2をオンにする駆動信号を比較器CP2から出力する。また、逆の半サイクルも同様にFETQ1、Q2に流れる各電流が等しくなった時にそれまでオンしていたFETQ2をオフにする駆動信号を比較器CP2から出力し、それまでオフしていたFETQ1をオンにする駆動信号を比較器CP1から出力すれば、FETQ1、Q2が同時にオンすることがなくなり、整流損失を減らせる。

【0085】そこで、本実施形態11では図12の回路構成においてFETQ1、Q2に流れる電流が等しくなるとときに、カレントトランスCT1、CT2で検出した各検出信号をダイオードD3、D4で半波整流した出力電圧、即ち定電圧ダイオードZD1、ZD2の各出力電圧を増幅器AMP1、2で各々増幅したFET素子P1、P2の各駆動信号が、FET素子P1、P2を十分オンできる電圧になるように、カレントトランスCT1の1次コイルL4と2次コイルL6との巻線比及び、カレントトランスCT2の1次コイルL5と2次コイルL7との巻線比を設定する。

【0086】図16は、本実施形態11におけるFET素子P1の駆動信号波形S15、FETQ1を流れる電流波形S16、定電圧ダイオードZD1のクランプ電圧N1と、FET素子P2の駆動信号波形S17、FETQ2を流れる電流波形S18、定電圧ダイオードZD2のクランプ電圧N2と、FET素子P1、P2を十分オンできる電圧Kとを示している。FETQ1を流れる電流波形S16の大きさとFETQ2を流れる電流波形S18の大きさが等しくなる時間t5において、FET素子P1の駆動信号波形S15がFET素子P1、P2

を十分オンできる電圧Kより下がってFET素子P1はオフになり、FET素子P2の駆動信号波形S17がFET素子P1、P2を十分オンできる電圧Kを超えてFET素子P2はオンになることでFET素子P1、P2が同時にオンすることがなくなり、整流損失を減らせて放熱板を含む2次側回路G2を小型化できる。

【0087】なお、前記波形S15、S17は定電圧電圧ダイオードZD1、ZD2のクランプ電圧N1、N2にクランプされる。

【0088】（実施形態12）図1に示す回路構成図のように、1つの同期整流用FETQ1を用いて半波整流を行う場合、FETQ1での整流損失を小さくするためにはFETQ1に電流が流れる整流サイクル中にできるだけ長い間FETQ1のFET素子P1をオンにする必要がある。

【0089】図1の電流検出部H1と駆動信号生成部E1とを、図13の電流検出部H9と駆動信号生成部E7に各々置き換えて、駆動信号生成部E7の比較器CP1の反転入力端子に接続している基準電圧源E1の基準電圧を0V付近にすることで、比較器CP1は前記整流サイクル中にできるだけ長い間FET素子P1をオンにする駆動信号を出力して、FETQ1での整流損失を減らせて放熱板を含む2次側回路G2を小型化できる。

【0090】上記以外の回路構成、動作については、実施形態1及び8で説明しているので省略する。

【0091】（実施形態13）図1に示す回路構成図のように、1つの同期整流用FETQ1を用いて半波整流を行う場合、FETQ1での整流損失を小さくするためにはFETQ1に電流が流れる整流サイクル中にできるだけ長い間FETQ1のFET素子P1をオンにする必要がある。

【0092】図1の電流検出部H1と駆動信号生成部E1とを、図12の電流検出部H7と駆動信号生成部E5に各々置き換えて、電流検出部H7のカレントトランスCT1の1次コイルL4と2次コイルL5の巻数比を大きくすることで、カレントトランスCT1の1次コイルL4に流れる電流が小さい時でも2次コイルL5の誘起電圧が大きくなり、FETQ1のFET素子P1をオンできる駆動信号が増幅器AMP1から出力される。したがって、整流素子P1は前記整流サイクル中にできるだけ長い間オンになり、FETQ1での整流損失を減らせて放熱板を含む2次側回路G2を小型化できる。

【0093】上記以外の回路構成、動作については、実施形態1及び7で説明しているので省略する。

【0094】

【発明の効果】請求項1の発明は、直流電源を供給する電源部と、前記直流電源を高周波電源に変換するインバータ部と、前記インバータ部から高周波電力を供給される1次コイルと1次コイルから受電した電力を出力する2次コイルとが分離可能なトランスの前記1次コイルと

で構成される1次側回路と、前記2次コイルと、前記2次コイルに並列に接続される負荷整合用コンデンサ及び前記2次コイルの出力電圧を整流する整流部とで構成される2次側回路とを有する非接触電力伝送装置において、スイッチング素子及び前記スイッチング素子に並列に逆接続されたダイオードとからなる同期整流要素を前記2次コイルに直列に接続して構成された前記整流部と、前記同期整流要素に流れる電流を検出する電流検知部と、前記電流検知部の検出信号に基づいて前記同期整流要素のスイッチング素子の駆動信号を生成する駆動信号生成部とからなることを特徴とし、2次側回路の整流損失を減らして、整流部の放熱板のサイズを小さくでき、回路全体の効率を上げることができるという効果がある。

【0095】請求項2の発明は、請求項1の発明において、前記トランスの2次コイルはセンタータップを備え、前記整流部は、前記トランスの2次コイルのセンタータップではない両出力端に直列に且つ互いに逆方向に接続する第1及び第2の前記同期整流要素の前記トランスの2次コイルに接続していない各他端同士を接続して全波整流部を構成することを特徴とし、全波整流することで半波整流よりも損失が少なく効率の良い整流を行えるという効果がある。

【0096】請求項3の発明は、請求項2の発明において、一つの前記電流検知部の検出信号より前記第1の同期整流要素のスイッチング素子の駆動信号を生成し、前記第2の同期整流要素のスイッチング素子の駆動信号は前記第1の同期整流要素のスイッチング素子の駆動信号の反転信号とすることを特徴とし、駆動信号生成部の簡素化を図ることができ、低コスト化、小型化ができるという効果がある。

【0097】請求項4の発明は、請求項1乃至3のいずれかの発明において、前記電流検知部は、前記同期整流要素に直列に接続した電流検出用抵抗からなり、前記電流検出用抵抗の両端に発生する電圧に基づいて前記駆動信号生成部にて前記同期整流要素のスイッチング素子の駆動信号を生成することを特徴とし、簡単な回路構成で電流検知部を構成できるという効果がある。

【0098】請求項5の発明は、請求項4の発明において、前記電流検出用抵抗の抵抗値は、前記電流検出用抵抗に流れる電流に対して発生する前記電流検出用抵抗の両端の電圧が前記駆動信号生成部にて前記同期整流要素のスイッチング素子を駆動できる電圧にまで増幅できる最小の電圧になる抵抗値であることを特徴とし、電流検知部での損失を減らすことができるという効果がある。

【0099】請求項6の発明は、請求項1乃至3いずれかの発明において、前記電流検知部は、前記同期整流要素に直列に接続した1次コイル及び2次コイルとからなるカレントトランスと、前記カレントトランスの2次コイルの両端に並列に接続した抵抗と、前記抵抗の両端間

の電圧を整流するために前記カレントトランスの2次コイルに直列に接続した整流ダイオードとから構成され、前記整流ダイオードから出力される前記電流検知部の出力に基づいて駆動信号生成部にて前記同期整流要素のスイッチング素子の駆動信号を生成することを特徴とし、2次側回路の整流損失を減らすことができるという効果がある。

【0100】請求項7の発明は、請求項1乃至6いずれかの発明において、前記駆動信号生成部は、前記電流検知部の出力と基準電圧とを比較し、前記比較結果に基づいて前記同期整流要素のスイッチング素子の駆動信号を生成することを特徴とし、2次側回路の整流損失を減らして、整流部の放熱板のサイズを小さくでき、回路全体の効率を上げることができるという効果がある。

【0101】請求項8の発明は、請求項2乃至7いずれかの発明において、前記同期整流要素を複数有する非接触電力伝送装置において、先に導通し整流を終了しつつある前記第1の同期整流要素を流れる電流値と、次の整流のために導通を行うべき前記第2の同期整流要素のダイオードに流れ始める電流値とが相等しくなる時刻に、前記第1の同期整流要素のスイッチング素子をオフにする駆動信号を出力する第1の駆動信号生成部と、前記第2の同期整流要素のスイッチング素子をオンにする駆動信号を出力する第2の駆動信号生成部とを有することを特徴とし、2次側回路の整流損失を減らして、整流部の放熱板のサイズを小さくでき、回路全体の効率を上げることができるという効果がある。

【0102】請求項9の発明は、請求項8記載の発明において、前記第1及び第2の駆動信号生成部は、先に導通し整流を終了しつつある第1の同期整流要素を流れる電流値と、次の整流のために導通を行うべき第2の同期整流要素のダイオードに流れ始める電流値とが相等しくなる時刻における前記電流検知部の出力電圧と同じ電圧である基準電圧と、前記電流検知部の検出信号とを比較し、前記比較結果に基づいて前記同期整流要素のスイッチング素子の駆動信号を生成することを特徴とし、2次側回路の整流損失を減らして、整流部の放熱板のサイズを小さくでき、回路全体の効率を上げることができるという効果がある。

【0103】請求項10の発明は、請求項8記載の発明において、前記第2の駆動信号生成部は、先に導通し整流を終了しつつある第1の同期整流要素を流れる電流値と、次の整流のために導通を行うべき第2の同期整流要素のダイオードに流れ始める電流値とが相等しくなる時刻に、前記第2の同期整流要素のスイッチング素子をオンにできる電圧にまで増幅した駆動信号を出力することを特徴とし、2次側回路の整流損失を減らして、整流部の放熱板のサイズを小さくでき、回路全体の効率を上げることができるという効果がある。

【0104】請求項11の発明は、請求項7記載の発明

において、前記整流部は前記同期整流要素を前記トランスの2次コイルに直列に1つ接続した半波整流部を構成し、前記駆動信号生成部は前記電流検知回路の検出信号と基準電圧とを比較して前記比較出力を前記同期整流要素のスイッチング素子の駆動信号とする比較器からなり、前記基準電圧は、前記同期整流要素のスイッチング素子に前記スイッチング素子に並列に逆接続されたダイオードの順電流方向と同じ方向の電流が最大時間流れ且つ前期同期整流要素のスイッチング素子に前記ダイオードの順電流と逆方向の電流が流れない電圧であることを特徴とし、2次側回路の整流損失を減らして、整流部の放熱板のサイズを小さくでき、回路全体の効率を上げることができるという効果がある。

【0105】請求項12の発明は、請求項1、4、5、6いずれか記載の発明において、前記整流部は前記同期整流要素を前記トランスの2次コイルに直列に1つ接続した半波整流部を構成し、前記駆動信号生成部は前記同期整流要素のダイオードに順電流が流れ始める時刻に、前記同期整流要素のスイッチング素子をオンにできる電圧にまで増幅した駆動信号を出力する駆動信号生成部を有することを特徴とし、2次側回路の整流損失を減らして、整流部の放熱板のサイズを小さくでき、回路全体の効率を上げることができるという効果がある。

【0106】請求項13の発明は、請求項1乃至12いずれか記載の発明において、前記インバータ部は、スイッチング素子を有するハーフブリッジのインバータからなり、前記スイッチング素子はゼロボルトスイッチングを行うことを特徴とし、2次側回路の整流損失を減らして、整流部の放熱板のサイズを小さくでき、回路全体の効率を上げることができるという効果がある。

【図面の簡単な説明】

【図1】本発明の実施形態1、12、13の回路構成を示す図である。

【図2】本発明の実施形態1のFETに流れる電流波形を示す図である。

【図3】本発明の実施形態2の回路構成を示す図である。

【図4】本発明の実施形態2の回路動作を示す図である。

【図5】本発明の実施形態2のFET素子のスイッチング動作を示す図である。

【図6】本発明の実施形態2の回路構成を示す図である。

【図7】本発明の実施形態3の回路構成を示す図である。

【図8】本発明の実施形態3の回路構成を示す図である。

【図9】本発明の実施形態4の回路構成を示す図である。

【図10】本発明の実施形態5の回路構成を示す図であ

る。

【図11】本発明の実施形態6の回路構成を示す図である。

【図12】本発明の実施形態7、11の回路構成を示す図である。

【図13】本発明の実施形態8、9、10の回路構成を示す図である。

【図14】本発明の実施形態8のスイッチング動作を示す図である。

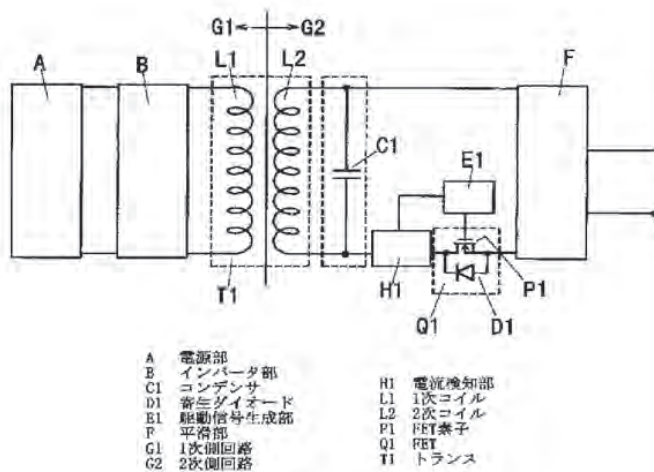
【図15】本発明の実施形態10のスイッチング動作を示す図である。

【図16】本発明の実施形態11のスイッチング動作を示す図である。

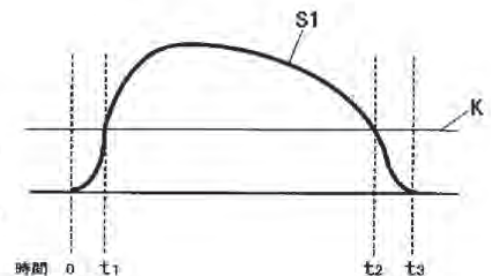
【符号の説明】

- A 電源部
- B インバータ部
- C1 コンデンサ
- D1 寄生ダイオード
- E1 駆動信号生成部
- F 平滑部
- G1 1次側回路
- G2 2次側回路
- H1 電流検知部
- L1 1次コイル
- L2 2次コイル
- P1 FET素子
- Q1 FET
- T1 トランス

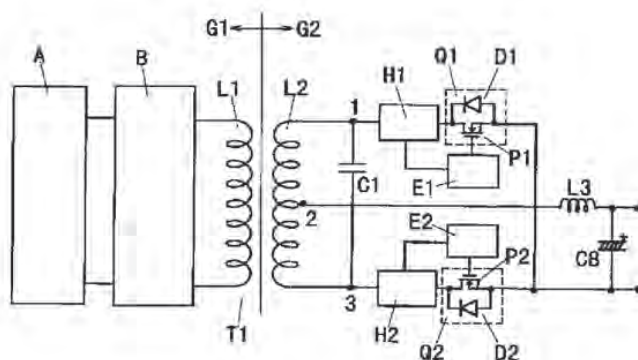
【図1】



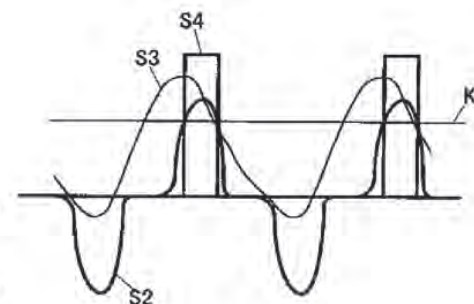
【図2】



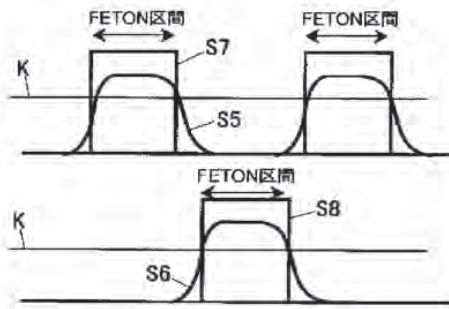
【図3】



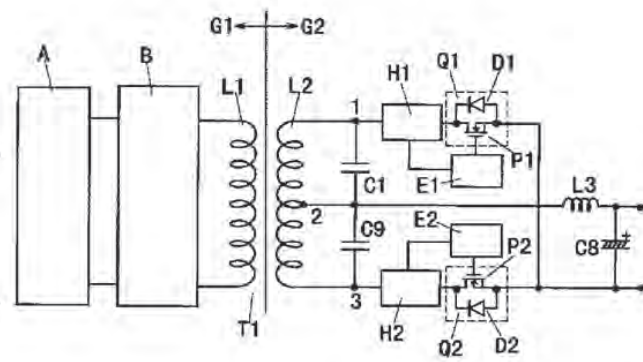
【図4】



【図 5】

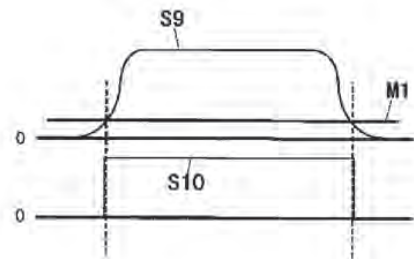
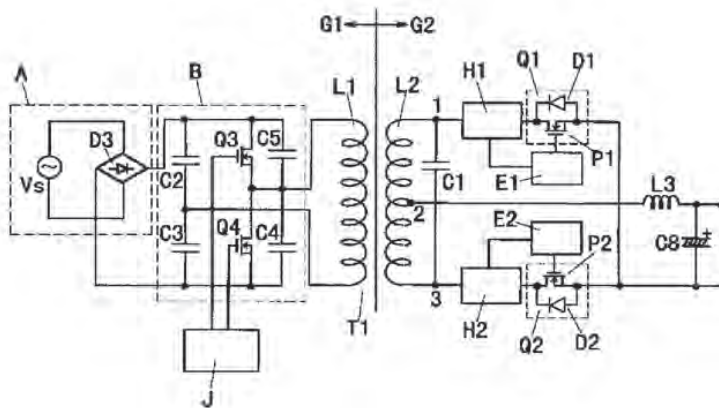


【図 6】



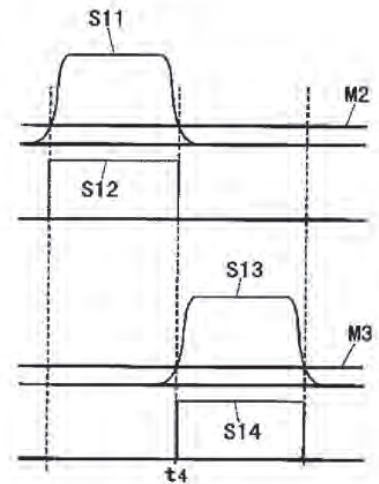
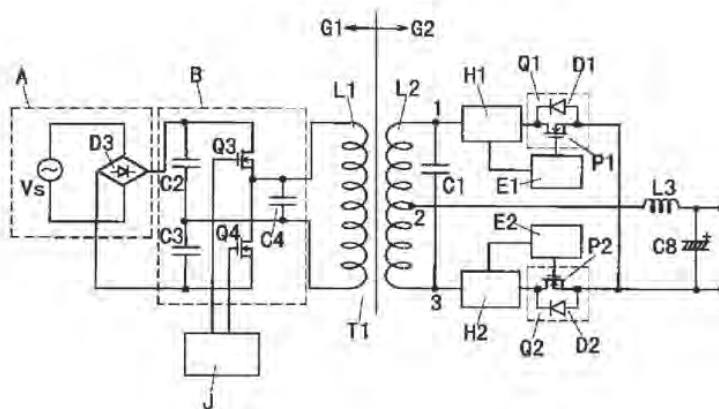
【図 7】

【図 1 4】

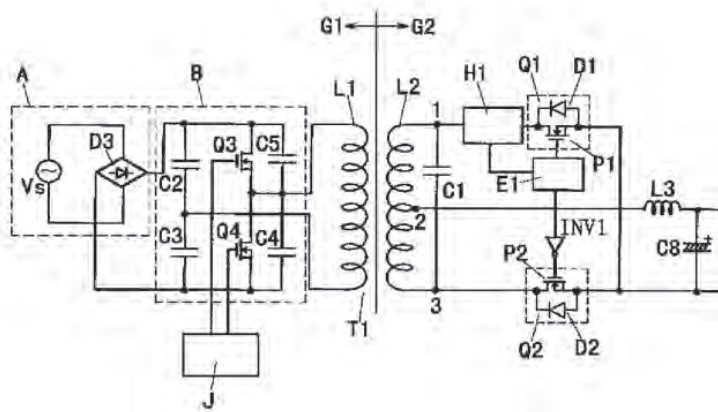


【図 1 5】

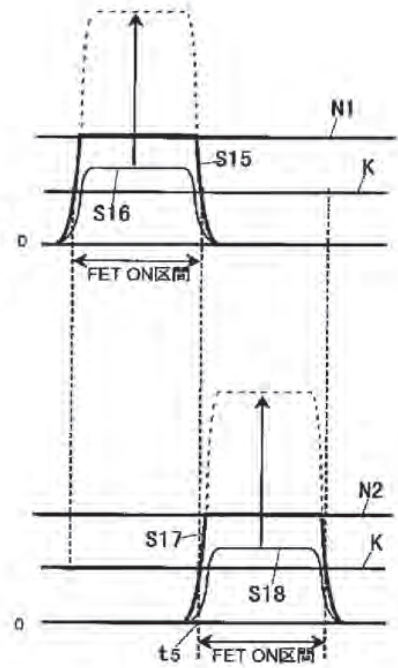
【図 8】



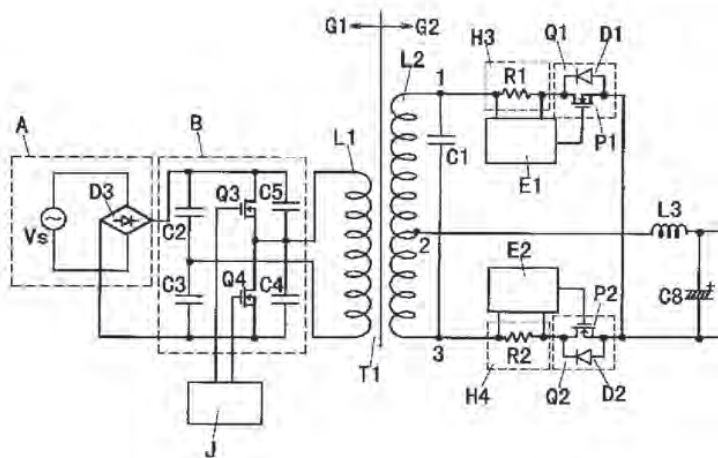
【図 9】



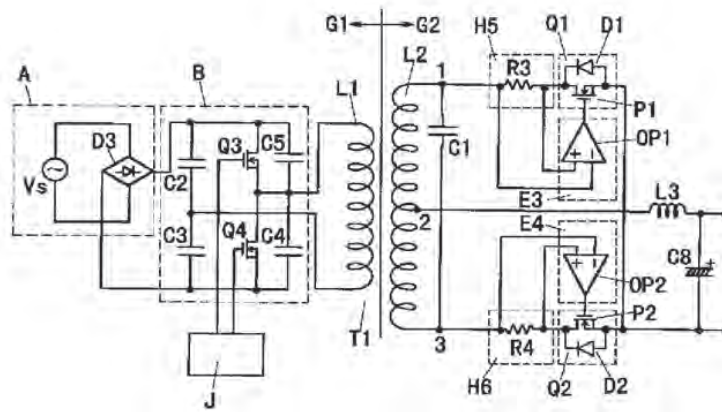
【図 16】



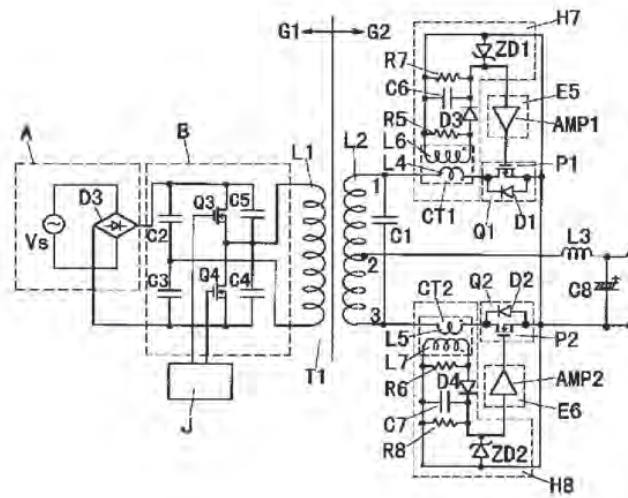
【図 10】



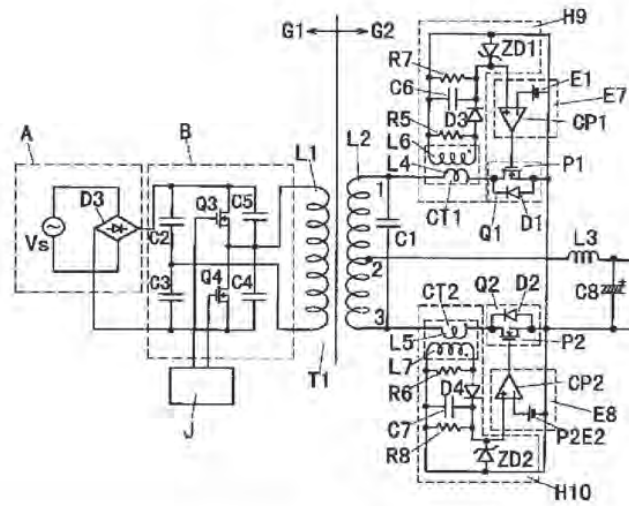
【図 1 1】



【図 1 2】



【図 13】



フロントページの続き

Fターム(参考) 5H006 CA02 CB01 CB07 CC01 DB03
 DC02 HA09
 5H730 BB25 BB26 CC01 DD04 DD21
 EE02 EE03 EE13 FD31

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Friday, April 11 2014

THOMSON INNOVATION

Patent/Publication: JP2002010535A**Bibliography****DWPI Title**

Non-contact electric power transmittance device has controller which performs decimation control, to stabilize high frequency voltage of primary coil

Original Title

NON-CONTACT POWER TRANSMISSION DEVICE

Non-contact power transmission apparatus (*Translation from Thomson Reuters*)**English Title**

NON-CONTACT POWER TRANSMISSION DEVICE

Assignee/ApplicantStandardized: **MATSUSHITA ELECTRIC WORKS LTD**

Original: MATSUSHITA ELECTRIC WORKS LTD

DWPI Assignee/Applicant

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ABE H; KAWAMOTO M; MUTO M

Publication Date (Kind Code)

2002-01-11 (A)

DWPI Accession / Update

2002-355609 / 200239

Application Number / Date

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Priority Number / Date / Country

JP2000193404A / 2000-06-27 / JP

Abstract**DWPI Abstract**<https://www.thomsoninnovation.com/tip-innovation/printRecView.do?ResultSetId=69744...> 4/11/2014

(JP2002010535A)

Novelty

A non-contact wall socket (1) has a controller which performs a decimation control, to stabilize high frequency voltage (V1) of a primary coil (L1), supplied from an inverter circuit (11).

Use

Non-contact electric power transmittance device.

Advantage

As the output voltage is stabilized to fixed value in the large load range, raise of the output voltage at the time of failure is suppressed, hence size of the rectification unit is reduced and the optimum load adjustment can be performed with improved efficiency.

Drawing Description

The figure shows the circuit block diagram of the non-contact electric power transmittance device. (Drawing includes non-English language text).

1 - Non-contact wall socket.

11 - Inverter circuit.

L1 - Primary coil.

Abstract

PROBLEM TO BE SOLVED: To provide a non-contact power transmission device capable of stabilizing output terminal voltage to a constant value in a wide load range.

SOLUTION: This non-contact power transmission device consists of a non-contact receptacle 1 including, a power circuit 10 outputting a DC voltage E and an inverter circuit 11 generating a constant frequency high-frequency voltage V1 by inputting the DC voltage E and switching a semiconductor switch and a primary coil L1 for power transmission to which is supplied the high-frequency voltage V1 from the inverter circuit 11, a non-contact plug 2 including a secondary coil L2 for receiving power in which a high-frequency voltage V2 is induced by the primary coil L1 for power transmission and a rectifying and smoothing circuit 20 rectifying and smoothing the high frequency voltage V2 induced in the secondary coil L2 for receiving power, and a terminal apparatus 3 connected to the output terminal of the non-contact plug 2 to serve as a load, and conducts thinning-out control for thinning out the high-frequency voltage V1 of constant frequency supplied to the primary coil L1 for power transmission from the inverter circuit 11.

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SUBJECT of the Invention The non-contact power transmission apparatus which can stabilize an output-terminal voltage to a constant value in the wide load range is provided.

PROBLEM to be solved The power supply circuit 10 and DC voltage E which output DC voltage E are inputted.

The non-contact outlet socket 1 which contains the primary coil L1 for electric power transmission to which the high frequency voltage V1 is supplied from the inverter circuit 11 which generates the high frequency voltage V1 of constant frequency by switching a semiconductor switch, and the inverter circuit 11, The non-contact plug 2 including the rectification/smoothing circuit 20 which rectifies/smoothes the high frequency voltage V2 induced by the secondary coil L2 for electric power power receiving and the secondary coil L2 for electric power power receiving which are induced in the high frequency voltage V2 from the primary coil L1 for electric power transmission,

It comprises from the terminal device 3 which is connected to the output terminal of the non-contact plug 2, and becomes load,

Thinning|dicimation control which thins|decimates out the high frequency voltage V1 of the constant frequency supplied to the primary coil L1 for electric power transmission from the inverter circuit 11 is performed.

[MAT_IMAGE 000002]

(Translation from Thomson Reuters)

Classes/Indexing

IPC

IPC Code(1-7) **H02J 17/00** H01F 38/14 H02J 1/00 H02M 3/28 H02M 3/335

(7)

Current IPC	Invention	Version	Additional	Version
Full	H01F 38/14	20060101		
	H02J 1/00	20060101		
	H02J 17/00	20060101	-	-
	H02M 3/28	20060101		
	H02M 3/335	20060101		
Main Group	-	-	-	-
Subclass	-	-	-	-

Original IPC	Invention	Version	Additional	Version
Advanced/Full	H01F 38/14	20060101		
	H02J 1/00	20060101		
	H02J 17/00	20060101	-	-
	H02M 3/28	20060101		
	H02M 3/335	20060101		
Core/Main Group	H01F 38/14	20060101		
	H02J 1/00	20060101		
	H02J 17/00	20060101	-	-
	H02M 3/24	20060101		
Subclass	-	-	-	-

JP FI Codes

H01F 23/00 B; H02J 1/00 306 B; H02J 17/00 B; H02M 3/28 H; H02M 3/28 Q; H02M 3/335 E

JP F Terms

<https://www.thomsoninnovation.com/tip-innovation/printRecView.do?ResultSetId=69744...> 4/11/2014

5E060

5G063

5G065: AA00; DA06; DA07; EA06; HA04; JA01; LA01; MA01; MA02; MA03; MA09; MA10; NA01; NA02;
NA03; NA09

5H730: AA17; AS01; BB25; BB26; BB57; BB75; CC01; EE03; EE08; EE59; FD01; FF18; FG07

DWPI Class

U24 V02 X12

DWPI Manual Codes[Expand DWPI Manual Codes](#)**DWPI Chemistry Resource Numbers**[Expand DWPI Chemistry Resource Numbers](#)**DWPI Registry Numbers**[Expand DWPI Registry Numbers](#)**Plasdoc Punch Codes**[Expand 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
2012-06-05	FPAY +	RENEWAL FEE PAYMENT (PRS DATE IS RENEWAL DATE OF DATABASE) PAYMENT UNTIL: 20130613
2012-05-31	FPAY +	RENEWAL FEE PAYMENT (PRS DATE IS RENEWAL DATE OF DATABASE) PAYMENT UNTIL: 20120613

<https://www.thomsoninnovation.com/tip-innovation/printRecView.do?ResultSetId=69744...> 4/11/2014

2011-05-31	FPAY +	RENEWAL FEE PAYMENT (PRS DATE IS RENEWAL DATE OF DATABASE) PAYMENT UNTIL: 20120613
2008-12-04	R350	WRITTEN NOTIFICATION OF REGISTRATION OF TRANSFER JAPANESE INTERMEDIATE CODE: R350
2008-12-04	FPAY +	RENEWAL FEE PAYMENT (PRS DATE IS RENEWAL DATE OF DATABASE) PAYMENT UNTIL: 20110613
2008-11-26	S533	WRITTEN REQUEST FOR REGISTRATION OF CHANGE OF NAME JAPANESE INTERMEDIATE CODE: R313533
2008-06-16	FPAY +	RENEWAL FEE PAYMENT (PRS DATE IS RENEWAL DATE OF DATABASE) PAYMENT UNTIL: 20110613
2008-06-12	A61 +	FIRST PAYMENT OF ANNUAL FEES (DURING GRANT PROCEDURE) JAPANESE INTERMEDIATE CODE: A61 2008-05-26
2008-05-15	A01 +	WRITTEN DECISION TO GRANT A PATENT OR TO GRANT A REGISTRATION (UTILITY MODEL) JAPANESE INTERMEDIATE CODE: A01
2008-05-14	A01 +	WRITTEN DECISION TO GRANT A PATENT OR TO GRANT A REGISTRATION (UTILITY MODEL) JAPANESE INTERMEDIATE CODE: A01 2008-05-13
2008-05-07	TRDD +	DECISION OF GRANT OR REJECTION WRITTEN
2008-04-08	A521	WRITTEN AMENDMENT JAPANESE INTERMEDIATE CODE: A523 2008-04-07
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2008-02-01	A977	REPORT ON RETRIEVAL JAPANESE INTERMEDIATE CODE: A971007 2008-02-01
2006-10-18	A621 +	WRITTEN REQUEST FOR APPLICATION EXAMINATION JAPANESE INTERMEDIATE CODE: A621 2006-10-17

Get Family Legal Status

Family**Family**

INPADOC Family (2)

Publication Number	Publication Date	Inventor	Assignee/Applicant	Title
JP2002010535A	2002-01-11	ABE HIDEAKI	MATSUSHITA ELECTRIC WORKS LTD	NON-CONTACT POWER TRANSMISSION DEVICE
JP04135299B2	2008-08-20	-	MATSUSHITA ELECTRIC WORKS LTD	-

DWPI Family (2); Countries (1)

Publication	DWPI Update	Publication Date	IPC Code	Language
JP2002010535A	200239	2002-01-11	H02J001700	Japanese
Local Applications: JP2000193404A filed 2000-06-27				
JP04135299B2	200857	2008-08-20	H02J001700	Japanese
Local Applications: JP2000193404A filed 2000-06-27				

Claims**Claims**
<https://www.thomsoninnovation.com/tip-innovation/printRecView.do?ResultSetId=69744...> 4/11/2014

All Claims (25)

Claims (English)

1. The non-contact outlet socket comprised from the primary coil for electric power transmission to which the said high frequency voltage is supplied from the power supply circuit which outputs a DC voltage, the inverter circuit which converts the said DC voltage into the high frequency voltage of constant frequency, and the said inverter circuit,

The non-contact plug comprised from the rectification/smoothing circuit which rectifies/smoothes the high frequency voltage induced by the secondary coil for electric power power receiving which comprises the said primary coil for electric power transmission, and a separative|detachable trans|transformer structure, and is induced in high frequency voltage, and the said secondary coil for electric power power receiving,

The non-contact power transmission apparatus comprised from the terminal device which is connected to the output terminal of the said non-contact plug, and becomes load

WHEREIN:

The said non-contact outlet socket,

The control means which performs thinning|decimation control which thins|decimates out and stabilizes the high frequency voltage to which the output-terminal voltage of the said non-contact plug with respect to the load area|region made into object is supplied from the said inverter circuit by the said primary coil for electric power transmission is provided.

The non-contact power transmission apparatus characterized by the above-mentioned.

2. When the output-terminal voltage of a non-contact plug exceeds a predetermined voltage, the said control means,

Supply of the high frequency voltage from an inverter circuit to the primary coil for electric power transmission is thinned|decimated out for a fixed time, and if the output-terminal voltage of the non-contact plug has exceeded the said predetermined voltage after thinning|decimating out for a definite period of time [said], it will repeat thinning|decimating out supply of the said high frequency voltage to the primary coil for electric power transmission for a fixed time again,

When the output-terminal voltage of a non-contact plug is less than a predetermined voltage after thinning|decimating out for a definite period of time [each said], the operation|movement which supplies the said high frequency voltage to the primary coil for electric power transmission continuously is continued until the output-terminal voltage of a non-contact plug exceeds a predetermined voltage.

The non-contact power transmission apparatus of Claim 1 characterized by the above-mentioned.

3. A non-contact plug converts the information showing the electric state inside a non-contact plug into a magnetic signal, and transmits it to a non-contact outlet socket,

The said control means is thinned|decimated out based on the said magnetic signal, and forms the control signal for control,

An inverter circuit is thinned|decimated out with the said control signal, and it controls.

The non-contact power transmission apparatus of Claim 1 or 2 characterized by the above-mentioned.

4. An inverter circuit is a partial resonance inverter of a half-bridge type|mode.

The non-contact power transmission apparatus in any one of the Claims 1 to 3 characterized by the above-mentioned.

5. The secondary coil for electric power power receiving is provided with a center tap, and a rectification/smoothing circuit has the full wave rectification part which connected each other end which have not been connected to the secondary coil for electric power power receiving of the rectifier in series and mutually connected to both the output terminals that are not the center taps of the secondary coil for electric power power receiving at a reverse direction,

A choke coil is connected to the connection middle point of the said rectifier.

The non-contact power transmission apparatus of Claim 4 characterized by the above-mentioned.

6. A capacitor|condenser is parallelly connected to the secondary coil for electric power power receiving.

The non-contact power transmission apparatus in any one of the Claims 1 to 5 characterized by the above-mentioned.

7. At the time of the maximum load of the load area|region made into object, the electrostatic capacitance value of the said capacitor|condenser is the polarity inversion time of the high frequency voltage supplied to the primary coil for electric power transmission,

It is an electrostatic capacitance value to which the time when the vibration voltage generate|occur|produced at the both ends of the said capacitor|condenser becomes maximum value or a

minimum value corresponds.

The non-contact power transmission apparatus of Claim 6 characterized by the above-mentioned.

8. Provide a primary side signal receiver coil in a non-contact outlet socket, and a non-contact plug opposingly arranges at the said primary side signal receiver coil, and the said primary side signal receiver coil and the secondary side signal transmission coil which comprises a separative|detachable trans|transformer structure are provided,

The signal which converted the information showing the electric state inside a non-contact plug into the alternating voltage is inputted into the said secondary side signal transmission coil, and it generate|occur|produces a magnetic flux signal as a magnetic signal,

The said primary side signal receiver coil is induced by the said magnetic flux signal in a voltage,

The said control means carries out the above-mentioned thinning|dication control of the inverter circuit with the control signal based on the induced said voltage.

The non-contact power transmission apparatus in any one of the Claims 3 to 7 characterized by the above-mentioned.

9. The partition for magnetic shieldings which consists of magnetic bodies was provided between at least one between the primary coil for electric power transmission, and a primary side signal receiver coil, and between the secondary coil for electric power power receiving, and a secondary side signal transmission coil.

The non-contact power transmission apparatus of Claim 8 characterized by the above-mentioned.

10. The primary coil for electric power transmission and the secondary coil for electric power power receiving were wound to the core consisting of a magnetic body, and the axial direction of the said core was made to mutually opposingly arrange the said core.

The non-contact power transmission apparatus of Claim 9 characterized by the above-mentioned.

11. The primary coil for electric power transmission and the secondary coil for electric power power receiving are wound to the core consisting of the magnetic body of the bottomed cylinder type|mold which has an opening part in a direction perpendicular|vertical to the axial direction of the said coil,

The axial direction of the said core is made to mutually opposingly arrange the said core.

The primary side signal receiver coil and the secondary side signal transmission coil have been arrange|positioned to the vicinity of the non-opening part of the said core.

The non-contact power transmission apparatus of Claim 9 characterized by the above-mentioned.

12. The signal which converted the information showing the electric state inside a non-contact plug into the alternating voltage is inputted into a secondary side signal transmission coil, and it generate|occur|produces the magnetic flux signal which has a phase of an antiphase with the magnetic flux which the primary coil for electric power transmission generates.

The non-contact power transmission apparatus in any one of the Claims 8 to 11 characterized by the above-mentioned.

13. One terminal of a secondary side signal transmission coil is connected to an any one of the terminals of the secondary coil for electric power power receiving.

The non-contact power transmission apparatus of Claim 12 characterized by the above-mentioned.

14. A non-contact outlet socket provides the coil for a magnetic flux detection which detects the magnetic flux generate|occur|produced between the primary coil for electric power transmission, and the secondary coil for electric power power receiving in the vicinity of the primary coil for electric power transmission, and the said coil for a magnetic flux detection detects the magnetic flux generate|occur|produced with the primary coil for electric power transmission as a magnetic signal, Based on the voltage output according to the said magnetic flux to detect from the said coil for a magnetic flux detection, the said control means thins|decimates out and controls an inverter circuit.

The non-contact power transmission apparatus in any one of the Claims 3 to 7 characterized by the above-mentioned.

15. The primary coil for electric power transmission and the secondary coil for electric power power receiving are provided in the core consisting of the magnetic body of the bottomed cylinder type|mold which has an opening part in a direction perpendicular|vertical to the axial direction of the said coil, and the axial direction of the said core is made to mutually opposingly arrange the said core.

The said coil for a magnetic flux detection has been arrange|positioned to the vicinity of the opening part of the core of the said primary coil for electric power transmission.

The non-contact power transmission apparatus of Claim 14 characterized by the above-mentioned.

16. One non-contact outlet socket adapts several non-contact plugs from which an output voltage differs,
It has the said control means that stores the output voltage of each said non-contact plug in the predetermined voltage range in all areas|domains including the load area|region which each non-contact plug makes object.

The non-contact power transmission apparatus in any one of the Claims 1 to 15 characterized by the above-mentioned.

17. Resistance is parallelly connected to the output terminal of a non-contact plug.

The non-contact power transmission apparatus in any one of the Claims 1 to 16 characterized by the above-mentioned.

18. When the non-contact plug has not couple|bonded with the predetermined position of a non-contact outlet socket, the said control means restrict|limits the output supplied to the primary coil for electric power transmission from an inverter circuit.

The non-contact power transmission apparatus in any one of the Claims 1 to 17 characterized by the above-mentioned.

19. A non-contact outlet socket is provided with the switch function which controls the restriction|limiting of supply of the high frequency voltage from an inverter circuit to the primary coil for electric power transmission,

If a non-contact plug is provided with the driver which controls the on-off state of the said switch function and a non-contact plug couple|bonds with the predetermined position of a non-contact outlet socket, the said control means will enable supply of the high frequency voltage from an inverter circuit to the primary coil for electric power transmission in operating the said switch function.

The non-contact power transmission apparatus of Claim 18 characterized by the above-mentioned.

20. The said switch function of a non-contact outlet socket consists of mechanical contacts, the driver with which a non-contact plug is provided consists of magnets, and if a non-contact plug couple|bonds with the predetermined position of a non-contact outlet socket, the said mechanical contact will operate|move by the magnetic force of the said magnet,

The said control means enables supply of the high frequency voltage from an inverter circuit to the primary coil for electric power transmission.

The non-contact power transmission apparatus of Claim 19 characterized by the above-mentioned.

21. If a non-contact plug couple|bonds with the predetermined position of a non-contact outlet socket, the display of a non-contact plug and a non-contact outlet socket which alert|reports use 可能 to which or one side at least will be performed.

The non-contact power transmission apparatus in any one of the Claims 1 to 20 characterized by the above-mentioned.

22. The display part of the load electric power of a terminal device of a non-contact outlet socket and a non-contact plug with which which or one side at least was connected to the output terminal of a non-contact plug, and the output voltage of a non-contact plug which displays which or one side at least was added.

The non-contact power transmission apparatus in any one of the Claims 1 to 21 characterized by the above-mentioned.

23. the terminal device connected to the output terminal of a non-contact plug is separative|detachable with respect to the said non-contact plug.

The non-contact power transmission apparatus in any one of the Claims 1 to 22 characterized by the above-mentioned.

24. Supply of the electric power from the output terminal of a non-contact plug to a terminal device is supplied by magnetic coupling.

The non-contact power transmission apparatus of Claim 23 characterized by the above-mentioned.

25. Voltage clamp elements are connected between the output terminals of a non-contact plug.

The non-contact power transmission apparatus in any one of the Claims 1 to 24 characterized by the above-mentioned.

(Translation from Thomson Reuters)

Description

DWPI Drawing Description

The figure shows the circuit block diagram of the non-contact electric power transmittance device. (Drawing includes non-English language text).

1 - Non-contact wall socket.

11 - Inverter circuit.

L1 - Primary coil.

Drawing Description

Drawing Description

Description

Description

TECHNICAL FIELD of the Invention

This invention relates to a non-contact power transmission apparatus.

PRIOR ART

In recent years, the utilization using an electromagnetic induction of non-contact power transmission is performed briskly.

The example of utilization even if that as which load is identified is most and makes several load object, or these are individual load, in case they change the load current a lot is not found.

In non-contact power transmission, an electrical insulator exists between the primary side which becomes the electric power supply side, and a secondary side with load,

Electric power is transmitted via the trans|transformer which has a structure which can carry out isolation|separation attachment or detachment with the primary side coil by the side of an electric power supply, and the secondary side coil of a load side.

The schematic block diagram of the prior art example 1 of the non-contact power transmission apparatus by the said trans|transformer is shown in FIG. 27.

The high frequency voltage V1 of about 20 kHz or more which is more than the audible area frequency produced|generated in the inverter circuit (it abbreviate|omits in this prior art example) is applied to the both ends of the primary side coil L1 by the side of an electric power supply, and a primary side is comprised,

The secondary side coil L2 of a load side in which a secondary side has the magnetic coupling degree M between the primary side coils L1,

It is comprised from the smooth rectifier circuit 20 which rectifies|straightens the voltage induced by the secondary side coil L2, and the load 3a which is the load connected to the output terminal of the smooth rectifier circuit 20, and the trans|transformer T1 for electric power transmission and reception which has a structure which can carry out isolation|separation attachment or detachment with the primary side coil L1 and the secondary side coil L2 is comprised.

FIG. 28 shows the structure of the trans|transformer T1 for electric power transmission and reception.

The primary side which supplies electric power has the primary side coil L1 provided in E-type core A4 which consists of magnetic materials,

The secondary side to which electric power is supplied from a primary side also has the secondary side coil L2 provided in E-type core A4 which consists of magnetic materials similarly,

It mutually faces each other via electrical insulation GAP116.

In such a trans|transformer T1 for electric power transmission and reception that can carry out isolation|separation attachment or detachment, the leakage flux F1 arises and the magnetic coupling degree M of the primary side coil L1 and the secondary side coil L2 falls.

The equivalent circuit which converted the circuit of FIG. 27 into FIG. 29 at the secondary side is shown here.

The leakage inductance L_4 is connected to the output of the voltage source E_2 which has an induced voltage of the secondary side coil L_2 in series, and it connects to the load $3a$ via the smooth rectifier circuit 20 .

If the interlinkage magnetic flux F_2 of the secondary side coil L_2 decreases among the total magnetic flux which the magnetic coupling degree M falls as mentioned above, and is produced with the primary coil L_1 , the leakage inductance L_4 by the leakage flux F_1 will arise.

Moreover, since the voltage V_1 applied by the both ends of the primary side coil L_1 is driven at high frequency of about 20 kHz or more which is more than an audible area frequency,

When the magnetic coupling degree M transmits electric power to the load $3a$ via the transformer T_1 for electric power transmission and reception which has the leakage inductance L_4 low, the induced voltage of the secondary coil L_2 , i.e., the voltage of the voltage source E_2 , falls,

A voltage drop is raised/generated for the inductive reactance by the leakage inductance L_4 ,

The output-terminal voltage V_3 falls as a result.

FIG. 30 is the figure which showed the characteristic 117a of the output-terminal voltage V_3 with respect to the load current I_3 and the characteristic 118a of the load electric power P which are shown in FIG. 29.

The output-terminal voltage V_3 falls linearly because of the alternating current impedance by the leakage inductance L_4 .

Moreover, as for the load electric power P , below with a predetermined voltage, the load current I_3 increases the load electric power P as the load current I_3 increases,

However,

The load electric power P declines as the load current I_3 will increase, if the load current I_3 becomes more than a predetermined voltage.

The output-terminal voltage V_3 falls, so that the load current I_3 increases above a predetermined electric current value, when the apparatus of a different load current which operates/moves in a fixed voltage input in having such a characteristic is provided as the load $3a$,

It deviates from the constant-voltage input conditions of the load 7 , and it becomes impossible to exhibit original performance.

Moreover, in non-contact charging, in non-contact power transmission, parallel or the power factor improvement connect a capacitor/condenser in series and according to a load adjustment is performed in the secondary coil L_2 ,

The active power which can supplement the influence of the said leakage inductance L_4 , and can be taken out by a secondary side is made to increase in many cases.

The circuit diagram of FIG. 31 is what connected the capacitor/condenser C_2 to the secondary side coil L_2 of the said FIG. 27 parallelly,

FIG. 32 shows the equivalent circuit which converted the circuit of FIG. 31 into the secondary side,

The leakage inductance L_4 is connected to the output of the voltage source E_2 which has an induced voltage of the secondary side coil L_2 in series, the capacitor/condenser C_2 is parallelly connected to the voltage source E_2 via the leakage inductance L_4 , and the both ends of the capacitor/condenser C_2 are connected to the load $3a$ via the rectification/smoothing circuit 20 .

By connecting the said capacitor/condenser C_2 , an electric power transmission efficiency improves significantly and size reduction is possible.

When charging the load $3a$, the output-terminal voltage V_3 turns into a battery voltage, and is substantially constant.

However,

For example, the load $3a$ is not constant-voltage load, to load like resistance, it is as follows,

If the load current I_3 increases compared with the case where it does not connect when the capacitor/condenser C_2 is connected, as shown in the characteristic 117b of the output-terminal voltage V_3 with respect to the load current I_3 of FIG. 33, and the characteristic 118b of the load electric power P , the fall of the output-terminal voltage V_3 will be seen notably.

Moreover, when the load electric power P is the output-terminal voltage V_3 of point K vicinity which is peaked, an optimal load adjustment is performed, and in the area/region where the load current I_3 is larger than the load current in this K point, the output-terminal voltage V_3 falls quickly.

The output-terminal voltage V_3 is falling inversely proportion to the load current I_3 also in the area/region where the load current I_3 is smaller than the load current in K point.

And in the area/region where the load current I_3 is very small, the output-terminal voltage V_3 is large suddenly.

As it shows in the non-contact electric power transmission with above characteristics and the characteristics in the characteristic 117c of the output-terminal voltage V3 with respect to the load current I3 of FIG. 34, and the characteristic 118c of the load electric power P.

A method of making constant and stabilizing the output-terminal voltage V3 in all the load area|regions made into object with respect to the load from which the load current I3 differs the output-terminal voltage V3 is desired.

In order to acquire this stable characteristic, the output-terminal voltage V3 of a secondary side is detected so that it may be carried out by voltage control of normal switched-mode power supply,

Difference|error amplification is compared and carried out with a reference voltage,

When the feedback control method which transmits non-contactedly the signal which carried out difference|error amplification to a primary side, and controls the drive voltage amplitude, the frequency, duty, and thinning|dicimation rate of a primary side was examined, it became clear that all produced a problem in a prior art.

PROBLEM to be solved by the Invention

In non-contact transmission, even if it gives that the noise by the leakage flux F1 increases for a while, and a load adjustment compared with normal switched-mode power supply, circuit efficiency falls for a while,

As for the inverter circuit for producing|generating from this the high frequency voltage V1 applied by the primary coil L1, it is optimal to employ|adopt a resonance type inverter.

And it is best to set the electrostatic capacitance of the capacitor|condenser C2 connected to performing the optimal load adjustment in a voltage area|region to stabilize at the time of the maximum load electric current made into object, i.e., a secondary side, to the optimal value for performing a load adjustment.

However, when performing the stabilization which makes the output-terminal voltage V3 regularity ranging from the time of a no load to the time of a full load in the above-mentioned circuit system, there exists a problem.

The capacitor|condenser C2 for a load adjustment linked to a secondary side,

A circuit operation|movement may become unstable if the inverter circuit for producing|generating the high frequency voltage V1 applied by the primary coil L1 has the large change width of a frequency or a duty ratio in a PWM system and a frequency-variable system, since it connects in all the load current area|regions.

In the voltage source E2 which has an induced voltage of the secondary side coil L2 as shown to the secondary side equivalent circuit shown in FIG. 32, this,

Since the series resonance circuit where the leakage inductance L4 and the capacitor|condenser C2 were connected in series is connected, if the frequency and duty ratio of a voltage which the frequency and duty ratio of the high frequency voltage V1 which are applied by the primary coil L1 change a lot, and induce in the secondary side coil L2 change a lot,

The operation|movement of the said series resonance circuit is also considered to be for changing a lot.

Even if this influence is able to be disregarded, when the load current I3 must be changed very a lot (for example, when there exists 100 times as much change width),

Since the frequency and duty ratio of the high frequency voltage V1 which are applied by the primary coil L1 are also very large and it must be made to change, control in a light load and the no load vicinity may get an out of control exceeding the practical limit of a circuit operation|movement especially.

Moreover, when the inverter circuit for producing|generating the high frequency voltage V1 applied by the primary coil L1 performs the conventional thinning|dicimation control,

The conventional thinning|dicimation control is "a control method which stops an inverter when the target voltage which wants to stabilize the detection voltage of an output-terminal voltage is exceeded, while carrying out the continuous drive of the high frequency voltage V1 applied by the primary coil L1 on the fixed frequency",

This method is also a light load and the no load vicinity.

WHEREIN:

While the on-off action which is less also than 1 period of driving frequency is performed frequently, and low-loss soft switching which is a merit of a resonance type inverter is not performed, but it hard-switches and a switching loss increases at target voltage vicinity,

It becomes a strong noise source.

And these control systems were feedback control by which information, such as the output-terminal voltage V3 of a secondary side, controls the drive voltage amplitude, the frequency, duty ratio, and thinning|dicimation rate of an inverter circuit of a primary side via the photocoupler using an optical

signal in the prior art.

However,

In a non-contact power transmission apparatus, when used by a harsh environment a place with many the circumferences of water, such as a bathroom and the outdoors, and stain|pollution|contamination, in order that the merit may come out, employment|adoption is difficult for a technical means to utilize the optical signal received by a surrounding brightness and the influence of stain|pollution|contamination etc.

This invention is made in view of the said reason,

The objective is to provide the non-contact power transmission apparatus which can stabilize an output-terminal voltage to a constant value in the wide load range.

MEANS to solve the Problem

Invention of Claim 1 is a non-contact outlet socket comprised from the primary coil for electric power transmission to which the said high frequency voltage is supplied from the power supply circuit which outputs a DC voltage, the inverter circuit which converts the said DC voltage into the high frequency voltage of constant frequency, and the said inverter circuit,

The non-contact plug comprised from the rectification/smoothing circuit which rectifies/smoothes the high frequency voltage induced by the secondary coil for electric power power receiving which comprises the said primary coil for electric power transmission, and a separative|detachable trans|transformer structure, and is induced in high frequency voltage, and the said secondary coil for electric power power receiving,

The non-contact power transmission apparatus comprised from the terminal device which is connected to the output terminal of the said non-contact plug, and becomes load

WHEREIN:

The said non-contact outlet socket,

The control means which performs thinning|decimation control which thins|decimates out and stabilizes the high frequency voltage to which the output-terminal voltage of the said non-contact plug with respect to the load area|region made into object is supplied from the said inverter circuit by the said primary coil for electric power transmission is provided,

It can be characterized by the above-mentioned and the non-contact power transmission apparatus which can stabilize an output-terminal voltage to a constant value in the wide load range can be provided.

In invention of Claim 1, invention of Claim 2 the said control means,

When the output-terminal voltage of a non-contact plug exceeds a predetermined voltage,

Supply of the high frequency voltage from an inverter circuit to the primary coil for electric power transmission is thinned|decimated out for a fixed time, and if the output-terminal voltage of the non-contact plug has exceeded the said predetermined voltage after thinning|decimating out for a definite period of time [said], it will repeat thinning|decimating out supply of the said high frequency voltage to the primary coil for electric power transmission for a fixed time again,

When the output-terminal voltage of a non-contact plug is less than a predetermined voltage after thinning|decimating out for a definite period of time [each said], the operation|movement which supplies the said high frequency voltage to the primary coil for electric power transmission continuously is continued until the output-terminal voltage of a non-contact plug exceeds a predetermined voltage,

It is characterized by the above-mentioned,

The non-contact power transmission apparatus which can stabilize an output-terminal voltage to a constant value in the wide load range can be provided.

In invention of Claim 1 or 2, invention of Claim 3 converts the information showing the electric state inside a non-contact plug into a magnetic signal, and transmits a non-contact plug to a non-contact outlet socket,

The said control means is thinned|decimated out based on the said magnetic signal, and forms the control signal for control,

An inverter circuit is thinned|decimated out with the said control signal, and it controls,

It is characterized by the above-mentioned,

Since a magnetic signal is used for the feedback signal for voltage stabilization, the non-contact power transmission apparatus which can stabilize an output-terminal voltage to a constant value in the wide load range can be provided without being received by a surrounding brightness and the influence of stain|pollution|contamination.

In the invention in any one of Claims 1 to 3, the inverter circuit of invention of Claim 4 is a partial resonance inverter of a half-bridge type|mode|, It can be characterized by the above-mentioned and a raise of the output voltage at the time of a failure can be suppressed.

In invention of Claim 4, invention of Claim 5 is provided with the secondary coil for electric power power receiving, and a center tap a rectification/smoothing circuit, It has the full wave rectification part which connected each other end which have not been connected to the secondary coil for electric power power receiving of the rectifier in series and mutually connected to both the output terminals that are not the center taps of the secondary coil for electric power power receiving at a reverse direction, A choke coil is connected to the connection middle point of the said rectifier, It can be characterized by the above-mentioned and a rectification|straightening part can be reduced in size.

Invention of Claim 6 connects a capacitor|condenser to the secondary coil for electric power power receiving parallelly in the invention in any one of Claims 1 to 5, It can be characterized by the above-mentioned and the active power which can be transmitted to a secondary side can be made to increase from a primary side by taking a load adjustment.

At the time of the maximum load of the load area|region which makes the electrostatic capacitance value of the said capacitor|condenser object in invention of Claim 6, invention of Claim 7 is the polarity inversion time of the high frequency voltage supplied to the primary coil for electric power transmission, It is an electrostatic capacitance value to which the time when the vibration voltage generate|occur|produced at the both ends of the said capacitor|condenser becomes maximum value or a minimum value corresponds, It can be characterized by the above-mentioned, an optimal load adjustment can be performed, and circuit efficiency can be improved.

Invention of Claim 8 provides a primary side signal receiver coil in a non-contact outlet socket in the invention in any one of Claims 3 to 7, A non-contact plug opposingly arranges at the said primary side signal receiver coil, and the said primary side signal receiver coil and the secondary side signal transmission coil which comprises a separative|detachable trans|transformer structure are provided, The signal which converted the information showing the electric state inside a non-contact plug into the alternating voltage is inputted into the said secondary side signal transmission coil, and it generate|occur|produces a magnetic flux signal as a magnetic signal, The said primary side signal receiver coil is induced by the said magnetic flux signal in a voltage, The said control means carries out [above-mentioned] thinning|dication control of the inverter circuit with the control signal based on the induced said voltage, It is characterized by the above-mentioned, Since a magnetic flux signal is used for the feedback signal for voltage stabilization, the non-contact power transmission apparatus which can stabilize an output-terminal voltage to a constant value in the wide load range can be provided without being received by a surrounding brightness and the influence of stain|pollution|contamination.

Invention of Claim 9 provided the partition for magnetic shieldings which consists of magnetic bodies between at least one between the primary coil for electric power transmission, and a primary side signal receiver coil, and between the secondary coil for electric power power receiving, and a secondary side signal transmission coil in invention of Claim 8. It can be characterized by the above-mentioned, the magnetic flux generate|occur|produced by the trans|transformer for electric current 送授 linked to the trans|transformer for signal transmission and reception can be reduced, and the magnetic flux signal for exact voltage stabilization can be transmitted/received.

Invention of Claim 10 wound the primary coil for electric power transmission, and the secondary coil for electric power power receiving to the core consisting of a magnetic body, and made the axial direction of the said core mutually opposingly arrange the said core in invention of Claim 9. It can be characterized by the above-mentioned, the magnetic flux generate|occur|produced by the trans|transformer for electric current 送授 linked to the trans|transformer for signal transmission and reception can be reduced, and the magnetic flux signal for exact voltage stabilization can be transmitted/received.

Invention of Claim 11 winds the primary coil for electric power transmission, and the secondary coil for electric power power receiving in invention of Claim 9 to the core consisting of the magnetic body of the bottomed cylinder type|mold which has an opening part in a direction perpendicular|vertical to the axial direction of the said coil,

The axial direction of the said core is made to mutually opposingly arrange the said core.

The primary side signal receiver coil and the secondary side signal transmission coil have been arrange|positioned to the vicinity of the non-opening part of the said core.

It can be characterized by the above-mentioned, the magnetic flux generate|occur|produced by the trans|transformer for electric current 送授 linked to the trans|transformer for signal transmission and reception can be reduced, and the magnetic flux signal for exact voltage stabilization can be transmitted/received.

In the invention In any one of Claims 8 to 11, the signal which converted into the alternating voltage the information in which a secondary side signal transmission coil represents the electric state inside a non-contact plug is inputted into invention of Claim 12,

With the magnetic flux which the primary coil for electric power transmission generates, the magnetic flux signal which has a phase of an antiphase is generate|occur|produced,

It can be characterized by the above-mentioned and the bundle|flux signal for exact voltage stabilization can be transmitted/received.

Invention of Claim 13 has connected one terminal of a secondary side signal transmission coil to an any one of the terminals of the secondary coil for electric power power receiving in invention of Claim 12,

It can be characterized by the above-mentioned and the magnetic flux signal for exact voltage stabilization can be transmitted/received.

In the invention in any one of Claims 3 to 7, invention of Claim 14 a non-contact outlet socket,

Providing the coil for a magnetic flux detection which detects the magnetic flux generate|occur|produced between the primary coil for electric power transmission, and the secondary coil for electric power power receiving in the vicinity of the primary coil for electric power transmission, the said coil for a magnetic flux detection detects the magnetic flux generate|occur|produced with the primary coil for electric power transmission as a magnetic signal,

Based on the voltage output according to the said magnetic flux to detect from the said coil for a magnetic flux detection, the said control means thins|decimates out and controls an inverter circuit,

It can be characterized by the above-mentioned and the magnetic flux signal for exact voltage stabilization can be received.

Invention of Claim 15 provides the primary coil for electric power transmission, and the secondary coil for electric power power receiving in the core consisting of the magnetic body of the bottomed cylinder type|mold which has an opening part in a direction perpendicular|vertical to the axial direction of the said coil, and makes the axial direction of the said core mutually opposingly arrange the said core in invention of Claim 14.

The said coil for a magnetic flux detection has been arrange|positioned to the vicinity of the opening part of the core of the said primary coil for electric power transmission.

It can be characterized by the above-mentioned and the magnetic flux signal for exact voltage stabilization can be received.

Invention of Claim 16 adapts several non-contact plugs from which an output voltage differs in one non-contact outlet socket in the invention in any one of Claims 1 to 15,

It has the said control means that stores the output voltage of each said non-contact plug in the predetermined voltage range in all areas|domains including the load area|region which each non-contact plug makes object,

It is characterized by the above-mentioned and is economical.

Invention of Claim 17 connects resistance to the output terminal of a non-contact plug parallelly in the invention in any one of Claims 1 to 16,

It can be characterized by the above-mentioned and the non-contact power transmission apparatus which can stabilize an output-terminal voltage to a constant value in the wide load range can be provided.

When the non-contact plug has not couple|bonded invention of Claim 18 with the predetermined position of a non-contact outlet socket in the invention in any one of Claims 1 to 17, the said control means sets it as the characteristic mark to restrict|limit the output supplied to the primary coil for electric power

transmission from an inverter circuit,
High safety|security and reliability can be provided.

Invention of Claim 19 is provided with the switch function by which a non-contact outlet socket controls the restriction|limiting of supply of the high frequency voltage from an inverter circuit to the primary coil for electric power transmission in invention of Claim 18,
If a non-contact plug is provided with the driver which controls the on-off state of the said switch function and a non-contact plug couple|bonds with the predetermined position of a non-contact outlet socket, the said control means will enable supply of the high frequency voltage from an inverter circuit to the primary coil for electric power transmission in operating the said switch function,
It can be characterized by the above-mentioned and high safety|security and reliability can be provided.

In invention of Claim 19, as for invention of Claim 20, the said switch function of a non-contact outlet socket consists of mechanical contacts, the driver with which a non-contact plug is provided consists of magnets, and if a non-contact plug couple|bonds with the predetermined position of a non-contact outlet socket, the said mechanical contact will operate|move by the magnetic force of the said magnet,
The said control means enables supply of the high frequency voltage from an inverter circuit to the primary coil for electric power transmission,
It can be characterized by the above-mentioned and high safety|security and reliability can be provided.

In the invention in any one of Claims 1 to 20, invention of Claim 21 will be characterized by performing the display of a non-contact plug and a non-contact outlet socket which alert|reports use 可能 to which or one side at least, if a non-contact plug couple|bonds with the predetermined position of a non-contact outlet socket,
The usage approval of a system or an apparatus can be judged.

In the invention in any one of Claims 1 to 21, a non-contact outlet socket and a non-contact plug at least invention of Claim 22 which or one,
The display part of the load electric power of the terminal device connected to the output terminal of a non-contact plug and the output voltage of a non-contact plug which displays which or one side at least was added.
It can be characterized by the above-mentioned and the usage approval of a system or an apparatus can be judged.

The terminal device by which invention of Claim 23 is connected to the output terminal of a non-contact plug in the invention in any one of Claims 1 to 22 is characterized by a separative|detachable thing with respect to the said non-contact plug,
An unspecified terminal device can be used.

As for invention of Claim 24, in invention of Claim 23, supply of the electric power from the output terminal of a non-contact plug to a terminal device is supplied by magnetic coupling,
It can be characterized by the above-mentioned and an unspecified terminal device can be used.

Invention of Claim 25 connects voltage clamp elements between the output terminals of a non-contact plug in the invention in any one of Claims 1 to 24,
It can be characterized by the above-mentioned and high safety|security and reliability can be provided.

EMBODIMENT of the Invention

Hereafter, embodiment of this invention is described based on drawing.

FIG. 1 shows the circuit structure of the non-contact power transmission apparatus which controls by thinning|decimating out using a magnetic signal.

The non-contact power transmission apparatus 5 consists of the non-contact outlet socket 1 which comprises the primary side which becomes the electric power supply side, and the non-contact plug 2 which comprises a secondary side with load,
and

The non-contact outlet socket 1 has the power supply circuit 10 which converts the alternating current input from AC power supply 4 into the direct current|flow which outputs DC voltage E, and a semiconductor switch,

The inverter circuit 11 which converts DC voltage E from the power supply circuit 10 into the high frequency voltage V1 of constant frequency by switching a semiconductor switch, and the primary coil L1 for electric power transmission to which the said high frequency voltage V1 is supplied from the inverter circuit 11,

It is comprised from the switching control circuit 12 which is a control part which outputs the control signal which controls switching of the semiconductor switch of the inverter circuit 11 according to the magnetic signal fed back from the non-contact plug 2,

The secondary coil L2 for electric power power receiving induced in high frequency voltage by linking the non-contact plug 2 with the interlinkage magnetic flux F2 among the leakage fluxes F1 and the interlinkage magnetic flux F2 which were generate|occur|produced with the high frequency voltage applied to the primary coil L1 for electric power transmission,

The output-terminal voltage V3 which are the rectification/smoothing circuit 20 which rectifies/smoothes the high frequency voltage output from the secondary coil L2 for electric power power receiving, and an output voltage of the non-contact plug 2 is detected,

It is comprised from the output-terminal voltage detection circuit 21 which outputs a magnetic signal to the switching control circuit 12 of the non-contact outlet socket 1 according to a detection result,

The output-terminal voltage V3 is output to the terminal device 3 which is load.

The primary coil L1 for electric power transmission and the secondary coil L2 for electric power power receiving comprise the trans|transformer T1 for electric power transmission and reception which can carry out isolation|separation attachment or detachment.

In a present Example, the output-terminal voltage detection circuit 21 which detected the output-terminal voltage V3 generates the magnetic signal according to the detection result,

When the output-terminal voltage V3 exceeds a predetermined voltage based on a magnetic signal, the switching control circuit 12 which received the magnetic signal,

Supply of the high frequency voltage V1 of the constant frequency from the inverter circuit 11 to the primary coil L1 for electric power transmission is thinned|decimated out for a fixed time,

If the output-terminal voltage V3 has still exceeded the predetermined voltage after thinning|decimating out for a fixed time, it will repeat thinning|decimating out supply of the high frequency voltage V1 to the primary coil L1 for electric power transmission for a fixed time again,

When the output-terminal voltage V3 is less than a predetermined voltage after thinning|decimating out for a definite period of time [each],

The control signal which performs thinning|dicimation control which continues the operation|movement which supplies the high frequency voltage V1 to the primary coil L1 for electric power transmission is output to the inverter circuit 11 until the output-terminal voltage V3 exceeds a predetermined voltage,

The semiconductor switch of the inverter circuit 11 performs a switch operation according to a control signal,

A fixed voltage is made to stabilize the output-terminal voltage V3.

FIG. 2 shows the concrete circuit structure of a present Example.

In FIG. 2, the power supply circuit 10 is represented by the DC-voltage source 10a which outputs DC voltage E, and abbreviate|omits the output-terminal voltage detection circuit 21 and the switching control circuit 12.

The capacitor|condenser C3 by which the non-contact outlet socket 1 was parallelly connected to the DC -voltage source 10a and the DC-voltage source 10a, the series circuit of C4 and the semiconductor switch Q1, and the series circuit of Q2,

It is comprised from the inverter circuit 11 which consists of the capacitor|condenser C1 connected between the connection middle points of the connection middle point of the capacitor|condenser C1 and the capacitor|condenser C2, the semiconductor switch Q1, and the semiconductor switch Q2, and the primary coil L1 for electric power transmission parallelly connected to the capacitor|condenser C1,

It becomes a partial resonance inverter circuit of a half-bridge type|mod.

The secondary coil L2 for electric power power receiving in which the non-contact plug 2 was provided with the center tap,

On the capacitor|condenser C2 parallelly connected to the secondary coil L2 for electric power power receiving, the diode D3 in series and mutually connected to both the output terminals that are not the center taps of the secondary coil L2 for electric power power receiving at the reverse direction, D4, the diode D3, and the connection middle point of D4, an end.

It is comprised from the rectification/smoothing circuit 20 which consists of the smoothing capacitor C5 connected between the other end of the connected choke coil L3 and the choke coil L3, and the center tap of the secondary coil L2 for electric power power receiving, and the terminal device 3 is parallelly connected to the smoothing capacitor C5.

The primary coil L1 for electric power transmission and the secondary coil L2 for electric power power receiving comprise the trans|transformer T1 for electric power transmission and reception which can carry out isolation|separation attachment or detachment.

A thing provided with the center tap is used for the secondary coil L2 for electric power power receiving,

and since it is rectifying/straightening by the two diodes D3 and D4, size reduction of an apparatus can be achieved.

In FIG. 3, next, the both-ends voltage V1 of the primary coil L1 for electric power transmission in FIG. 2, Each waveform of the electric current I1 which flows through the primary coil L1 for electric power transmission, the both-ends voltage V4a of the semiconductor switch Q1, electric current I4a which flows through the semiconductor switch Q1, the both-ends voltage V4b of the semiconductor switch Q2, and electric current I4b which flows through the semiconductor switch Q2 is shown.

The semiconductor switch Q1 and Q2 repeat on/off alternately,

However,

At this time, one semiconductor switch turned off from one/on,

Then, after both of semiconductor switches pass through a fixed period come by off, it is controlling so that the other semiconductor switch turns ON,

Therefore

The both-ends voltage V1 of the primary coil L1 for electric power transmission becomes a waveform on trapezoid.

The partial resonance areas 100 are the semiconductor switch Q1 and an area which Q2 turns off,

They are the inductance which looked at the secondary side from the primary coil L1 for electric power transmission, and a period when the voltage vibration by resonance operation/movement with the capacitor/condenser C1 is performed.

Since the parasitic diode D1 and D2 will be parallelly connected to the semiconductor switch Q1 and Q2 as shown in FIG. 2 if MOSFET is used for a semiconductor switch,

If the vibration voltage of the both-ends voltage V1 of the primary coil L1 for electric power transmission becomes large, is voltage $E/2$, or voltage $E/2$ and is clamped,

The both-ends voltage V4a of the semiconductor switch Q1 and the both-ends voltage V4b of the semiconductor switch Q2 become a trapezoid wave clamped by the voltage E or ground level of DC power supply 10a.

Moreover, when MOSFET is used for the semiconductor switch Q1 and Q2, even if it utilizes the parasitic capacitance of MOSFET, a partial resonance operation/movement can be performed.

The semiconductor switch Q1 and Q2 can perform soft switching by this partial resonance, and the loss at the time of turn-on and turn-off can reduce significantly.

FIG. 4 shows the output-terminal voltage V3 when loaded condition performs thinning/dicimation control of a prior art in a no load and the light load vicinity, and the both-ends voltage V1 of the primary coil L1 for electric power transmission.

Thinning/dicimation control of a prior art detects the output-terminal voltage V3,

Only when the detection result exceeds the target voltage 101, the fixed frequency drive of the inverter circuit 11 is stopped,

The output of the high frequency voltage V1 of constant frequency is stopped.

In [as shown in FIG. 4 in such control] a light load and the no load vicinity,

The semiconductor switch Q1 which is less also than 1 period of driving frequency at vicinity of the target voltage 101, and on/off of Q2 are performed frequently,

While low-loss soft switching which is a merit of a resonance type inverter is not performed but being hard-switched, it is as the said prior art having also described to become a strong noise source.

In non-contact power transmission, in order that noise may ride on an output terminal easily under the influence of the magnetic field by the breadth of a leakage flux or magnetic flux, this tendency appears especially easily notably.

Loaded condition is a no load and the light load vicinity to FIG. 5 with respect to thinning/dicimation control of the said prior art.

WHEREIN:

If the two target voltages 102 and 103 are provided as a target voltage of the output-terminal voltage V3 and the output-terminal voltage V3 exceeds the target voltage 102, the fixed frequency drive of the inverter circuit 11 will be stopped,

If the output-terminal voltage V3 is less from the target voltage 103, the output-terminal voltage V3 when control which performs the fixed frequency drive of the inverter circuit 11 is performed, and the both-ends voltage V1 of the primary coil L1 for electric power transmission will be shown.

An operation/movement and stop of a fixed frequency drive of the inverter circuit 11 are performed by the two target voltages 102 and 103 favorable compared with the conventional system shown in FIG. 4 by making a hysteresis.

Although there exist some which can be used by this system practical, when it superimposes on noise largely, hysteresis width must be enlarged, and it becomes a cause of ripple voltage increase of the output-terminal voltage V3.

So, as shown in FIG. 6 in invention, when the output-terminal voltage V3 exceeds the target voltage 108,

Supply of the high frequency voltage V1 of the constant frequency from the inverter circuit 11 to the primary coil L1 for electric power transmission is thinned|decimated out 106 for a fixed time,

If the output-terminal voltage V3 has still exceeded the target voltage 108 after thinning|decimating out 106 for a fixed time, it will repeat thinning|decimating out supply of the high frequency voltage V1 to the primary coil L1 for electric power transmission 106 for a fixed time again,

When the output-terminal voltage V3 is less than the target voltage 108 after thinning|decimating out 106 during one scheduled time each, thinning|decimation control which continues the operation|movement which supplies the high frequency voltage V1 to the primary coil L1 for electric power transmission is performed until the output-terminal voltage V3 exceeds the target voltage 108, The stabilization which continues this the operation|movement of a series of and makes the output-terminal voltage V3 regularity is performed.

In the range from a light load to a full load, for a fixed time, at the time of completion|finish of the idle period of 106, the output-terminal voltage V3 is reliably less than the target voltage 108 to some extent, and, in this system, 1 periods or more of continuation can also ensure the fixed frequency drive of the inverter circuit 11.

And in the case of a perfect no load, the fixed frequency drive of the inverter circuit 11 can be less than 1 period.

However,

In this case, since it is regularly repeated with the period when the period of the period of a fixed frequency drive operation|movement of the inverter circuit 11 and a stop of being also alike is constant, harmonic noise can be reduced compared with the case of FIG. 4 by which the period of a fixed frequency drive of the inverter circuit 11 and the period of a stop are repeated irregularly.

moreover, the case where the low voltage especially used by the circumference of water, such as a bathroom, is stabilized since the another merit of a present Example can make substantially comparable the maximum voltage 107 of the output-terminal voltage V3 also when loaded condition is close to a no load, and also when close to a full load,

Since the output-terminal voltage V3 is reliably controllable within the upper limit of a voltage specification if the target voltage 108 is set to some voltages low by a margin with respect to the upper limit of the voltage specification, voltage stabilization of the output-terminal voltage V3 considered to safe relief can be performed.

Next, in FIG. 7, each waveform of the both-ends voltage V1 of the primary coil L1 for electric power transmission, the both-ends voltage V2 of the capacitor|condenser C2, the electric current I2 that flows through the capacitor|condenser C2, and the load current I3 which flows through the terminal device 3 is shown.

The conditions which can connect the capacitor|condenser C2 to the secondary coil L2 for electric power power receiving parallelly, and can perform an optimal load adjustment,

As shown to the timing 109 at FIG. 7, at the time of the polarity inversion of the both-ends voltage V1 of the primary coil L1 for electric power transmission.

It is equivalent to the time of the polarity inversion of the both-ends voltage V1 of the primary coil L1 for electric power transmission and the time of the vibration voltage of the both-ends voltage V2 of the capacitor|condenser C2 reaching a minimum value corresponding like that the time of the vibration voltage of the both-ends voltage V2 of the capacitor|condenser C2 reaching maximum value corresponds, and the timing 110.

The electrostatic capacitance value of the capacitor|condenser C2 for performing an optimal load adjustment like FIG. 7 is received by influence also to the rectification|straightening system of the output-terminal voltage V3 or the rectification/smoothing circuit 20 in addition to leakage inductance L4 between the driving frequency of the inverter circuit 11, and the primary coil L1 for electric power transmission and the secondary coil L2 for electric power power receiving.

FIG. 8, 9 shows the characteristics 117d and 117e of the output-terminal voltage V3 with respect to the load current I3 in a present Example.

The load current I3 in the small area|regions 111 and 113 from the point K which has taken the point K, i.e., a load adjustment, which can take maximum load electric power optimal the output-terminal voltage V3,

Since it is higher than the output-terminal voltage V3 in the point K, the output-terminal voltage V3 can be stabilized by the voltage reduction operation|movement by thinning|decimation control of a present Example.

In the area|regions 112 and 114 in which the load current I3 exceeds the point K on the other hand, rapidly, the output-terminal voltage V3 can raise|generate a voltage drop, and cannot utilize it.

Thus, by performing an optimal load adjustment by the capacitor|condenser C2, the non-contacting power transmission apparatus 5 of this invention can be operated in a state with most high efficiency. Moreover, when the application load range is exceeded, even if an internal short circuit occurs, for example by failure of the terminal device 3, if the load current I3 becomes large from the point K, while the voltage drop of the output-terminal voltage V3 will occur rapidly and the output-terminal voltage V3 will turn into a low voltage, the load current I3 requires current limiting, and is safety, It is the system considered to safe relief.

FIG. 10 thru|or 23 shows the example of embodiment of this invention, the fundamental structure is as substantially the same as FIG.1 and FIG.2, the same code|symbol is attached|subjected to the same component and description is abbreviate|omitted.

The non-contact outlet socket 1 which comprises the primary side which becomes the electric power supply side in FIG. 10,

The primary coil L1 for electric power transmission to which the said high frequency voltage is supplied from the inverter circuit 11 which DC power supply is inputted and outputs the high frequency voltage of constant frequency, and (In FIG. 10 thru|or 16, the power supply circuit which outputs DC power supply is abbreviate|omitted.) and the inverter circuit 11,

The primary side signal receiver coil 14 induced in a voltage by the magnetic signal fed back from the secondary side signal transmission coil 23 of the non-contact plug 2,

It is comprised from the signal-conversion circuit 13 which outputs the signal based on the said induced voltage, and the switching control circuit 12 which outputs the control signal which thins|decimates out and controls switching of the semiconductor switch of the inverter circuit 11 according to the output signal of the signal-conversion circuit 13,

The non-contact plug 2 which comprises a secondary side with load,

The secondary coil L2 for electric power power receiving induced in high frequency voltage by linking with the magnetic flux F3 generate|occur|produced with the high frequency voltage applied to the primary coil L1 for electric power transmission, the rectification/smoothing circuit 20 which rectifies/smoothes the high frequency output of the secondary coil L2 for electric power power receiving, and the output-terminal voltage V3 of the non-contact plug 2 are detected,

The output-terminal voltage detection circuit 21 which outputs a detection signal,

The AC signal output from the signal-conversion circuit 22 which outputs the AC signal according to the said detection signal, and the signal-conversion circuit 22 is inputted,

It is comprised from the secondary side signal transmission coil 23 which generate|occur|produces the magnetic flux signal as a magnetic signal, and the output of the non-contact plug 2 is connected to the terminal device 3.

The primary coil L1 for electric power transmission and the secondary coil L2 for electric power power receiving comprise the trans|transformer T1 for electric power transmission and reception which can carry out isolation|separation attachment or detachment,

The primary side signal receiver coil 14 and the secondary side signal transmission coil 23 comprise the trans|transformer T2 for signal transfer which can carry out isolation|separation attachment or detachment.

However,

If the trans|transformer T1 for electric power transmission and reception and the trans|transformer T2 for signal transfer are mutually arrange|positioned in the vicinity like the circuit structure shown in FIG. 10, by the breadth of the magnetic flux F3, a part of magnetic flux F3 will be linked in the primary side signal receiver coil 14 and the secondary side signal transmission coil 23,

Noise will enter into the trans|transformer T2 for signal transfer, and information of the output-terminal voltage V3 of the exact non-contact plug 2 cannot be fed back in the non-contact outlet socket 1.

Then, the Example which improves the above-mentioned problem is shown in FIGS. 11-14.

It is centralizing the magnetic flux F3 which FIG. 11's provides partition A1 which consists of a magnetic body which is easy to let a magnetism pass between the non-contact outlet socket 1, the non-contact plug 2, and the trans|transformer T2 for signal transfer, and is generate|occur|produced with the primary coil L1 for electric power transmission on obstacle A1,

The magnetic flux linked to the trans|transformer T2 for signal transfer among the magnetic flux F3 is reduced.

FIG. 12 winds the primary coil L1 for electric power transmission, and the secondary coil L2 for electric power power receiving to core A2 which consists of magnetic bodies,

The axial direction of the primary coil L1 for electric power transmission and the secondary coil L2 for electric power power receiving is made to mutually opposingly arrange.

By centralizing the magnetic flux F3 generate|occur|produced with the primary coil L1 for electric power

transmission on core A2, the breadth degree of the magnetic flux F3 is reduced,
The magnetic flux linked to the trans|transformer T2 for signal transfer among the magnetic flux F3 is reduced.

FIG. 13 is wound to core A3 for trans|transformers which consists the primary coil L1 for electric power transmission, and the secondary coil L2 for electric power power receiving of magnetic bodies, and has an opening part and which is generally often used,

The axial direction of the primary coil L1 for electric power transmission and the secondary coil L2 for electric power power receiving is made to mutually opposingly arrange.

By centralizing the magnetic flux F3 generate|occur|produced with the primary coil L1 for electric power transmission on core A3, the breadth degree of the magnetic flux F3 is reduced,

The magnetic flux linked to the trans|transformer T2 for signal transfer among the magnetic flux F3 is reduced.

Moreover, since a part of magnetic flux F3 leaks from the opening part 122 of core A3 in FIG. 13, the trans|transformer T2 for signal transfer is installed in the non-opening part 123 side of core A3 so that the magnetic flux may not link.

The output-terminal voltage V3 is inputted into the signal-conversion circuit 24 in the Example shown in FIG. 14,

The signal-conversion circuit 24 outputs the signal according to the output-terminal voltage V3,
One end of the secondary side signal transmission coil 23 is connected to the output of the signal-conversion circuit 24 where the said signal is output, and the other end is connected to one end of the secondary coil for electric power power receiving.

Moreover, a direction with the magnetic flux F3b which is generate|occur|produced with the primary coil L1 for electric power transmission, is generate|occur|produced with the secondary coil L2 for electric power power receiving, magnetic flux F3a to link, and the primary coil L1 for electric power transmission, and is linked with the primary side signal receiver coil 14,

So that the direction of the magnetic flux signal F4 generate|occur|produced with the secondary side signal transmission coil 23 may turn into a mutually opposing direction.

The direction of a coil|winding with the primary coil L1 for electric power transmission, and the primary side signal receiver coil 14, and the direction of a coil|winding with the secondary coil L2 for electric power power receiving, and the secondary side signal transmission coil 23 by using a mutually opposing direction,

The phase of the magnetic flux signal F4 generate|occur|produced with the secondary side signal transmission coil 23 turns into magnetic flux F3a generate|occur|produced with the primary coil L1 for electric power transmission, and a phase of F3b with an antiphase,

The trans|transformer T2 for signal transfer becomes difficult to be received by the influence of magnetic flux F3a generate|occur|produced with the primary coil L1 for electric power transmission, and F3b.

Moreover, if it becomes close to a non-loaded state as shown in the characteristic 117b of the output-terminal voltage V3 with respect to the load current I3 of the said FIG. 33, the output-terminal voltage V3 will tend to become high,

Stabilization of the output-terminal voltage V3 is become difficult, so that load becomes lighter.

A feedback control system can be designed to cover a full load area|region by thinning|dicimation control,

However,

The components of a control circuit also increase in number by the resolution enhancement of a control signal, a response-speed improvement, opposite noise property reinforcement|strengthening, etc., and it becomes disadvantageous in cost and size.

However,

As shown in FIG. 14, by connecting parallelly, resistance R1 between the output terminals of the non-contact plug 2,

The electric current 115 is always sent through resistance R1, and the output-terminal voltage V3 can be stabilized in the area|region 111 so that it may show in characteristic of 117 f of the output-terminal voltage V3 with respect to the load current I3 of FIG. 24.

Furthermore, since there may also exist a raise of the transient output-terminal voltage V3 at the time of sudden change of load, the output-terminal voltage V3 can always be stabilized by connecting constant voltage diode ZD1 parallelly between the output terminals of the non-contact plug 2, as shown in FIG. 14.

Since the raise frequency of the output-terminal voltage V3 at the time of the above load sudden change is low and its rising voltage is also small, the loss of constant voltage diode ZD1 is small.

In a present Example, although the constant voltage diode is used, what is necessary is just voltage clamp elements.

Next, FIG. 15 obtains the electric information of the non-contact plug 2 required for thinning|dication control from the change of the magnetic flux F3 generate|occur|produced with the primary coil L1 for electric power transmission,

The magnetic detection coil 14a detects the change of the magnetic flux F3 generate|occur|produced with the primary coil L1 for electric power transmission,

The inverter circuit 11 is thinned|decimated out and controlled based on the detection result.

In non-contact transmission, if the electric power to transmit increases, the magnetic flux F3 generate|occur|produced with the primary coil L1 for electric power transmission will also increase in proportion to electric power, and an output-terminal voltage will fall inversely proportion to electric power.

The above-mentioned characteristic is the same characteristic in one system,

Therefore

If the magnetic detection coil 14a detects the change of the magnetic flux F3 generate|occur|produced with the primary coil L1 for electric power transmission, the information of the output-terminal voltage of the non-contact plug 2 can be obtained indirectly, and the inverter circuit 11 can be thinned|decimated out and controlled.

The circuit shown in FIG. 15 makes an air core the primary coil L1 for electric power transmission, and the secondary coil L2 for electric power power receiving, enlarges the breadth of the magnetic flux F3, and a leak, and makes the magnetic detection coil 14a link the magnetic flux F3.

The circuit shown in FIG. 16 is provided in core A3 for trans|transformers which consists of magnetic bodies the primary coil L1 for electric power transmission of a circuit and the secondary coil L2 for electric power power receiving which were shown in the said FIG. 15, and has the opening part 122 and which is generally often used, and is mutually opposingly arranged,

The magnetic detection coil 14a is made to link the magnetic flux which leaks from the opening part 122 to the opening part 122 vicinity among the magnetic flux F3 by arrange|positioning the magnetic detection coil 14a.

As shown above, this invention can perform the stabilization to a required voltage with respect to a wide load area|region.

The external appearance of the example of a non-contact power transmission system of this invention used for FIG. 17 by a bathroom interior is shown.

The non-contact outlet socket 1 embed|buried under the wall 200 provides the seal|sticker 15 in the outer peripheral part which touches the surface of the wall 200, and is improving waterproofness.

The circuit block X1 which the said power supply circuit 10, the inverter circuit 11, the switching control circuit 12, and the signal-conversion circuit 13 were incorporated in the inside of the non-contact outlet socket 1, and was connected with AC power supply 4,

The primary coil L1 for electric power transmission arrange|positioned with respect to the recessed part 19 and the primary side signal receiver coil 14 similarly arrange|positioned with respect to the recessed part 19 are provided, and outlet socket electricity supply display LED16 which carries out a lamp the time of the non-contact outlet socket 1 being a usable state is provided in the surface by the side of the non-contact plug 2.

The non-contact plug 2 makes the recessed part 19 of the non-contact outlet socket 1 fit at the time of electricity supply.

The secondary coil L2 for electric power power receiving provided in the inside so that it might opposingly arrange in the primary coil L1 for electric power transmission at the time of a fitting, and the secondary side signal transmission coil 23 provided so that it might opposingly arrange to the primary side signal receiver coil 14,

The circuit block X2 incorporating the said rectification/smoothing circuit 20, the output-terminal voltage detection circuit 21, and the signal-conversion circuit 22,

It is comprised from the cable code 26 which transmits electric power to the apparatus 3, and the cable code 26 is connected, electric power is transmitted to the terminal device 3, and plug electricity supply display LED25 which carries out a lamp the time of the non-contact plug 2 being a usable state is provided in the surface.

FIG. 18 shows the figure which looked at FIG. 17 from the non-contact plug 2 side.

It is required for a user to display whether it can use the non-contact outlet socket 1 and the non-contact plug 2,

Outlet socket electricity supply display LED16 which carries out a lamp the time of the non-contact outlet socket 1 being a usable state was provided in the non-contact plug 2 side surface of the non-contact outlet socket 1, and outlet socket electricity supply display LED16 which carries out a lamp the time of

the non-contact plug 2 being a usable state is provided in the non-contact plug 2 surface. Moreover, since the wide load area|region is made into object, the terminal device 3 used now is important for the information of not being it over application limits what load it is.

This information is thinned|decimated out and can be obtained from the thinning|dicimation rate of control.

That is, it is equivalent to load being so large that load being small and a thinning|dicimation rate being small, when a thinning|dicimation rate is large.

Furthermore, the minimum thinning|dicimation rate is set previously, and if a thinning|dicimation rate is less than the minimum thinning|dicimation rate and crosses an object load area|region, the output-terminal voltage V3 will fall rapidly,

Therefore

An overload state can be determined because the output-terminal voltage V3 became below a predetermined voltage value.

The load dose|amount display indicator 17 provided in the non-contact plug 2 side surface of the non-contact outlet socket 1 displays this operating load dose|amount.

FIG. 19 has shown that power transmission is possible at 1 unit|set of the non-contact outlet socket 1 in the non-contact plug 2a for 12 V sets|machines connected to the terminal device 3a for 12V, and the non-contact plug 2b for 24 V sets|machines connected to the terminal device 3b for 24V.

As mentioned above thinning|dicimation control of the non-contact power transmission system of this invention,

Since it is controllable even if a load area|region is wide, even when the winding|turns number of the primary coil L1 for electric power transmission of the non-contact outlet socket 1 is constant,

Each output-terminal voltage V3 can be stabilized by changing the winding|turns number of secondary coil L2a for electric power power receiving of the non-contact plug 2a for 12 V sets|machines, and the non-contact plug 2b for 24 V sets|machines, and secondary coil L2b for electric power power receiving,

Moreover, arbitrary voltages can also be stabilized.

Moreover, in a non-contact power transmission system, the electric power which can be transmitted, so that the distance of the primary coil L1 for electric power transmission and the secondary coil L2 for electric power power receiving becomes long needs to maintain the relative location relationship between the non-contact outlet socket 1 and the non-contact plug 2 at predetermined positional relationship in order to reduce.

FIG. 20 has shown the state which is not making the recessed part 19 of the non-contact outlet socket 1 fit the non-contact plug 2 completely,

In such a case, it is necessary to stop the power transmission from the non-contact outlet socket 1 to the non-contact plug 2.

Then, only when the non-contact outlet socket 1 provides the mechanical contact 18 arrange|positioned with respect to the recessed part 19 and the mechanical contact 18 turns ON, the inverter circuit 11 incorporated in the circuit block X1 of the non-contact outlet socket 1 operate|moves,

Power transmission from the non-contact outlet socket 1 to the non-contact plug 2 is performed,

The non-contact plug 2 provides the permanent magnet 30 so that it may opposingly arrange to the mechanical contact 18 at the time of a fitting.

The mechanical contact 18 is a switch which operate|moves by the magnetic force of the permanent magnet 30, and since the non-contact plug 2 is not completely fitted to the recessed part 19 of the non-contact outlet socket 1 in FIG. 20, the permanent magnet 30 and the mechanical contact 18 are left|separated too much,

The magnetic force of the permanent magnet 30 cannot operate the mechanical contact 18.

FIG. 21 has shown the state which is making the recessed part 19 of the non-contact outlet socket 1 fit the non-contact plug 2 completely,

The magnetic force of the permanent magnet 30 can operate the mechanical contact 18, and the inverter circuit 11 incorporated in the circuit block X1 of the non-contact outlet socket 1 operate|moves, Power transmission from the non-contact outlet socket 1 to the non-contact plug 2 can be performed.

In addition, since the permanent magnet 30 is a permanent magnet, it does not have a bad influence on the magnetic flux signal of the primary side signal receiver coil 14, the secondary side signal transmission coil 23, and the coil 14a for a magnetic flux detection.

Moreover, outlet socket electricity supply display LED16 can be made to be able to light because the mechanical contact 18 turns ON, and plug electricity supply display LED25 can be made to light under monitoring the output-terminal voltage V3.

Next, it is more desirable to make an integrated type the connection of the non-contact plug 2 and the terminal device 3, when using it by the circumference of water,

However,

Since simple waterproof may be sufficient as long as it is a time of not carrying out a use method which is attached in water, when not using it by the circumference of water, and even when using it by the circumference of water, you may make it the structure which can remove|desorb the connection of the non-contact plug 2 and the terminal device 3.

In this way, if it exists, the non-contact outlet socket 1 and every one non-contact plug 2 each are economical in order to arrange|equalize only the terminal device 3 according to an application.

In FIG. 22, the terminal devices 3c and 3d are provided with the cable codes 26c and 26d, and the connectors 27c and 27d are respectively connected to the cable codes [26c and 26d] terminal,

The sockets 28c and 28d which were provided in the surface of the non-contact plug 2, and have connected with the output terminal of the non-contact plug 2, and the isolation|separation attachment or detachment are attained,

Several terminal devices 3c and 3d can be connected now to the one non-contact plug 2.

In FIG. 23, the terminal device 3e is provided with the cable code 26e, and the electric power receiving coil L5 is connected to the terminal of the cable code 26e,

The surface vicinity of the non-contact plug 2 is equipped with the electric power transmission coil L4 linked to the output terminal of the non-contact plug 2, the electric power receiving coil L5 is fitted with the recessed part 29 of the non-contact plug 2 surface, and power transmission is carried out by the electromagnetic induction from the electric power transmission coil L4.

In FIG. 23, the output voltage of the circuit block X2 applied by the electric power transmission coil L4 is high frequency voltage.

Moreover, it is used by the circumference of water like bathroom interior,

For the countermeasure against an electric shock, when a low-voltage output is required, at the time of a failure of the non-contact outlet socket 2, you have to suppress the voltage raise by the non-contact plug 2 and the terminal device 3 as much as possible.

In this invention, in order to perform power transmission using the trans|transformer T1 for electric power transmission which can carry out isolation|separation attachment or detachment, the voltage proportional to the amplitude of the high frequency voltage V1 applied by the primary side electric power transmission coil L1 of the non-contact outlet socket 1 is induced by the secondary side electric power receiving coil L2 of the non-contact plug 2.

Therefore, when a high voltage is applied to the primary side electric power transmission coil L1 by failure of the inverter circuit by the side of the non-contact outlet socket 1, and a control circuit, the voltage V2 induced by the secondary side electric power receiving coil L2 also rises,

A high voltage may be built over the output-terminal voltage V3 of the non-contact plug 2 across a controllable area|region.

So, in this invention, as shown in FIG. 2, the inverter circuit 11 uses the half-bridge circuit,

Therefore

The both-ends voltage V1 of the primary side electric power transmission coil L1 is reliably clamped by voltage $-E/2$, and voltage $E/2$ with respect to the voltage E of DC power supply 10a, as for a raise of the voltage V2 induced by the secondary side electric power receiving coil L2, more than a fixed voltage does not raise, but it becomes a safe system.

In addition, the capacitor|condenser C2 of FIG. 2 may connect the capacitor|condenser C21 and C22 with the center tap of the secondary coil L2 for electric power power receiving between other terminals, as shown in FIG. 25, and,

The same effect can be acquired even if it connects the capacitor|condenser C21 and C22 to the diode D3 and D4 respectively parallelly, as shown in FIG. 26.

This is a capacitor|condenser by which the capacitor|condenser C2 acts on high frequency alternating current,

It is because alternating current the equivalent circuit of FIG.2, FIG.25 and FIG.26 becomes equivalent, The waveform conditions of the both-ends voltage V2 of the secondary coil L2 for electric power power receiving which all show in FIG. 7 can be acquired.

Thus, if each waveform conditions of this invention are satisfy|filled, this is also the same as when the secondary coil L2 for electric power power receiving is not provided with the center tap as well as their being contained in this invention.

ADVANTAGE of the Invention

Invention of Claim 1 is a non-contact outlet socket comprised from the primary coil for electric power transmission to which the said high frequency voltage is supplied from the power supply circuit which outputs a DC voltage, the inverter circuit which converts the said DC voltage into the high frequency voltage of constant frequency, and the said inverter circuit,

The non-contact plug comprised from the rectification/smoothing circuit which rectifies/smoothes the

high frequency voltage induced by the secondary coil for electric power power receiving which comprises the said primary coil for electric power transmission, and a separative|detachable trans|transformer structure, and is induced in high frequency voltage, and the said secondary coil for electric power power receiving,

The non-contact power transmission apparatus comprised from the terminal device which is connected to the output terminal of the said non-contact plug, and becomes load

WHEREIN:

The said non-contact outlet socket,

The control means which performs thinning|dication control which thins|decimates out and stabilizes the high frequency voltage to which the output-terminal voltage of the said non-contact plug with respect to the load area|region made into object is supplied from the said inverter circuit by the said primary coil for electric power transmission is provided,

It is characterized by the above-mentioned and is effective in the ability to provide the non-contact power transmission apparatus which can stabilize an output-terminal voltage to a constant value in the wide load range.

In invention of Claim 1, invention of Claim 2 the said control means,

When the output-terminal voltage of a non-contact plug exceeds a predetermined voltage,

Supply of the high frequency voltage from an inverter circuit to the primary coil for electric power transmission is thinned|decimated out for a fixed time, and if the output-terminal voltage of the non-contact plug has exceeded the said predetermined voltage after thinning|decimating out for a definite period of time [said], it will repeat thinning|decimating out supply of the said high frequency voltage to the primary coil for electric power transmission for a fixed time again,

When the output-terminal voltage of a non-contact plug is less than a predetermined voltage after thinning|decimating out for a definite period of time [each said], the operation|movement which supplies the said high frequency voltage to the primary coil for electric power transmission continuously is continued until the output-terminal voltage of a non-contact plug exceeds a predetermined voltage,

It is characterized by the above-mentioned,

It is effective in the ability to provide the non-contact power transmission apparatus which can stabilize an output-terminal voltage to a constant value in the wide load range.

In invention of Claim 1 or 2, invention of Claim 3 converts the information showing the electric state inside a non-contact plug into a magnetic signal, and transmits a non-contact plug to a non-contact outlet socket,

The said control means is thinned|decimated out based on the said magnetic signal, and forms the control signal for control,

An inverter circuit is thinned|decimated out with the said control signal, and it controls,

It is characterized by the above-mentioned,

In order to use a magnetic signal for the feedback signal for voltage stabilization, it is effective in the ability to provide the non-contact power transmission apparatus which can stabilize an output-terminal voltage to a constant value in the wide load range, without being received by a surrounding brightness and the influence of stain|pollution|contamination.

In the invention in any one of Claims 1 to 3, the inverter circuit of invention of Claim 4 is a partial resonance inverter of a half-bridge type|mod,

It is characterized by the above-mentioned and is effective in the ability to suppress a raise of the output voltage at the time of a failure.

In invention of Claim 4, invention of Claim 5 is provided with the secondary coil for electric power power receiving, and a center tap a rectification/smoothing circuit,

It has the full wave rectification part which connected each other end which have not been connected to the secondary coil for electric power power receiving of the rectifier in series and mutually connected to both the output terminals that are not the center taps of the secondary coil for electric power power receiving at a reverse direction,

A choke coil is connected to the connection middle point of the said rectifier,

It is characterized by the above-mentioned and is effective in the ability to reduce a rectification|straightening part in size.

Invention of Claim 6 connects a capacitor|condenser to the secondary coil for electric power power receiving parallelly in the invention in any one of Claims 1 to 5,

It is characterized by the above-mentioned and there exists an effect of the ability to make the active power which can be transmitted to a secondary side increase from a primary side by taking a load adjustment.

At the time of the maximum load of the load area|region which makes the electrostatic capacitance value of the said capacitor|condenser object in invention of Claim 6, invention of Claim 7 is the polarity inversion time of the high frequency voltage supplied to the primary coil for electric power transmission, It is an electrostatic capacitance value to which the time when the vibration voltage generate|occur|produced at the both ends of the said capacitor|condenser becomes maximum value or a minimum value corresponds,

It is characterized by the above-mentioned and is effective in the ability to perform an optimal load adjustment and improve circuit efficiency.

Invention of Claim 8 provides a primary side signal receiver coil in a non-contact outlet socket in the invention in any one of Claims 3 to 7,

A non-contact plug opposingly arranges at the said primary side signal receiver coil, and the said primary side signal receiver coil and the secondary side signal transmission coil which comprises a separative|detachable trans|transformer structure are provided,

The signal which converted the information showing the electric state inside a non-contact plug into the alternating voltage is inputted into the said secondary side signal transmission coil, and it generate|occur|produces a magnetic flux signal as a magnetic signal,

The said primary side signal receiver coil is induced by the said magnetic flux signal in a voltage,

The said control means carries out [above-mentioned] thinning|dicimation control of the inverter circuit with the control signal based on the induced said voltage,

It is characterized by the above-mentioned,

In order to use a magnetic flux signal for the feedback signal for voltage stabilization, it is effective in the ability to provide the non-contact power transmission apparatus which can stabilize an output-terminal voltage to a constant value in the wide load range, without being received by a surrounding brightness and the influence of stain|pollution|contamination.

Invention of Claim 9 provided the partition for magnetic shieldings which consists of magnetic bodies between at least one between the primary coil for electric power transmission, and a primary side signal receiver coil, and between the secondary coil for electric power power receiving, and a secondary side signal transmission coil in invention of Claim 8.

It is characterized by the above-mentioned, the magnetic flux generate|occur|produced by the trans|transformer for electric current 送授 linked to the trans|transformer for signal transmission and reception is reduced, and it is effective in the ability to transmit or receive the magnetic flux signal for exact voltage stabilization.

Invention of Claim 10 wound the primary coil for electric power transmission, and the secondary coil for electric power power receiving to the core consisting of a magnetic body, and made the axial direction of the said core mutually opposingly arrange the said core in invention of Claim 9.

It is characterized by the above-mentioned, the magnetic flux generate|occur|produced by the trans|transformer for electric current 送授 linked to the trans|transformer for signal transmission and reception is reduced, and it is effective in the ability to transmit or receive the magnetic flux signal for exact voltage stabilization.

Invention of Claim 11 winds the primary coil for electric power transmission, and the secondary coil for electric power power receiving in invention of Claim 9 to the core consisting of the magnetic body of the bottomed cylinder type|mold which has an opening part in a direction perpendicular|vertical to the axial direction of the said coil,

The axial direction of the said core is made to mutually opposingly arrange the said core.

The primary side signal receiver coil and the secondary side signal transmission coil have been arrange|positioned to the vicinity of the non-opening part of the said core.

It is characterized by the above-mentioned, the magnetic flux generate|occur|produced by the trans|transformer for electric current 送授 linked to the trans|transformer for signal transmission and reception is reduced, and it is effective in the ability to transmit or receive the magnetic flux signal for exact voltage stabilization.

In the invention in any one of Claims 8 to 11, the signal which converted into the alternating voltage the information in which a secondary side signal transmission coil represents the electric state inside a non-contact plug is inputted into invention of Claim 12,

With the magnetic flux which the primary coil for electric power transmission generates, the magnetic flux signal which has a phase of an antiphase is generate|occur|produced,

It is characterized by the above-mentioned and is effective in the ability to transmit or receive the bundle|flux signal for exact voltage stabilization.

Invention of Claim 13 has connected one terminal of a secondary side signal transmission coil to an any one of the terminals of the secondary coil for electric power power receiving in invention of Claim 12, It is characterized by the above-mentioned and is effective in the ability to transmit or receive the magnetic flux signal for exact voltage stabilization.

In the invention in any one of Claims 3 to 7, invention of Claim 14 a non-contact outlet socket, Providing the coil for a magnetic flux detection which detects the magnetic flux generate|occur|produced between the primary coil for electric power transmission, and the secondary coil for electric power power receiving in the vicinity of the primary coil for electric power transmission, the said coil for a magnetic flux detection detects the magnetic flux generate|occur|produced with the primary coil for electric power transmission as a magnetic signal, Based on the voltage output according to the said magnetic flux to detect from the said coil for a magnetic flux detection, the said control means thins|decimates out and controls an inverter circuit, It is characterized by the above-mentioned and is effective in the magnetic flux signal for exact voltage stabilization being receivable.

Invention of Claim 15 provides the primary coil for electric power transmission, and the secondary coil for electric power power receiving in the core consisting of the magnetic body of the bottomed cylinder type|mold which has an opening part in a direction perpendicular|vertical to the axial direction of the said coil, and makes the axial direction of the said core mutually opposingly arrange the said core in invention of Claim 14. The said coil for a magnetic flux detection has been arrange|positioned to the vicinity of the opening part of the core of the said primary coil for electric power transmission. It is characterized by the above-mentioned and is effective in the magnetic flux signal for exact voltage stabilization being receivable.

Invention of Claim 16 adapts several non-contact plugs from which an output voltage differs in one non-contact outlet socket in the invention in any one of Claims 1 to 15, It has the said control means that stores the output voltage of each said non-contact plug in the predetermined voltage range in all areas|domains including the load area|region which each non-contact plug makes object, It is characterized by the above-mentioned and is effective in being economical.

Invention of Claim 17 connects resistance to the output terminal of a non-contact plug parallelly in the invention in any one of Claims 1 to 16, It is characterized by the above-mentioned and is effective in the ability to provide the non-contact power transmission apparatus which can stabilize an output-terminal voltage to a constant value in the wide load range.

When the non-contact plug has not couple|bonded invention of Claim 18 with the predetermined position of a non-contact outlet socket in the invention in any one of Claims 1 to 17, the said control means sets it as the characteristic mark to restrict|limit the output supplied to the primary coil for electric power transmission from an inverter circuit, It is effective in the ability to provide high safety|security and reliability.

Invention of Claim 19 is provided with the switch function by which a non-contact outlet socket controls the restriction|limiting of supply of the high frequency voltage from an inverter circuit to the primary coil for electric power transmission in invention of Claim 18, If a non-contact plug is provided with the driver which controls the on-off state of the said switch function and a non-contact plug couple|bonds with the predetermined position of a non-contact outlet socket, the said control means will enable supply of the high frequency voltage from an inverter circuit to the primary coil for electric power transmission in operating the said switch function, It is characterized by the above-mentioned and is effective in the ability to provide high safety|security and reliability.

In invention of Claim 19, as for invention of Claim 20, the said switch function of a non-contact outlet socket consists of mechanical contacts, the driver with which a non-contact plug is provided consists of magnets, and if a non-contact plug couple|bonds with the predetermined position of a non-contact outlet socket, the said mechanical contact will operate|move by the magnetic force of the said magnet, The said control means enables supply of the high frequency voltage from an inverter circuit to the primary coil for electric power transmission,

It is characterized by the above-mentioned and is effective in the ability to provide high safety|security and reliability.

In the invention in any one of Claims 1 to 20, invention of Claim 21 will be characterized by performing the display of a non-contact plug and a non-contact outlet socket which alert|reports use 可能 to which or one side at least, if a non-contact plug couple|bonds with the predetermined position of a non-contact outlet socket,

It is effective in the ability to judge the usage approval of a system or an apparatus.

In the invention in any one of Claims 1 to 21, a non-contact outlet socket and a non-contact plug at least invention of Claim 22 which or one,

The display part of the load electric power of the terminal device connected to the output terminal of a non-contact plug and the output voltage of a non-contact plug which displays which or one side at least was added.

It is characterized by the above-mentioned and is effective in the ability to judge the usage approval of a system or an apparatus.

The terminal device by which invention of Claim 23 is connected to the output terminal of a non-contact plug in the invention in any one of Claims 1 to 22 is characterized by a separative|detachable thing with respect to the said non-contact plug,

It is effective in the ability to use an unspecified terminal device.

As for invention of Claim 24, in invention of Claim 23, supply of the electric power from the output terminal of a non-contact plug to a terminal device is supplied by magnetic coupling,

It is characterized by the above-mentioned and is effective in the ability to use an unspecified terminal device.

Invention of Claim 25 connects voltage clamp elements between the output terminals of a non-contact plug in the invention in any one of Claims 1 to 24,

It is characterized by the above-mentioned and is effective in the ability to provide high safety|security and reliability.

Thus, the non-contact power transmission system comprised by this invention electrifies circumference environments of water, such as a bathroom, safety and against the background of relief and against the background of high reliability,

It can respond to various user needs by various electric equipments.

BRIEF DESCRIPTION OF THE DRAWINGS

[FIG. 1]

It is a circuit block diagram which shows the Example of this invention.

[FIG. 2]

It is a concrete circuit block diagram which shows the Example of this invention.

[FIG. 3]

It is a figure which shows the characteristic of the Example of this invention.

[FIG. 4]

It is a figure which shows the characteristic of the Example of this invention.

[FIG. 5]

It is a figure which shows the characteristic of the Example of this invention.

[FIG. 6]

It is a figure which shows the characteristic of the Example of this invention.

[FIG. 7]

It is a figure which shows the characteristic of the Example of this invention.

[FIG. 8]

It is a figure which shows the characteristic of the Example of this invention.

[FIG. 9]

It is a figure which shows the characteristic of the Example of this invention.

[FIG. 10]

It is a circuit block diagram which shows the Example of this invention.

[FIG. 11]

It is a circuit block diagram which shows the Example of this invention.

[FIG. 12]

It is a circuit block diagram which shows the Example of this invention.

[FIG. 13]
It is a circuit block diagram which shows the Example of this invention.
[FIG. 14]
It is a circuit block diagram which shows the Example of this invention.
[FIG. 15]
It is a circuit block diagram which shows the Example of this invention.
[FIG. 16]
It is a circuit block diagram which shows the Example of this invention.
[FIG. 17]
It is an external view which shows the Example of this invention.
[FIG. 18]
It is an external view which shows the Example of this invention.
[FIG. 19]
It is an external view which shows the Example of this invention.
[FIG. 20]
It is an external view which shows the Example of this invention.
[FIG. 21]
It is an external view which shows the Example of this invention.
[FIG. 22]
It is an external view which shows the Example of this invention.
[FIG. 23]
It is an external view which shows the Example of this invention.
[FIG. 24]
It is a figure which shows the characteristic of the Example of this invention.
[FIG. 25]
It is a circuit block diagram which shows the Example of this invention.
[FIG. 26]
It is a circuit block diagram which shows the Example of this invention.
[FIG. 27]
It is a circuit block diagram which shows the prior art example of this invention.
[FIG. 28]
It is a block diagram which shows the trans|transformer for electric power transfer of the prior art example of this invention.
[FIG. 29]
It is a circuit block diagram which shows the prior art example of this invention.
[FIG. 30]
It is a figure which shows the characteristic of the prior art example of this invention.
[FIG. 31]
It is a circuit block diagram which shows the prior art example of this invention.
[FIG. 32]
It is a circuit block diagram which shows the prior art example of this invention.
[FIG. 33]
It is a figure which shows the characteristic of the prior art example of this invention.
[FIG. 34]
It is a figure which shows the characteristic of the prior art example of this invention.

Description of Symbols

1 Non-contact outlet socket
2 Non-contact plug
3 Terminal device
10 Power supply circuit
11 Inverter circuit
20 Rectification/smoothing circuit
E DC voltage
V1 High frequency voltage
V2 High frequency voltage
L1 Primary coil for electric power transmission
L2 Secondary coil for electric power power receiving
[FIG. 4]
[MAT_IMAGE 000006]
[FIG. 5]

[MAT_IMAGE 000007]
[FIG. 8]
[MAT_IMAGE 000010]
[FIG. 1]
[MAT_IMAGE 000003]
[FIG. 2]
[MAT_IMAGE 000004]
[FIG. 3]
[MAT_IMAGE 000005]
[FIG. 7]
[MAT_IMAGE 000009]
[FIG. 9]
[MAT_IMAGE 000011]
[FIG. 18]
[MAT_IMAGE 000020]
[FIG. 6]
[MAT_IMAGE 000008]
[FIG. 10]
[MAT_IMAGE 000012]
[FIG. 11]
[MAT_IMAGE 000013]
[FIG. 24]
[MAT_IMAGE 000026]
[FIG. 27]
[MAT_IMAGE 000029]
[FIG. 28]
[MAT_IMAGE 000030]
[FIG. 29]
[MAT_IMAGE 000031]
[FIG. 12]
[MAT_IMAGE 000014]
[FIG. 13]
[MAT_IMAGE 000015]
[FIG. 14]
[MAT_IMAGE 000016]
[FIG. 30]
[MAT_IMAGE 000032]
[FIG. 31]
[MAT_IMAGE 000033]
[FIG. 32]
[MAT_IMAGE 000034]
[FIG. 33]
[MAT_IMAGE 000035]
[FIG. 15]
[MAT_IMAGE 000017]
[FIG. 16]
[MAT_IMAGE 000018]
[FIG. 17]
[MAT_IMAGE 000019]
[FIG. 34]
[MAT_IMAGE 000036]
[FIG. 19]
[MAT_IMAGE 000021]
[FIG. 20]
[MAT_IMAGE 000022]
[FIG. 21]
[MAT_IMAGE 000023]
[FIG. 22]
[MAT_IMAGE 000024]
[FIG. 23]
[MAT_IMAGE 000025]
[FIG. 25]

[MAT_IMAGE 000027]

[FIG. 26]

[MAT_IMAGE 000028]

(Translation from Thomson Reuters)

Citations

Citation *Record level*

Expand Citing Patents (20)

Expand Cited Patents (13)

Cited Non-patents (0)

DPCI Citation *Patent family level*

Expand DPCI Citing Patents (7)

Expand DPCI Cited Patents (13)

DPCI Cited Non-patents (0)

Expand DPCI Citation Counts

DPCI Field of Search

-

DPCI Citing Patents Country

WO; JP; US; KR; GB

DPCI Cited Patents Country

JP

Other

DWPI Title Terms

NON CONTACT ELECTRIC POWER TRANSMITTANCE DEVICE CONTROL PERFORMANCE DECIMATE
STABILISED HIGH FREQUENCY VOLTAGE PRIMARY COIL

DWPI Related Accession Numbers

-

Custom Fields

Test

-

Relevance

-

Product Name

-

Docket number

-

Notes

-

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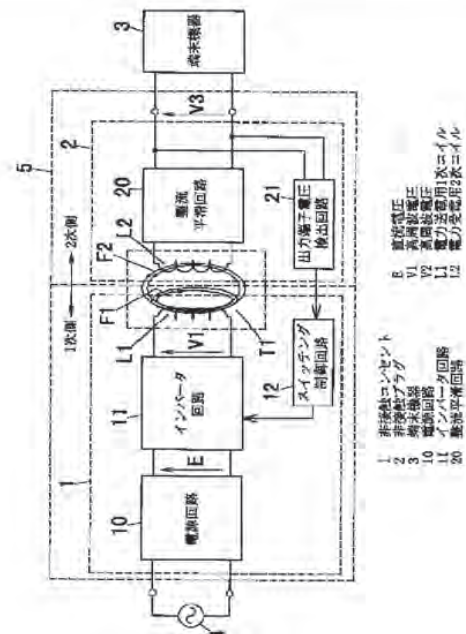
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(54) 【発明の名称】 非接触電力伝達装置

(57) 【要約】

【課題】 広い負荷範囲で出力端子電圧を一定値に安定化できる非接触電力伝達装置を提供する

【解決手段】 直流電圧Eを出力する電源回路10と直流電圧Eを入力して半導体スイッチをスイッチングさせることで一定周波数の高周波電圧V1を発生させるインバータ回路11とインバータ回路11から高周波電圧V1を供給される電力送電用1次コイルL1とを含む非接触コンセント1と、電力送電用1次コイルL1から高周波電圧V2を誘起される電力受電用2次コイルL2と電力受電用2次コイルL2に誘起される高周波電圧V2を整流平滑する整流平滑回路20とを含む非接触プラグ2と、非接触プラグ2の出力端子に接続され負荷となる端末機器3とから構成し、インバータ回路11より電力送電用1次コイルL1に供給される一定周波数の高周波電圧V1を間引く間引き制御を行う。



【特許請求の範囲】

【請求項1】 直流電圧を出力する電源回路と前記直流電圧を一定周波数の高周波電圧に変換するインバータ回路と前記インバータ回路から前記高周波電圧を供給される電力送電用1次コイルとから構成される非接触コンセントと、前記電力送電用1次コイルと分離着脱自在なトランス構造を構成して高周波電圧を誘起される電力受電用2次コイルと前記電力受電用2次コイルに誘起される高周波電圧を整流平滑する整流平滑回路とから構成される非接触プラグと、前記非接触プラグの出力端子に接続され負荷となる端末機器とから構成される非接触電力伝達装置において、前記非接触コンセントは、対象としている負荷領域に対する前記非接触プラグの出力端子電圧を、前記インバータ回路より前記電力送電用1次コイルに供給される高周波電圧を間引いて安定化させる間引き制御を行う制御手段を備えることを特徴とする非接触電力伝達装置。

【請求項2】 前記制御手段は、非接触プラグの出力端子電圧が所定の電圧を上回った場合には、インバータ回路から電力送電用1次コイルへの高周波電圧の供給を一定時間間引き、前記一定時間間引きを行った後非接触プラグの出力端子電圧が前記所定の電圧を上回っていれば再び電力送電用1次コイルへの前記高周波電圧の供給を一定時間間引くことを繰り返し、前記各一定時間間引きを行った後で非接触プラグの出力端子電圧が所定の電圧を下回った場合には、非接触プラグの出力端子電圧が所定の電圧を上回るまで電力送電用1次コイルへの前記高周波電圧の供給を連続的に行う動作を継続させることを特徴とする請求項1記載の非接触電力伝達装置。

【請求項3】 非接触プラグは、非接触プラグ内部の電気状態を表す情報を磁気信号に変換して非接触コンセントに伝送し、前記制御手段は、前記磁気信号に基づいて間引き制御のための制御信号を形成し、前記制御信号によりインバータ回路を間引き制御することを特徴とする請求項1または2記載の非接触電力伝達装置。

【請求項4】 インバータ回路は、ハーフブリッジ型の部分共振インバータであることを特徴とする請求項1乃至3いずれか記載の非接触電力伝達装置。

【請求項5】 電力受電用2次コイルはセンタータップを備え、整流平滑回路は、電力受電用2次コイルのセンタータップではない両出力端に直列に且つ互いに逆方向に接続する整流素子の電力受電用2次コイルに接続していない各他端同士を接続した全波整流部を有し、前記整流素子の接続中点にチョークコイルを接続することを特徴とする請求項4記載の非接触電力伝達装置。

【請求項6】 電力受電用2次コイルに並列にコンデンサを接続することを特徴とする請求項1乃至5いずれか記載の非接触電力伝達装置。

【請求項7】 前記コンデンサの静電容量値は、対象とする負荷領域の最大負荷時において、電力送電用1次コ

イルに供給される高周波電圧の極性反転時期と、前記コンデンサの両端に発生する振動電圧が極大値または極小値となる時期とが一致する静電容量値であることを特徴とする請求項6記載の非接触電力伝達装置。

【請求項8】 非接触コンセントに1次側信号受信コイルを設け、非接触プラグには前記1次側信号受信コイルに対向配置され前記1次側信号受信コイルと分離着脱自在なトランス構造を構成する2次側信号送信コイルを設け、前記2次側信号送信コイルは非接触プラグの内部の電気状態を表す情報を交流電圧に変換した信号を入力され、磁気信号として磁束信号を発生し、前記1次側信号受信コイルは前記磁束信号により電圧を誘起され、前記制御手段はインバータ回路を前記誘起された電圧に基づいた制御信号により前記間引き制御することを特徴とする請求項3乃至7いずれか記載の非接触電力伝達装置。

【請求項9】 電力送電用1次コイルと1次側信号受信コイルとの間、及び電力受電用2次コイルと2次側信号送信コイルとの間の少なくとも一方の間に磁性体からなる磁気シールド用隔壁を設けたことを特徴とする請求項8記載の非接触電力伝達装置。

【請求項10】 電力送電用1次コイルと電力受電用2次コイルとを、磁性体からなるコアに巻装し、前記コアを互いに前記コアの軸方向に対向配置させたことを特徴とする請求項9記載の非接触電力伝達装置。

【請求項11】 電力送電用1次コイルと電力受電用2次コイルとを、前記コイルの軸方向に垂直な方向に開口部を有する有底筒型の磁性体からなるコアに巻装し、前記コアを互いに前記コアの軸方向に対向配置させ、前記コアの非開口部の近傍に1次側信号受信コイルと2次側信号送信コイルとを配置したことを特徴とする請求項9記載の非接触電力伝達装置。

【請求項12】 2次側信号送信コイルは、非接触プラグの内部の電気状態を表す情報を交流電圧に変換した信号を入力されて、電力送電用1次コイルが発生させる磁束とは逆位相の位相を有する磁束信号を発生することを特徴とする請求項8乃至11いずれか記載の非接触電力伝達装置。

【請求項13】 2次側信号送信コイルの一方の端子は、電力受電用2次コイルのどちらか一方の端子に接続していることを特徴とする請求項12記載の非接触電力伝達装置。

【請求項14】 非接触コンセントは、電力送電用1次コイルの近傍に電力送電用1次コイルと電力受電用2次コイルとの間に発生する磁束を検出する磁束検出用コイルを設け、前記磁束検出用コイルは、磁気信号として電力送電用1次コイルで発生する磁束を検出し、前記磁束検出用コイルから前記検出する磁束に応じて出力される電圧に基づいて前記制御手段は、インバータ回路を間引き制御することを特徴とする請求項3乃至7いずれか記載の非接触電力伝達装置。

【請求項 1 5】 電力送電用 1 次コイルと電力受電用 2 次コイルとを、前記コイルの軸方向に垂直な方向に開口部を有する有底筒型の磁性体からなるコアに設けて前記コアを互いに前記コアの軸方向に対向配置させ、前記電力送電用 1 次コイルのコアの開口部の近傍に前記磁束検出用コイルを配置したことを特徴とする請求項 1 4 記載の非接触電力伝達装置。

【請求項 1 6】 一つの非接触コンセントは、出力電圧の異なる複数の非接触プラグに適合し、各非接触プラグが対象としている負荷領域を含む全領域において前記各非接触プラグの出力電圧を所定の電圧範囲内に収める前記制御手段を有することを特徴とする請求項 1 乃至 1 5 いずれか記載の非接触電力伝達装置。

【請求項 1 7】 非接触プラグの出力端子に並列に抵抗を接続することを特徴とする請求項 1 乃至 1 6 いずれか記載の非接触電力伝達装置。

【請求項 1 8】 非接触プラグが非接触コンセントの所定の位置に結合していない場合は、前記制御手段は、インバータ回路から電力送電用 1 次コイルへ供給する出力を制限することを特徴とする請求項 1 乃至 1 7 いずれか記載の非接触電力伝達装置。

【請求項 1 9】 非接触コンセントはインバータ回路から電力送電用 1 次コイルへの高周波電圧の供給の制限を制御するスイッチ機能を備え、非接触プラグは前記スイッチ機能のオン・オフ状態を制御する駆動体を備え、非接触プラグが非接触コンセントの所定の位置に結合すると前記スイッチ機能を動作させることで前記制御手段はインバータ回路から電力送電用 1 次コイルへの高周波電圧の供給を可能にすることを特徴とする請求項 1 8 記載の非接触電力伝達装置。

【請求項 2 0】 非接触コンセントの前記スイッチ機能が機械接点からなり、非接触プラグが備える駆動体は磁石からなり、非接触プラグが非接触コンセントの所定の位置に結合すると前記磁石の磁力によって前記機械接点が動作して、前記制御手段はインバータ回路から電力送電用 1 次コイルへの高周波電圧の供給を可能にすることを特徴とする請求項 1 9 記載の非接触電力伝達装置。

【請求項 2 1】 非接触プラグが非接触コンセントの所定の位置に結合すると、非接触プラグ及び非接触コンセントの少なくともどちらか一方に使用可能を報知する表示を行うことを特徴とする請求項 1 乃至 2 0 いずれか記載の非接触電力伝達装置。

【請求項 2 2】 非接触コンセント及び非接触プラグの少なくともどちらか一方は、非接触プラグの出力端子に接続された端末機器の負荷電力、及び非接触プラグの出力電圧の少なくともどちらか一方を表示する表示部を付加したことを特徴とする請求項 1 乃至 2 1 いずれか記載の非接触電力伝達装置。

【請求項 2 3】 非接触プラグの出力端子に接続される端末機器は前記非接触プラグに対して、分離着脱自在な

ことを特徴とする請求項 1 乃至 2 2 いずれか記載の非接触電力伝達装置。

【請求項 2 4】 非接触プラグの出力端子から端末機器への電力の供給は、磁気結合によって供給されることを特徴とする請求項 2 3 記載の非接触電力伝達装置。

【請求項 2 5】 非接触プラグの出力端子間に、電圧クランプ素子を接続することを特徴とする請求項 1 乃至 2 4 いずれか記載の非接触電力伝達装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】 本発明は、非接触電力伝達装置に関するものである。

【0002】

【従来の技術】 近年、電磁誘導を利用した非接触電力伝達の実用化が盛んに行われている。これらは負荷が特定されているものが大半であり、複数の負荷を対象としたり、単独負荷であってもその負荷電流が大きく変わる場合の実用化例は見当たらない。非接触電力伝達では電力供給側となる 1 次側と負荷を持つ 2 次側との間に電氣的絶縁物があり、電力供給側の 1 次側コイルと負荷側の 2 次側コイルとで分離着脱できる構造を有するトランスを介して電力を伝達する。図 2 7 に前記トランスによる非接触電力伝達装置の従来例 1 の概略構成図を示す。1 次側は、電力供給側の 1 次側コイル L 1 の両端に、インバータ回路（本従来例では省略）で生成された可聴域周波数以上である約 20 KHz 以上の高周波電圧 V 1 が印加されて構成され、2 次側は、1 次側コイル L 1 との間に磁気結合度 M を有する負荷側の 2 次側コイル L 2 と、2 次側コイル L 2 に誘起された電圧を整流する平滑整流回路 2 0 と、平滑整流回路 2 0 の出力端に接続される負荷である負荷 3 a とから構成され、1 次側コイル L 1 と 2 次側コイル L 2 とで分離着脱できる構造を有する電力送受用トランス T 1 を構成している。図 2 8 は、電力送受用トランス T 1 の構造を示す。電力を供給する 1 次側は、磁性材料からなる E 型コア A 4 に設けられた 1 次側コイル L 1 を有し、1 次側から電力を供給される 2 次側も同様に磁性材料からなる E 型コア A 4 に設けられた 2 次側コイル L 2 を有し、互いに電氣的絶縁 G A P 1 1 6 を介して対向設置されている。このような分離着脱できる電力送受用トランス T 1 においては、漏れ磁束 F 1 が生じ、1 次側コイル L 1 と 2 次側コイル L 2 との磁気結合度 M は低下する。ここで図 2 9 に、図 2 7 の回路を 2 次側に換算した等価回路を示す。2 次側コイル L 2 の誘起電圧を有する電圧源 E 2 の出力に直列に漏れインダクタンス L 4 が接続され、平滑整流回路 2 0 を介して負荷 3 a に接続される。前述のように磁気結合度 M が低下して 1 次コイル L 1 で生じる総磁束の内 2 次側コイル L 2 の鎖交磁束 F 2 が少なくなると、漏れ磁束 F 1 による漏れインダクタンス L 4 が生じる。また、1 次側コイル L 1 の両端に印可される電圧 V 1 は可聴域周波数以上であ

る約20KHz以上の高周波で駆動されるため、磁気結合度Mが低く漏れインダクタンスL4を有する電力送受用トランスT1を介して負荷3aへ電力を伝達する場合、2次コイルL2の誘起電圧即ち、電圧源E2の電圧は低下し、漏れインダクタンスL4による誘導リアクタンスのために電圧降下を起こし、結果として出力端子電圧V3は低下する。図30は図29に示す負荷電流I3に対する出力端子電圧V3の特性117a及び負荷電力Pの特性118aを示した図である。出力端子電圧V3は漏れインダクタンスL4による交流インピーダンスのために線形的に低下する。また、負荷電力Pは、負荷電流I3が所定の電圧以下では負荷電流I3が増加するにしたがって負荷電力Pも増加するが、負荷電流I3が所定の電圧以上になると負荷電流I3が増加するにしたがって負荷電力Pは低下する。このような特性を持つ場合には、一定電圧入力で動作する異なる負荷電流の機器を負荷3aとして設けた場合、負荷電流I3が所定の電流値以上では増加するほど、出力端子電圧V3は低下し、負荷7の定電圧入力条件を外れてしまい、本来の性能を発揮できなくなる。

【0003】また、非接触電力伝達において非接触充電の場合には2次コイルL2に並列または直列にコンデンサを接続して負荷整合による力率改善を行い、前記漏れインダクタンスL4の影響を補い2次側で取り出すことのできる有効電力を増加させる場合が多い。図31の回路図は前記図27の2次側コイルL2に並列にコンデンサC2を接続したもので、図32は図31の回路を2次側に換算した等価回路を示し、2次側コイルL2の誘起電圧を有する電圧源E2の出力に直列に漏れインダクタンスL4が接続され、漏れインダクタンスL4を介して電圧源E2に並列にコンデンサC2が接続され、コンデンサC2の両端は整流平滑回路20を介して負荷3aに接続される。前記コンデンサC2を接続することにより電力伝送効率が大幅に向上し、小型化ができる。負荷3aに充電を行う場合には出力端子電圧V3は例えば電池電圧となりほぼ一定である。しかし、負荷3aが定電圧負荷ではない例えば抵抗のような負荷に対しては、図33の負荷電流I3に対する出力端子電圧V3の特性117b及び負荷電力Pの特性118bに示すようにコンデンサC2が接続されている場合には接続されていない場合に比べて、負荷電流I3が増加すると出力端子電圧V3の低下が顕著に見られる。また負荷電力Pがピークとなる点K付近の出力端子電圧V3の時に最適な負荷整合が行われ、負荷電流I3がこのK点での負荷電流より大きい領域では、出力端子電圧V3が急速に低下する。負荷電流I3がK点での負荷電流よりも小さい領域でも負荷電流I3に反比例して出力端子電圧V3は低下している。そして、負荷電流I3が非常に小さい領域では出力端子電圧V3は急に大きくなっている。

【0004】前述のような特性や特徴を持つ非接触電力

伝送において図34の負荷電流I3に対する出力端子電圧V3の特性117c及び負荷電力Pの特性118cに示すように、出力端子電圧V3を、負荷電流I3の異なる負荷に対して出力端子電圧V3を対象とする全ての負荷領域で一定として安定化させる方法が望まれる。この安定した特性を得るために通常のスイッチング電源の電圧制御で行われるように、2次側の出力端子電圧V3を検出し、基準電圧と比較、誤差増幅し、1次側に誤差増幅した信号を非接触で伝送して1次側の駆動電圧振幅、周波数、デューティ及び間引き率を制御するフィードバック制御方法を検討したところ、いずれも従来技術では不都合を生じることが判明した。

【0005】

【発明が解決しようとする課題】非接触伝送では、通常のスイッチング電源に比べて、漏れ磁束F1によるノイズが少し多くなること、負荷整合を施しても回路効率が少し低下することから、1次コイルL1に印可される高周波電圧V1を生成するためのインバータ回路は共振型インバータを採用することが最適である。そして、安定化したい電圧領域で、対象とする最大負荷電流時において最適負荷整合を行うこと、即ち2次側に接続されるコンデンサC2の静電容量を、負荷整合を行うのに最適な値に設定することが最良である。

【0006】ところが、前述の回路方式において無負荷時から全負荷時にわたって出力端子電圧V3を一定にする安定化を行う場合、不都合がある。2次側に接続した負荷整合用のコンデンサC2は、全ての負荷電流領域において接続されているため1次コイルL1に印可される高周波電圧V1を生成するためのインバータ回路が、PWM方式及び周波数可変方式では、周波数やデューティ比の変化幅が大きいと回路動作が不安定になる場合がある。これは図32に示す2次側等価回路に示すように2次側コイルL2の誘起電圧を有する電圧源E2には、漏れインダクタンスL4とコンデンサC2とが直列に接続された直列共振回路が接続されているため、1次コイルL1に印可される高周波電圧V1の周波数やデューティ比が大きく変化して2次側コイルL2に誘起する電圧の周波数やデューティ比が大きく変化すると、前記直列共振回路の動作も大きく変化するためであると考えられる。もし、この影響が無視できたとしても、負荷電流I3を非常に大きく変化させなければならない時（例えば100倍の変化幅がある時）には、1次コイルL1に印可される高周波電圧V1の周波数やデューティ比も非常に大きく変化させなければならないため、特に軽負荷、無負荷近辺での制御が回路動作の実用限界を超えて制御不能になる場合がある。

【0007】また1次コイルL1に印可される高周波電圧V1を生成するためのインバータ回路が、従来の間引き制御を行った場合には、従来の間引き制御は、1次コイルL1に印可される高周波電圧V1を固定周波数で

連続駆動させる中で、出力端子電圧の検出電圧が安定化したい目標電圧を超えた場合にインバータを休止させる制御方法」であり、この方法も軽負荷、無負荷近辺において、目標電圧付近で、駆動周波数の1周期にも満たないオン・オフ動作が頻繁に行われ、共振型インバータのメリットである低損失のソフトスイッチングが行われず、ハードスイッチングを行ってスイッチング損失が増加すると共に、強いノイズ源となる。

【0008】そしてこれらの制御方式は、従来技術では、2次側の出力端子電圧V3などの情報は光信号を利用したフォトカプラを介して、1次側のインバータ回路の駆動電圧振幅、周波数、デューティ比及び間引き率を制御するフィードバック制御であった。しかし、非接触電力伝達装置においては、浴室や屋外などの水まわりや汚れの多いところ悪環境で使われる場合にそのメリットが出るため、まわりの明るさや、汚れ等の影響を受ける光信号を利用する技術手段は採用が難しい。

【0009】本発明は、上記事由に鑑みてなされたものであり、その目的は、広い負荷範囲で出力端子電圧を一定値に安定化できる非接触電力伝達装置を提供することにある。

【0010】

【課題を解決するための手段】請求項1の発明は、直流電圧を出力する電源回路と前記直流電圧を一定周波数の高周波電圧に変換するインバータ回路と前記インバータ回路から前記高周波電圧を供給される電力送電用1次コイルとから構成される非接触コンセントと、前記電力送電用1次コイルと分離着脱自在なトランス構造を構成して高周波電圧を誘起される電力受電用2次コイルと前記電力受電用2次コイルに誘起される高周波電圧を整流平滑する整流平滑回路とから構成される非接触プラグと、前記非接触プラグの出力端子に接続され負荷となる端末機器とから構成される非接触電力伝達装置において、前記非接触コンセントは、対象としている負荷領域に対する前記非接触プラグの出力端子電圧を、前記インバータ回路より前記電力送電用1次コイルに供給される高周波電圧を間引いて安定化させる間引き制御を行う制御手段を備えることを特徴とし、広い負荷範囲で出力端子電圧を一定値に安定化できる非接触電力伝達装置を提供することができる。

【0011】請求項2の発明は、請求項1の発明において、前記制御手段は、非接触プラグの出力端子電圧が所定の電圧を上回った場合には、インバータ回路から電力送電用1次コイルへの高周波電圧の供給を一定時間間引き、前記一定時間間引きを行った後非接触プラグの出力端子電圧が前記所定の電圧を上回っていれば再び電力送電用1次コイルへの前記高周波電圧の供給を一定時間間引くことを繰り返し、前記各一定時間間引きを行った後で非接触プラグの出力端子電圧が所定の電圧を下回った場合には、非接触プラグの出力端子電圧が所定の電圧を

上回るまで電力送電用1次コイルへの前記高周波電圧の供給を連続的に行う動作を継続させることを特徴とし、広い負荷範囲で出力端子電圧を一定値に安定化できる非接触電力伝達装置を提供することができる。

【0012】請求項3の発明は、請求項1または2の発明において、非接触プラグは、非接触プラグ内部の電気状態を表す情報を磁気信号に変換して非接触コンセントに伝送し、前記制御手段は、前記磁気信号に基づいて間引き制御のための制御信号を形成し、前記制御信号によりインバータ回路を間引き制御することを特徴とし、電圧安定化のためのフィードバック信号に磁気信号を使うため、まわりの明るさや汚れの影響を受けずに、広い負荷範囲で出力端子電圧を一定値に安定化できる非接触電力伝達装置を提供することができる。

【0013】請求項4の発明は、請求項1乃至3いずれかの発明において、インバータ回路は、ハーフブリッジ型の部分共振インバータであることを特徴とし、故障時の出力電圧の上昇を抑えることができる。

【0014】請求項5の発明は、請求項4の発明において、電力受電用2次コイルはセンタータップを備え、整流平滑回路は、電力受電用2次コイルのセンタータップではない両出力端に直列に且つ互いに逆方向に接続する整流素子の電力受電用2次コイルに接続していない各他端同士を接続した全波整流部を有し、前記整流素子の接続中点にチョークコイルを接続することを特徴とし、整流部を小型化することができる。

【0015】請求項6の発明は、請求項1乃至5いずれかの発明において、電力受電用2次コイルに並列にコンデンサを接続することを特徴とし、負荷整合をとることで1次側から2次側へ伝達できる有効電力を増加させることができる。

【0016】請求項7の発明は、請求項6の発明において、前記コンデンサの静電容量値は、対象とする負荷領域の最大負荷時において、電力送電用1次コイルに供給される高周波電圧の極性反転時期と、前記コンデンサの両端に発生する振動電圧が極大値または極小値となる時期とが一致する静電容量値であることを特徴とし、最適な負荷整合を行って回路効率を向上させることができる。

【0017】請求項8の発明は、請求項3乃至7いずれかの発明において、非接触コンセントに1次側信号受信コイルを設け、非接触プラグには前記1次側信号受信コイルに対向配置され前記1次側信号受信コイルと分離着脱自在なトランス構造を構成する2次側信号送信コイルを設け、前記2次側信号送信コイルは非接触プラグの内部の電気状態を表す情報を交流電圧に変換した信号を入力され、磁気信号として磁束信号を発生し、前記1次側信号受信コイルは前記磁束信号により電圧を誘起され、前記制御手段はインバータ回路を前記誘起された電圧に基づいた制御信号により前記間引き制御することを特徴

とし、電圧安定化のためのフィードバック信号に磁束信号を使うため、まわりの明るさや汚れの影響を受けずに、広い負荷範囲で出力端子電圧を一定値に安定化できる非接触電力伝達装置を提供することができる。

【0018】請求項9の発明は、請求項8の発明において、電力送電用1次コイルと1次側信号受信コイルとの間、及び電力受電用2次コイルと2次側信号送信コイルとの間の少なくとも一方の間に磁性体からなる磁気シールド用隔壁を設けたことを特徴とし、信号送受用トランスに鎖交する電流送授用トランスで発生する磁束を低減させて、正確な電圧安定化のための磁束信号を送受信することができる。

【0019】請求項10の発明は、請求項9の発明において、電力送電用1次コイルと電力受電用2次コイルとを、磁性体からなるコアに巻装し、前記コアを互いに前記コアの軸方向に対向配置させたことを特徴とし、信号送受用トランスに鎖交する電流送授用トランスで発生する磁束を低減させて、正確な電圧安定化のための磁束信号を送受信することができる。

【0020】請求項11の発明は、請求項9の発明において、電力送電用1次コイルと電力受電用2次コイルとを、前記コイルの軸方向に垂直な方向に開口部を有する有底筒型の磁性体からなるコアに巻装し、前記コアを互いに前記コアの軸方向に対向配置させ、前記コアの非開口部の近傍に1次側信号受信コイルと2次側信号送信コイルとを配置したことを特徴とし、信号送受用トランスに鎖交する電流送授用トランスで発生する磁束を低減させて、正確な電圧安定化のための磁束信号を送受信することができる。

【0021】請求項12の発明は、請求項8乃至11いずれかの発明において、2次側信号送信コイルは、非接触プラグの内部の電気状態を表す情報を交流電圧に変換した信号を入力されて、電力送電用1次コイルが発生させる磁束とは逆位相の位相を有する磁束信号を発生することを特徴とし、正確な電圧安定化のための束信号を送受信することができる。

【0022】請求項13の発明は、請求項12記載の発明において、2次側信号送信コイルの一方の端子は、電力受電用2次コイルのどちらか一方の端子に接続していることを特徴とし、正確な電圧安定化のための磁束信号を送受信することができる。

【0023】請求項14の発明は、請求項3乃至7いずれかの発明において、非接触コンセンタは、電力送電用1次コイルの近傍に電力送電用1次コイルと電力受電用2次コイルとの間に発生する磁束を検出する磁束検出用コイルを設け、前記磁束検出用コイルは、磁気信号として電力送電用1次コイルで発生する磁束を検出し、前記磁束検出用コイルから前記検出する磁束に応じて出力される電圧に基づいて前記制御手段は、インバータ回路を開閉制御することを特徴とし、正確な電圧安定化のた

めの磁束信号を受信することができる。

【0024】請求項15の発明は、請求項14の発明において、電力送電用1次コイルと電力受電用2次コイルとを、前記コイルの軸方向に垂直な方向に開口部を有する有底筒型の磁性体からなるコアに設けて前記コアを互いに前記コアの軸方向に対向配置させ、前記電力送電用1次コイルのコアの開口部の近傍に前記磁束検出用コイルを配置したことを特徴とし、正確な電圧安定化のための磁束信号を受信することができる。

【0025】請求項16の発明は、請求項1乃至15いずれかの発明において、一つの非接触コンセンタは、出力電圧の異なる複数の非接触プラグに適合し、各非接触プラグが対象としている負荷領域を含む全領域において前記各非接触プラグの出力電圧を所定の電圧範囲内に収める前記制御手段を有することを特徴とし、経済的である。

【0026】請求項17の発明は、請求項1乃至16いずれかの発明において、非接触プラグの出力端子に並列に抵抗を接続することを特徴とし、広い負荷範囲で出力端子電圧を一定値に安定化できる非接触電力伝達装置を提供することができる。

【0027】請求項18の発明は、請求項1乃至17いずれかの発明において、非接触プラグが非接触コンセンタの所定の位置に結合していない場合は、前記制御手段は、インバータ回路から電力送電用1次コイルへ供給する出力を制限することを特徴とし、高い安全性と信頼性とを備えることができる。

【0028】請求項19の発明は、請求項18の発明において、非接触コンセンタはインバータ回路から電力送電用1次コイルへの高周波電圧の供給の制限を制御するスイッチ機能を備え、非接触プラグは前記スイッチ機能のオン・オフ状態を制御する駆動体を備え、非接触プラグが非接触コンセンタの所定の位置に結合すると前記スイッチ機能を動作させることで前記制御手段はインバータ回路から電力送電用1次コイルへの高周波電圧の供給を可能にすることを特徴とし、高い安全性と信頼性とを備えることができる。

【0029】請求項20の発明は、請求項19の発明において、非接触コンセンタの前記スイッチ機能が機械接点からなり、非接触プラグが備える駆動体は磁石からなり、非接触プラグが非接触コンセンタの所定の位置に結合すると前記磁石の磁力によって前記機械接点が動作して、前記制御手段はインバータ回路から電力送電用1次コイルへの高周波電圧の供給を可能にすることを特徴とし、高い安全性と信頼性とを備えることができる。

【0030】請求項21の発明は、請求項1乃至20いずれかの発明において、非接触プラグが非接触コンセンタの所定の位置に結合すると、非接触プラグ及び非接触コンセンタの少なくともどちらか一方に使用可能を報知する表示を行うことを特徴とし、システムや機器の使用

可否の判断をおこなうことができる。

【0031】請求項22の発明は、請求項1乃至21いずれかの発明において、非接触コンセント及び非接触プラグの少なくともどちらか一方は、非接触プラグの出力端子に接続された端末機器の負荷電力、及び非接触プラグの出力電圧の少なくともどちらか一方を表示する表示部を付加したことを特徴とし、システムや機器の使用可否の判断をおこなうことができる。

【0032】請求項23の発明は、請求項1乃至22いずれかの発明において、非接触プラグの出力端子に接続される端末機器は前記非接触プラグに対して、分離着脱自在なことを特徴とし、不特定の端末機器を使用することができる。

【0033】請求項24の発明は、請求項23の発明において、非接触プラグの出力端子から端末機器への電力の供給は、磁気結合によって供給されることを特徴とし、不特定の端末機器を使用することができる。

【0034】請求項25の発明は、請求項1乃至24いずれかの発明において、非接触プラグの出力端子間に、電圧クランプ素子を接続することを特徴とし、高い安全性と信頼性とを備えることができる。

【0035】

【発明の実施の形態】以下、本発明の実施の形態を図面に基いて説明する。

【0036】図1は、磁気信号を用いて間引き制御を行う非接触電力伝達装置の回路構成を示す。非接触電力伝達装置5は、電力供給側となる1次側を構成する非接触コンセント1と負荷を持つ2次側を構成する非接触プラグ2とからなり、非接触コンセント1は、交流電源4からの交流入力、直流電圧Eを出力する直流に変換する電源回路10と、半導体スイッチを有し、半導体スイッチをスイッチングさせることで電源回路10からの直流電圧Eを一定周波数の高周波電圧V1に変換するインバータ回路11と、インバータ回路11から前記高周波電圧V1を供給される電力送電用1次コイルL1と、非接触プラグ2からフィードバックされた磁気信号に応じてインバータ回路11の半導体スイッチのスイッチングを制御する制御信号を出力する制御部であるスイッチング制御回路12とから構成され、非接触プラグ2は、電力送電用1次コイルL1に印加された高周波電圧により発生した漏れ磁束F1と鎖交磁束F2との内、鎖交磁束F2と鎖交することで高周波電圧を誘起される電力受電用2次コイルL2と、電力受電用2次コイルL2から出力される高周波電圧を整流平滑する整流平滑回路20と、非接触プラグ2の出力電圧である出力端子電圧V3を検出し、検出結果に応じて非接触コンセント1のスイッチング制御回路12に磁気信号を出力する出力端子電圧検出回路21とから構成され、出力端子電圧V3は負荷である端末機器3に出力される。電力送電用1次コイルL1と電力受電用2次コイルL2とは、分離着脱できる電

力送受用トランスT1を構成する。

【0037】本実施例では、出力端子電圧V3を検出した出力端子電圧検出回路21は、その検出結果に応じた磁気信号を発生させ、その磁気信号を受信したスイッチング制御回路12は磁気信号に基づいて、出力端子電圧V3が所定の電圧を上回った場合には、インバータ回路11から電力送電用1次コイルL1への一定周波数の高周波電圧V1の供給を一定時間間引き、一定時間間引きを行った後出力端子電圧V3が所定の電圧をまだ上回っていれば再び電力送電用1次コイルL1への高周波電圧V1の供給を一定時間間引くことを繰り返し、各一定時間間引きを行った後で出力端子電圧V3が所定の電圧を下回った場合には、出力端子電圧V3が所定の電圧を上回るまで電力送電用1次コイルL1への高周波電圧V1の供給を行う動作を継続させる間引き制御を行う制御信号をインバータ回路11に出力し、インバータ回路11の半導体スイッチは制御信号に応じて、スイッチング動作を行い、出力端子電圧V3を一定電圧に安定化させる。

【0038】図2は、本実施例の具体的な回路構成を示す。図2において、電源回路10は直流電圧Eを出力する直流電圧源10aで表し、出力端子電圧検出回路21及びスイッチング制御回路12は省略する。非接触コンセント1は、直流電圧源10aと、直流電圧源10aに並列に接続されたコンデンサC3、C4の直列回路及び半導体スイッチQ1、Q2の直列回路と、コンデンサC1とコンデンサC2との接続中点と半導体スイッチQ1と半導体スイッチQ2との接続中点との間に接続されたコンデンサC1とからなるインバータ回路11と、コンデンサC1に並列に接続された電力送電用1次コイルL1とから構成され、ハーフブリッジ型の部分共振インバータ回路となる。非接触プラグ2は、センタータップを備えた電力受電用2次コイルL2と、電力受電用2次コイルL2に並列に接続されたコンデンサC2、電力受電用2次コイルL2のセンタータップではない両出力端に直列且つ互いに逆方向に接続されたダイオードD3、D4、ダイオードD3、D4の接続中点に一端を接続されたチョークコイルL3、チョークコイルL3の他端と電力受電用2次コイルL2のセンタータップとの間に接続される平滑コンデンサC5からなる整流平滑回路20とから構成され、端末機器3は平滑コンデンサC5に並列に接続される。電力送電用1次コイルL1と電力受電用2次コイルL2とは、分離着脱できる電力送受用トランスT1を構成する。電力受電用2次コイルL2にはセンタータップを備えているものを使用し、2つのダイオードD3、D4で整流しているので装置の小型化を図ることができる。

【0039】次に図3に、図2における電力送電用1次コイルL1の両端電圧V1と、電力送電用1次コイルL1を流れる電流I1と、半導体スイッチQ1の両端電圧

V4aと、半導体スイッチQ1を流れる電流I4aと、半導体スイッチQ2の両端電圧V4bと、半導体スイッチQ2を流れる電流I4bとの各波形を示す。半導体スイッチQ1、Q2は交互にオン・オフを繰り返すが、この時一方の半導体スイッチがオンからオフした後、両方の半導体スイッチがオフになる一定期間を経てから他方の半導体スイッチがオンするように制御しているので、電力送電用1次コイルL1の両端電圧V1は、台形上の波形となる。部分共振区間100は半導体スイッチQ1、Q2ともにオフしている区間であり、電力送電用1次コイルL1から2次側を見たインダクタンスと、コンデンサC1との共振動作による電圧振動が行われる期間である。半導体スイッチにMOSFETを用いると、図2に示すように寄生ダイオードD1、D2が半導体スイッチQ1、Q2に並列に接続されるため、電力送電用1次コイルL1の両端電圧V1の振動電圧が大きくなり、電圧E/2または電圧E/2にてクランプされると、半導体スイッチQ1の両端電圧V4aと半導体スイッチQ2の両端電圧V4bとは直流電源10aの電圧Eまたはグラウンドレベルにクランプされた台形波となる。また半導体スイッチQ1、Q2にMOSFETを用いた場合は、MOSFETの寄生容量を利用しても部分共振動作ができる。この部分共振により半導体スイッチQ1、Q2はソフトスイッチングを行うことができ、ターンオン及びターンオフ時の損失が大幅に低減できる。

【0040】図4は、負荷状態が無負荷、軽負荷近辺において従来技術の間引き制御を行った時の出力端子電圧V3と電力送電用1次コイルL1の両端電圧V1とを示す。従来技術の間引き制御は、出力端子電圧V3を検出し、その検出結果が目標電圧101を超えた時のみインバータ回路11の固定周波数駆動を休止させて、一定周波数の高周波電圧V1の出力を停止させる。このような制御では、図4に示すように軽負荷、無負荷近辺において、目標電圧101の付近で駆動周波数の1周期にも満たない半導体スイッチQ1、Q2のオン・オフが頻繁に行われ、共振型インバータのメリットである低損失のソフトスイッチングが行われず、ハードスイッチングになるとともに、強いノイズ源になることは前記従来の技術でも述べたとおりである。特に、非接触電力伝達では、漏れ磁束や磁束の広がりによる磁界の影響で、出力端子にノイズが乗りやすいためこの傾向は顕著に現れやすい。

【0041】前記従来技術の間引き制御に対し、図5に、負荷状態が無負荷、軽負荷近辺において、出力端子電圧V3の目標電圧として2つの目標電圧102、103を設け、出力端子電圧V3が目標電圧102を超えるとインバータ回路11の固定周波数駆動を停止させ、出力端子電圧V3が目標電圧103より下回るとインバータ回路11の固定周波数駆動を行う制御を行った時の出力端子電圧V3と電力送電用1次コイルL1の両端電圧

V1とを示す。2つの目標電圧102、103によってヒステリシスをつくることでインバータ回路11の固定周波数駆動の動作と停止が図4に示す従来の方式に比べて良好に行われる。実用的にはこの方式で使用可能なものもあるが、ノイズが大きく重量される場合にはヒステリシス幅を大きくしなければならず、出力端子電圧V3のリプル電圧増大の原因となる。

【0042】そこで発明では図6に示すように、出力端子電圧V3が目標電圧108を上回った場合には、インバータ回路11から電力送電用1次コイルL1への一定周波数の高周波電圧V1の供給を一定時間106間引き、一定時間106の間引きを行った後出力端子電圧V3が目標電圧108をまだ上回っていれば再び電力送電用1次コイルL1への高周波電圧V1の供給を一定時間106間引くことを繰り返し、各一定時間106の間引きを行った後で出力端子電圧V3が目標電圧108を下回った場合には、出力端子電圧V3が目標電圧108を上回るまで電力送電用1次コイルL1への高周波電圧V1の供給を行う動作を継続させる間引き制御を行い、この一連の動作を継続させて出力端子電圧V3を一定にする安定化を行う。この方式では、軽負荷から全負荷までの範囲において、一定時間106の休止期間の終了時には出力端子電圧V3は目標電圧108を確実にある程度下回り、インバータ回路11の固定周波数駆動も連続1周期以上は確保できる。そして、完全な無負荷の場合にはインバータ回路11の固定周波数駆動が1周期未満になることもありうるが、この場合にでもインバータ回路11の固定周波数駆動動作の期間と停止の期間とは一定の周期で規則的に繰り返されるため、インバータ回路11の固定周波数駆動の期間と停止の期間とが不規則に繰り返される図4の場合に比べて高調波ノイズは低減できる。また、本実施例のもう一つのメリットは、負荷状態が無負荷に近い時も全負荷に近い時も、出力端子電圧V3の最大電圧107をほぼ同程度にできるため、とくに浴室などの水まわりで使う低い電圧を安定化させる場合に、その電圧規格の上限値に対し少しのマージン分だけ低い電圧に目標電圧108を設定すれば、確実に電圧規格の上限値以内に出力端子電圧V3を制御できるため、安全安心に配慮した出力端子電圧V3の電圧安定化を行うことができる。

【0043】次に図7に、電力送電用1次コイルL1の両端電圧V1と、コンデンサC2の両端電圧V2と、コンデンサC2を流れる電流I2と、端末機器3を流れる負荷電流I3との各波形を示す。コンデンサC2を電力受電用2次コイルL2に並列に接続して最適な負荷整合を行うことができる条件は、図7にタイミング109に示すように電力送電用1次コイルL1の両端電圧V1の極性反転時と、コンデンサC2の両端電圧V2の振動電圧が極大値に達する時とが一致すること及びタイミング110のように電力送電用1次コイルL1の両端電圧V

1の極性反転時と、コンデンサC2の両端電圧V2の振動電圧が極小値に達する時とが一致することと等価である。図7のように最適な負荷整合を行うためのコンデンサC2の静電容量値は、インバータ回路11の駆動周波数や、電力送電用1次コイルL1と電力受電用2次コイルL2間の漏れインダクタンスL4以外に出力端子電圧V3や整流平滑回路20の整流方式にも影響を受ける。

【0044】図8、9は本実施例における負荷電流I3に対する出力端子電圧V3の特性117d、117eを示す。最大負荷電力がとれる点K、即ち負荷整合が最適にとれている点Kより負荷電流I3が小さい領域111及び113では出力端子電圧V3は、点Kにおける出力端子電圧V3より高くなっているため、本実施例の間引き制御による電圧低減動作により出力端子電圧V3の安定化を行うことができる。一方負荷電流I3が点Kを超える領域112、114では、出力端子電圧V3は急激に電圧降下を起こし利用できない。このようにコンデンサC2により最適な負荷整合を行うことで、本発明の無接触電力伝達装置5を最も効率の高い状態で動作させることができる。また、適用負荷範囲を超えた場合、例えば端末機器3の故障により内部短絡が起こっても、点Kよりも負荷電流I3が大きくなると出力端子電圧V3の電圧降下が急激に起こり、出力端子電圧V3は低電圧になるとともに負荷電流I3は電流制限がかかり安全であり、安全安心に配慮したシステムとなっている。

【0045】図10乃至23は本発明の実施形態の具体例を示し、基本的な構成は図1及び図2とほぼ同様であり、同一の構成要素には同一の符号を付して説明は省略する。図10において、電力供給側となる1次側を構成する非接触コンセント1は、直流電源を入力されて一定周波数の高周波電圧を出力するインバータ回路11と

(図10乃至16では直流電源を出力する電源回路は省略)、インバータ回路11から前記高周波電圧を供給される電力送電用1次コイルL1と、非接触プラグ2の2次側信号送信コイル23からフィードバックされた磁気信号により電圧を誘起される1次側信号受信コイル14と、前記誘起電圧に基づいた信号を出力する信号変換回路13と、信号変換回路13の出力信号に応じてインバータ回路11の半導体スイッチのスイッチングを間引き制御する制御信号を出力するスイッチング制御回路12とから構成され、負荷を持つ2次側を構成する非接触プラグ2は、電力送電用1次コイルL1に印加された高周波電圧により発生した磁束F3と鎖交することで高周波電圧を誘起される電力受電用2次コイルL2と、電力受電用2次コイルL2の高周波出力を整流平滑する整流平滑回路20と、非接触プラグ2の出力端子電圧V3を検出し、検出信号を出力する出力端子電圧検出回路21と、前記検出信号に応じた交流信号を出力する信号変換回路22と、信号変換回路22から出力される交流信号を入力されて、磁気信号としての磁束信号を発生する2

次側信号送信コイル23とから構成され、非接触プラグ2の出力は端末機器3に接続される。電力送電用1次コイルL1と電力受電用2次コイルL2とは、分離着脱できる電力送受用トランスT1を構成し、1次側信号受信コイル14と2次側信号送信コイル23とは、分離着脱できる信号授受用トランスT2を構成する。

【0046】しかし、図10に示す回路構成のように電力送受用トランスT1と信号授受用トランスT2とが互いに近傍に配置されると磁束F3の広がりによって、磁束F3の一部は1次側信号受信コイル14と2次側信号送信コイル23とに鎖交しており、信号授受用トランスT2にはノイズが入ることになり正確な非接触プラグ2の出力端子電圧V3の情報を非接触コンセント1にフィードバックできない。そこで、前述の問題を改善する実施例を図11～図14に示す。

【0047】図11は、非接触コンセント1、非接触プラグ2と、信号授受用トランスT2との間に磁気を通しやすい磁性体からなる隔壁A1を設け、電力送電用1次コイルL1により発生する磁束F3を隔壁A1に集中させることで、磁束F3の内、信号授受用トランスT2に鎖交する磁束を低減させたものである。

【0048】図12は、電力送電用1次コイルL1と電力受電用2次コイルL2とを磁性体からなるコアA2に巻装し、電力送電用1次コイルL1と電力受電用2次コイルL2との軸方向に互に対向配置させており、電力送電用1次コイルL1により発生する磁束F3をコアA2に集中させることで、磁束F3の広がり度合いを低減させて、磁束F3の内、信号授受用トランスT2に鎖交する磁束を低減させたものである。

【0049】図13は、電力送電用1次コイルL1と電力受電用2次コイルL2とを、磁性体からなり開口部を有する一般によく使われているトランス用のコアA3に巻装し、電力送電用1次コイルL1と電力受電用2次コイルL2との軸方向に互に対向配置させており、電力送電用1次コイルL1により発生する磁束F3をコアA3に集中させることで、磁束F3の広がり度合いを低減させて、磁束F3の内、信号授受用トランスT2に鎖交する磁束を低減させたものである。また、図13においてはコアA3の開口部122から磁束F3の一部が漏れるので、信号授受用トランスT2は、その磁束が鎖交しないようにコアA3の非開口部123側に設置しておく。

【0050】図14に示す実施例においては、出力端子電圧V3を信号変換回路24に入力して、信号変換回路24は出力端子電圧V3に応じた信号を出力し、2次側信号送信コイル23の一端は前記信号が出力される信号変換回路24の出力に接続され、他端は電力受電用2次コイルの一端に接続されている。また、電力送電用1次コイルL1で発生し電力受電用2次コイルL2と鎖交する磁束F3a及び電力送電用1次コイルL1で発生し1

次側信号受信コイル14と鎖交する磁束F3bとの方向と、2次側信号送信コイル23で発生する磁束信号F4の方向とが互いに反対方向になるように、電力送電用1次コイルL1と1次側信号受信コイル14との巻線の方向と、電力受電用2次コイルL2と2次側信号送信コイル23との巻線の方向とを互いに反対方向にすることで、2次側信号送信コイル23で発生する磁束信号F4の位相は、電力送電用1次コイルL1で発生する磁束F3a、F3bの位相とは逆位相となり、信号授受用トランスT2は電力送電用1次コイルL1で発生する磁束F3a、F3bの影響を受けにくくなる。

【0051】また、前記図33の負荷電流I3に対する出力端子電圧V3の特性117bに示すように、無負荷状態に近くなると出力端子電圧V3は高くなる傾向があり、負荷が軽くなるほど出力端子電圧V3の安定化は難しくなる。間引き制御によって全負荷領域をカバーするようにフィードバック制御系を設計できるが、制御信号の分解能向上、応答速度向上、対ノイズ性強化などで制御回路の部品も増えコスト、サイズで不利となる。しかし、図14に示すように非接触プラグ2の出力端子間に抵抗R1を並列に接続することで、図24の負荷電流I3に対する出力端子電圧V3の特性117fに示すように、抵抗R1に電流I15を常に流しておき、領域111において出力端子電圧V3の安定化を行うことができる。さらに、負荷の急変時には過渡的な出力端子電圧V3の上昇もありうるため、図14に示すように非接触プラグ2の出力端子間に定電圧ダイオードZD1を並列に接続することで、出力端子電圧V3を常に安定化させることができる。前述のような負荷急変時の出力端子電圧V3の上昇頻度は少なく、また上昇電圧も小さいため定電圧ダイオードZD1の損失は小さい。本実施例では定電圧ダイオードを使っているが電圧クランプ素子であればよい。

【0052】次に図15は、間引き制御に必要な非接触プラグ2の電気情報を電力送電用1次コイルL1で発生する磁束F3の変化から得るもので、電力送電用1次コイルL1で発生する磁束F3の変化を磁束検出コイル14aで検出して、その検出結果に基づいてインバータ回路11の間引き制御するものである。非接触伝送においては、伝送する電力が増加すれば、電力送電用1次コイルL1で発生する磁束F3も電力に比例して増加し、出力端子電圧は電力に反比例して低下する。前述の特性は、一つのシステムにおいては同一な特性であるので、電力送電用1次コイルL1で発生する磁束F3の変化を磁束検出コイル14aで検出すれば、間接的に非接触プラグ2の出力端子電圧の情報を得ることができ、インバータ回路11の間引き制御することができる。図15に示す回路は、電力送電用1次コイルL1と電力受電用2次コイルL2とを空芯とし、磁束F3の広がりや漏れを大きくして磁束F3を磁束検出コイル14aに鎖交させ

るものである。

【0053】図16に示す回路は、前記図15に示した回路の電力送電用1次コイルL1と電力受電用2次コイルL2とを、磁性体からなり開口部122を有する一般によく使われているトランス用のコアA3に設けて互に対向配置させており、開口部122近傍に磁束検出コイル14aを配置することで、磁束F3の内、開口部122から漏れる磁束を磁束検出コイル14aに鎖交させるものである。

【0054】以上に示したように、本発明は広い負荷領域に対して、必要な電圧への安定化を行うことができる。

【0055】図17に、浴室内で使う本発明の非接触電力伝達システム例の外観を示す。壁200に埋設された非接触コンセント1は、壁200の表面と接する外周部にシール15を設けて防水性を高めている。非接触コンセント1の内部には、前記の電源回路10、インバータ回路11、スイッチング制御回路12及び信号変換回路13が内蔵され、交流電源4と接続された回路ブロックX1と、凹部19に対して配置された電力送電用1次コイルL1と、同様に凹部19に対して配置された1次側信号受信コイル14とが設けられ、非接触プラグ2側の面には非接触コンセント1が使用可能状態である時点灯するコンセント通電表示LED16が設けられている。非接触プラグ2は、通電時は、非接触コンセント1の凹部19に嵌合させて、内部には、嵌合時に電力送電用1次コイルL1に対向配置するように設けられた電力受電用2次コイルL2と、1次側信号受信コイル14に対向配置するように設けられた2次側信号送信コイル23と、前記整流平滑回路20、出力端子電圧検出回路21及び信号変換回路22が内蔵された回路ブロックX2と、機器3に電力を伝達するケーブルコード26とから構成され、端末機器3は、ケーブルコード26を接続されて電力を伝達され、表面に非接触プラグ2が使用可能状態である時点灯するプラグ通電表示LED25が設けられている。

【0056】図18は、図17を非接触プラグ2側から見た図を示す。非接触コンセント1及び非接触プラグ2が使用可能かどうかを表示することはユーザにとって必要であり、非接触コンセント1の非接触プラグ2側表面には、非接触コンセント1が使用可能状態である時点灯するコンセント通電表示LED16を設け、非接触プラグ2表面には非接触プラグ2が使用可能状態である時点灯するコンセント通電表示LED16を設けている。また、広い負荷領域を対象としているため、現在使っている端末機器3がどの程度の負荷なのか、使用限界を超えていないのかなどの情報は重要である。この情報は間引き制御の間引き率より得ることができる。即ち間引き率が大きいと負荷は小さく、間引き率が小さいほど負荷は大きいことに相当する。さらに予め最低間引き率を設定

しておき、間引き率が最低間引き率を下回り、対象負荷領域を越ええると出力端子電圧V3は急激に低下するので、出力端子電圧V3が所定の電圧値以下になったことで過負荷状態を判定できる。この使用負荷量を表示するのが非接触コンセント1の非接触プラグ2側表面に設けられた負荷量表示インジケータ17である。

【0057】図19は、12V用端末機器3aに接続された12V機器用非接触プラグ2aと、24V用端末機器3bに接続された24V機器用非接触プラグ2bとを、1台の非接触コンセント1で電力伝達可能なことを示している。前記のように本発明の非接触電力伝達システムの間引き制御は、負荷領域が広くても制御可能なので、非接触コンセント1の電力送電用1次コイルL1の巻数が一定でも、12V機器用非接触プラグ2aと24V機器用非接触プラグ2bとの電力受電用2次コイルL2aと電力受電用2次コイルL2bとの巻数を変えることで各々の出力端子電圧V3を安定化させることができ、また任意の電圧に安定化させることもできる。

【0058】また、非接触電力伝達システムでは、電力送電用1次コイルL1と電力受電用2次コイルL2との距離が長くなるほど伝達できる電力は減少するため、非接触コンセント1と非接触プラグ2との相対的位置関係を所定の位置関係に保つ必要がある。図20は、非接触プラグ2を非接触コンセント1の凹部19に完全に嵌合させていない状態を示しており、このような場合には非接触コンセント1から非接触プラグ2への電力伝達を停止させる必要がある。そこで、非接触コンセント1は凹部19に対して配置された機械接点18を設け、機械接点18がオンした時のみ、非接触コンセント1の回路ブロックX1に内蔵されたインバータ回路11が動作し、非接触コンセント1から非接触プラグ2への電力伝達を行い、非接触プラグ2は嵌合時に機械接点18に対向配置するように永久磁石30を設ける。機械接点18は、永久磁石30の磁力によって動作するスイッチで、図20においては非接触プラグ2は非接触コンセント1の凹部19に完全に嵌合していないので、永久磁石30と機械接点18とは離れすぎており、永久磁石30の磁力は機械接点18を動作させることはできない。図21は非接触プラグ2を非接触コンセント1の凹部19に完全に嵌合させている状態を示しており、永久磁石30の磁力は機械接点18を動作させることができ、非接触コンセント1の回路ブロックX1に内蔵されたインバータ回路11が動作し、非接触コンセント1から非接触プラグ2への電力伝達を行うことができる。なお、永久磁石30は永久磁石なので、1次側信号受信コイル14、2次側信号送信コイル23、磁束検出用コイル14aの磁束信号に悪影響を与えない。また、コンセント通電表示LED16は、機械接点18がオンすることで点灯させることができ、プラグ通電表示LED25は出力端子電圧V3を監視することで点灯させることができる。

【0059】次に、非接触プラグ2と端末機器3との接続は、水まわりで使用するときは一体型とするほうが望ましいが、水まわりで使用しないとき、及び水まわりで使用するときでも水中につけるような使い方をしないときであれば簡易防水でもよい。非接触プラグ2と端末機器3との接続を脱着可能な構造にしてもよい。このようにすれば、非接触コンセント1と非接触プラグ2とは各1つずつあれば、端末機器3のみ用途に応じて揃えればよい。図22において、端末機器3c、3dはケーブルコード26c、26dを備え、ケーブルコード26c、26dの端末には各々コネクタ27c、27dが接続されており、非接触プラグ2の表面に設けられ非接触プラグ2の出力端と接続しているソケット28c、28dと分離着脱可能になっており、1つの非接触プラグ2に複数の端末機器3c、3dを接続できるようになっている。図23においては、端末機器3eはケーブルコード26eを備え、ケーブルコード26eの端末には電力受電コイルL5が接続され、非接触プラグ2の表面近傍には非接触プラグ2の出力端と接続している電力送電コイルL4を備え、電力受電コイルL5は非接触プラグ2表面の凹部29と嵌合して電力送信コイルL4から電磁誘導により電力伝達される。図23においては、電力送信コイルL4に印可される回路ブロックX2の出力電圧は高周波電圧である。

【0060】また、浴室内のように水まわりで使用し、感電対策のために低電圧出力が必要な場合には、非接触コンセント2の故障時においても非接触プラグ2及び端末機器3での電圧上昇をできる限り抑えなければならない。本発明においては、分離着脱できる電力伝送用トランスT1を使って電力伝達を行うため、非接触コンセント1の1次側電力送電コイルL1に印可される高周波電圧V1の振幅に比例した電圧が、非接触プラグ2の2次側電力受電コイルL2に誘起される。そのため非接触コンセント1側のインバータ回路や、制御回路の故障で1次側電力送電コイルL1に高い電圧が印加された場合には2次側電力受電コイルL2に誘起される電圧V2も上昇し、制御可能な領域を越えて非接触プラグ2の出力端子電圧V3に高い電圧がかかる可能性がある。そこで本発明では、図2に示すようにインバータ回路11はハーフブリッジ回路を用いているので、1次側電力送電コイルL1の両端電圧V1は、直流電源10aの電圧Eに対して電圧 $-E/2$ と電圧 $E/2$ とで確実にクランプされ、2次側電力受電コイルL2に誘起される電圧V2の上昇は一定電圧以上上昇せず、安全なシステムとなっている。

【0061】なお図2のコンデンサC2は、図25に示すように電力受電用2次コイルL2のセンタータップと他の端子間にコンデンサC21、C22を接続してもよいし、図26に示すようにダイオードD3、D4に並列にコンデンサC21、C22を各々接続しても同様の効

果を得ることができる。これは、コンデンサC2は高周波交流に作用するコンデンサであり、図2、図25及び図26の交流的な等価回路は同等になるためであり、いずれも図7に示す電力受電用2次コイルL2の両端電圧V2の波形条件を得ることができる。このように本発明の各波形条件を満たしておればそれらは本発明に含まれることはもちろん、このことは電力受電用2次コイルL2がセンタータップを備えていない場合も同様である。

【0062】

【発明の効果】請求項1の発明は、直流電圧を出力する電源回路と前記直流電圧を一定周波数の高周波電圧に変換するインバータ回路と前記インバータ回路から前記高周波電圧を供給される電力送電用1次コイルとから構成される非接触コンセントと、前記電力送電用1次コイルと分離着脱自在なトランス構造を構成して高周波電圧を誘起される電力受電用2次コイルと前記電力受電用2次コイルに誘起される高周波電圧を整流平滑する整流平滑回路とから構成される非接触プラグと、前記非接触プラグの出力端子に接続され負荷となる端末機器とから構成される非接触電力伝達装置において、前記非接触コンセントは、対象としている負荷領域に対する前記非接触プラグの出力端子電圧を、前記インバータ回路より前記電力送電用1次コイルに供給される高周波電圧を間引いて安定化させる間引き制御を行う制御手段を備えることを特徴とし、広い負荷範囲で出力端子電圧を一定値に安定化できる非接触電力伝達装置を提供することができるという効果がある。

【0063】請求項2の発明は、請求項1の発明において、前記制御手段は、非接触プラグの出力端子電圧が所定の電圧を上回った場合には、インバータ回路から電力送電用1次コイルへの高周波電圧の供給を一定時間間引き、前記一定時間間引きを行った後非接触プラグの出力端子電圧が前記所定の電圧を上回っていれば再び電力送電用1次コイルへの前記高周波電圧の供給を一定時間間引くことを繰り返し、前記各一定時間間引きを行った後で非接触プラグの出力端子電圧が所定の電圧を下回った場合には、非接触プラグの出力端子電圧が所定の電圧を上回るまで電力送電用1次コイルへの前記高周波電圧の供給を連続的に行う動作を継続させることを特徴とし、広い負荷範囲で出力端子電圧を一定値に安定化できる非接触電力伝達装置を提供することができるという効果がある。

【0064】請求項3の発明は、請求項1または2の発明において、非接触プラグは、非接触プラグ内部の電気状態を表す情報を磁気信号に変換して非接触コンセントに伝送し、前記制御手段は、前記磁気信号に基づいて間引き制御のための制御信号を形成し、前記制御信号によりインバータ回路の間引き制御することを特徴とし、電圧安定化のためのフィードバック信号に磁気信号を使うため、まわりの明るさや汚れの影響を受けずに、広い負

荷範囲で出力端子電圧を一定値に安定化できる非接触電力伝達装置を提供することができるという効果がある。

【0065】請求項4の発明は、請求項1乃至3いずれかの発明において、インバータ回路は、ハーフブリッジ型の部分共振インバータであることを特徴とし、故障時の出力電圧の上昇を抑えることができるという効果がある。

【0066】請求項5の発明は、請求項4の発明において、電力受電用2次コイルはセンタータップを備え、整流平滑回路は、電力受電用2次コイルのセンタータップではない両出力端に直列に且つ互いに逆方向に接続する整流素子の電力受電用2次コイルに接続していない各他端同士を接続した全波整流部を有し、前記整流素子の接続中点にチョークコイルを接続することを特徴とし、整流部を小型化することができるという効果がある。

【0067】請求項6の発明は、請求項1乃至5いずれかの発明において、電力受電用2次コイルに並列にコンデンサを接続することを特徴とし、負荷整合をとることで1次側から2次側へ伝達できる有効電力を増加させることができるという効果がある。

【0068】請求項7の発明は、請求項6の発明において、前記コンデンサの静電容量値は、対象とする負荷領域の最大負荷時において、電力送電用1次コイルに供給される高周波電圧の極性反転時期と、前記コンデンサの両端に発生する振動電圧が極大値または極小値となる時期とが一致する静電容量値であることを特徴とし、最適な負荷整合を行って回路効率を向上させることができるという効果がある。

【0069】請求項8の発明は、請求項3乃至7いずれかの発明において、非接触コンセントに1次側信号受信コイルを設け、非接触プラグには前記1次側信号受信コイルに対向配置され前記1次側信号受信コイルと分離着脱自在なトランス構造を構成する2次側信号送信コイルを設け、前記2次側信号送信コイルは非接触プラグの内部の電気状態を表す情報を交流電圧に変換した信号を入力され、磁気信号として磁束信号を発生し、前記1次側信号受信コイルは前記磁束信号により電圧を誘起され、前記制御手段はインバータ回路を前記誘起された電圧に基づいた制御信号により前記間引き制御することを特徴とし、電圧安定化のためのフィードバック信号に磁束信号を使うため、まわりの明るさや汚れの影響を受けずに、広い負荷範囲で出力端子電圧を一定値に安定化できる非接触電力伝達装置を提供することができるという効果がある。

【0070】請求項9の発明は、請求項8の発明において、電力送電用1次コイルと1次側信号受信コイルとの間、及び電力受電用2次コイルと2次側信号送信コイルとの間の少なくとも一方の間に磁性体からなる磁気シールド用隔壁を設けたことを特徴とし、信号送受用トランスに鎮交する電流送受用トランスで発生する磁束を低減

させて、正確な電圧安定化のための磁束信号を送受信することができるという効果がある。

【0071】請求項10の発明は、請求項9の発明において、電力送電用1次コイルと電力受電用2次コイルとを、磁性体からなるコアに巻装し、前記コアを互いに前記コアの軸方向に対向配置させたことを特徴とし、信号送受用トランスに鎖交する電流送授用トランスで発生する磁束を低減させて、正確な電圧安定化のための磁束信号を送受信することができるという効果がある。

【0072】請求項11の発明は、請求項9の発明において、電力送電用1次コイルと電力受電用2次コイルとを、前記コイルの軸方向に垂直な方向に開口部を有する有底筒型の磁性体からなるコアに巻装し、前記コアを互いに前記コアの軸方向に対向配置させ、前記コアの非開口部の近傍に1次側信号受信コイルと2次側信号送信コイルとを配置したことを特徴とし、信号送受用トランスに鎖交する電流送授用トランスで発生する磁束を低減させて、正確な電圧安定化のための磁束信号を送受信することができるという効果がある。

【0073】請求項12の発明は、請求項8乃至11いずれかの発明において、2次側信号送信コイルは、非接触プラグの内部の電気状態を表す情報を交流電圧に変換した信号を入力されて、電力送電用1次コイルが発生させる磁束とは逆位相の位相を有する磁束信号を発生することを特徴とし、正確な電圧安定化のための束信号を送受信することができるという効果がある。

【0074】請求項13の発明は、請求項12記載の発明において、2次側信号送信コイルの一方の端子は、電力受電用2次コイルのどちらか一方の端子に接続していることを特徴とし、正確な電圧安定化のための磁束信号を送受信することができるという効果がある。

【0075】請求項14の発明は、請求項3乃至7いずれかの発明において、非接触コンセントは、電力送電用1次コイルの近傍に電力送電用1次コイルと電力受電用2次コイルとの間に発生する磁束を検出する磁束検出用コイルを設け、前記磁束検出用コイルは、磁気信号として電力送電用1次コイルで発生する磁束を検出し、前記磁束検出用コイルから前記検出する磁束に応じて出力される電圧に基づいて前記制御手段は、インバータ回路を間引き制御することを特徴とし、正確な電圧安定化のための磁束信号を受信することができるという効果がある。

【0076】請求項15の発明は、請求項14の発明において、電力送電用1次コイルと電力受電用2次コイルとを、前記コイルの軸方向に垂直な方向に開口部を有する有底筒型の磁性体からなるコアに設けて前記コアを互いに前記コアの軸方向に対向配置させ、前記電力送電用1次コイルのコアの開口部の近傍に前記磁束検出用コイルを配置したことを特徴とし、正確な電圧安定化のための磁束信号を受信することができるという効果がある。

【0077】請求項16の発明は、請求項1乃至15いずれかの発明において、一つの非接触コンセントは、出力電圧の異なる複数の非接触プラグに適合し、各非接触プラグが対象としている負荷領域を含む全領域において前記各非接触プラグの出力電圧を所定の電圧範囲内に収める前記制御手段を有することを特徴とし、経済的であるという効果がある。

【0078】請求項17の発明は、請求項1乃至16いずれかの発明において、非接触プラグの出力端子に並列に抵抗を接続することを特徴とし、広い負荷範囲で出力端子電圧を一定値に安定化できる非接触電力伝達装置を提供することができるという効果がある。

【0079】請求項18の発明は、請求項1乃至17いずれかの発明において、非接触プラグが非接触コンセントの所定の位置に結合していない場合は、前記制御手段は、インバータ回路から電力送電用1次コイルへ供給する出力を制限することを特徴とし、高い安全性と信頼性をと備えることができるという効果がある。

【0080】請求項19の発明は、請求項18の発明において、非接触コンセントはインバータ回路から電力送電用1次コイルへの高周波電圧の供給の制限を制御するスイッチ機能を備え、非接触プラグは前記スイッチ機能のオン・オフ状態を制御する駆動体を備え、非接触プラグが非接触コンセントの所定の位置に結合すると前記スイッチ機能を動作させることで前記制御手段はインバータ回路から電力送電用1次コイルへの高周波電圧の供給を可能にすることを特徴とし、高い安全性と信頼性をと備えることができるという効果がある。

【0081】請求項20の発明は、請求項19の発明において、非接触コンセントの前記スイッチ機能が機械接点からなり、非接触プラグが備える駆動体は磁石からなり、非接触プラグが非接触コンセントの所定の位置に結合すると前記磁石の磁力によって前記機械接点が動作して、前記制御手段はインバータ回路から電力送電用1次コイルへの高周波電圧の供給を可能にすることを特徴とし、高い安全性と信頼性をと備えることができるという効果がある。

【0082】請求項21の発明は、請求項1乃至20いずれかの発明において、非接触プラグが非接触コンセントの所定の位置に結合すると、非接触プラグ及び非接触コンセントの少なくともどちらか一方に使用可能を報知する表示を行うことを特徴とし、システムや機器の使用可否の判断をおこなうことができるという効果がある。

【0083】請求項22の発明は、請求項1乃至21いずれかの発明において、非接触コンセント及び非接触プラグの少なくともどちらか一方は、非接触プラグの出力端子に接続された端末機器の負荷電力、及び非接触プラグの出力電圧の少なくともどちらか一方を表示する表示部を付加したことを特徴とし、システムや機器の使用可否の判断をおこなうことができるという効果がある。

【0084】請求項23の発明は、請求項1乃至22いずれかの発明において、非接触プラグの出力端子に接続される端末機器は前記非接触プラグに対して、分離着脱自在なことを特徴とし、不特定の端末機器を使用することができるという効果がある。

【0085】請求項24の発明は、請求項23の発明において、非接触プラグの出力端子から端末機器への電力の供給は、磁気結合によって供給されることを特徴とし、不特定の端末機器を使用することができるという効果がある。

【0086】請求項25の発明は、請求項1乃至24いずれかの発明において、非接触プラグの出力端子間に、電圧クランプ素子を接続することを特徴とし、高い安全性と信頼性とを備えることができるという効果がある。

【0087】このように本発明で構成される非接触電力伝達システムは、安全や安心と、高い信頼性を背景に、浴室などの水まわり環境を電化し、様々な電気機器により多様なユーザーニーズに応えることができるものである。

【図面の簡単な説明】

【図1】本発明の実施例を示す回路構成図である。

【図2】本発明の実施例を示す具体的な回路構成図である。

【図3】本発明の実施例の特性を示す図である。

【図4】本発明の実施例の特性を示す図である。

【図5】本発明の実施例の特性を示す図である。

【図6】本発明の実施例の特性を示す図である。

【図7】本発明の実施例の特性を示す図である。

【図8】本発明の実施例の特性を示す図である。

【図9】本発明の実施例の特性を示す図である。

【図10】本発明の実施例を示す回路構成図である。

【図11】本発明の実施例を示す回路構成図である。

【図12】本発明の実施例を示す回路構成図である。

【図13】本発明の実施例を示す回路構成図である。

【図14】本発明の実施例を示す回路構成図である。

【図15】本発明の実施例を示す回路構成図である。

【図16】本発明の実施例を示す回路構成図である。

【図17】本発明の実施例を示す外観図である。

【図18】本発明の実施例を示す外観図である。

【図19】本発明の実施例を示す外観図である。

【図20】本発明の実施例を示す外観図である。

【図21】本発明の実施例を示す外観図である。

【図22】本発明の実施例を示す外観図である。

【図23】本発明の実施例を示す外観図である。

【図24】本発明の実施例の特性を示す図である。

【図25】本発明の実施例を示す回路構成図である。

【図26】本発明の実施例を示す回路構成図である。

【図27】本発明の従来例を示す回路構成図である。

【図28】本発明の従来例の電力授受用トランスを示す構成図である。

【図29】本発明の従来例を示す回路構成図である。

【図30】本発明の従来例の特性を示す図である。

【図31】本発明の従来例を示す回路構成図である。

【図32】本発明の従来例を示す回路構成図である。

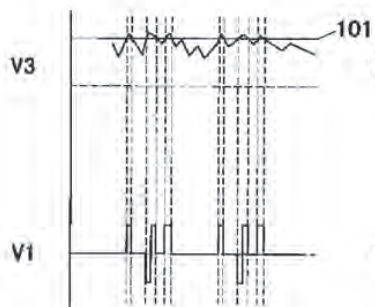
【図33】本発明の従来例の特性を示す図である。

【図34】本発明の従来例の特性を示す図である。

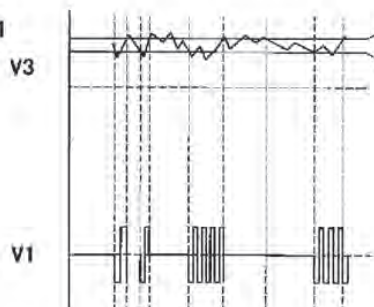
【符号の説明】

- 1 非接触コンセント
- 2 非接触プラグ
- 3 端末機器
- 10 電源回路
- 11 インバータ回路
- 20 整流平滑回路
- E 直流電圧
- V1 高周波電圧
- V2 高周波電圧
- L1 電力送電用1次コイル
- L2 電力受電用2次コイル

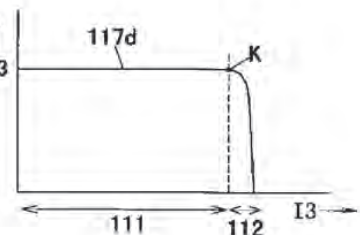
【図4】



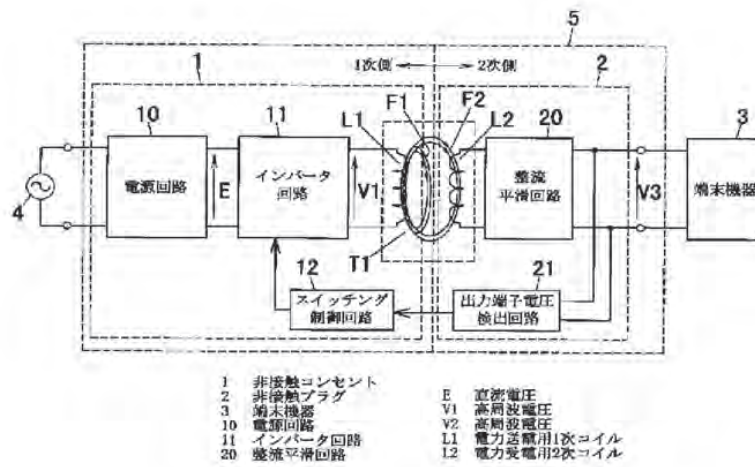
【図5】



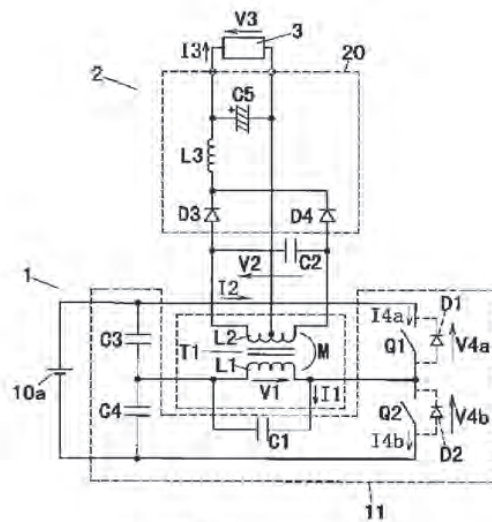
【図8】



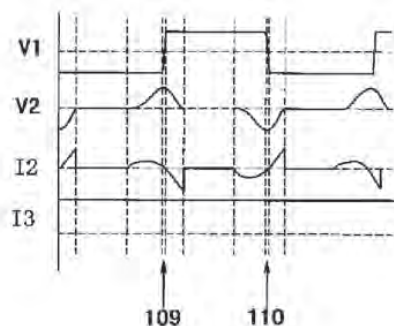
【図1】



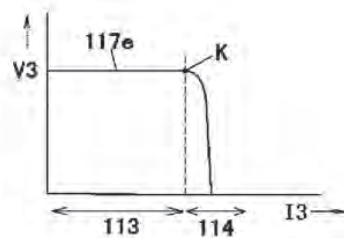
【図2】



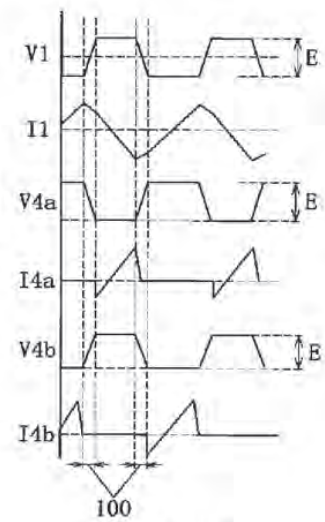
【図7】



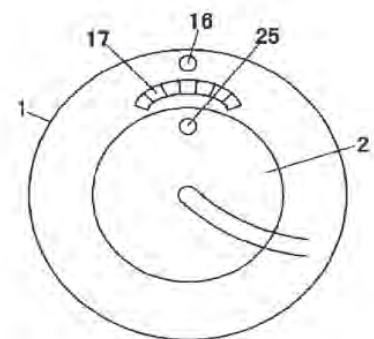
【図9】



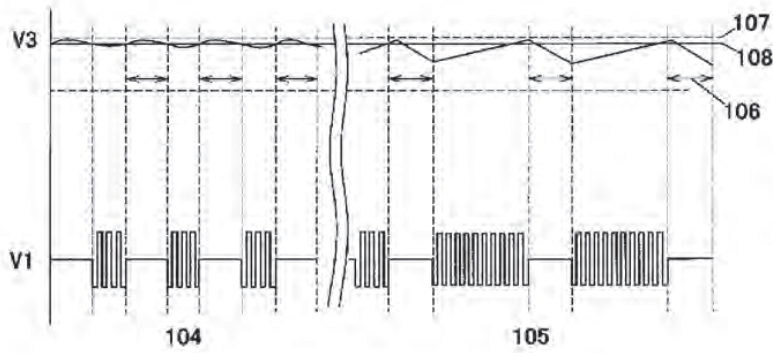
【図3】



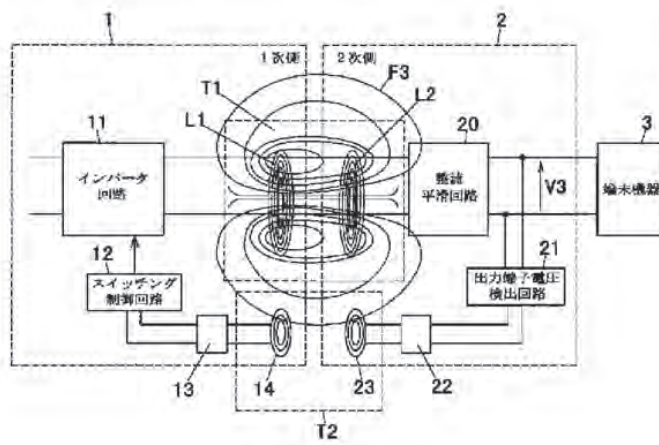
【図18】



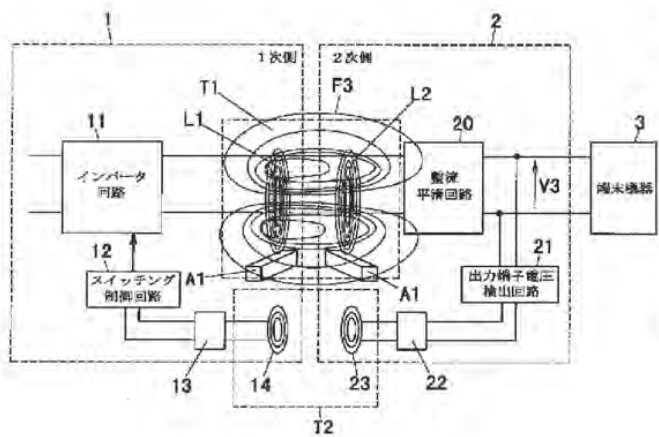
【図6】



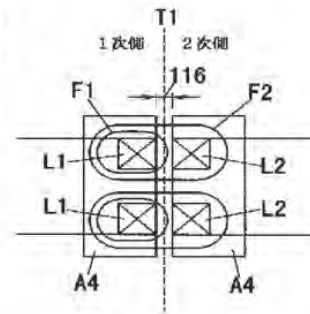
【図10】



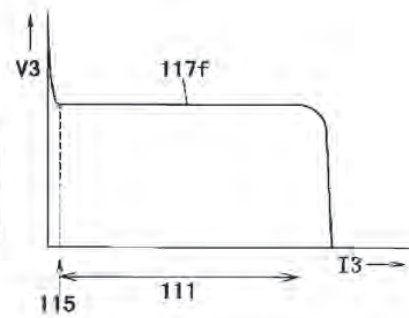
【図11】



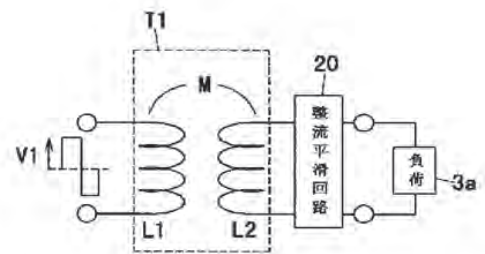
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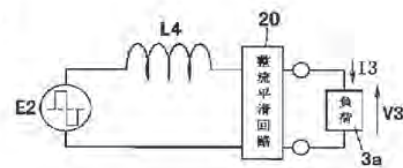
【図24】



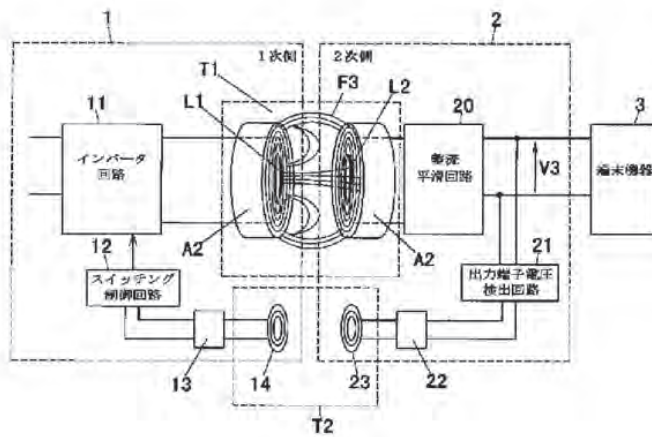
【図27】



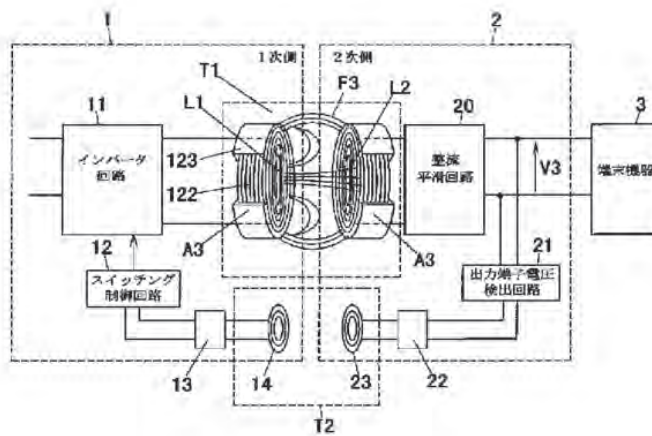
【図29】



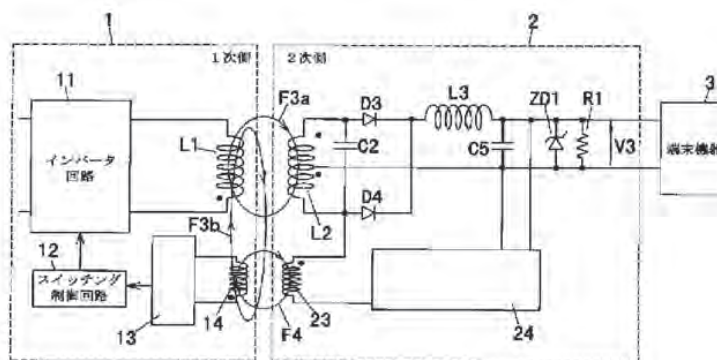
【図12】



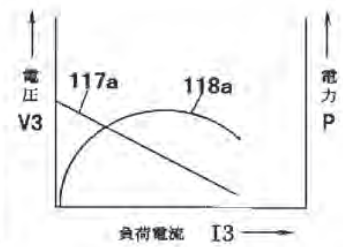
【図13】



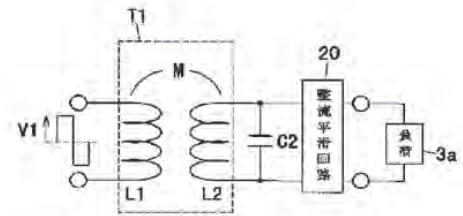
【図14】



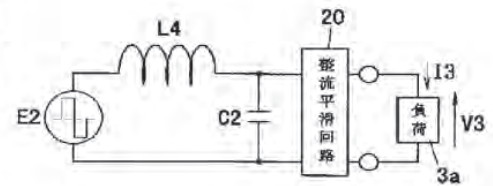
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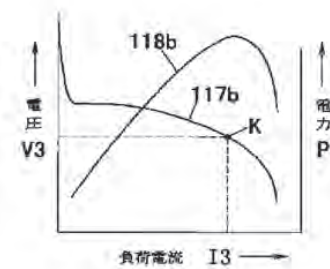
【図31】



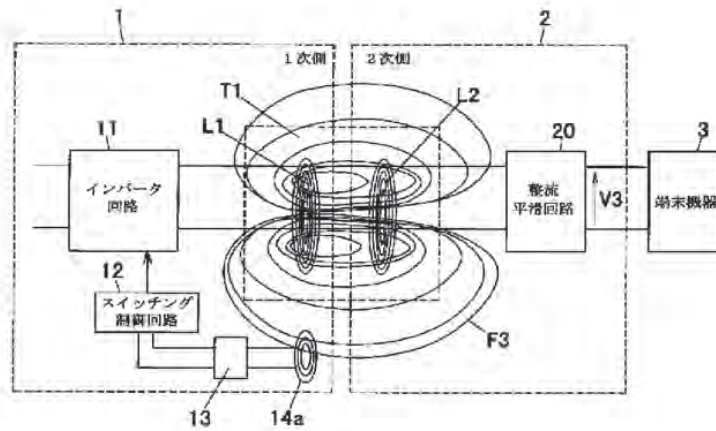
【図32】



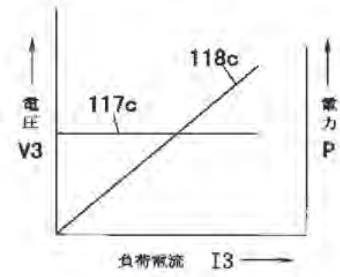
【図33】



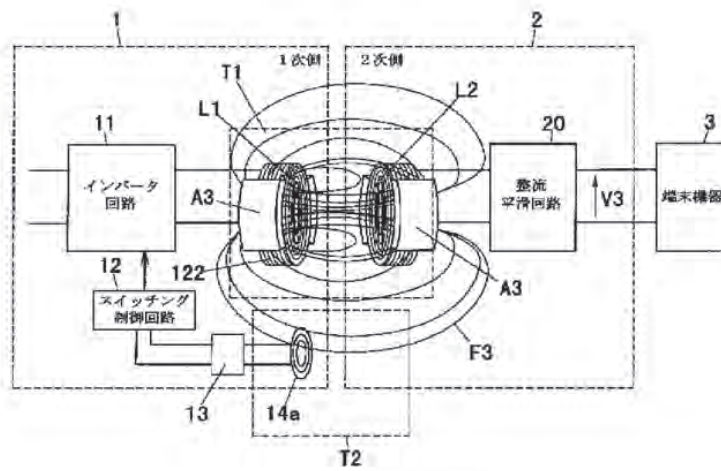
【図15】



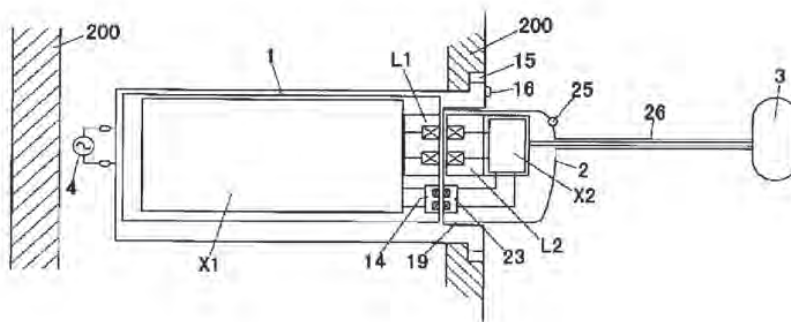
【図34】



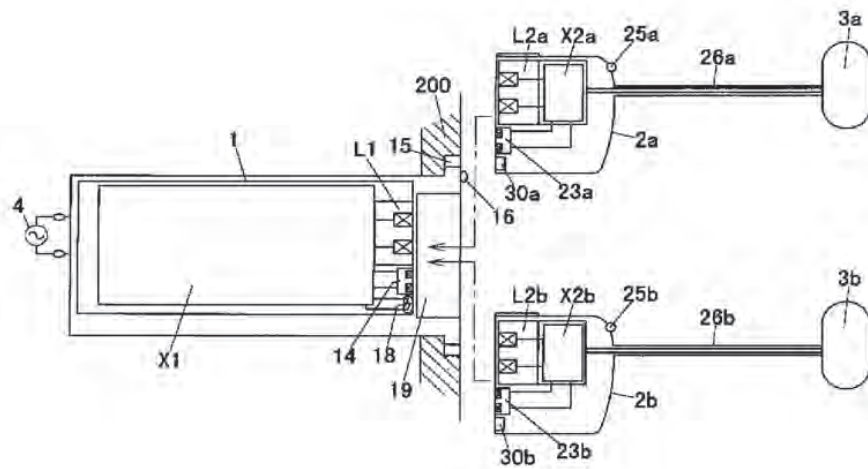
【図16】



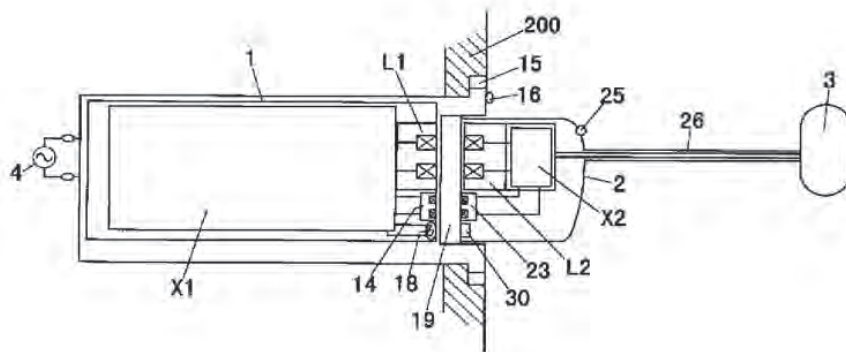
【図17】



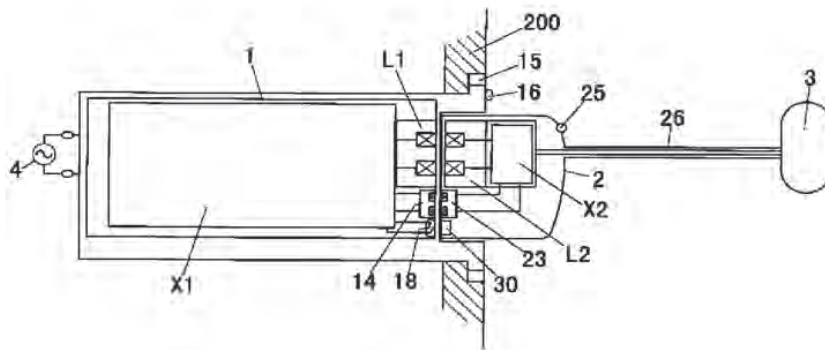
【図 19】



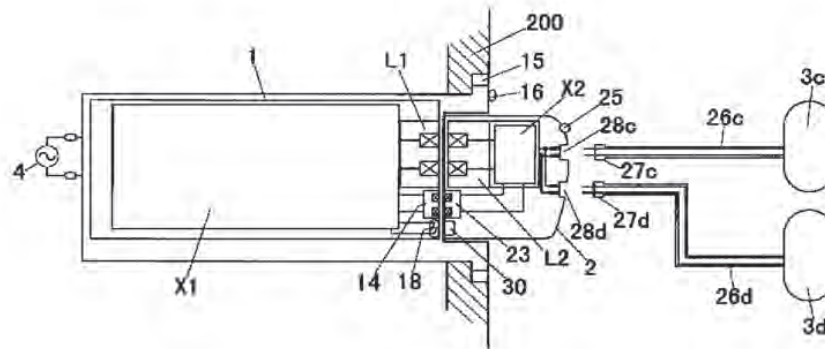
【図 20】



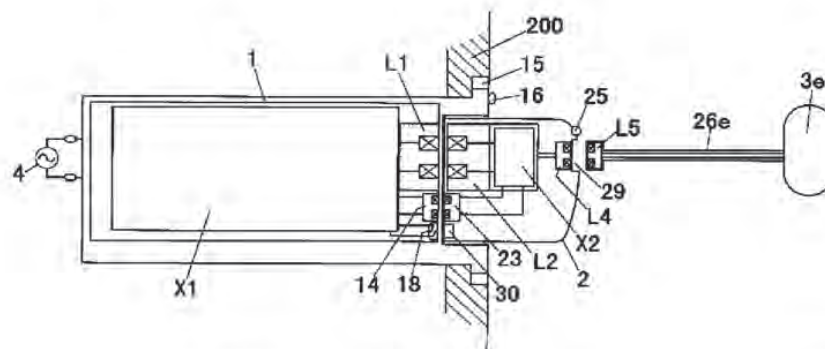
【図 21】



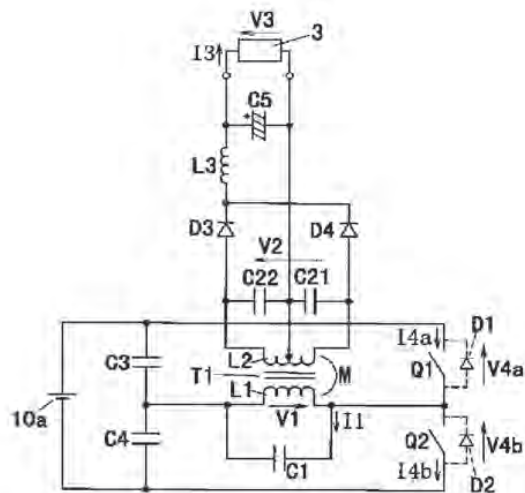
【図 2 2】



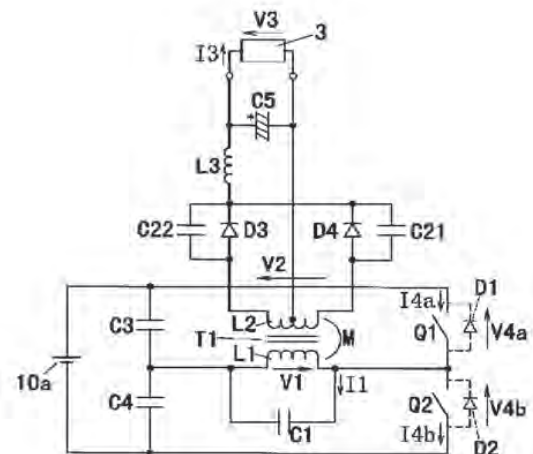
【図 2 3】



【図 2 5】



【図 2 6】



フロントページの続き

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H 0 2 M 3/335

識別記号

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H 0 1 F 23/00

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式会社内

F ターム(参考) 5G065 AA00 DA06 DA07 EA06 HA04

JA01 LA01 MA01 MA02 MA03

MA09 MA10 NA01 NA02 NA03

NA09

5H730 AA17 AS01 BB25 BB26 BB57

BB75 CC01 EE03 EE08 EE59

FD01 FF18 FG07

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Friday, April 11 2014

THOMSON INNOVATION

Patent/Publication: JP2005149238A

Working... |

Bibliography**DWPI Title**

Charger for integrated circuit card e.g. prepaid card, has package which accommodates oscillator, coil-shaped antenna and secondary battery

Original Title

BATTERY CHARGER FOR IC CARD AND PASSCASE

The charger for IC cards, and a holder for a commuter pass (*Translation from Thomson Reuters*)**English Title**

BATTERY CHARGER FOR IC CARD AND PASSCASE

Assignee/ApplicantStandardized: **TDK CORP**

Original: TDK CORP

DWPI Assignee/Applicant

TDK CORP (DENK-C)

Inventor

TAKAHASHI TETSUYA,

DWPI Inventor

TAKAHASHI T

Publication Date (Kind Code)

2005-06-09 (A)

DWPI Accession / Update

2005-448163 / 200546

Application Number / Date

JP2003387181A / 2003-11-17

Priority Number / Date / Country

JP2003387181A / 2003-11-17 / JP

Abstract**DWPI Abstract**<https://www.thomsoninnovation.com/tip-innovation/printRecView.do?ResultSetId=69744...> 4/11/2014

(JP2005149238A_)

Novelty

A coil-shaped antenna (32) receives alternating current (AC) signal from an oscillator (30), and produces an electromagnetic wave. A package (38) accommodates the oscillator, coil-shaped antenna and a secondary battery (24).

Detailed Description

An INDEPENDENT CLAIM is also included for holder for commuter pass.

Use

For non-contact integrated circuit (IC) cards e.g. prepaid card, electronic ticket of transport system.

Advantage

Enables a user of IC card to conveniently use the charger without requiring power supply from outside.

Drawing Description

The figure shows the block diagram of the IC card and the charger for IC cards. (Drawing includes non-English language text).

24 - secondary battery.

30 - oscillator.

32 - coil-shaped antenna.

38 - package.

50 - IC card.

Abstract

PROBLEM TO BE SOLVED: To provide a battery charger for an IC card and a passcase having highly convenience.

SOLUTION: The battery charger for an IC card comprises a secondary battery 24, an oscillator 30 producing alternate signals by being supplied power from the secondary battery, a coil-shaped antenna 32 producing electromagnetic waves by receiving the alternate signals from the oscillator 30, and an exterior body 38 housing the secondary battery 24, the oscillator 30, and the antenna 32. External power supply is not required during charge of the IC card so that the battery charger provides the secondary battery 24 producing power. Therefore, an accumulation electricity element of the IC card 50 can be easily charged at desired time and a desired location required by a user so that the user carries a battery charger 20 for an IC card.

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SUBJECT of the InventionIt aims at providing the convenient high charger for IC cards and a convenient high holder for a commuter pass.

PROBLEM to be solvedIt has the exterior|packing body 38 which accommodates a secondary battery 24,

<https://www.thomsoninnovation.com/tip-innovation/printRecView.do?ResultSetId=69744...> 4/11/2014

oscillator 30 which receives supply of the electric power from a secondary battery 24, and generate|occur|produces an AC signal, the coil-shaped antenna 32 which receives the AC signal from oscillator 30 and generate|occur|produces an electromagnetic wave, and a secondary battery 24, oscillator 30 and antenna 32.

It has the secondary battery 24 which generate|occur|produces electric power,

Therefore

Supply of the power supply from the outside is not required in the case of the charge of an IC card.

Therefore, when a user carries this charger 20 for IC cards, and a user desires, in * place, the electrical-storage element of IC card 50 can be charged easily.

SELECTED DRAWINGSFIG. 1

[MAT_IMAGE 000002]

(Translation from Thomson Reuters)

Classes/Indexing

IPC

IPC Code(1-7) **G06K 19/00** A45C 11/18 B42D 15/10 G06K 19/07 H02J 7/00 H02J 17/00

(7)

Current IPC	Invention	Version	Additional	Version
Full	B42D 15/10 A45C 11/18 G06K 19/00 G06K 19/07 H02J 7/00 H02J 17/00	20060101 20060101 20060101 20060101 20060101 20060101	-	-
Main Group	-	-	-	-
Subclass	-	-	-	-

Original IPC	Invention	Version	Additional	Version
Advanced/Full	A45C 11/18 B42D 15/10 G06K 19/00 G06K 19/07 H02J 7/00 H02J 17/00	20060101 20060101 20060101 20060101 20060101 20060101	-	-
Core/Main Group	A45C 11/18 B42D 15/10 G06K 19/00 G06K 19/07 H02J 7/00 H02J 17/00	20060101 20060101 20060101 20060101 20060101 20060101	-	-
Subclass	-	-	-	-

JP FI Codes

A45C 11/18 B; B42D 15/10 521 ; G06K 19/00 H; G06K 19/00 J; G06K 19/00 K; G06K 19/00 Y; H02J 7/00 301 D; H02J 17/00 B

<https://www.thomsoninnovation.com/tip-innovation/printRecView.do?ResultSetId=69744...> 4/11/2014

JP F Terms

2C005: MB10; NA09; QA02; QA03; QA05; QB01; TA22

3B045: BA00; CE00; CE07; CE09; DA00; DA33; FC02; FC04; FC05; IA06

5B035: BA09

5G003: AA04; AA06; BA01; DA04; GB08

5G063

5G503: AA04; AA05; AA06; AA08; BA01; BB01; BB02; BB03; CC02; DA04; FA03; FA08; GB01; GB08;
GC02

DWPI Class

T04 U24 X16 P24 P76

DWPI Manual Codes

DWPI Manual Codes

EPI Manual Codes: T04-K; U24-H02; X16-G03

DWPI Chemistry Resource Numbers

DWPI Chemistry Resource Numbers

-

DWPI Registry Numbers

DWPI Registry Numbers

-

Plasdoc Punch Codes

Plasdoc Punch Codes

-

Plasdoc Key Serial Codes

Plasdoc Key Serial Codes

-

Enhanced Polymer Indexing

Enhanced Polymer Indexing

-

Chemical Fragment Codes

Chemical Fragment Codes

-

Legal Status**INPADOC Legal Status**

Gazette Date	Code	Description
2013-02-26	FPAY +	RENEWAL FEE PAYMENT (PRS DATE IS RENEWAL DATE OF DATABASE) PAYMENT UNTIL: 20140430
2010-05-10	FPAY +	RENEWAL FEE PAYMENT (PRS DATE IS RENEWAL DATE OF DATABASE) PAYMENT UNTIL: 20130430
2010-04-30	R150 +	CERTIFICATE OF PATENT (=GRANT) OR REGISTRATION OF UTILITY MODEL JAPANESE INTERMEDIATE CODE: R150
2010-04-30	A61 +	FIRST PAYMENT OF ANNUAL FEES (DURING GRANT PROCEDURE) JAPANESE INTERMEDIATE CODE: A61 2010-04-12
2010-04-01	A01 +	WRITTEN DECISION TO GRANT A PATENT OR TO GRANT A REGISTRATION (UTILITY MODEL) JAPANESE INTERMEDIATE CODE: A01
2010-03-31	A01 +	WRITTEN DECISION TO GRANT A PATENT OR TO GRANT A REGISTRATION (UTILITY MODEL) JAPANESE INTERMEDIATE CODE: A01 2010-03-30
2010-03-19	TRDD +	DECISION OF GRANT OR REJECTION WRITTEN
2010-01-26	A521	WRITTEN AMENDMENT JAPANESE INTERMEDIATE CODE: A523 2010-01-25
2009-11-25	A131 -	NOTIFICATION OF REASONS FOR REFUSAL JAPANESE INTERMEDIATE CODE: A131 2009-11-24
2009-09-15	A521	WRITTEN AMENDMENT JAPANESE INTERMEDIATE CODE: A523 2009-09-14
2009-07-15	A131 -	NOTIFICATION OF REASONS FOR REFUSAL JAPANESE INTERMEDIATE CODE: A131 2009-07-14
2009-07-03	A977	REPORT ON RETRIEVAL JAPANESE INTERMEDIATE CODE: A971007 2009-07-03
2006-09-01	A621 +	WRITTEN REQUEST FOR APPLICATION EXAMINATION JAPANESE INTERMEDIATE CODE: A621 2006-08-31

Get Family Legal Status

Family**Family**

INPADOC Family (2)

	Publication Number	Publication Date	Inventor	Assignee/Applicant	Title
	JP2005149238A_	2005-06-09	TAKAHASHI TETSUYA	TDK CORP	BATTERY CHARGER FOR IC CARD AND PASSCASE
	JP04501416B2	2010-07-14	-	TDK CORP	-

Expand DWPI Family (2); Countries (1)

<https://www.thomsoninnovation.com/tip-innovation/printRecView.do?ResultSetId=69744...> 4/11/2014

Claims

Claims

1. Electric power source,
The oscillator which receives supply of the electric power from said electric power source, and generate|occur|produces an AC signal,
The coil-shaped antenna which receives the AC signal from said oscillator and generate|occur|produces an electromagnetic wave,
A said electric power source, said oscillator, and the charger for IC cards equipped with the exterior|packing body which accommodates said antenna.

[Expand All Claims \(11\)](#)

Description

DWPI Drawing Description

The figure shows the block diagram of the IC card and the charger for IC cards. (Drawing includes non-English language text).

24 - secondary battery.

30 - oscillator.

32 - coil-shaped antenna.

38 - package.

50 - IC card.

Drawing Description

[Expand Drawing Description](#)

Description

[Expand Description](#)

Citations

Citation *Record level*

[Expand Citing Patents \(13\)](#)

[Expand Cited Patents \(4\)](#)

[Cited Non-patents \(0\)](#)

DPCI Citation *Patent family level*

[Expand DPCI Citing Patents \(4\)](#)

[Expand DPCI Cited Patents \(4\)](#)

<https://www.thomsoninnovation.com/tip-innovation/printRecView.do?ResultSetId=69744...> 4/11/2014

DPCI Cited Non-patents (0)

Expand DPCI Citation Counts

DPCI Field of Search

-

DPCI Citing Patents Country

WO; JP; US

DPCI Cited Patents Country

JP

Other

DWPI Title Terms

CHARGE INTEGRATE CIRCUIT CARD PREPAYMENT PACKAGE ACCOMMODATE OSCILLATOR COIL SHAPE
ANTENNA SECONDARY BATTERY

DWPI Related Accession Numbers

-

Custom Fields

Test

-

Relevance

-

Product Name

-

Docket number

-

Notes

-

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A45C 11/18	A45C 11/18 B	5B035
B42D 15/10	B42D 15/10 521	5G003
G06K 19/07	H02J 7/00 301D	
H02J 7/00	H02J 17/00 B	

審査請求 未請求 請求項の数 11 O L (全 16 頁) 最終頁に続く

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 東京都中央区日本橋一丁目13番1号 T
 DK株式会社内

最終頁に続く

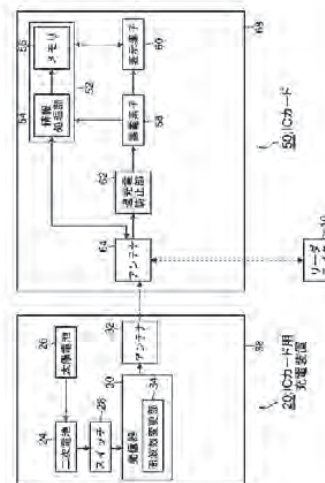
(54) 【発明の名称】 ICカード用充電装置及びバscケース

(57) 【要約】

【課題】 利便性の高いICカード用充電装置及びバscケースを提供することを目的とする。

【解決手段】 二次電池24と、二次電池24からの電力の供給を受けて交流信号を発生する発振器30と、発振器30からの交流信号を受けて電磁波を発生するコイル状のアンテナ32と、二次電池24、発振器30、及び、アンテナ32を収容する外装体38と、を備える。電力を発生する二次電池24を備えているので、ICカードの充電の際に外部からの電源の供給を必要としない。したがって、このICカード用充電装置20をユーザが携帯することにより、ユーザが所望する時・場所においてICカード50の蓄電素子を手軽に充電することができる。

【選択図】 図1



【特許請求の範囲】

【請求項 1】

電力源と、
前記電力源からの電力の供給を受けて交流信号を発生する発振器と、
前記発振器からの交流信号を受けて電磁波を発生するコイル状のアンテナと、
前記電力源、前記発振器、及び、前記アンテナを収容する外装体と、
を備える IC カード用充電装置。

【請求項 2】

前記電力源から前記発振器への電力の供給／遮断を制御するスイッチを更に備える請求項 1 に記載の IC カード用充電装置。

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【請求項 3】

前記発振器が発生する交流信号の周波数を変更させる周波数変更手段を更に備える請求項 1 又は 2 に記載の IC カード用充電装置。

【請求項 4】

前記発振器は、コイル及びコンデンサを含む LC 共振回路を有し、
前記コイルのインダクタンス、及び、前記コンデンサのキャパシタンスの少なくとも一方が可変である請求項 3 に記載の IC カード用充電装置。

【請求項 5】

前記 LC 共振回路のコンデンサは、複数の個別コンデンサ及びこれら複数の個別コンデンサを並列に接続する配線層を含む請求項 4 に記載の IC カード用充電装置。

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【請求項 6】

前記複数の個別コンデンサは、前記外装体内において前記外装体の表面に沿って並設されており、前記外装体の表面には、前記各個別コンデンサに接続された配線層の位置を示す標識が設けられている請求項 5 に記載の IC カード用充電装置。

【請求項 7】

前記外装体は板状であり、前記コイル状のアンテナは、前記外装体内において前記外装体の主面と交差する軸回りに巻き回されている請求項 1～6 の何れか一項に記載の IC カード用充電装置。

【請求項 8】

前記アンテナは、前記外装体の主面に垂直な方向から見たときに前記外装体の面積の $1/4$ 以上を占有する請求項 7 に記載の IC カード用充電装置。

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【請求項 9】

前記アンテナは、前記外装体の主面に垂直な方向から見たときに前記外装体の面積の $1/2$ 以上を占有する請求項 8 に記載の IC カード用充電装置。

【請求項 10】

太陽電池を更に備え、前記電力源は前記太陽電池によって生じた電力によって充電される請求項 1～9 の何れか一項に記載の IC カード用充電装置。

【請求項 11】

IC カード用充電装置と、前記 IC カード用充電装置を収容する第一収容部と、充電されるべき IC カードを前記 IC カード用充電装置と対向するように収容可能な第二収容部と、を備え、

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前記 IC カード用充電装置は、

電力源と、

前記電力源からの電力の供給を受けて交流信号を発生する発振器と、

前記発振器からの交流信号を受けて電磁波を発生するコイル状のアンテナと、

前記電力源、前記発振器、及び、前記アンテナを収容する外装体と、を有するパケース。

【発明の詳細な説明】

【技術分野】

50

【0001】

本発明はＩＣカード用充電装置及びこれを有するパスケースに関し、より詳しくは、電磁波を供給してＩＣカード内の蓄電素子を充電させるＩＣカード用充電装置及びこれを有するパスケースに関する。

【背景技術】

【0002】

近年、マイクロプロセッサやメモリなどのＩＣ（集積回路）と、ＩＣと接続され電磁波を送受信可能なコイル状のアンテナとが、矩形の板状外装体に収容された非接触型のＩＣカードが知られている。このような非接触型のＩＣカードを専用のリーダライタにかざすと、ＩＣカードはリーダライタからの電磁波をアンテナで受け、これにより生じる電力によってマイクロプロセッサを駆動し、マイクロプロセッサは必要に応じてメモリに記録された情報をアンテナからリーダライタに送信したりメモリに記録された情報を書き換えたりする。

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【0003】

このようなＩＣカードは、偽造や不正使用が難しく情報の機密保持性に優れると共に、磁気カードに比べて大きな記憶容量をもつことができ、さらに、リーダライタにかざすだけで情報の送受信ができる等の特徴がある。そこで、このような非接触型のＩＣカードは、例えば、電子マネー、プリペイドカード、交通機関の乗車券等として広く普及している

【0004】

最近では、このような非接触型のＩＣカードにおいて、ユーザが好きな時・場所において、ＩＣカードに記録された情報、例えば、残高やポイント等を確認したいという要望がある。

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【0005】

そして、これを可能とすべく、ＩＣやアンテナに加えて、さらに、情報を表示するためのＬＣＤ等の表示部、及び、この表示部やＩＣを駆動するための電力源である蓄電素子を有する非接触型のＩＣカードが、例えば、特許文献１に開示されている。このような非接触型のＩＣカードにおいては、このＩＣカードをリーダライタにかざす際にアンテナに発生する電力の内、ＩＣによって利用されなかった余剰分の電力が蓄電素子に充電され、このようにして蓄電素子に充電された電力を用いて表示部等を駆動する。すなわち、リーダライタをＩＣカード用充電装置として用いている。

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【特許文献１】実用新案登録第３０８９９１２号公報

【発明の開示】

【発明が解決しようとする課題】

【0006】

しかしながら、ＬＣＤ等の表示部を駆動するためには、比較的大きな電力を必要とする場合が多い。したがって、蓄電素子に蓄電された電力量が十分でない場合や、表示部を長時間駆動した場合等には、蓄電素子の電力量が底をつく場合がある。この場合、ＩＣカードの表示部を再び駆動するためには、ＩＣカードをリーダライタにかざして蓄電素子を充電しなければならず、わざわざユーザがＩＣカードをリーダライタの設置場所へ持って行くのは不便である。

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【0007】

本発明は、上記課題に鑑みてなされたものであり、ＩＣカードのユーザにとって利便性の高いＩＣカード用充電装置及びこれを有するパスケースを提供することを目的とする。

【課題を解決するための手段】

【0008】

本発明に係るＩＣカード用充電装置は、電力源と、電力源からの電力の供給を受けて交流信号を発生する発振器と、発振器からの交流信号を受けて電磁波を発生するコイル状のアンテナと、電力源、発振器、及び、アンテナを収容する外装体と、を備える。

【0009】

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本発明のＩＣカード用充電装置によれば、電力によって発振器が作動し、この発振によってアンテナから電磁波が送信される。したがって、このようにして送信される電磁波によって、ＩＣカードのアンテナに対して電力を供給でき、ＩＣカードの蓄電素子を充電することができる。

【００１０】

ここで、このＩＣカード用充電装置は、例えば電池やキャパシタ等、電力の発生源となる電力源を備えているので、充電の際に外部の電力線等からの電源の供給を必要としない。したがって、このＩＣカード用充電装置をユーザが携帯することにより、ユーザが所望する時・場所においてＩＣカードの蓄電素子を手軽に充電することができる。さらに、電池やキャパシタは、例えば、コイン型、フィルム型等のように、小型、薄型化することができるので、携帯性が良いＩＣカード用充電装置が得られる。

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【００１１】

ここで、電池は、化学反応により電気エネルギーを発生する素子であり、例えば、アルカリマンガン電池等の一次電池、リチウムイオン電池等の二次電池、燃料電池等を含む。また、キャパシタとは、化学反応によらずに電極間に電気エネルギーを蓄えることができ、蓄えた電気エネルギーを放出することができる素子であり、例えば、電気二重層キャパシタ、アルミ電解コンデンサ、積層セラミックコンデンサ等を含む。

【００１２】

ここで、本発明に係るＩＣカード用充電装置は、電力源から発振器への電力の供給／遮断を制御可能なスイッチを更に備えることが好ましい。

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【００１３】

これによれば、ユーザが所望する時に所望の時間だけ充電操作ができ、無駄な電力の消費を抑制できる。

【００１４】

ところで、ＩＣカードに充電するために必要とされる電磁波の周波数は、ＩＣカードの種類毎に異なる値に設定されている場合が多い。そこで、ＩＣカード用充電装置は、発振器で発生する交流信号の周波数を変更する周波数変更手段を更に備えることが好ましい。

【００１５】

これによれば、一つのＩＣカード用充電装置によって多種のＩＣカードに好適に充電することができ、ＩＣカード用充電装置の汎用性が高まる。

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【００１６】

具体的には、発振器が、コイル及びコンデンサを含むＬＣ共振回路を有し、コイルのインダクタンス、及び、コンデンサのキャパシタンスの少なくとも一方が変更可能とされていることが好ましい。

【００１７】

このようなＬＣ共振回路を有する発振器は、主としてコイルのインダクタンス及びコンデンサのキャパシタンスにより定まる共振周波数で発振する。したがって、インダクタンス及びキャパシタンスの少なくとも一方を変更可能とすることによりアンテナから発生する周波数の変更を容易に行える。

【００１８】

また、ＬＣ共振回路のコンデンサは、複数の個別コンデンサ及びこれらの複数の個別コンデンサを並列に接続する配線層により構成されていてもよい。

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【００１９】

これによれば、一つ又は複数の個別コンデンサを切り取ったり、個別コンデンサの接続配線を、例えば、外装体の表面からピン等で刺して切断したりすることによって、所望の個別コンデンサを無効とすることができ、並列接続された個別コンデンサによって構成されるコンデンサ全体のキャパシタンスを変更できるので、ＬＣ回路の共振周波数を簡易に変更することができる。

【００２０】

ここで、複数の個別コンデンサは、外装体内において外装体の表面に沿って並設されて

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