

Receipt date: 05/20/2013

12649635 - GAU: 2836

Sheet 1 of 1

Substitute Disclosure Form	U.S. Department of Commerce Patent and Trademark Office	Attorney Docket No. 01997-0359015	Application No. 12/649,635
Information Disclosure Statement by Applicant (Use several sheets if necessary)		Applicant John D. Joannopoulos et al.	
		Filing Date December 30, 2009	Group Art Unit 2836
(37 CFR §1.98(b))			

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

Foreign Patent Documents or Published Foreign Patent Applications								
Examiner Initial	Desig. ID	Document Number	Publication Date	Country or Patent Office	Class	Subclass	Translation	
							Yes	No
	2	JP 11-75329	3/16/1999	Japan	H02J	17/00	Abstract and Machine Translation	
	3	JP 2003-179526	6/27/2003	Japan	H04B	5/02	Abstract and Machine Translation	
	4	JP 2004-166459	6/10/2004	Japan	H02J	7/00	Abstract and Machine Translation	
	5	JP 2004-201458	7/15/2004	Japan	H02M	3/28	Abstract and Machine Translation	
	6	JP 2005-57444	3/3/2005	Japan	H01Q	7/09	Abstract and Machine Translation	
	7							

Other Documents (include Author, Title, Date, and Place of Publication)		
Examiner Initial	Desig. ID	Document
	8	Klaus Finkenzeller, "RFID Handbook (2 nd Edition)", The Nikkan Kogyo Shimbun, Ltd., pp. 19, 20, 38, 39, 43, 44, 62, 63, 67, 68, 87, 88, 291, 292 (Published on May 31, 2004)
	9	Copy of Translation of Information Statement by Third Party submitted to the Japanese Patent Office for Japanese Application No. 2011-83009, translation received on May 15, 2013
	10	Copy of Submission of Publication to the Japanese Patent Office for Japanese Application No. 2011-256,729, translation received on May 2, 2013
	11	Copy of Submission of Publication to the Japanese Patent Office for Japanese Application No. 2011-509,705, translation received on May 2, 2013
	12	

Examiner Signature /Fritz Fleming/ (06/17/2013)	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./

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	12528	high adj q	USPAT	OR	OFF	2012/03/20 16:45
S2	296	S1 same wireless	USPAT	OR	OFF	2012/03/20 16:45
S3	88674	("5876425" "20040130916" "6345203" "20050151511" "5455467" "6597076" "6307468" "6047214" "5517194" "20030014091" "7355150" "20030114769" "6442434" "20040130915" "6364735" "20030069051").PN	US-PGPUB; USPAT	OR	OFF	2012/03/20 16:48
S4	16	("5876425" "20040130916" "6345203" "20050151511" "5455467" "6597076" "6307468" "6047214" "5517194" "20030014091" "7355150" "20030114769" "6442434" "20040130915" "6364735" "20030069051").PN.	US-PGPUB; USPAT	OR	OFF	2012/03/20 16:49
S5	5	S4 and q	US-PGPUB; USPAT	OR	OFF	2012/03/20 16:57
S6	2141	(307/104).OCLS.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/03/20 16:59
S7	39	S6 and q	USPAT	OR	OFF	2012/03/20 16:59
S8	306	S6 and q	US-PGPUB; USPAT	OR	OFF	2012/03/20 16:59
S9	362	(320/108).OCLS.	USPAT; USOCR	OR	OFF	2012/03/20 17:35
S10	893	(320/108).OCLS.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/03/20 17:36
S11	129	S10 and q	US-PGPUB; USPAT	OR	OFF	2012/03/20 17:36
S12	5432	(high adj q) same resonator	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2012/03/20 17:51
S13	480	(high adj q) same resonator same (contactless or (contact adj less) or inductive or inductively or wireless or wirelessly)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2012/03/20 17:52

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S14	402	("2133494" "20030062794" "20030199778" "20040130916" "20050127849" "20060185809" "20080197710" "20090033564" "20090072627" "20090224608" "6450946" "6960968" "7069064" "7116200" "7180248" "7385357" "20080067874" "20090085408" "20090085706" "20090251008" "0649621" "7514818" "8022576" "1119732" "20030214255" "20040201361" "20060022636" "20080211320" "20090127937" "20090153273" "4088999" "5027709" "5070293" "5999308" "6436299" "7239110" "7248017" "7474058" "7518267" "20050288740" "20090189458" "20090284082" "7191007" "20070145830" "20090267709" "20100123355" "20100207458" "20110074218" "20110193419" "20030038641" "20040000974" "20040267501" "20050093475" "20050156560" "20070178945" "20080014897" "20090195333" "20090224856" "20100038970" "5898579" "6597076" "6749119" "6798716" "6831417" "6917431" "7126450" "7375493" "0787412" "20090108997" "20090284227" "20090289595" "7795708" "20080266748" "20100133918" "20110043046" "20020105343" "20020118004" "20040232845" "20050116650" "20060270440" "20090058189" "20090212636" "20090213028" "20090273242" "5216402" "5437057" "6937130" "7042196" "7382636" "7525283" "20090096413" "20090230777" "20090281678" "20090284220" "5986895" "7147604" "7639514" "7843288" "7741734" "20100123353" "20040113847" "20040150934" "20050007067" "20050122059" "20070267918" "20080191638" "20090010028" "20090072628" "20090072629" "20090224609" "5493691" "5118997" "7599743" "7825543" "20090108679" "0645576" "20090284083" "20100102641" "20100133919" "20100187911" "20110089895" "20020032471" "20030062980" "20060132045" "20070276538" "20080278264" "20090045772" "20090079268" "20090102292" "20090134712" "20090179502" "20090243397" "5341083" "6452465" "6731071" "6806649" "7118240" "7212414" "7462951" "20080012569" "20080030415" "20090146892" "20090237194" "20090267558"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2012/03/20 21:29
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S15	10488	tet same q	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2012/03/20 22:31
S16	4	tet same q same implant	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2012/03/20 22:32
S17	2	transcutaneous adj energy adj transfer	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2012/03/20 22:34
S18	550	transcutaneous adj energy adj transfer	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2012/03/20 22:34
S19	60	S18 and q	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	ON	2012/03/20 22:34

			DERWENT; IBM_TDB			
S20	1060	("near" adj field) same wireless same power	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2012/03/20 22:49
S21	76	("near" adj field) same wireless same power same q	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2012/03/20 22:49
S22	233	("near" adj field) same (wireless adj power)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2012/03/20 22:52
S23	156	("near" adj field) adj inductive	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2012/03/20 23:01
S24	178	("near" adj field) same implant\$ same power	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2012/03/20 23:19
S25	192	("near" adj field) same power same q	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2012/03/20 23:40
S26	2141	(307/104).OCLS.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/03/20 23:54
S27	893	(320/108).OCLS.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/03/20 23:54
S28	2316	S26 or S27	US-PGPUB; USPAT	OR	OFF	2012/03/20 23:54
S29	319	S28 and "near" adj field	US-PGPUB; USPAT	OR	ON	2012/03/20 23:54
S30	31	("3167168" "4023753" "4331225" "4459438" "4603640" "4689530" "4800328" "4833337" "4836344" "4879522").PN. OR ("5519262").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/03/21 00:10
S31	4	("near" adj field) same implant\$ same q	US-PGPUB; USPAT;	OR	ON	2012/03/21 00:16

			USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			
S32	186	("near" adj field) same high adj q	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2012/03/21 00:20
S33	34	("2401572" "2426226" "2805414" "3546699" "3713162" "3771075" "3786376" "3810183" "3914715" "4150345" "4157516" "4163961" "4233580" "4253101" "4258365" "4288759" "4358746" "Re29296").PN. OR ("4516097").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/03/21 00:30
S34	1	("20100102639").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/03/21 11:50
S35	1	((("2010012355") or ("7741734"))).PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/03/21 12:29
S36	2	((("20100012355") or ("7741734"))).PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/03/21 12:29
S37	2	((("20100123355") or ("7741734"))).PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/03/21 12:30
S38	2	((("20100096934") or ("7741734"))).PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/03/21 12:52
S39	2	((("20100123355") or ("7741734"))).PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/03/21 20:45
S40	0	S39 and (tunable)	US-PGPUB; USPAT	OR	OFF	2012/03/21 20:45
S41	0	S39 and (tuning)	US-PGPUB; USPAT	OR	OFF	2012/03/21 20:46
S42	0	S39 and (tune)	US-PGPUB; USPAT	OR	OFF	2012/03/21 20:46
S43	1	("20100127574").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/03/26 06:11
S44	1	S43 and rate	US-PGPUB; USPAT	OR	OFF	2012/03/26 06:13
S45	1	S43 and "0.2"	US-PGPUB; USPAT	OR	OFF	2012/03/26 06:18
S46	1	S43 and (tunable or tuning or tuned or feedback)	US-PGPUB; USPAT	OR	ON	2012/03/26 06:20
S47	1	S43 and (tunable or tuning or tuned or feedback or detune or detuning)	US-PGPUB; USPAT	OR	ON	2012/03/26 06:21
S48	1	("20090085408").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/03/26 06:57

S49	1	("20110140544").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/04/09 13:11
S50	1	S49 and common	US-PGPUB; USPAT	OR	OFF	2012/04/09 13:11
S51	3	((("20110140544") or ("7825543") or ("7741734"))).PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/04/09 13:14
S52	3	S51 and common	US-PGPUB; USPAT	OR	OFF	2012/04/09 13:14
S53	1	S51 and (common adj inductance)	US-PGPUB; USPAT	OR	ON	2012/04/09 13:15
S54	4	((("20110140544") or ("20100117456") or ("7825543") or ("7741734"))).PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/04/09 13:19
S55	1	S52 and (common adj inductance)	US-PGPUB; USPAT	OR	ON	2012/04/09 13:19
S56	3	S52 and common	US-PGPUB; USPAT	OR	OFF	2012/04/09 13:20
S57	4	S54 and common	US-PGPUB; USPAT	OR	OFF	2012/04/09 13:20
S58	368	(high adj q) same resonant same (tune or tuning)	USPAT	OR	OFF	2012/04/09 13:54
S59	587	(high adj q) same resonant same (tune or tuning)	US-PGPUB; USPAT	OR	ON	2012/04/09 13:54
S60	1485	(307/104).OCLS.	USPAT; USOCR	OR	OFF	2012/05/07 04:48
S61	3	S60 and young and fleming	USPAT	OR	OFF	2012/05/07 04:48
S62	2	((("7825543") or ("7741734"))).PN.	USPAT; USOCR	OR	OFF	2012/05/07 08:04
S63	5	"2006011769"	EPO; DERWENT	OR	OFF	2012/05/07 08:16
S64	4	"2004072581"	EPO; DERWENT	OR	OFF	2012/05/07 08:17
S65	2179	(307/104).OCLS.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/05/07 12:02
S66	921	(320/108).OCLS.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/05/07 12:02
S67	1199	S65 or S66	USPAT	OR	OFF	2012/05/07 12:02
S68	2381	S65 or S66	US-PGPUB; USPAT	OR	OFF	2012/05/07 12:02
S69	100	S68 and (nano or nanoscale)	US-PGPUB; USPAT	OR	ON	2012/05/07 12:02
S70	409	capacitor same inductor same(nano or nanoscale)	US-PGPUB; USPAT	OR	ON	2012/05/07 12:07
S71	5	capacitor same inductor same(nano or nanoscale) same transponder	US-PGPUB; USPAT	OR	ON	2012/05/07 12:13
S72	365	capacitor same inductor same powder	US-PGPUB; USPAT	OR	ON	2012/05/07 12:19
S73	87	q same (inductor or inductance) same (air adj core) same frequency	US-PGPUB; USPAT	OR	ON	2012/05/07 13:09

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S74	5	q same (inductor or inductance) same (air adj core) same adjustable	US-PGPUB; USPAT	OR	ON	2012/05/07 13:13
S75	24	(inductor or inductance) same (air adj core) same adjustable	US-PGPUB; USPAT	OR	ON	2012/05/07 13:14
S76	79	(inductor or inductance) same (air adj core) same variable	US-PGPUB; USPAT	OR	ON	2012/05/07 13:15
S77	166	S68 and (air adj core)	US-PGPUB; USPAT	OR	ON	2012/05/07 13:24
S78	21	(inductor or inductance) same (air adj core) same variable	EPO; JPO; DERWENT	OR	ON	2012/05/07 13:38
S79	98	S68 and (variable or adjustable) near2 (inductor or inductance)	US-PGPUB; USPAT	OR	ON	2012/05/07 13:43
S80	53	("20020082059" "20030006880" "20030090239" "3689885" "3938018" "3949268" "4800328" "4818855" "5229652" "5341280" "5428659" "5455466" "5455467" "5550452" "5600225" "5701657" "5734254" "5814900" "5831348" "5982764" "6057668" "6127799" "6252380" "6265791" "6301128" "6323775" "6424124" "6429622" "6462432" "6597076" "6683438" "6703920" "6821670" "6844702" "6977479").PN. OR ("7518267").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/05/07 13:51
S81	1	("6436299").PN.	USPAT; USOCR	OR	OFF	2012/05/07 13:59
S82	2222	(307/104).OCLS.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/06/18 05:48
S83	962	(320/108).OCLS.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/06/18 05:48
S84	2222	(307/104).OCLS.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/06/18 05:49
S85	962	(320/108).OCLS.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/06/18 05:49
S86	2458	S84 or S85	US-PGPUB; USPAT	OR	OFF	2012/06/18 05:49
S87	511	(high adj q) same resonator same (contactless or (contact adj less) or inductive or inductively or wireless or wirelessly)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2012/06/18 05:50
S88	264	("near" adj field) same (wireless adj power)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2012/06/18 05:50
S89	163	("near" adj field) adj inductive	US-PGPUB; USPAT; USOCR;	OR	ON	2012/06/18 05:50

			FPRS; EPO; JPO; DERWENT; IBM_TDB			
S90	2458	S84 or S85	US-PGPUB; USPAT	OR	OFF	2012/06/18 05:51
S91	350	S90 and "near" adj field	US-PGPUB; USPAT	OR	ON	2012/06/18 05:51
S92	11	("20040100338" "20040233043" "20060202665" "20120068549" "5053774" "5287112" "6772011" "8076800" "8076801" "8084889" "8097983").PN.	US-PGPUB; USPAT	OR	ON	2012/06/18 07:40
S93	4	("20030124050" "20030126948" "5455467" "6772011").PN.	US-PGPUB; USPAT	OR	ON	2012/06/18 07:40
S94	2	((("7825543") or ("7741734")).PN.	USPAT; USOCR	OR	OFF	2012/06/18 08:05
S95	2	S94 and characteristic	USPAT	OR	OFF	2012/06/18 08:05
S96	1	("20030210106").PN.	US-PGPUB; USPAT	OR	OFF	2012/07/03 10:37
S97	1	("5959433").PN.	US-PGPUB; USPAT	OR	OFF	2012/07/03 10:39
S98	447	evanescent adj tail	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/07/03 10:40
S99	50	S98 and inductive	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/07/03 10:41
S100	97	S98 same power	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/07/03 10:42
S101	50	S98 same wireless\$	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/07/03 10:43
S102	60	S98 and wireless\$	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/07/03 10:44
S103	37316	computer same (wireless\$ or inductive\$)	US-PGPUB;	OR	ON	2012/07/03

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		same power	USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM TDB			11:05
S104	4230	computer same (wireless\$ or inductive\$) same power same (coupling or transfer)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM TDB	OR	ON	2012/07/03 11:05
S105	56	("2967267" "3549990" "4038625" "4654573" "4697183" "4755783" "4914561" "4924171" "4996638" "5122729" "5157319" "5166965").PN. OR ("5455467").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/07/03 11:06
S106	1358	computer same (wireless\$ or inductive\$) same power same (charging)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM TDB	OR	ON	2012/07/03 11:09
S107	2	("2005/0151511").URPN.	USPAT	OR	OFF	2012/07/03 11:19
S108	971	(320/108).CCLS.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/07/03 11:20
S109	130	S108 and computer	USPAT	OR	OFF	2012/07/03 11:20
S110	364	S108 and computer	US-PGPUB; USPAT	OR	OFF	2012/07/03 11:21
S111	1	("20100277005").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/07/03 11:28
S112	2	((("20100277005") or ("20110049996"))).PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/07/03 11:29
S113	0	S112 and base	USPAT	OR	OFF	2012/07/03 11:30
S114	0	S112 and hold	USPAT	OR	OFF	2012/07/03 11:30
S115	0	S112 and portable	USPAT	OR	OFF	2012/07/03 11:31
S116	2	S112 and portable	US-PGPUB; USPAT	OR	OFF	2012/07/03 11:31
S117	2	S112 and base	US-PGPUB; USPAT	OR	OFF	2012/07/03 11:31
S118	135	S108 and contacts	USPAT	OR	OFF	2012/07/03 11:44
S119	1	("5367242").PN.	USPAT; USOCR	OR	OFF	2012/07/03 12:01
S120	0	S119 and phone	USPAT	OR	OFF	2012/07/03 12:01
S121	244	S108 and ferrite	US-PGPUB;	OR	OFF	2012/07/03

			USPAT			12:19
S122	1	S112 and desktop	US-PGPUB; USPAT	OR	OFF	2012/07/03 13:38
S123	2	S112 and "near"	US-PGPUB; USPAT	OR	OFF	2012/07/03 13:48
S124	2	S112 and evanescent	US-PGPUB; USPAT	OR	OFF	2012/07/03 14:44
S125	2	S112 and radiative	US-PGPUB; USPAT	OR	OFF	2012/07/03 14:46
S126	2	((("7825543") or ("7741734"))).PN.	USPAT; USOCR	OR	OFF	2012/07/03 14:50
S127	1	("20100207458").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/08/13 02:46
S128	1	S127 and characteristic	US-PGPUB; USPAT	OR	OFF	2012/08/13 02:46
S129	1	("20100127575").PN.	US-PGPUB; USPAT	OR	OFF	2012/08/27 06:11
S130	1	S129 and second and third	US-PGPUB; USPAT	OR	OFF	2012/08/27 06:14
S131	0	("7687939").PN.	USPAT; USOCR	OR	OFF	2012/08/27 06:15
S132	0	("7687939").PN.	US-PGPUB; USPAT	OR	OFF	2012/08/27 06:16
S133	0	("7687939").PN.	US-PGPUB; USPAT	OR	OFF	2012/08/27 06:16
S134	1	("7741734").PN.	US-PGPUB; USPAT	OR	OFF	2012/08/27 06:21
S135	0	S134 and second and third	USPAT	OR	OFF	2012/08/27 06:22
S136	1	("20110074347").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/08/27 12:22
S137	3	((("20110074347") or ("7825543") or ("7741734"))).PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/08/27 12:23
S138	1	("20100237708").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/08/29 08:48
S139	1	S138 and housing	US-PGPUB; USPAT	OR	OFF	2012/08/29 08:49
S140	1	S138 and housing	US-PGPUB; USPAT	OR	ON	2012/08/29 09:17
S141	2	((("20101117456") or ("20080278264") or ("7825543"))).PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/09/04 11:41
S142	3	((("20100117456") or ("20080278264") or ("7825543"))).PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/09/04 11:42
S143	3	S142 and impedance	US-PGPUB; USPAT	OR	ON	2012/09/04 11:44
S144	0	S142 and (impedance same (match or matching))	US-PGPUB; USPAT	OR	ON	2012/09/04 11:45
S145	3	((("20100127573") or ("7741734") or ("7825543"))).PN.	US-PGPUB; USPAT;	OR	OFF	2012/09/10 10:27

			USOCR			
S146	3	S145 and characteristic	US-PGPUB; USPAT	OR	OFF	2012/09/10 10:28
S147	1706	(307/104).OCLS.	US-PGPUB; USPAT	OR	OFF	2012/09/10 12:09
S148	1095	(333/195).OCLS.	US-PGPUB; USPAT	OR	OFF	2012/09/10 12:09
S149	1017	(320/108).OCLS.	US-PGPUB; USPAT	OR	OFF	2012/09/10 12:09
S155	1	("20100096934").PN.	US-PGPUB; USPAT	OR	OFF	2012/09/10 13:29
S157	1	("20100102641").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/09/10 14:44
S159	1	("20110169339").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/09/11 07:05
S160	0	S159 and (voltage same capacitor)	USPAT	OR	OFF	2012/09/11 07:08
S161	1	S159 and (voltage same capacitor)	US-PGPUB; USPAT	OR	ON	2012/09/11 07:08
S162	1	S159 and (information same exchange)	US-PGPUB; USPAT	OR	ON	2012/09/11 07:09
S163	1	S159 and planar	US-PGPUB; USPAT	OR	ON	2012/09/11 07:18
S164	25	(high adj q) same feedback same (wireless\$ or (non adj contact) or contactless)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2012/09/11 08:16
S165	1110	q same feedback same (wireless\$ or (non adj contact) or contactless or inductive\$)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2012/09/11 08:18
S166	78	q same feedback same (wireless\$ or (non adj contact) or contactless or inductive\$) same power same transfer	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2012/09/11 08:18
S167	1019	(320/108).OCLS.	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2012/09/11 08:21
S168	1794	(307/104).OCLS.	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2012/09/11 08:21
S169	0	("032or33").PN.	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2012/09/11 08:22

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S170	2717	S167 or S168	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/09/11 08:22
S171	485	S170 and feedback	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/09/11 08:22
S172	507	S170 and (secondary same current same voltage)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/09/11 09:33
S173	128	S170 and (secondary same current same voltage same resonant)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/09/11 09:33
S174	145	(implant\$) and (secondary same current same voltage same resonant)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/09/11 10:29
S175	9	tet same (secondary same current same voltage same resonant)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/09/11 10:39
S176	45	tet and (secondary same current same voltage same resonant)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/09/11 10:40
S177	54	tet and (secondary same power same resonant)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/09/11 10:40
S178	316	tet and (power same feedback)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	OFF	2012/09/11 10:45

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			DERWENT; IBM_TDB			
S179	126	high same q same wireless same power same transfer	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2012/09/11 11:12
S180	1790	(307/104).OCLS.	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2012/09/21 20:55
S181	1013	(320/108).OCLS.	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2012/09/21 20:56
S183	0	20016655u1	EPO; DERWENT	OR	OFF	2012/09/30 18:52
S184	9	"20016655"	EPO; DERWENT	OR	OFF	2012/09/30 18:52
S185	3	"10221484"	EPO; DERWENT	OR	OFF	2012/09/30 18:53
S186	0	("200902677710").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/09/30 19:05
S187	1	("20090267710").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/09/30 19:05
S188	0	S187 and radiative	USPAT	OR	OFF	2012/09/30 19:05
S189	0	S187 and nonradiative	USPAT	OR	OFF	2012/09/30 19:05
S190	0	S187 and nonradiative	US-PGPUB	OR	OFF	2012/09/30 19:05
S191	1	S187 and radiative	US-PGPUB; USPAT	OR	OFF	2012/09/30 19:06
S192	2	((("7825543") or ("7741734"))).PN.	USPAT; USOCR	OR	OFF	2012/10/01 07:01
S193	1020	(320/108).OCLS.	US-PGPUB; USPAT	OR	OFF	2012/10/01 07:16
S194	746	(320/109).OCLS.	US-PGPUB; USPAT	OR	OFF	2012/10/01 07:16
S195	67	S193 and S194	US-PGPUB; USPAT	OR	OFF	2012/10/01 07:16
S196	1	("20110018361").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/10/01 08:01
S197	1	S196 and motorized	US-PGPUB; USPAT	OR	OFF	2012/10/01 08:01
S198	1	S196 and movement	US-PGPUB; USPAT	OR	OFF	2012/10/01 08:02
S199	1	S196 and position	US-PGPUB; USPAT	OR	OFF	2012/10/01 08:04
S200	1	("20100327660").PN.	US-PGPUB; USPAT;	OR	OFF	2012/10/01 09:41

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			USOCR			
S201	1	S200 and optimize	US-PGPUB; USPAT	OR	OFF	2012/10/01 09:41
S202	1	S200 and optimizing	US-PGPUB; USPAT	OR	OFF	2012/10/01 09:43
S203	1	S200 and optimiz\$	US-PGPUB; USPAT	OR	OFF	2012/10/01 09:44
S204	1	("20110074218").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/10/01 17:14
S205	3	((("20100123354") or ("20100123353") or ("20090267710")).PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/11/23 11:14
S206	3	S205 and resonator	US-PGPUB; USPAT	OR	OFF	2012/11/23 11:19
S207	60	"7741734"	US-PGPUB; USPAT	OR	OFF	2012/11/23 12:01
S208	1	("7741734").PN.	USPAT; USOCR	OR	OFF	2012/11/23 12:01
S209	1	("7741734").PN.	USPAT; USOCR	OR	OFF	2012/11/26 19:58
S210	0	S209 and storing	USPAT	OR	OFF	2012/11/26 19:58
S211	0	S209 and store	USPAT	OR	OFF	2012/11/26 19:58
S212	0	S209 and store	USPAT	OR	ON	2012/11/26 20:05
S213	1	S209 and energy	USPAT	OR	ON	2012/11/26 20:05
S214	1	S209 and stored	USPAT	OR	ON	2012/11/26 20:07
S215	1	S209 and intrinsic	USPAT	OR	ON	2012/11/26 20:12
S216	2	((("6960968") or ("7069064")).PN.	USPAT; USOCR	OR	OFF	2012/12/10 15:46
S217	1802	(307/104).OCLS.	US-PGPUB; USPAT	OR	OFF	2012/12/10 22:53
S219	4	((("20110140544") or ("20100117456") or ("7825543") or ("7741734")).PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/12/17 08:16
S220	4	S219 and acoustic	US-PGPUB; USPAT	OR	OFF	2012/12/17 08:16
S221	233	acoustic near3 power near3 transmission	US-PGPUB; USPAT	OR	ON	2012/12/17 08:17
S222	34	S221 and resonant	US-PGPUB; USPAT	OR	ON	2012/12/17 08:17
S223	774	(self adj (resonant or resonating)) near5 (coil or loop)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/01/24 09:19
S224	593	(self adj (resonant or resonating)) near2 (coil or loop)	US-PGPUB; USPAT;	OR	ON	2013/01/24 09:20

			USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			
S225	303	(self adj (resonant or resonating)) adj (coil or loop)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/01/24 09:20
S226	123	("3859624" "4450431" "4630044" "4658263" "4868915").PN. OR ("5084699").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2013/01/24 09:29
S227	23	S223 same ("near" adj field)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/01/24 09:38
S228	1	("5012236").PN.	USPAT; USOCR	OR	OFF	2013/01/24 09:40
S229	900	self near2 (resonant or resonate or resonance or resonating) near2 (coil or loop)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/01/24 12:09
S230	2524	(307/104).OCLS.	US-PGPUB; USPAT; USOCR	OR	OFF	2013/01/24 12:19
S231	209	S230 and (self near2 (resonant or resonate or resonance or resonating))	US-PGPUB; USPAT; USOCR	OR	ON	2013/01/24 12:19
S232	782	S229 or S231	US-PGPUB; USPAT; USOCR	OR	ON	2013/01/24 12:20
S233	209	S230 and (self near2 (resonant or resonate or resonance or resonating))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/01/24 12:20
S234	957	S233 or S229	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/01/24 12:20
S235	17	self same resonant same coil same transponder	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	ON	2013/02/07 10:50

			IBM_TDB			
S236	1	("20100231053").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2013/02/21 08:45
S237	2993	contactless same (energy or power)	EPO; JPO; DERWENT	OR	OFF	2013/02/28 01:50
S238	137	contactless same (energy or power) same (resonant or resonance or resonating)	EPO; JPO; DERWENT	OR	ON	2013/02/28 01:50
S239	934	wireless same (energy or power) same (resonant or resonance or resonating)	EPO; JPO; DERWENT	OR	ON	2013/02/28 02:15
S240	233	wireless same (energy or power) same (resonant or resonance or resonating) same coil	EPO; JPO; DERWENT	OR	ON	2013/02/28 02:15
S241	118	wireless same (energy or power) same q	EPO; JPO; DERWENT	OR	ON	2013/02/28 02:23
S242	29	wireless same (energy or power) same (resonant or resonance or resonating) same q	EPO; JPO; DERWENT	OR	ON	2013/02/28 02:29
S243	0	(h02j5/0005).IPCR.	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2013/02/28 08:48
S244	975	h02j5/005.cpc.	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2013/02/28 08:52
S245	0	h02j5/005.cpc.	EPO; JPO; DERWENT	OR	OFF	2013/02/28 08:55
S246	0	h02j5/005	EPO; JPO; DERWENT	OR	OFF	2013/02/28 08:55
S247	0	h02j5/005.cpc.	EPO; JPO; DERWENT	OR	OFF	2013/02/28 09:03
S248	0	h02j5.cpcl.	EPO; JPO; DERWENT	OR	OFF	2013/02/28 09:06
S249	0	h02j.cpcl.	EPO; JPO; DERWENT	OR	OFF	2013/02/28 09:07
S250	9041	h02j17/00	EPO; JPO; DERWENT	OR	OFF	2013/02/28 09:18
S251	0	h02j17/00	EPO	OR	OFF	2013/02/28 09:21
S252	7452	h02j17/00	DERWENT	OR	OFF	2013/02/28 09:21
S253	9041	h02j17/00	JPO; DERWENT	OR	OFF	2013/02/28 09:21
S254	1589	h02j17/00	JPO	OR	OFF	2013/02/28 09:21
S255	0	h02j17/00.ipc.	EPO	OR	OFF	2013/02/28 09:26
S256	0	h02j17/00.ipc.	DERWENT	OR	OFF	2013/02/28 09:26
S257	0	h02j17/00.epc.	EPO	OR	OFF	2013/02/28 09:27
S258	0	H02J17/00.epc.	EPO	OR	OFF	2013/02/28 09:27

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S259	0	H02J17/00.ipc.	EPO	OR	OFF	2013/02/28 09:27
S260	1589	H02J17/00.ipc.	JPO	OR	OFF	2013/02/28 09:28
S261	1095	S252 and q	DERWENT	OR	OFF	2013/02/28 09:28
S262	25	S252 and (high adj q)	DERWENT	OR	OFF	2013/02/28 09:30
S263	1	schuerman and (high adj q)	USPAT	OR	OFF	2013/02/28 09:32
S264	1	("5053774").PN.	USPAT	OR	OFF	2013/02/28 09:32
S265	8	schuerman and q	USPAT	OR	OFF	2013/02/28 09:36
S266	1	("5374930").PN.	USPAT; USOCR	OR	OFF	2013/02/28 09:39
S267	97	("5287112").PN. OR ("5374930").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2013/02/28 09:39
S268	230	S252 and (resonator)	DERWENT	OR	OFF	2013/02/28 09:45
S269	242	S252 and (resonator)	DERWENT	OR	ON	2013/02/28 09:46
S270	554	S252 and (resonant)	DERWENT	OR	ON	2013/02/28 09:51
S271	61	transponder and (resonance or resonant or resonating) and q	JPO; DERWENT; IBM_TDB	OR	ON	2013/02/28 10:34
S272	1	("5095224").PN.	USPAT; USOCR	OR	OFF	2013/02/28 10:44
S273	43	("3166718" "3360732" "3391345" "4345604" "4489370" "4584499" "4654574" "4675796" "4694387" "4743789" "4829415").PN. OR ("5095224").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2013/02/28 10:44
S274	1069	S252 and resonance	DERWENT	OR	OFF	2013/02/28 10:47
S275	44	S274 and quality	DERWENT	OR	OFF	2013/02/28 10:47
S276	541	S252 and resonance and coil	DERWENT	OR	OFF	2013/02/28 10:48
S277	557	S252 and resonance and coil	DERWENT	OR	ON	2013/02/28 10:48
S278	71	(high adj q) and coil and resonance	DERWENT	OR	ON	2013/02/28 10:59
S279	453	(high adj q) same coil same resonance	US-PGPUB; USPAT	OR	ON	2013/02/28 11:03
S280	33	(high adj q) same transponder same power	US-PGPUB; USPAT	OR	ON	2013/02/28 11:22
S281	34	(high adj q) same wireless\$ same power	EPO; JPO; DERWENT	OR	ON	2013/02/28 11:45
S282	786	(resonance or resonator or resonating) same wireless\$ same power	EPO; JPO; DERWENT	OR	ON	2013/02/28 11:46
S283	521	(resonance or resonator or resonating) same inductive\$ same power	EPO; JPO; DERWENT	OR	ON	2013/02/28 11:53

S284	41	S252 and meter	EPO; JPO; DERWENT	OR	ON	2013/02/28 12:04
S285	108	"10" and power and distance and resonant	EPO; JPO; DERWENT	OR	ON	2013/02/28 14:47
S286	7452	h02j17/00	DERWENT	OR	OFF	2013/02/28 14:51
S287	77	S286 and power and distance and resonant	EPO; JPO; DERWENT	OR	ON	2013/02/28 14:51
S288	477	magnetic and resonant and power and (transfer or transmission or coupling)	EPO; JPO; DERWENT	OR	ON	2013/02/28 14:52
S289	39	S286 and repeater	EPO; JPO; DERWENT	OR	ON	2013/02/28 15:02
S290	2569	(307/104).OCLS.	US-PGPUB; USPAT; USOCR	OR	OFF	2013/02/28 15:04
S291	145	S290 and repeater	US-PGPUB; USPAT	OR	ON	2013/02/28 15:04
S292	67	implant same repeater	US-PGPUB; USPAT	OR	ON	2013/02/28 15:07
S293	9	"near field" and q and loop	EPO; JPO; DERWENT	OR	ON	2013/03/01 10:26
S294	193	"near field" and loop	EPO; JPO; DERWENT	OR	ON	2013/03/01 10:27
S295	201	"near field" and power and transmission	EPO; JPO; DERWENT	OR	ON	2013/03/01 10:31
S296	1374	"near field" same power same transmission	US-PGPUB; USPAT	OR	ON	2013/03/01 10:33
S297	130	"near field" same power same transmission same q	US-PGPUB; USPAT	OR	ON	2013/03/01 10:33
S298	160	"near field" same power same transmission same resonance	US-PGPUB; USPAT	OR	ON	2013/03/01 10:35
S299	256	"near field" same (wireless or contactless or inductive) same resonance	US-PGPUB; USPAT	OR	ON	2013/03/01 10:36
S300	101	("3036295" "3137847" "3182314" "3182315" "3218638" "3299424" "3363246" "3467962" "3518546" "3522602" "3737911" "3739279").PN. OR ("4160971").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2013/03/01 10:39
S301	228	"wireless power transfer"	EPO; JPO; DERWENT	OR	OFF	2013/03/01 10:42
S302	807	"wireless power transfer"	US-PGPUB; USPAT	OR	OFF	2013/03/01 10:46
S303	110	"contactless power transfer"	US-PGPUB; USPAT	OR	OFF	2013/03/01 10:51
S304	3053	((contactless or wireless\$ or inductive\$) adj power)	EPO; JPO; DERWENT	OR	ON	2013/03/01 10:57
S305	7642	((contactless or wireless or inductive or inductively) adj3 power)	EPO; JPO; DERWENT	OR	ON	2013/03/01 10:58
S306	3011	((contactless or wireless or inductive or inductively) adj power)	EPO; JPO; DERWENT	OR	ON	2013/03/01 10:58
S307	56	((contactless or wireless or inductive or inductively) adj3 power) same q	EPO; JPO; DERWENT	OR	ON	2013/03/01 10:58
S308	115	((contactless or wireless or inductive or inductively) adj3 power) and ("near" adj	EPO; JPO; DERWENT	OR	ON	2013/03/01 11:00

		field)				
S309	522	((contactless or wireless or inductive or inductively) adj3 power) same ("near" adj field)	US-PGPUB; USPAT	OR	ON	2013/03/01 11:01
S310	392	(self adj resonance) same q	US-PGPUB; USPAT	OR	ON	2013/03/01 11:04
S311	2569	(307/104).OCLS.	US-PGPUB; USPAT; USOCR	OR	OFF	2013/03/01 11:10
S312	48	S311 and quality	USPAT	OR	OFF	2013/03/01 11:10
S313	331	S311 and quality	US-PGPUB; USPAT	OR	OFF	2013/03/01 11:10
S314	264	S311 and (q adj factor)	US-PGPUB; USPAT	OR	OFF	2013/03/01 11:11
S315	303	(self adj (resonance or resonating)) and (q adj factor)	US-PGPUB; USPAT	OR	OFF	2013/03/01 11:12
S316	102	(loop adj antenna) same q same resonance	US-PGPUB; USPAT	OR	ON	2013/03/01 11:15
S317	1	("7741734").PN.	USPAT; USOCR	OR	OFF	2013/03/01 11:26
S318	0	S317 and yates	USPAT	OR	OFF	2013/03/01 11:26
S319	1	S317 and optimal	USPAT	OR	OFF	2013/03/01 11:26
S320	1	S317 and markoff	USPAT	OR	OFF	2013/03/01 11:26
S321	1	("7741734").PN.	USPAT; USOCR	OR	OFF	2013/03/01 23:46
S322	4	"3824972"	EPO; DERWENT	OR	OFF	2013/03/02 00:54
S323	235	magnetic adj antenna	EPO; JPO; DERWENT	OR	OFF	2013/03/02 01:48
S324	252	magnetic adj antenna	EPO; JPO; DERWENT	OR	ON	2013/03/02 01:48
S325	680	magnetic adj antenna	US-PGPUB; USPAT	OR	ON	2013/03/02 02:05
S326	28	S325 same q	US-PGPUB; USPAT	OR	ON	2013/03/02 02:06
S327	290	S325 and "near field"	US-PGPUB; USPAT	OR	ON	2013/03/02 02:08
S328	10	("20040046663" "20050086264" "20050178832" "6236315" "6259369" "6839035" "7005968").PN. OR ("7280045").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2013/03/02 02:17
S329	133	(quality adj factor) same (loss adj rate)	US-PGPUB; USPAT; USOCR	OR	ON	2013/03/02 02:51
S330	70	(quality adj factor) same (loop adj antenna)	US-PGPUB; USPAT; USOCR	OR	ON	2013/03/02 02:52
S331	11	(quality adj factor) and (loop adj antenna)	EPO; JPO; DERWENT	OR	ON	2013/03/02 02:59
S332	321	(quality adj factor) and (resonant adj frequency)	EPO; JPO; DERWENT	OR	ON	2013/03/02 03:08

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S333	265	(quality adj factor) same (resonant adj frequency)	EPO; JPO; DERWENT	OR	ON	2013/03/02 03:08
S334	1587	(quality adj factor) same (resonant adj frequency)	USPAT	OR	ON	2013/03/02 03:12
S335	1	("20100207458").PN.	US-PGPUB; USPAT	OR	OFF	2013/06/02 08:29
S336	0	S335 and dynamically	USPAT	OR	OFF	2013/06/02 08:34
S337	0	S335 and dynamic\$	USPAT	OR	OFF	2013/06/02 08:55
S338	0	S335 and intrinsic	USPAT	OR	OFF	2013/06/02 09:09
S339	0	S335 and dynamically	US-PGPUB; USPAT	OR	OFF	2013/06/02 09:11
S340	1	S335 and intrinsic	US-PGPUB; USPAT	OR	OFF	2013/06/02 09:11
S341	0	S335 and " high intrinsic"	US-PGPUB; USPAT	OR	OFF	2013/06/02 09:13
S342	1	S335 and high	US-PGPUB; USPAT	OR	OFF	2013/06/02 09:13
S343	1	S335 and rate	US-PGPUB; USPAT	OR	OFF	2013/06/02 09:16
S344	1	("20110089895").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2013/06/03 01:10
S345	1	S344 and repeater	US-PGPUB; USPAT	OR	OFF	2013/06/03 01:10
S346	1	S344 and enhances	US-PGPUB; USPAT	OR	OFF	2013/06/03 01:12
S347	1	S344 and "coupling mode region"	US-PGPUB; USPAT	OR	OFF	2013/06/03 01:13
S348	0	qualcom and "coupling mode region"	US-PGPUB; USPAT	OR	OFF	2013/06/03 01:14
S349	0	qualcom and (wireless same repeater same "near" same field)	US-PGPUB; USPAT	OR	OFF	2013/06/03 01:15
S350	16	qualcom and (wireless same repeater)	US-PGPUB; USPAT	OR	OFF	2013/06/03 01:15
S351	6	nigel and (wireless same repeater)	US-PGPUB; USPAT	OR	OFF	2013/06/03 01:16
S352	1	("20090284218").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2013/06/03 01:20
S353	1	("20090286470").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2013/06/03 01:23
S354	2	((("20100207458") or ("20110089895")).PN.	US-PGPUB; USPAT	OR	OFF	2013/06/03 15:30
S355	2	((("20090224856") or ("20110089895")).PN.	US-PGPUB; USPAT	OR	OFF	2013/06/03 15:32
S356	1	("20090286470").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2013/06/03 15:39
S357	1	S356 and (resonant or resonator)	US-PGPUB; USPAT	OR	ON	2013/06/03 15:39

S358	0	S356 and q	US-PGPUB; USPAT	OR	ON	2013/06/03 15:57
S359	66	("2274557" "3694803" "3723966" "3798642" "3806905" "3911434" "3990041" "4067235" "4074227" "4174515" "4303910").PN. OR ("4450431").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2013/06/03 17:03
S360	11	("20040046663" "20050086264" "20050178832" "6236315" "6259369" "6839035" "7005968").PN. OR ("7280045").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2013/06/03 17:20
S361	36228	(rfid or (rf adj2 id)) smae passive same repeater	EPO; JPO; DERWENT	OR	ON	2013/06/03 17:26
S362	6	(rfid or (rf adj2 id)) same passive same repeater	EPO; JPO; DERWENT	OR	ON	2013/06/03 17:26
S363	11	(rfid or (rf adj2 id)) near2 passive near2 repeater	US-PGPUB; USPAT	OR	ON	2013/06/03 19:50
S364	73	(rfid or (rf adj2 id)) near2 repeater	US-PGPUB; USPAT	OR	ON	2013/06/03 19:51
S365	3	((("8097983") or ("7825543") or ("7741734")).PN.	USPAT; USOCR	OR	OFF	2013/06/03 20:13
S366	3	((("8097983") or ("7825543") or ("7741734") or ("201100898985")).PN.	US-PGPUB; USPAT	OR	OFF	2013/06/03 20:15
S367	0	S366 and repeater	US-PGPUB; USPAT	OR	ON	2013/06/03 20:16
S368	4	((("8097983") or ("7825543") or ("7741734") or ("20110089895")).PN.	US-PGPUB; USPAT	OR	OFF	2013/06/03 20:17
S369	1	S368 and repeater	US-PGPUB; USPAT	OR	OFF	2013/06/03 20:17
S370	0	tranponder same resonator	EPO; JPO; DERWENT	OR	OFF	2013/06/05 09:37
S371	64	transponder same resonator	EPO; JPO; DERWENT	OR	ON	2013/06/05 09:37
S372	103	transponder near5 resonator	US-PGPUB; USPAT	OR	ON	2013/06/05 09:45
S373	36	transponder same resonator same q	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/06/05 09:50
S374	36	transponder same resonator same q and resonator	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/06/05 09:56
S375	7	("20030161511" "20030200814" "20070176773" "5443987" "5663072" "6025725" "6204764").PN. OR ("7714593").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2013/06/05 09:58
S376	32	rfid same resonator same q	US-PGPUB; USPAT; USOCR; FPRS;	OR	ON	2013/06/05 09:59

			EPO; JPO; DERWENT; IBM_TDB			
S377	7	rfid and resonator and q	EPO; JPO; DERWENT	OR	ON	2013/06/05 10:01
S378	112	tire and pressure and resonator	EPO; JPO; DERWENT	OR	ON	2013/06/05 10:02
S379	1	("4450431").PN.	USPAT; USOCR	OR	OFF	2013/06/05 17:13
S380	0	S379 and resonator	USPAT	OR	OFF	2013/06/05 17:13
S381	1	S379 and resonant	USPAT	OR	OFF	2013/06/05 17:13
S382	4	((("8097983") or ("7825543") or ("7741734") or ("20110089895")).PN.	US-PGPUB; USPAT	OR	OFF	2013/06/11 08:29
S383	4	S382 and enhanc\$	US-PGPUB; USPAT	OR	OFF	2013/06/11 08:29
S384	1	S382 and "loop inductor"	US-PGPUB; USPAT	OR	OFF	2013/06/11 09:05
S385	2	hochstein and tire and pressure and "267,261"	US-PGPUB; USPAT	OR	OFF	2013/06/11 10:28
S386	6	("3662335" "3806905" "3858174" "4006449" "4074227" "4174515").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2013/06/11 10:43
S387	2	("2274557").PN.	USPAT; USOCR	OR	OFF	2013/06/11 10:49
S388	3	((("2274557") or ("3723966")).PN.	USPAT; USOCR	OR	OFF	2013/06/11 10:49
S389	4	(tire adj pressure) same resonant same repeat\$	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2013/06/11 13:44
S390	39	(tire adj pressure) same resonant same passive	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2013/06/11 13:52
S391	2	contactless same resonant same repeater	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/06/11 13:54
S392	87	wireless\$ same resonant same repeater	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/06/11 13:54
S393	1	wireless\$ same resonant same extender	US-PGPUB; USPAT;	OR	ON	2013/06/11 13:56

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			USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			
S394	2	rfid same resonant same extender	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/06/11 13:56
S395	5	rfid same resonant same repeater	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/06/11 13:57
S396	1	rfid and resonant and repeater	FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/06/11 13:58
S397	0	rfid and resonant and extender	FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/06/11 13:58
S398	6	rfid and extender	FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/06/11 13:58
S399	73	rfid and booster	FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/06/11 14:01
S400	14	rfid and booster and range	FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/06/11 14:01
S401	176	rfid and passive and range	FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/06/11 14:02
S402	1150	rfid same range same (boost\$ or (extend or extender or extending))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/06/11 14:28
S403	814	rfid same range same (extend or extender or extending)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/06/11 14:29
S404	172	rfid same range same (extend or extender or extending) same passive\$	US-PGPUB; USPAT; USOCR;	OR	ON	2013/06/11 14:29

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			FPRS; EPO; JPO; DERWENT; IBM_TDB			
S405	7	("5379455" "5600333" "6107910" "6137403" "6223990" "6278413" "6359444").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2013/06/11 14:34
S406	284	rfid same range same improved same antenna	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/06/11 14:37
S407	1	("8097983").PN.	USPAT; USOCR	OR	OFF	2013/06/12 00:16
S408	1	("5053774").PN.	USPAT; USOCR	OR	OFF	2013/06/12 00:40
S409	97	rfid same resonant same detun\$	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2013/06/12 01:44
S410	97	rfid same resonant same detun\$	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/06/12 01:44
S411	76	resonator same resonant same frequency same q same l same c	USPAT	OR	OFF	2013/06/12 16:27
S412	148	resonator same resonant same frequency same q same l same c	US-PGPUB	OR	OFF	2013/06/12 16:31
S413	0	rfid same resonant same frequency same q same l same c	US-PGPUB	OR	OFF	2013/06/12 16:33
S414	12	transponder same resonant same frequency same q same l same c	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/06/12 17:19
S415	112	transponder same resonant same frequency same q	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/06/12 17:44
S416	4206	l same c same resonant same frequency same q	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/06/12 17:52

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S417	19	I same c same resonant same frequency same q	FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/06/12 17:52
S418	1	charger same resonant same frequency same q	FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/06/12 17:54
S419	47	charger same resonant same frequency same q	US-PGPUB; USPAT	OR	ON	2013/06/12 17:55
S420	429	(resonant adj circuit) near5 resonator	USPAT	OR	ON	2013/06/12 18:58
S421	51	(resonant adj circuit) near5 resonator same q	USPAT	OR	ON	2013/06/12 18:58
S422	74	("3440633" "4429314" "4712070" "5084699").PN. OR ("5373303").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2013/06/12 19:03
S423	56	(resonant adj circuit) near5 resonator same LC	USPAT	OR	ON	2013/06/12 19:06
S424	2101	(307/104).OCLS.	US-PGPUB; USPAT	OR	OFF	2013/06/12 19:08
S425	1298	(320/108).OCLS.	US-PGPUB; USPAT	OR	OFF	2013/06/12 19:08
S426	1432	S424 or S425	USPAT	OR	OFF	2013/06/12 19:09
S427	62	S426 and resonator	USPAT	OR	OFF	2013/06/12 19:09
S428	1	("20100127575").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2013/06/12 23:35
S429	1	S428 and resonator	US-PGPUB; USPAT	OR	ON	2013/06/12 23:35

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S150	0	((resonator or resonant or resonance) same intrinsic same loss same characteristic same size).clm.	US-PGPUB; USPAT; UPAD	OR	ON	2012/09/10 11:55
S151	0	((resonator or resonant or resonance) and intrinsic and loss and characteristic and size).clm.	US-PGPUB; USPAT; UPAD	OR	ON	2012/09/10 11:56
S152	15	((resonator or resonant or resonance) and intrinsic and loss and characteristic and size)	US-PGPUB; USPAT; UPAD	OR	ON	2012/09/10 11:57
S153	0	((resonator or resonant or resonance) same characteristic same size).clm.	US-PGPUB; USPAT; UPAD	OR	ON	2012/09/10 11:59
S154	147	((resonator or resonant or resonance) same characteristic same size).clm.	US-PGPUB; USPAT; UPAD	OR	ON	2012/09/10 12:03

EAST Search History

S156	10	(resonator same (resonance or resonant) same frequency same intrinsic same loss same transfer same rate).clm.	US-PGPUB; USPAT; UPAD	OR	ON	2012/09/10 13:42
S158	1	(resonator same (resonance or resonant) same frequency same intrinsic same loss same "near" same field same q same factor).clm.	US-PGPUB; USPAT; UPAD	OR	ON	2012/09/10 14:50
S182	10	(resonator same (resonance or resonant) same frequency same intrinsic same loss same transfer same rate).clm.	US-PGPUB; USPAT; UPAD	OR	ON	2012/09/21 20:55
S218	1	(resonator same (resonance or resonant) same frequency same intrinsic same loss same high same (q or quality)).clm.	US-PGPUB; USPAT; UPAD	OR	ON	2012/12/10 23:01

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Receipt date: 01/25/2013

12649635 - GAU: 2836

Sheet 1 of 1

Substitute Disclosure Form	U.S. Department of Commerce Patent and Trademark Office	Attorney Docket No. 01997-0359015	Application No. 12/649,635
Information Disclosure Statement by Applicant (Use several sheets if necessary) (37 CFR §1.98(b))		Applicant John D. Joannopoulos et al.	
		Filing Date December 30, 2009	Group Art Unit 2836

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

Foreign Patent Documents or Published Foreign Patent Applications								
Examiner Initial	Desig. ID	Document Number	Publication Date	Country or Patent Office	Class	Subclass	Translation	
							Yes	No
	2							

Other Documents (include Author, Title, Date, and Place of Publication)							
Examiner Initial	Desig. ID	Document					
	3	"Automatic Recharging, From a Distance" by Anne Eisenberg, The New York Times, (see www.nytimes.com/2012/03/11/business/built-in-wireless-charging-for-electronic-devices.html?_r=0) (published on March 10, 2012)					
	4	"How Wireless Charging Will Make Life Simpler (And Greener)" by David Ferris, Forbes (See forbes.com/sites/davidferris/2012/07/24/how-wireless-charging-will-make-life-simpler-and-greener/print/) (dated 7/24/2012)					
	5	"Wireless charging - the future for electric cars?" by Katia Moskvitch, BBC News Technology (See www.bbc.co.uk/news/technology-14183409) (dated July 21, 2011)					
	6	"Next Little Thing 2010 Electricity without wires", CNN Money (See money.cnn.com/galleries/2009/smallbusiness/0911/gallery.next_little_thing_2010.smb/) (dated November 30, 2009)					
	7	Copy of Non-Final Office Action with regard to U.S. Application Serial No. 12/649,777 by Examiner Fritz M. Fleming dated December 24, 2012 (43 pages)					
	8	Copy of Non-Final Office Action with regard to U.S. Application Serial No. 12/649,813 by Examiner Fritz M. Fleming dated December 21, 2012 (40 pages)					
	9	Copy of Non-Final Office Action with regard to U.S. Application Serial No. 12/649,852 by Examiner Fritz M. Fleming dated December 21, 2012 (41 pages)					
	10	Copy of Non-Final Office Action with regard to U.S. Application Serial No. 12/649,904 by Examiner Fritz M. Fleming dated December 28, 2012 (43 pages)					

Examiner Signature /Fritz Fleming/ (06/17/2013)	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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Information Disclosure Statement by Applicant (Use several sheets if necessary) (37 CFR §1.98(b))		Applicant John D. Joannopoulos et al.	
		Filing Date December 30, 2009	Group Art Unit 2836

U.S. Patent Documents							
Examiner Initial	Desig. ID	Document Number	Publication Date	Patentee	Class	Subclass	Filing Date If Appropriate
	1	5,034,658	7/23/1991	Hiering et al.			
	2	6,459,218	10/1/2002	Boys et al.			
	3	8,362,651	1/29/2013	Hamam et al.			
	4	8,395,282	3/12/2013	Joannopoulos et al.			
	5	8,395,283	3/12/2013	Joannopoulos et al.			
	6	8,400,018	3/19/2013	Joannopoulos et al.			
	7	8,400,019	3/19/2013	Joannopoulos et al.			
	8	8,400,020	3/19/2013	Joannopoulos et al.			
	9	8,400,021	3/19/2013	Joannopoulos et al.			
	10	8,400,022	3/19/2013	Joannopoulos et al.			
	11	8,400,023	3/19/2013	Joannopoulos et al.			
	12	8,400,024	3/19/2013	Joannopoulos et al.			
	13						

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
	14	WO 95/11545	4/27/1995	WIPO	H02J	17/00		
	15							

Other Documents (include Author, Title, Date, and Place of Publication)		
Examiner Initial	Desig. ID	Document
	16	

Examiner Signature /Fritz Fleming/ (06/17/2013)	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./

Index of Claims 	Application/Control No. 12649635	Applicant(s)/Patent Under Reexamination JOANNOPOULOS ET AL.
	Examiner FRITZ M FLEMING	Art Unit 2836

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant				☐ CPA		☐ T.D.		☐ R.1.47	
CLAIM		DATE							
Final	Original	12/17/2012	06/17/2013						
	1	✓	✓						
	2	✓	✓						
	3	✓	✓						
	4	✓	-						
	5	✓	✓						
	6	✓	✓						
	7	✓	✓						
	8	✓	-						
	9	✓	✓						
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	32	✓	✓						
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	34	✓	✓						
	35	✓	✓						
	36	✓	✓						

<i>Index of Claims</i> 	Application/Control No. 12649635	Applicant(s)/Patent Under Reexamination JOANNOPOULOS ET AL.
	Examiner FRITZ M FLEMING	Art Unit 2836

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant				☐ CPA		☐ T.D.		☐ R.1.47	
CLAIM		DATE							
Final	Original	12/17/2012	06/17/2013						
	37		✓						
	38		✓						
	39		✓						
	40		✓						
	41		✓						
	42		✓						
	43		✓						
	44		✓						

Search Notes 	Application/Control No. 12649635	Applicant(s)/Patent Under Reexamination JOANNOPOULOS ET AL.
	Examiner FRITZ M FLEMING	Art Unit 2836

CPC- SEARCHED		
Symbol	Date	Examiner

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner
307	104	12/17/2012	FMF

SEARCH NOTES		
Search Notes	Date	Examiner
EAST, PLUS	12/17/2012	FMF
updated search.	6/17/2013	FMF

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner

	/FRITZ M FLEMING/ Primary Examiner, Art Unit 2836
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Request for Continued Examination (RCE) Transmittal													
Address to: Mail Stop RCE Commissioner for Patents P.O. Box 1450 Alexandria, VA 22313-1450	<table border="1"><tr><td>Application Number</td><td>12/649,635</td></tr><tr><td>Filing Date</td><td>December 30, 2009</td></tr><tr><td>First Named Inventor</td><td>John D. Joannopoulos</td></tr><tr><td>Art Unit</td><td>2836</td></tr><tr><td>Examiner Name</td><td>Fritz Fleming</td></tr><tr><td>Attorney Docket Number</td><td>01997-0359015</td></tr></table>	Application Number	12/649,635	Filing Date	December 30, 2009	First Named Inventor	John D. Joannopoulos	Art Unit	2836	Examiner Name	Fritz Fleming	Attorney Docket Number	01997-0359015
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Art Unit	2836												
Examiner Name	Fritz Fleming												
Attorney Docket Number	01997-0359015												

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.

Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. See Instruction Sheet for RCEs (not to be submitted to the USPTO) on page 2.

1. **Submission required under 37 CFR 1.114** Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).
- a. ☐ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.
- i. ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____
- ii. ☐ Other _____
- b. ☒ Enclosed
- i. ☒ Amendment/Reply
- ii. ☐ Affidavit(s)/ Declaration(s)
- iii. ☒ Information Disclosure Statement (IDS)
- iv. ☐ Other _____
2. **Miscellaneous**
- Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a
- a. ☐ period of _____ months. (Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)
- b. ☐ Other _____
3. **Fees** The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed. The Director is hereby authorized to charge the following fees any underpayment of fees or credit any overpayments to
- a. ☒ Deposit Account No. 06-1050
- i. ☒ RCE fee required under 37 CFR 1.17(e)
- ii. ☒ Extension of time fee (37 CFR 1.136 and 1.17)
- iii. ☒ Other any deficiencies
- b. ☐ Check in the amount of \$ _____ enclosed
- c. ☐ Payment by credit card (Form PTO-2038 enclosed)

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED			
Signature	/Marc M. Wefers Reg. No. 56,842/	Date	November 20, 2013
Name (Print/Type)	Marc M. Wefers	Registration No.	56,842



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : John D. Joannopoulos et al. Art Unit : 2836
Serial No. : 12/649,635 Examiner : Fritz Fleming
Filed : December 30, 2009 Conf. No. : 5891

Title : WIRELESS ENERGY TRANSFER TO A MOVING DEVICE BETWEEN HIGH-
Q RESONATORS

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

AMENDMENT IN REPLY TO ACTION OF JUNE 20, 2013

Please amend the above-identified application as follows:

Amendments to the Claims:

This listing of claims replaces all prior versions and listings of claims in the application:

Listing of Claims:

1. (Previously Presented) A system, comprising:
a first resonator having a resonant frequency ω_1 and an intrinsic loss rate Γ_1 , and capable of storing electromagnetic energy with an intrinsic quality factor $Q_1 = \omega_1 / (2\Gamma_1)$ greater than 100, and configured to be coupled to an energy source to generate an oscillating near field region; and
a second resonator having a resonant frequency ω_2 and an intrinsic loss rate Γ_2 , and capable of storing electromagnetic energy with an intrinsic quality factor $Q_2 = \omega_2 / (2\Gamma_2)$ greater than 100, and configured to move freely within the near field region of the first resonator,
wherein the first resonator and the second resonator are configured to be coupled to transfer electromagnetic energy from said first resonator to said second resonator when the first resonator is coupled to the energy source as the second resonator moves freely within the near field region.
2. (Original) The system of claim 1, wherein near field of the near field region is a magnetic field.
3. (Original) The system of claim 1, wherein near field of the near field region is an electromagnetic field.
4. (Canceled)

5. (Previously Presented) A method, comprising:

providing a first resonator having a resonant frequency ω_1 and an intrinsic loss rate Γ_1 , and capable of storing electromagnetic energy with an intrinsic quality factor $Q_1 = \omega_1 / (2\Gamma_1)$ greater than 100, coupled to an energy source, generating an oscillating near field region; and

providing a second resonator having a resonant frequency ω_2 and an intrinsic loss rate Γ_2 , and capable of storing electromagnetic energy with an intrinsic quality factor $Q_2 = \omega_2 / (2\Gamma_2)$, greater than 100, and moving freely within the near field region of the first resonator,

wherein the first resonator and the second resonator are coupled to transfer electromagnetic energy from said first resonator to said second resonator as the second resonator moves freely within the near field region.

6. (Original) The method of claim 5, wherein near field of the near field region is a magnetic field.

7. (Original) The method of claim 5, wherein near field of the near field region is an electromagnetic field.

8. (Canceled)

9. (Previously Presented) A system, comprising:

a first resonator having a resonant frequency ω_1 and an intrinsic loss rate Γ_1 , and capable of storing electromagnetic energy with an intrinsic quality factor $Q_1 = \omega_1 / (2\Gamma_1)$, and configured to be coupled to an energy source to generate a near field region comprising an oscillating magnetic field; and

a second resonator having a resonant frequency ω_2 and an intrinsic loss rate Γ_2 , and capable of storing electromagnetic energy with an intrinsic quality factor $Q_2 = \omega_2 / (2\Gamma_2)$, and configured to move freely within the near field region of the first resonator,

wherein the first resonator and the second resonator are configured to be coupled to wirelessly transfer electromagnetic energy from said first resonator to said second resonator

when the first resonator is coupled to the energy source as the second resonator moves freely within the near field region,

wherein $\sqrt{Q_1 Q_2} > 100$.

10. (Previously Presented) The system of claim 9, where $Q_1 > 100$ and $Q_2 > 100$.
11. (Previously Presented) The system of claim 9, further comprising an energy drain coupled to the second resonator.
12. (Previously Presented) The system of claim 11, wherein the energy drain comprises a robot, vehicle, computer, cell phone, or a portable electronic device.
13. (Previously Presented) The system of claim 9, further comprising a third resonator, optionally coupled to an energy drain, located at a variable distance from the first resonator, and wherein the first resonator and the third resonator are coupled to wirelessly transfer electromagnetic energy from the first resonator to the third resonator.
14. (Previously Presented) The system of claim 9, further comprising a third resonator, optionally coupled to an external power supply, located at a variable distance from the second resonator, and wherein the third resonator and the second resonator are coupled to wirelessly transfer electromagnetic energy from the third resonator to the second resonator.
15. (Previously Presented) The system of claim 9, wherein at least one of the resonators is a tunable resonator.
16. (Previously Presented) The system of claim 9, wherein the energy transfer in the near-field region occurs over a range of distances that includes 5 cm.
17. (Previously Presented) The system of claim 9, wherein the energy transfer in the near-field region occurs over a range of distances that includes 10 cm.

18. (Previously Presented) The system of claim 9, wherein the energy transfer in the near-field region occurs over a range of distances that includes 30 cm.

19. (Previously Presented) The system of claim 9, wherein the efficiency of the wireless energy transfer is at least 20% over a range of distances in the near-field region.

20. (Previously Presented) The system of claim 9, further comprising a feedback mechanism coupled to at least one of the resonators to correct for detuning.

21. (Previously Presented) The system of claim 9, further comprising the energy drain coupled to the second resonator, and wherein the power supply 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 first resonator and the second resonator.

22. (Previously Presented) The system of claim 9, wherein the first 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 first resonator and the second resonator.

23. (Previously Presented) A method, comprising:
providing a first resonator having a resonant frequency ω_1 and an intrinsic loss rate Γ_1 , and capable of storing electromagnetic energy with an intrinsic quality factor $Q_1 = \omega_1 / (2\Gamma_1)$, coupled to an energy source, generating a near field region comprising an oscillating magnetic field; and

providing a second resonator having a resonant frequency ω_1 and an intrinsic loss rate Γ_1 , and capable of storing electromagnetic energy with an intrinsic quality factor $Q_1 = \omega_1 / (2\Gamma_1)$, and moving freely within the near field region of the first resonator,

wherein the first resonator and the second resonator are coupled to wirelessly transfer electromagnetic energy from said first resonator to said second resonator as the second resonator moves freely within the near field region,

wherein $\sqrt{Q_1 Q_2} > 100$.

24. (Previously Presented) The method of claim 23, where $Q_1 > 100$ and $Q_2 > 100$.

25. (Previously Presented) The method of claim 23, wherein an energy drain is coupled to the second resonator.

26. (Previously Presented) The method of claim 25, wherein the energy drain comprises a robot, vehicle, computer, cell phone, or a portable electronic device.

27. (Previously Presented) The method of claim 23, wherein a third resonator is optionally coupled to an energy drain and is located at a variable distance from the first resonator, and further comprising wirelessly transferring electromagnetic energy from the first resonator to the third resonator.

28. (Previously Presented) The method of claim 23, wherein a third resonator is optionally coupled to an external power supply and is located at a variable distance from the second resonator, and further comprising wirelessly transferring electromagnetic energy from the third resonator to the second resonator.

29. (Previously Presented) The method system of claim 23, wherein at least one of the resonators is a tunable resonator.

30. (Previously Presented) The method of claim 23, wherein the energy transfer in the near-field region occurs over a range of distances that includes 5 cm.

31. (Previously Presented) The method of claim 23, wherein the energy transfer in the near-field region occurs over a range of distances that includes 10 cm.

32. (Previously Presented) The method of claim 23, wherein the energy transfer in the near-field region occurs over a range of distances that includes 30 cm.

33. (Previously Presented) The method of claim 23, wherein the efficiency of the wireless energy transfer is at least 20% over a range of distances in the near-field region.

34. (Previously Presented) The method of claim 23, wherein a feedback mechanism is coupled to at least one of the resonators to correct for detuning.

35. (Previously Presented) The method of claim 23, wherein the energy drain is coupled to the second resonator, and wherein the power supply and energy drain are driven to increase the ratio of useful-to-lost power for varying wireless energy transfer rates κ between the first resonator and the second resonator.

36. (Previously Presented) The method of claim 23, wherein the first 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 first resonator and the second resonator.

37. (Previously Presented) The system of claim 9, further comprising the energy source configured to be coupled to the first resonator and an energy drain configured to be coupled to the second resonator to provide useful power to the energy drain, and wherein the energy source is configured to provide energy to the first resonator at a rate that varies with a rate of wireless energy transfer κ between the first resonator and the second resonator.

38. (Previously Presented) The system of claim 37, wherein the energy source is configured to provide energy to the first resonator at a rate that substantially minimizes the energy stored in the first resonator and the second resonator.

39. (Previously Presented) The system of claim 37, wherein the energy source is configured to provide energy to the first resonator at a rate that substantially maximizes a ratio of the useful power to lost power from the energy source to the energy drain.

40. (Previously Presented) The system of claim 9, where $Q_1 > 200$ and $Q_2 > 200$.

41. (Previously Presented) The method of claim 23, wherein an energy drain is coupled to the second resonator to provide useful power to the energy drain, and the method further comprises providing energy to the first resonator at a rate that varies with a rate of wireless energy transfer κ between the first resonator and the second resonator.

42. (Previously Presented) The method of claim 41, wherein the energy source provides energy to the first resonator at a rate that substantially minimizes the energy stored in the first resonator and the second resonator.

43. (Previously Presented) The method of claim 41, wherein the energy source provides energy to the first resonator at a rate that substantially maximizes a ratio of the useful power to lost power from the energy source to the energy drain.

44. (Previously Presented) The method of claim 23, where $Q_1 > 200$ and $Q_2 > 200$.

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

46. (New) The method of claim 5, wherein each intrinsic loss rate comprises a resistive component and a radiative component.

47. (New) The system of claim 9, wherein each intrinsic loss rate comprises a resistive component and a radiative component.

Applicant : John D. Joannopoulos et al.
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No. 11757

48. (New) The method of claim 23, wherein each intrinsic loss rate comprises a resistive component and a radiative component.

REMARKS

This Reply is being filed together with a Request for Continued Examination ("RCE") and an Information Disclosure Statement ("IDS").

Claim Status

Claims 1-3, 5-7, 9-48 are pending. Claims 1, 5, 9, and 23 are independent claims. Claims 45-48 are newly added dependent claims.

Obviousness-type Double Patenting Rejection

The pending claims are provisionally rejected for obviousness type double patenting over applications nos. 12/649,777, 12/649,852, and 12/649,813. Applicants respectively ask that the rejection be held in abeyance until the claims in the present application are otherwise in condition for allowance.

Clarifications regarding the claim term "resonator"

At pages 2-3, the Final Office Action states:

Turning to the claim language, claims 1 and 2 have been amended to recite that the resonator has a resonant frequency, an intrinsic loss [sic] rate, and is capable of storing electromagnetic energy with a high intrinsic quality factor Q , without setting forth any particular structure of the resonator itself. Various examples of "resonators" are given by applicants, one of which is a capacitively loaded conducting wire loop, which appears to not be shown. None the less, the claim is given its broadest reasonable interpretation in that a "resonator" is not limited to a "cavity resonator", but is also applicable to "resonator circuits", as explained in section 8.4 of the Staelin et al. reference supplied by applicants. In this section, the Q of a series RLC is found directly from equation 8.3.3 and 8.3.7, where one finds that Q is the total energy divided by the energy lost per radian. Page 359 also states that Q is the total energy stored divided by the power dissipated, and that $Q = \omega / 2\alpha$, which basically corresponds to applicants' claimed relationship of Q , as α appears to be an "intrinsic loss/loss rate", as α is proportional to R , which is the lossy element where power is dissipated (again page 359). Page 361 then goes on to state that when $\alpha \ll \omega$, the circuit is a

high quality resonator. Therefore, for purposes of an art rejection, a "high-Q" resonant circuit is reasonably construed to be a "resonator" to the extent claimed, as per the above, the discrete element resonator circuits of the references would exhibit the same capability to store electromagnetic energy by virtue of the "high-Q". Thus once something is determined to be a "resonator" it will inherently show the intrinsic quality factor with the attendant capability to store electromagnetic energy and the intrinsic loss rate and resonant frequency.

We take this opportunity to address certain points raised in this section of the Action.

First, "the capacitively loaded conducting wire loop" example of a resonator is expressly described and disclosed in at least the following sections of the patent application (referring to published patent application US 2010/0102640): paragraphs [0019], [0025], [0030], [0040], [0046] – [0050], [0058], and Fig. 3.

Second, Applicants agree with the Examiner that the claimed term resonator "is not limited to a 'cavity resonator', but is also applicable to 'resonator circuits'." For example, the capacitively loaded conducting wire loop depicted in Fig. 3 can be represented, at least in part, as a resonant circuit comprising an inductor element (formed by the conducting wire loop) and a capacitor element (formed by the spaced-apart conductive plates at the two open ends of the conducting wire loop). As explained in paragraph [0047] of the published application, the loss associated with this resonant circuit depiction of the capacitively loaded conducting wire loop includes not only ohmic losses, but also radiative losses. See new dependent claims 45-48.

In any case, the Examiner is correct to conclude that the intended scope of the claim term "resonator" is broad. For example, the published application states:

[0040] The invention is very general and any type of resonant structure satisfying the above requirements can be used for its implementation. As examples and for definiteness, one can choose to work with two well-known, but quite different electromagnetic resonant systems: dielectric disks and capacitively-loaded conducting-wire loops. Even without optimization, and despite their simplicity, both will be shown to exhibit fairly good performance. Their difference lies mostly in the frequency range of applicability due to practical considerations, for example, in the optical regime dielectrics prevail, since conductive materials are highly lossy.

Third, Applicants also agree with the Examiner that the Staelin reference defines the quality factor Q for a resonator formed by a series RLC circuit and that when the loss rate for the circuit is much, much less than the resonant frequency for the circuit, the circuit is a high-quality

resonator. Accordingly, determining whether or not a series RLC circuit is a “resonator ... with an intrinsic quality factor Q ,” as claimed, requires determining the intrinsic loss channels for the physical manifestation of the RLC circuit, including, for example, not only ohmic losses, but also radiative losses, and then determining whether the resonant frequency for the RLC circuit is much less than twice the loss rate for these channels. The claims set a lower limit for this ratio. Specifically, independent claims 1 and 5 require $Q_1 > 100$ and $Q_2 > 100$, and independent claims 9 and 23 require $\sqrt{Q_1 Q_2} > 100$.

As explained further below, Applicants submit that they were first to invent the use of at least two high- Q resonators, each with $Q > 100$ or with $\sqrt{Q_1 Q_2} > 100$, to facilitate wireless power over intermediate distances and/or without constraints on the positioning of the resonators (i.e., one resonator can “move freely” relative to the other). Furthermore, Applicants submit that they have received abundant acclaim and praise as a result.

Prior Art Rejections

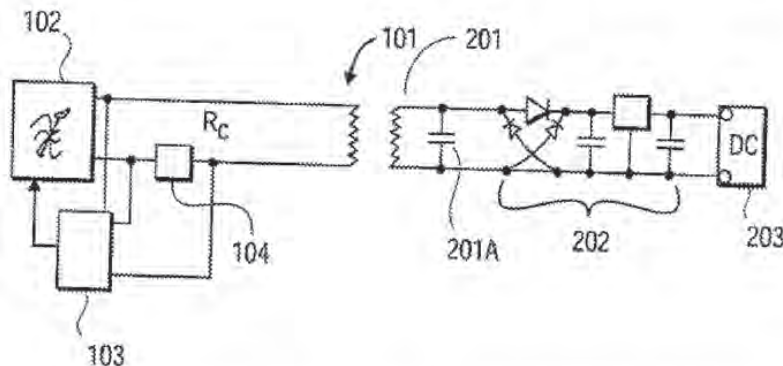
Claims 1-3, 5-7, 9-19, 21-33, and 35-44 stand rejected as obvious over PCT Patent Publication WO2004/015885 A1 (“Dayan”), in view of US Patent No. 5,374,930 (“Schuermann”) and US Patent No. 4,180,795 (“Matsuda”) and Powering an Artificial Heart: Birth of the Inductively Coupled Radio Frequency System in 1960 by John C. Schuder in *Artificial Organs*, 26(11):909-915, (2002) (“Schuder”). Below we address each cited reference

With respect to Dayan, the primary reference, the Action states:

“Dayan sets forth the basic principle of narrow band resonance coupling (abstract). Technical features are a pad 100 with a coil 101, which coil is driven by a power oscillator 102 connected to a not shown energy source with the near field shown to be 110 and on the order of 5 inches determined to be within the geometry size of the coil itself. Thus is shown a source coil, not disclosed to be a resonator with the high- Q . Also shown in Figure 2 is a second device in the form of a notebook computer 200 with a coil 201 and an RF-DC converter 202. Figure 3 ties the two together with use in 900MHz, 13.5MHz, or 2.4GHz range. The regulator 103 can control frequency, frequency spread, and total power pushed into the antenna. The recipient inductor 201 has a capacitor 201a to form a narrowly tuned, resonance antenna wherein the higher the Q , the narrower the power band, and the better the coupling even if the mechanical situation is not ideal. Per page 4, multiple devices can be controlled by slightly skewing the resonance frequencies of the different devices. Figures 5 and 6 show how multiple devices are accommodated, such that there is wireless electromagnetic energy

transferred from a source coil to multiple recipient higher-Q resonant coil and capacitor devices, devices that are free to move and located a distance (i.e. within the near field) from the source coil. Dayan lacks the resonator terminology.” (Action at pp. 6-7.)

Applicants respectfully disagree. Dayan lacks more than just “the resonator terminology.” Dayan lacks *multiple* resonators, *each of which* has a resonant frequency, an intrinsic loss rate, and is capable of storing electromagnetic energy with a high intrinsic quality factor. What Dayan shows is a *single* resonant circuit. For example, source coil 101 is not a resonator capable of storing electromagnetic energy with a high intrinsic quality factor. To the contrary, coil 101 is simply an “inductor coil 110” that is driven by power generator 102. (See, e.g., Dayan at p. 2 and Fig. 3, reproduced below.) It is true that Dayan describes: “The recipient antenna or inductor 201 forms, with capacitor 201a (previously not shown), a resonance receiving system that is narrowly tuned.” (Dayan at p. 3.) But this forms only one resonator, not the multiple resonators claimed. Moreover, there would be no reason to modify the system to include a source resonator, because Dayan already expressly describes driving source coil 101 with power generator 102, presumably at the resonant frequency defined by capacitor 201a.



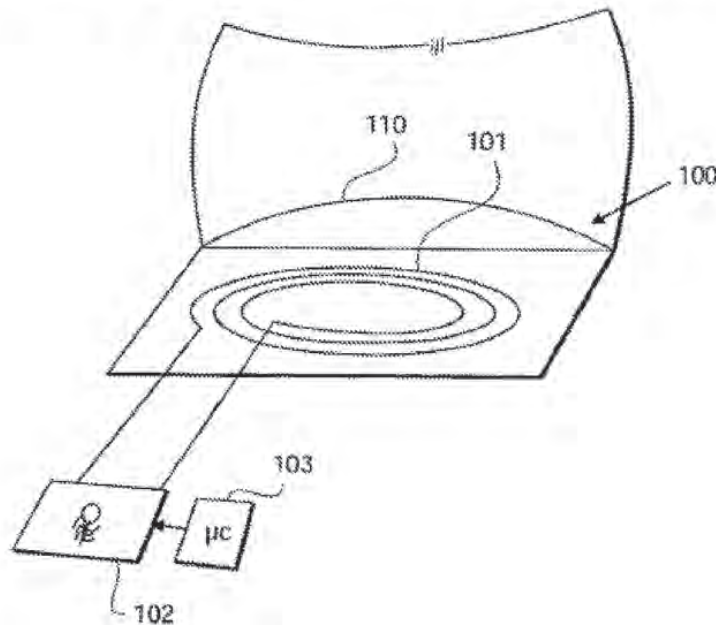
Furthermore, while Dayan states: “The higher the Q (quality quotient of the resonant circuit), the narrower the band it draws power on, and the better the coupling between the two, even if the mechanical situation is not ideal,” this statement is again with a regard to a single resonant circuit, not multiple resonators, as claimed. (Dayan at 3.) Moreover, Dayan is silent as how to determine the Q of this circuit (such as accounting for both ohmic and radiative losses),

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and whether this Q is *higher* than 100. To the contrary, Dayan emphasizes that the higher the Q , “the narrower the band [the resonance receiving circuit] draws power on,” and thus, the power generator needs to be more carefully tuned, and thereby teaches away $Q_1 > 100$ and $Q_2 > 100$, or $\sqrt{Q_1 Q_2} > 100$ as claimed. (Dayan at 3.)

Moreover, with the hindsight of Applicants’ invention, the fact that Dayan teaches away from high- Q is not surprising because Dayan is trying to provide power wireless *only* within geometry size of coil 101, which is similar to conventional induction. Specifically, with respect to Figure 1 (reproduced below), Dayan states:

“Also shown [in Figure 1] is the near field 110 and the far field 111, which are available. The near field is defined typically as the field within the geometry size of the coil itself (i.e., if the coil is 5 inches in diameter, the near field would be that order of magnitude, whereas a point 50 inches away would be considered in the far field), while the far field is typically defined as the field seen from a distance of a multiple of the geometry of the device.” (Dayan at 3.)



“What is clearly needed is a method and system to improve the yield by doing a finely tuned microprocessor-controlled, narrow-band resonance coupling, hence improving the coupling to almost no loss in the near field, and *at the same time keeping the far field virtually zero.*” (Dayan at 1, emphasis added.)

On the other hand, Applicants discovered that at least two high-Q resonators, each with $Q > 100$, enabled non-radiative wireless power transfer, not only within the coil size, but also over distances greater than the coil size. Applicants refer to such distances as “mid-range” distances, that is, distances “D” a “few” times the resonator size “r”, and many of the examples in Applicants’ specification describe wireless power over such mid-range distances $D/r = 10, 7, 5, 3, \dots$ etc.. (See, e.g., applicants published application at paragraphs [0034], [0045], [0049], [0055].)

With respect to Schuermann, the Action states:

“Schuermann teaches the use of “high-Q” resonant circuits in both the interrogator and transponder (bottom of column 2), as it is known in prior art devices that optimal power transfer is achieved by the use of highly tuned, high-Q factor resonant circuits (top of column 2).

...

Therefore it would have been obvious to one having ordinary skill in the art at the time that the invention was made to modify Dayan by the teachings of Schuermann (use highly tuned high-Q resonant circuits for both sides), ... in order to benefit from optimal power transfer by the use of highly tuned high-Q factor resonant circuits at the source and device sides, such that the resonant circuits are in fact resonators.” (Action at 7.)

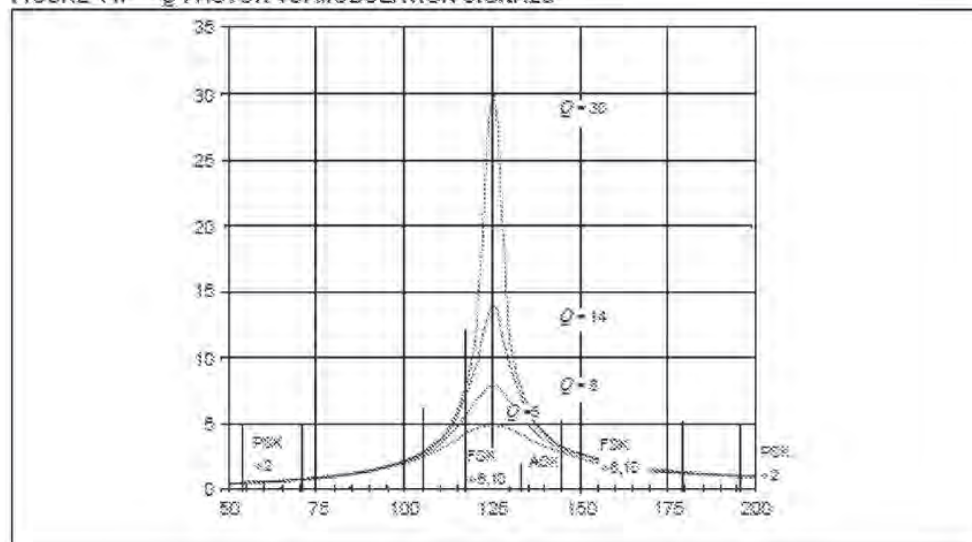
Applicants disagree. First, Schuermann is directed to an application (powering a radio frequency identification (“RFID”) tag) that is very different from the application in Dayan (powering electronic devices like a laptop computer). In RFID technology, minimal energy is required to power the transponder from the interrogator, and the primary focus of the circuitry is to process the communication signal enabled by the powered transponder. The Action fails to explain, how or why, a person of skill in the art would have modified source coil 101 in Dayan to form a second resonant circuit in addition to the resonance receiving circuit. To the contrary, such a modification would complicate the powering of source coil 101 by power generator 102 in Dayan. The Action fails to explain why or how a person of skill in the art would make such a modification, especially where Dayan already explains how the coupling between the coils can be increased by increasing the Q of the single resonant circuit.

Furthermore, while Schuermann describes “high-Q resonant circuits” for use in a RFID system, Schuermann does not explain how to determine the Q of this circuit (such as accounting for both ohmic and radiative losses), and whether this “high-Q” is higher than 100. To the

contrary, a "high-Q" resonant circuit in RFID applications is generally understood to refer to a Q much less than 100, as presently claimed.

For example, in "RFID Coil Design" by Youbok Lee, Specification No. AN678 from Microchip (1998) ("AN678") (available at <http://www1.microchip.com/downloads/en/AppNotes/00678b.pdf>),¹ and like Schuermann, it is explained that the antenna coil in an RFID system is used: 1) to transmit the radio frequency ("RF") carrier signal to power up the tag; and 2) to receive data signals from the tag. (AN678, p. 1.) AN678 goes on to discuss the quality factor of such antenna circuit and the interrelationship between it and bandwidth. (AN678, pp. 12-15.) For example, for full recovery of data using common forms of modulation like Frequency Shift Keying ("FSK") and Phase Shift Keying ("PSK"), at a carrier frequency 125 KHz, AN678 estimates the Q to be 5 and 1, respectively. (AN678 p. 15.) Furthermore, AN678 shows that even if data recovery is sacrificed in favor of read range, as contemplated by the high-Q mode in Schuermann, the highest Q value is about 30, as indicated in Figure 14, reproduced below. (AN678, p. 15.)

FIGURE 14: Q FACTOR VS. MODULATION SIGNALS



Finally, AN678 at p. 15 explains additional reasons not to select such high-Qs:

¹ AN678 was submitted as Reference 203 in the Information Disclosure Statement filed April 23, 2010.

Limitation on Q

When designing a reader antenna circuit, the temptation is to design a coil with very high Q . There are three important limitations to this approach.

- a) Very high voltages can cause insulation breakdown in either the coil or resonant capacitor.

For example, a 1 ampere of current flow in a 2 mH coil will produce a voltage drop of 1500 VPP. Such voltages are easy to obtain but difficult to isolate. In addition, in the case of single coil reader designs, recovery of the return signal from the tag must be accomplished in the presence of these high voltages.

- b) Tuning becomes critical.

To implement a high Q antenna circuit, high voltage components with a close tolerance and high stability would have to be used. Such parts are generally expensive and difficult to obtain.

- c) As the Q of the circuit gets higher, the amplitude of the return signal relative to the power of the carrier gets proportionally smaller complicating its recovery by the reader circuit.

This Figure 14 shown above from AN678 can be compared with Fig. 3 from Schuermann (reproduced below), which depicts the "high-Q" frequency band used for power (denoted A) having a bandwidth about four times less (and therefore a Q about four times more) than that for the "low-Q" frequency band used for communication (denoted B). Specifically, Figure 14 in AN678 indicates that for data demodulation FSK or PSK, the Q is no more than ~ 5 . Mapping this value onto the low-Q band B in Fig. 3 of Schuermann indicates that even the high-Q band only has a Q no more than ~ 20 , and therefore, much less than the $Q_1 > 100$ and $Q_2 > 100$, $\sqrt{Q_1 Q_2} > 100$, claimed here.

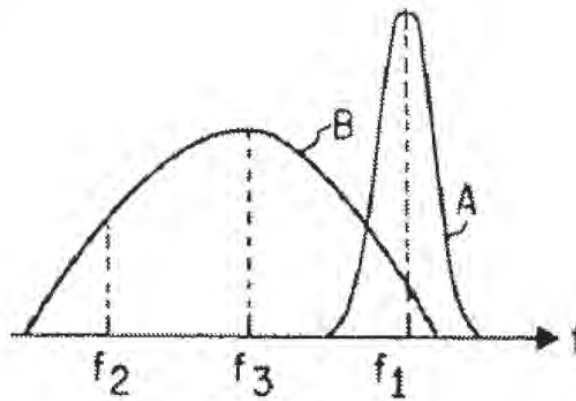


Fig. 3

This point is reiterated in another RFID reference by Texas Instruments, the assignee of the Schuermann patent. Specifically, in Figure 10 (reproduced below with emphasis added) and the text related thereto in “HF Antenna Design Notes - Technical Application Report,” Literature No. 11-08-26-003 - Radio Frequency Identification Systems from Texas Instruments (September 2003) (hereinafter the “TI RFID reference”)², Q’s greater than ~ 20 are described as being “too high”:

“In general, the higher the Q, the higher the power output for a particular sized antenna. Unfortunately, too high a Q may conflict with the band-pass characteristics of the reader and the increased ringing could create problems in the protocol bit timing. For these reasons the Q or the antenna when connected to 50-Ohm load (i.e. the reader) *should be 20 or less.*” (TI RFID reference at 13, emphasis added.)

² TI RFID was submitted as Reference 223 in the Information Disclosure Statement filed April 23, 2010.

6.3 Determining the Q

The performance of an antenna is related with its Quality (Q) factor.

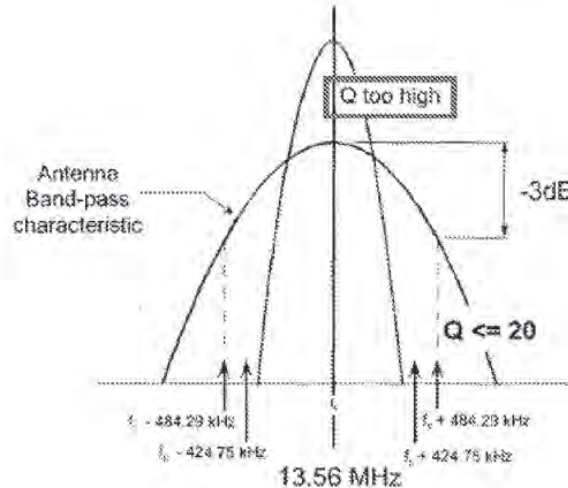


Figure 10. Antenna Q

Finally, in another RFID reference, “Tutorial overview of inductively coupled RFID Systems” from UPM (May 2003) (<http://www.mobiusconsulting.com/papers/rfidsystems.pdf>) (“UPM”)³ expressly directed to an RFID system operating at the much larger ISM carrier frequency at 13.56 MHz, it is explained that:

Practical smart label systems usually operate with a coupling element resonator Q within the range of 30 to 80. Higher Q values than this are generally not feasible because the information bearing amplitude modulated reply sidebands are undesirably attenuated by the resonator’s bandpass frequency response characteristic. (UPM, p. 2, emphasized added.)

Accordingly, work in the RFID field emphasizes lower Q values than those claimed here. With the benefit of hindsight, this is not surprising because the ultimate application of RFID is to wireless communication, whereas Applicants’ discovery is directed wireless power for doing work (e.g., powering or charging electronic devices, robots, vehicles).

As best we understand, the Action cites to Matsuda as demonstrating that a resonator can be formed by a series combination of a resonance coil (which is an example of an inductive

³ UPM was submitted as Reference 228 in the Information Disclosure Statement filed April 23, 2010.

element) and a capacitor. See, e.g., Matsuda at 2:40-44. On this point, Applicants do not disagree. However, this disclosure in Matsuda does not remedy the deficiencies in Dayan, including the presence of only one resonator in Dayan, and the failure in Dayan to disclose a high-Q, and especially an intrinsic $Q > 100$, for each of multiple resonators coupled to one another to provide wireless energy transfer among each other.

Finally, with respect to Schuder the Action states:

"Finally, Schuder quantifies what a "high-Q" is. Q values are shown to be slightly more than 200 and 180 depending on the size of the coil." (Action at p. 7.)

We respectfully disagree with this reliance on Schuder. First, like Dayan, Schuder only describes a single resonant circuit. For example, as indicated in FIG. 2 and the cited paragraph below, Schuder describes the coupled coils *as a whole* as constituting the resonant circuit, and expressly describes only a single capacitor on the receiver coil side to make the coil resonate:

"The first focus was on the circuit problem as sketched in Fig. 2. Here, R simulates the load, that is, the artificial heart and associated circuitry. Power into R is considered as successfully transferred. The resistances R_1 and R_2 are the effective resistances of the external and internal coils, respectively. The capacitor, C, is considered to be loss-free. The quantity, M, is the mutual inductance between the two coils. After considerable manipulation of the circuit equations, with L_2 optimized, and with C selected to resonate with L_2 , it was found that the minimum ratio of the losses in the coils to the power supplied can be expressed very simply in terms of 2 derived quantities, Q, the figure of merit of the coils, and k, the coefficient of coupling between the coils." (Schuder at 910, emphasis added.)

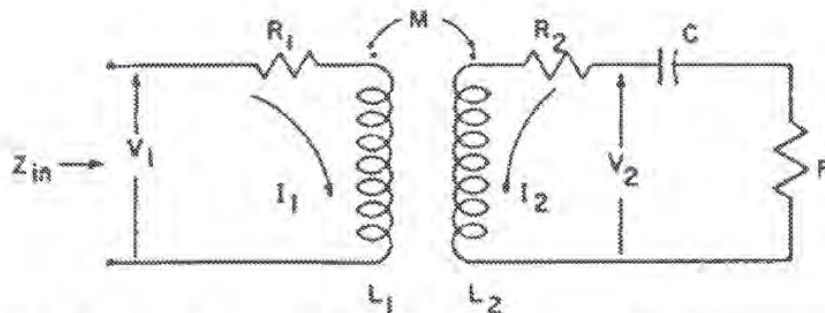


FIG. 2. The circuit is shown (4). (Reproduced with permission. ©1961 IRE now IEEE).

Thus, like Dayan, Schuder forms only one resonator, not the multiple resonators claimed. Moreover, there would be no reason to modify the system to include a source resonator, because Schuder expressly describes using only a single capacitor C to make the circuit resonant.

Furthermore, even though Schuder defines an expression for Q and describes values for this Q as 200 and 180, this expression for Q is not an intrinsic quality factor Q *for a resonator*, as claimed, but rather, Schuder is describing an expression to characterize the loss in each *individual coil* at the operating frequency f. For example, Schuder states: "The resistances R₁ and R₂ are the effective resistances of external and internal coils, respectively" (Schuder at 910), and then goes on define Q in terms of such coil properties.

In addition, Schuder states:

In general, a given coil will have a broad peak in Q as a function of frequency. Furthermore, with given external geometry, one can usually design coils with a desired inductance and with the frequency range of fairly invariant Q being centered somewhat as desired. (Schuder at pp. 910-911.)

This paragraph confirms that when Schuder refers to "Q", he is not referring to the intrinsic quality factor of a resonator, as claimed, because a resonator has a bandwidth that varies *inversely* with its intrinsic quality factor, and thus a *resonator* will not "have a broad peak in Q as a function of frequency," as described in Schuder.

Accordingly, even though Schuder describes *coil* Q's of 200 and 180, he does not describe a *resonator* Q greater than 100, let alone *multiple* resonators, each having an intrinsic quality factor Q greater than 100 or $\sqrt{Q_1 Q_2} > 100$, as claimed.

Finally, even with respect to the *coil* Q described in Schuder, there is no disclosure in Schuder to account for *radiative* losses by the coils. Only resistive losses are described. Therefore, unlike Applicants' application and contrary to the express language of new dependent claims 45-48, Schuder does not account for both resistive and radiative losses relevant to wireless power transfer.

The Action further rejects dependent claims 20 and 34 based on the Dayan, Schuermann, Matsuda, and Schuder, further in view U.S. Patent No. 6,650,227 ("Bradin"), which the Action contends discloses the feedback mechanism additionally claimed in dependent claims 20 and 34. Even if this were true, which Applicants do not concede, Bradin does not remedy the

deficiencies of the initial combination of Dayan, Schuermann, Matsuda, and Schuder with regard to any of independent claims 1, 5, 9, and 23.

Summary of why the cited references fail to establish a *prima facie* obviousness

In sum, the primary reference, Dayan, lacks several limitations from independent claims 1, 5, 9, and 23, including at least: 1) a first resonator and a second resonator *each* having a respective resonant frequency and *each* being capable of storing electromagnetic energy with a high intrinsic quality factor (Q_1 and Q_2 , respectively); and 2) wherein $Q_1 > 100$ and $Q_2 > 100$, or $\sqrt{Q_1 Q_2} > 100$. As explained above, Dayan describes only a *single* resonant circuit, and does not disclose the high Q's claimed.

As best understood, the Action relies on Schuermann to remedy the first deficiency (to "use highly-tuned high-Q resonant circuits for both sides"). But, this modification would profoundly change Dayan's circuit. The Action fails to explain why or how a person of skill in the art would make such a modification, let alone whether such a person would have a reasonable expectation of success. In addition, the Action does not explain why such a person would even look to RFID art like Schuermann, because the power requirements in Schuermann's RFID system are much lower than those for powering electronic devices as in Dayan. Specifically, in RFID systems, the power to the tag is only used to enable the tag to send a wireless communication signal. In other words, RFID prior art generally pertains to wireless communication, not wireless power as in Dayan and Applicants' invention.

Finally, even if there were a basis to modify the single resonant circuit in Dayan with multiple resonators as claimed, which Applicants dispute, Schuermann would teach away from having intrinsic quality factors $Q > 100$ for both the first resonator and the second resonator, or $\sqrt{Q_1 Q_2} > 100$, as claimed. As explained above, work in the radio frequency RFID area generally emphasizes "high" Q's of about 30, and not more than 80.

The failures in Dayan are also not remedied by Schuder. First, even if one skilled in the art would modify the quality factor Q of Dayan's *single* resonant circuit to be 200 or 180, as allegedly taught in Schuder, this modification would contradict the proposed modification based on Schuermann. Specifically, one skilled in the art would not modify Dayan's single resonant

circuit to form *both* a first resonator and a second resonator, because Schuder, like Dayan, also teaches only a *single* resonant circuit to provide wireless power to the receiving device.

Second, even if one skilled in the art would look to Schuder to modify the Dayan circuit, or any modifications to it, the quality factor described in Schuder is with respect to the coil only, and therefore does not describe the intrinsic quality factor of *resonators* capable of storing electromagnetic energy as claimed. Furthermore, in determining quality factors of 200 and 180 for his coils, Schuder does not account for radiative losses.

Accordingly, Applicants submit that the obviousness rejection of independent claims 1, 5, 9, and 23 fails to establish a prima facie case of obviousness, and should therefore be withdrawn. The obviousness rejections of the dependent claims should be withdrawn for at least the same reasons.

Secondary Consideration of Non-obviousness

Even if the Office Action establishes a prima facie case of obviousness, which Applicants dispute, this is not the conclusion of the obviousness analysis. Objective evidence of non-obviousness including, for example, commercial success, industry praise, unexpected results, long-felt need, and copying by others *must* also be considered. Transocean Offshore Deepwater Inc. v. Maersk Drilling USA Inc., 699 F.3d 1340, 1349-1354 (Fed. Cir. 2012). As explained below, following the academic publication and subsequent demonstration of Applicants' invention, Applicants have received abundant acclaim and praise, as their work has plainly met a long-felt need (e.g., efficient wireless power over distance), and press releases from companies such as Intel have explained how their work "builds" on Applicants' invention. This is evidence of the non-obviousness of Applicants' invention.

Below we address in greater detail some of the evidentiary documents mentioned in our prior response and also identify some new evidentiary documents. In this way, we address the concern raised in the Action that: "Applicants merely mention 'abundant claim' and then assert this is 'evidence,' without pointing to anything in particular in any of the numerous articles mentioned. Applicants need to clearly explain what the secondary considerations, and make a clear connection between the claims and the articles." (Action at p. 2.)

First, we explain certain aspects of the invention and how they are set forth in the rejected claims. Embodiments of the invention are generally directed to efficiently transferring energy wirelessly to power a device over “mid-range” distances. Such “mid-range” distances can generally be characterized as approximately a few times the size of the device to which the energy is being transferred, and/or without constraints on relative orientation. Applicants’ specification describes numerous applications of such technology, such as powering modern consumer electronic devices like laptops, cellphones, and robots, as well as powering electric vehicles.

The Applicants’ invention is to be contrasted with conventional inductive technology, such as conventional wireless charges for electric toothbrushes, where the power is transferred over a very small distance for certain orientations, and is also to be contrasted with radiative wireless communication systems, where capacitively-loaded conductive loops are used as resonant antennas. (See, e.g., Applicants’ published application at para. [0050].) It is also to be contrasted with technologies such as radio frequency identification devices (“RFID”), which is generally directed to wireless transfer of information, not efficient transfer of energy to power a device.

While the Action alleges that claims are obvious, there can be no reasonable dispute that in the modern world of abundant autonomous electronic devices, there has been long-felt need for efficient power transfer. As described in greater detail below, shortly after Applicants’ application was filed, Applicants’ experimentally demonstrated their invention and received abundant acclaim. Since this demonstration, there has been an explosion in research, patent filings, and popular press towards similar approaches to providing efficient power transfer over such mid-range distances.

The independent claims affirmatively set forth the basic elements of the wireless energy transfer method. First, they require at least a first resonator and a second resonator, each of which has a resonant frequency, an intrinsic loss rate, and is capable of storing electromagnetic energy with an intrinsic quality factor $Q > 100$. The first resonator is configured to be coupled to an energy source to generate a near field region comprising an oscillating magnetic field. The second resonator (and a third resonator) can be (each) coupled to an energy drain such as a robot, vehicle, computer, cell phone, or a portable electronic device. (See, e.g., dependent claims 11-

14, and 25-28). The very high values for Q , for each of multiple resonators, establish “highly resonant” wireless power transfer and enable efficient wireless power transfer.

For example, at paragraph [0037], the published application generally states:

“[T]he invention requires resonant modes of high $Q = \omega / (2\Gamma)$ for low intrinsic-loss rates $\Gamma_{1,2}$ and with evanescent tails significantly longer than the characteristic sizes L_1 and L_2 of the two objects for strong coupling rate $|\kappa_{12,21}|$ over large distances D , where D is the closest distance between the two objects. This is a regime of operation that has not been studied extensively, since one usually prefers short tails, to minimize interference with nearby devices.”

The absolute values for the high Q (i.e., $Q_1 > 100$ and $Q_2 > 100$ or $\sqrt{Q_1 Q_2} > 100$) are expressly claimed in the independent claims. Moreover, dependent claims 40 and 44 require $Q_1 > 200$ and $Q_2 > 200$. Certain dependent claims also set forth absolute values for the “mid-range” distances (see, e.g., dependent claims 16-18, 30-32), as well as minimum efficiencies (see, e.g., dependent claims 19 and 33).

Applicants’ specification describes examples of resonator including dielectric disks and capacitively loaded, conducting wire loops. For each such example, detailed calculations were made to determine frequencies and resonator parameters for which high- Q values for the resonator structures could be achieved. (See, e.g., paragraphs [0041] – [0045] in the published application for dielectric disks, and paragraphs [0046] – [0050] in the published application for capacitively loaded conducting wire loops.)

Objective Evidence

Shortly after filing the original application to which the present application claims benefit, Applicants published an experimental demonstration of their work in the prestigious journal *Science*. See, Andre Kurs et al., “Wireless Power Transfer via Strongly Coupled Magnetic Resonances”, *Science* Vol. 317, pp. 83-86 (July 6, 2007) (hereinafter “the Science Paper”). (Submitted as reference no. 201 in the IDS filed April 23, 2010.)

The Science Paper presents substantially the same mathematical description of the inventive technique as that set forth in the application, including the insight that the quality factors Q for the resonators need to be high, and conversely the intrinsic loss rates Γ for the resonators need to be low: “It is easy to show that the key to efficient energy transfer is to have $k^2/\Gamma_S\Gamma_D > 1$.” (See, p. 83, following Eq. 2.) The Science Paper also describes substantially the

same considerations for designing conducting wire loop resonators structures to have a high quality factor Q , including accounting for both ohmic and radiative losses. (See, e.g., Eqs. 6-7 on p. 84.)

Ultimately, the Science Paper describes constructing conducting wire loop resonators (using self-capacitance) to have experimentally measures quality factors of about $Q \sim 950$ at 9.9 MHz. (See p. 84, third col.) The conducting wire loops were made of copper and were helical with a coil radius of 30 cm (see, p. 84, second col.), which is the same radius as that for several examples in the patent application. (See, e.g., paragraphs [0048] and [0049] in the published application.) The Science Paper then describes providing power to the first coil (using a Colpitts oscillator), and transferring energy from the first coil to the second coil across 2 meters to light a 60 Watt light bulb connected to the second coil. (See, e.g., p. 85, first col.) The Science Paper estimates the efficiency of the wireless energy transfer between the two coils to be 40 to 50%, despite the distance being *six to seven times greater* than the coil radius. (Id.)

Therefore the Science Paper demonstrates that the basic elements necessary for highly resonant wireless power transfer – at least two resonators with quality factors greater than 100 (or $\sqrt{Q_1 Q_2} > 100$) – are claimed. Accordingly, there is a nexus between what is claimed in the present application and the acclaim associated with the Science Paper.

The fact that the experimental result (powering of a 60 W light bulb across 2 meters) was an achievement significant enough to be published in *Science* demonstrates the non-obviousness of the invention. In fact, not only was this work published in *Science*, but the inventors' article was first introduced by a "*Perspectives*" editorial entitled "The Power to Set You Free" by a non-author, Professor Will Stewart from the Optoelectronics Research Center at Southampton University, who touted the significance of the inventors' work. (Submitted as Reference No. 17 in the IDS filed with this response) (hereinafter "the Stewart Article".)

For example, Professor Stewart identified the need for wireless power and how prior attempts were limited by distance and/or were not mobile.

We all want to be connected, but none of us loves the cables that connect. Of course, a rapidly expanding plethora of wireless technologies—cellular phones, WiFi, ID tags, Bluetooth, and many others—provide data connectivity. But despite improvements in battery technology and Moore's Law, the increasing

performance of portable devices still has us reaching for a power cord far more often than we would like.

...

Getting around these issues is tricky. There have been a number of moderately successful efforts to make working systems (2), mostly based on near-contact (i.e., centimeter-range) power transfer. These use the sort of magnetic field induction found in a transformer or an induction motor, both of which rely on a nonradiating "evanescent" field that reduces the power lost to radiation. But the power transfer falls off very steeply and the range is very short. The result is a powered pad on which a suitably enabled device can be placed to charge—wireless indeed, but not very mobile. (The Stewart Article at 56.)

He then touts the Applicants' work as a solution to this long-felt problem:

"Kurs et al. work around this by making both the "sender" and the "receiver" of electrical power operate at the same moderate radio frequency. With carefully chosen parameters, the two coils form a single coupled resonant structure and behave as though a "tunnel" was opened between them that can carry substantial power over ranges of several meters (see the figure)." (The Stewart Article at paragraph bridging pp. 56-57.)

The "carefully chosen parameters" are the ones that establish a high-quality factor for each resonator, as presently claimed.

Significant acclaim followed from the work published in the 2007 Science Paper (and an earlier theoretical publication from November 2006), including in prominent sources such as BBC News, the Wall Street Journal, the New York Times, and the Economist. See, for example, the following articles:

"Physics Promises Wireless Power" by Jonathan Fildes, Science and Technology Reporter, BBC News, (November 15, 2006) **(Ref. No. 241 – IDS filed on 4/23/10)**

"Man tries wirelessly boosting batteries", by Seth Borenstein, AP Science Writer, Boston.com, (See http://www.boston.com/business/technology/articles/2006/11/15/man_tries_wirelessly_b..) (November 15, 2006) **(Ref. No. 245 – IDS filed on 4/23/10)**

"Wireless energy promise powers up", by Jonathon Fildes, BBC News, June 7, 2007 (See <http://news.bbc.co.uk/2/hi/6725955.stm>) **(Submitted as Reference No. 14 in the IDS filed with this response.)** (hereinafter "the 2007 BBC News Article")

"MIT Scientists Pave the Way For Wireless Battery Charging", by William M. Bulkeley, The Wall Street Journal, (See http://online.wsj.com/article/SB118123955549228045.html?mod=googlenews_wsj)

(June 8, 2007) **(Ref. No. 265 – IDS filed on 4/23/10)** (hereinafter “the 2007 Wall Street Journal Article”)

"Intel Moves to Free Gadgets of Their Recharging Cords", By John Markoff, The New York Times - nytimes.com, August 21, 2008 **(Ref. No. 267 – IDS filed on 4/23/10)** (hereinafter “the 2008 New York Times Intel Article”)

"Intel CTO Says Gap between Humans, Machines Will Close by 2050", Intel News Release, (See intel.com/.../20080821comp.htm?iid=S...) (Printed 11/6/2009) **(Ref. No. 195 – IDS filed on 4/23/10)** (hereinafter “the 2008 Intel Press Release”)

“Next Little Thing 2010 Electricity without wires”, CNN Money (See money.cnn.com/galleries/2009/smallbusiness/0911/gallery.next_little_thing_2010.smb/) (dated November 30, 2009) **(Ref. No. 9 – IDS filed 2/28/13)**

“Automatic Recharging, From a Distance” by Anne Eisenberg, The New York Times, (see www.nytimes.com/2012/03/11/business/built-in-wireless-charging-for-electronic-devices.html?_r=0) (published on March 10, 2012) **(Ref. No. 6 – IDS filed 2/28/13)** (hereinafter “the 2012 New York Times Article”)

“Wireless charging – the future for electric cars?” by Katia Moskvitch, BBC News Technology (See www.bbc.co.uk/news/technology-14183409) (dated July 21, 2011) **(Ref. No. 8 – IDS filed 2/28/13)**

“How Wireless Charging Will Make Life Simpler (And Greener)” by David Ferris, Forbes (See forbes.com/sites/davidferris/2012/07/24/how-wireless-charging-will-make-life-simpler-and-greener/print/) (dated 7/24/2012) **(Ref. No. 7 – IDS filed 2/28/13)**

For example, in 2007, the wireless powering of the 60-Watt light bulb across 2 meters described in *Science* was picked-up by the BBC News and the Wall Street Journal (see the 2007 BBC News Article and the 2007 Wall Street Journal Article listed above, respectively). Third party professors interviewed in the 2007 BBC News Article touted the relevance of the inventors’ work, describing it as “truly pioneering,” despite its apparent simplicity in hindsight. Specifically, the 2007 BBC News Article states:

WiTricity, as it is called, exploits simple physics and could be adapted to charge other devices such as laptops.

"There is nothing in this that would have prevented them inventing this 10 or even 20 years ago," commented Professor Sir John Pendry of Imperial College London who has seen the experiments.

"But I think there is an issue of time. In the last few years we have seen an exponential growth of mobile devices that need power. The power cable is the last wire to be cut in a wireless connection."

Professor Moti Segev of the Israel Institute of Technology described the work as "truly pioneering".

Thereafter, in 2008, the New York Times reported how Intel was working on similar technology to "demonstrate the use of a magnetic field to broadcast up to 60 watts of power two to three feet," and how the Intel research project "builds on the work of the Massachusetts Institute of Technology physicists Marin Soljacic, who pioneered the idea of wirelessly transmitting power using resonant magnetic fields." (See the 2008 New York Times Intel Article listed above.) An Intel press release from 2008 similarly attributes such research as being "[b]ased on principles proposed by MIT physicists." (See the 2008 Intel Press Release listed above.)

More recently, the New York Times wrote an article in 2012 emphasizing the importance of this technology and again attributing it to Applicants' work from 2007:

"WiTricity's technology was developed by Marin Soljacic, a physics professor at the Massachusetts Institute of Technology, and colleagues. It was reported in the journal Science in 2007, the year the company was founded. Dr. Soljacic, who received a \$500,000 MacArthur award in 2008, serves on the board of WiTricity as it commercializes the system." (See the 2012 New York Times Article listed above.)

This same article interviews professors from Princeton and Yale Universities, both of whom praise the work. Specifically, the 2012 New York Times Articles states:

"This is a better form of induction," said Jason W. Fleischer, an associate professor of electrical engineering at Princeton who is familiar with the technology. Professor Fleischer, whose research is in electromagnetics and optics, has no financial connection to the company. "Direct contact of a device to the counter isn't necessary," he said, "And you don't have to place your phone or tablet with a specific orientation on the counter for them to recharge."

WITRICITY'S technology is timely, said A. Douglas Stone, chairman of the Department of Applied Physics at Yale, and not only for the billions of people who use personal electronic devices. Electric cars might be more appealing to some consumers if they could be charged wirelessly, rather than by attaching cables. And, soon, the technology could benefit rechargeable electronic medical implants, like pacemakers and neurostimulation systems for pain management. For all these products, Dr. Stone said, induction that works at distances of a meter or two — about three to six feet — might be useful. "The difference in what you

can do when you charge at a very short range — essentially contact — and when you can do it at a meter or two, is huge,” he said.

Finally, the Economist produced a YouTube documentary video in 2010 to describe this wireless power technique – See <http://www.youtube.com/watch?v=11IDC8FEIBU> .

This evidence of abundant acclaim and praise of an invention that addresses a long felt need (e.g., efficient wireless power) demonstrates the non-obviousness of Applicants' claims. Accordingly, Applicants ask the Examiner to withdraw the obviousness rejection.

Applicant : John D. Joannopoulos et al.
Serial No. : 12/649,635
Filed : December 30, 2009
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No. 11757

Conclusion

In view of the above, we ask that the application be allowed.

Nonetheless, if the Examiner is not persuaded, or otherwise has questions or concerns, Applicants invite the Examiner to contact their undersigned representative, Marc M. Wefers, by telephone at 617-521-7857.

Canceled claims, if any, have been canceled without prejudice or disclaimer. Any circumstance in which we have: (a) addressed certain comments in the Action does not mean that we concede other comments in the Action; (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 we concede any of the Action's positions with respect to that claim or other claims

The fees in the amount of \$320 for excess claim fees and the fees in the amount of \$600 for the Petition for Extension of Time fee are being paid concurrently herewith on the Electronic Filing System (EFS) by way of Deposit Account authorization. Please apply any other necessary charges or make any credits to Deposit Account 06-1050, referencing the above attorney docket number.

Respectfully submitted,

Date: November 20, 2013

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

Marc M. Wefers

Reg. No. 56,842

Customer Number 26161
Fish & Richardson P.C.
Telephone: (617) 542-5070
Facsimile: (877) 769-7945

23048610.doc

Electronic Patent Application Fee Transmittal				
Application Number:		12649635		
Filing Date:		30-Dec-2009		
Title of Invention:		WIRELESS ENERGY TRANSFER TO A MOVING DEVICE BETWEEN HIGH-Q RESONATORS		
First Named Inventor/Applicant Name:		John D. Joannopoulos		
Filer:		Marc M. Wefers/Cheryl Forrest		
Attorney Docket Number:		01997-0359015 / 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:				
Pages:				
Claims:				
Claims In Excess of 20	1202	4	80	320
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Extension - 2 months with \$0 paid	1252	1	600	600
Miscellaneous:				
Request for Continued Examination	1801	1	1200	1200
Total in USD (\$)				2120

Electronic Acknowledgement Receipt	
EFS ID:	17453382
Application Number:	12649635
International Application Number:	
Confirmation Number:	5891
Title of Invention:	WIRELESS ENERGY TRANSFER TO A MOVING DEVICE BETWEEN HIGH-Q RESONATORS
First Named Inventor/Applicant Name:	John D. Joannopoulos
Customer Number:	26161
Filer:	Marc M. Wefers/Cheryl Forrest
Filer Authorized By:	Marc M. Wefers
Attorney Docket Number:	01997-0359015 / MIT 11757
Receipt Date:	20-NOV-2013
Filing Date:	30-DEC-2009
Time Stamp:	13:30:01
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	\$2120
RAM confirmation Number	11498
Deposit Account	061050
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
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1		IDS.pdf	139353 535a5d667f58bc20f4adfe2de7053e6a881b c0ed	yes	3
Multipart Description/PDF files in .zip description					
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2	Foreign Reference	ART1.pdf	48985 39a0f60b8aacbe5cd0a94e0310f99c4ec3 77c	no	3
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Information:					
10	Non Patent Literature	NPL20.pdf	938928 f0a9b03ed48cd080e680571da1638ecd a3d5	no	16
Warnings:					
Information:					
11	Non Patent Literature	NPL21.pdf	952285 011a5d0cf252323ca699c1cc069cb70113f13 187	no	17
Warnings:					
Information:					
12	Non Patent Literature	NPL22.pdf	948097 1c80e8f92b1cd353a2eccc0c3233c24884 05834	no	17
Warnings:					
Information:					
13	Non Patent Literature	NPL23.pdf	1171259 551530638aec2e1c21b4d86d3d3d84999 aff654	no	19
Warnings:					
Information:					
14	Non Patent Literature	NPL24.pdf	1379763 7a2d897c74ced7d966e03ee7d7a3d933921 da18f	no	23
Warnings:					
Information:					
15	Extension of Time	PetforExt.pdf	41908 8702d1643ac09932b7d54590362577b1a3 d27f9	no	1
Warnings:					
Information:					
16	Request for Continued Examination (RCE)	RCE.pdf	92121 1ca91d99c8144a6d0d2b464374b23211ac2 d1502	no	1
Warnings:					
This is not a USPTO supplied RCE SB30 form.					
Information:					

17		ReplytoFinal.pdf	400266 e0172b49a6a06180f1645fd8e0d70c2ab67561	yes	31
Multipart Description/PDF files in .zip description					
	Document Description	Start	End		
	Response After Final Action	1	1		
	Claims	2	9		
	Applicant Arguments/Remarks Made in an Amendment	10	31		
Warnings:					
Information:					
18	Fee Worksheet (SB06)	fee-info.pdf	34212 5290d21a06a24f75300c0791f4bba0ef98f91c24	no	2
Warnings:					
Information:					
Total Files Size (in bytes):			18761537		
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. : 12/649,635 Examiner : Fritz Fleming
Filed : December 30, 2009 Conf. No. : 5891
Title : WIRELESS ENERGY TRANSFER TO A MOVING DEVICE BETWEEN HIGH-
Q RESONATORS

MAIL STOP RCE

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 filing is being made with the filing of a Request for Continued Examination. No fee
is required.

Respectfully submitted,

Date: November 20, 2013

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

Marc M. Wefers

Reg. No. 56,842

Customer Number 26161
Fish & Richardson P.C.
Telephone: (617) 542-5070
Facsimile: (877) 769-7945

23123407.doc

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. 01997-0359015	Application No. 12/649,635
	Applicant John D. Joannopoulos et al.	
	Filing Date December 30, 2009	Group Art Unit 2836

U.S. Patent Documents							
Examiner Initial	Desig. ID	Document Number	Publication Date	Patentee	Class	Subclass	Filing Date If Appropriate
	1	4,588,978	5/13/1986	Allen			
	2	5,033,295	7/23/1991	Schmid et al.			
	3	5,864,323	1/26/1999	Berthon			
	4	6,563,425	05/13/2003	Nicholson et al.			
	5	6,650,227	11/18/2003	Bradin			
	6	6,839,035	1/4/2005	Addonisio et al.			
	7	7,443,135	10/28/2008	Cho			
	8	7,545,337	6/9/2009	Guenther			
	9	7,863,859	1/4/2011	Soar			
	10	8,131,378	3/6/2012	Greenberg et al.			
	11	2005/0027192	2/3/2005	Govari 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
	12	SG 112842	7/28/2005	Singapore			English Abstract Only	

Other Documents (include Author, Title, Date, and Place of Publication)		
Examiner Initial	Desig. ID	Document
	13	Shanhui Fan et al., "Rate-Equation Analysis of Output Efficiency and Modulation Rate of Photonic-Crystal Light-Emitting Diodes", <u>IEEE Journal of Quantum Electronics</u> , Vol. 36, No. 10, pp. 1123-1130 (October 2000)
	14	Jonathan Fildes, "Wireless Energy Promise Powers Up", <u>BBC News</u> , June 7, 2007 (See http://news.bbc.co.uk/2/hi/6725955.stm)
	15	Klaus Finkenzeller, <u>RFID Handbook – Fundamentals and Applications in Contactless Smart Cards</u> -, Nikkan Kohgyo-sya, Kanno Taihei, first version, pp. 32-37, 253 (8/21/2001),
	16	S. L. Ho et al., "A Comparative Study Between Novel Witricity and Traditional Inductive Magnetic Coupling in Wireless Charging", <u>IEEE Transactions on Magnetics</u> , Vol. 47, No. 5, pp. 1522-1525 (May 2011)
	17	Will Stewart, "The Power to Set you Free", <u>Science</u> , Vol. 317, pp. 55-56 (July 6, 2007)
	18	Copy of Final Office Action with regard to U.S. Application No. 12/639,958 by Examiner Fritz M. Fleming dated June 6, 2013 (18 pages)

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

Substitute Disclosure Form

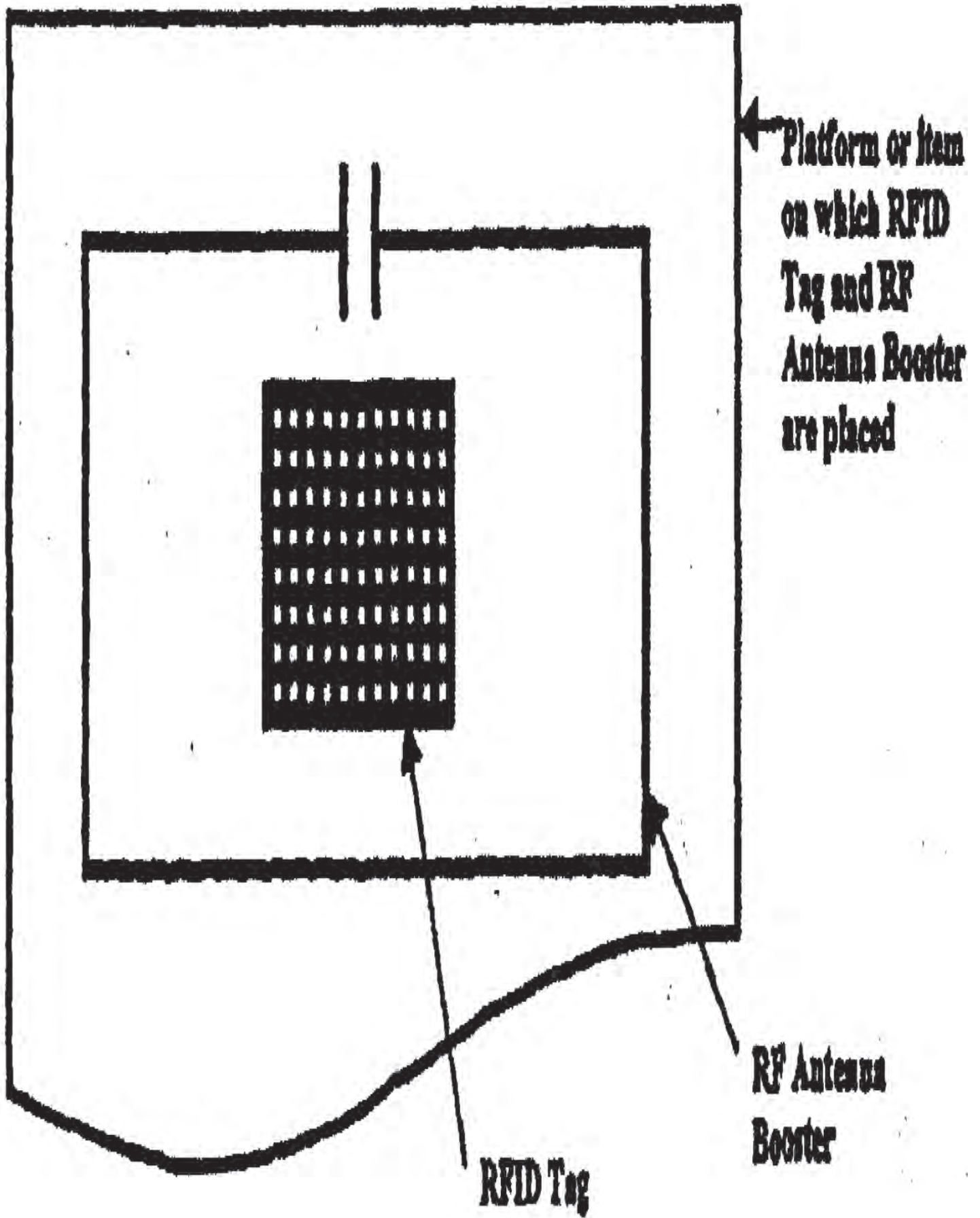
Substitute Disclosure Form	U.S. Department of Commerce Patent and Trademark Office	Attorney Docket No. 01997-0359015	Application No. 12/649,635
Information Disclosure Statement by Applicant (Use several sheets if necessary)		Applicant John D. Joannopoulos et al.	
		Filing Date December 30, 2009	Group Art Unit 2836

(37 CFR §1.98(b))

Other Documents (include Author, Title, Date, and Place of Publication)		
Examiner Initial	Desig. ID	Document
	19	Copy of Non-Final Office Action with regard to U.S. Application No. 12/949,580 by Examiner Fritz M. Fleming dated June 17, 2013 (55 pages)
	20	Copy of Final Office Action with regard to U.S. Application No. 12/639,963 by Examiner Fritz M. Fleming dated June 18, 2013 (16 pages)
	21	Copy of Final Office Action with regard to U.S. Application No. 12/649,813 by Examiner Fritz M. Fleming dated June 24, 2013 (17 pages)
	22	Copy of Final Office Action with regard to U.S. Application No. 12/649,777 by Examiner Fritz M. Fleming dated June 26, 2013 (17 pages)
	23	Copy of Final Office Action with regard to U.S. Application No. 12/649,852 by Examiner Fritz M. Fleming dated June 27, 2013 (19 pages)
	24	Copy of Final Office Action with regard to U.S. Application No. 12/649,904 by Examiner Fritz M. Fleming dated September 26, 2013 (23 pages)

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

Substitute Disclosure Form



DERWENT- 2005-568809

ACC-NO:

DERWENT- 200558

WEEK:

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TITLE: Passive range extender/booster for radio frequency identification tag/reader, has passive closed loop inductance-capacitance tuned circuit to couple and amplify electro-magnetic field energy of RFID tag or RFID reader antenna

INVENTOR: HUI L P; KIN C S

PATENT-ASSIGNEE: TUNITY PTE LTD[TUNIN]

PRIORITY-DATA: 2002SG-003891 (June 28, 2002)

PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE
SG 112842 A1	July 28, 2005	EN

APPLICATION-DATA:

PUB-NO	APPL-DESCRIPTOR	APPL-NO	APPL-DATE
SG 112842A1	N/A	2002SG-003891	June 28, 2002

INT-CL-CURRENT:

TYPE	IPC DATE
CIPS	G06K19/077 20060101
CIPS	H01Q5/01 20060101

ABSTRACTED-PUB-NO: SG 112842 A1

BASIC-ABSTRACT:

NOVELTY - The extender/booster has a passive closed loop inductance-capacitance (LC) tuned circuit of 13.56 MHz to couple and amplify the electro-magnetic field energy of the RFID tag or RFID reader antenna.

USE - For radio frequency identification tag/reader.

ADVANTAGE - Increases the read range of 13.56 MHz RFID tag.

DESCRIPTION OF DRAWING(S) - The figure shows a model of the passive range extender/booster.

CHOSEN- Dwg.1/1

DRAWING:

TITLE- PASSIVE RANGE EXTEND BOOST RADIO FREQUENCY IDENTIFY

TERMS: TAG READ CLOSE LOOP INDUCTANCE CAPACITANCE TUNE

CIRCUIT COUPLE AMPLIFY ELECTRO MAGNETIC FIELD
ENERGY ANTENNA

DERWENT-CLASS: T04 W02

EPI-CODES: T04-K02; W02-G05B;

SECONDARY-ACC-NO:

Non-CPI Secondary Accession Numbers: 2005-466293

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : John D. Joannopoulos et al. Art Unit : 2836
Serial No. : 12/649,635 Examiner : Fritz Fleming
Filed : December 30, 2009 Conf. No. : 5891
Title : WIRELESS ENERGY TRANSFER TO A MOVING DEVICE BETWEEN HIGH-
Q RESONATORS

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

PETITION FOR TWO-MONTH EXTENSION OF TIME UNDER 37 C.F.R. §1.136

Please extend the period for response to the action dated June 20, 2013, for two months to and including November 20, 2013.

The fees in the amount of \$600 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: November 20, 2013

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

Marc M. Wefers

Reg. No. 56,842

Customer Number 26161
Fish & Richardson P.C.
Telephone: (617) 542-5070
Facsimile: (877) 769-7945

23123396.doc

CERTIFICATE OF (A) MAILING BY FIRST CLASS MAIL OR (B) TRANSMISSION

I hereby certify under 37 CFR §1.8(a) that this correspondence is either (A) addressed as set out in 37 CFR §1.1(a) and being deposited with the United States Postal Service as first class mail with sufficient postage, or (B) being transmitted by facsimile in accordance with 37 CFR § 1.6(d) or via the Office electronic filing system in accordance with 37 CFR § 1.6(a)(4), on the date indicated below.

Date of Deposit or Transmission

Applicant's signature

Signature

Typed or Printed Name of Person Signing Certificate

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

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875				Application or Docket Number 12/649,635		Filing Date 12/30/2009		☐ To be Mailed	
ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO									
APPLICATION AS FILED – PART I									
(Column 1)		(Column 2)							
FOR	NUMBER FILED	NUMBER EXTRA			RATE (\$)		FEE (\$)		
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A			N/A				
☐ SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A			N/A				
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A			N/A				
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*			X \$	=			
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*			X \$	=			
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).								
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))									
* If the difference in column 1 is less than zero, enter "0" in column 2.					TOTAL				
APPLICATION AS AMENDED – PART II									
(Column 1)		(Column 2)		(Column 3)					
AMENDMENT	11/20/2013	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE (\$)		ADDITIONAL FEE (\$)
	Total (37 CFR 1.16(i))	* 46	Minus	** 42	= 4		X \$80 =		320
	Independent (37 CFR 1.16(h))	* 4	Minus	*** 4	= 0		X \$420 =		0
	☐ Application Size Fee (37 CFR 1.16(s))								
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))								
						TOTAL ADD'L FEE		320	
(Column 1)		(Column 2)		(Column 3)					
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE (\$)		ADDITIONAL FEE (\$)
	Total (37 CFR 1.16(i))	*	Minus	**	=		X \$	=	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		X \$	=	
	☐ Application Size Fee (37 CFR 1.16(s))								
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))								
						TOTAL ADD'L FEE			
* If the entry in column 1 is less than the entry in column 2, write "0" in column 3. ** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20". *** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3". The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.									

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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

LIE
/MONIQUE BRUNSON/

Substitute Disclosure Form	U.S. Department of Commerce Patent and Trademark Office	Attorney Docket No. 01997-0359015	Application No. 12/649,635
Information Disclosure Statement by Applicant (Use several sheets if necessary)		Applicant John D. Joannopoulos et al.	
		Filing Date December 30, 2009	Group Art Unit 2836

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

Substitute Disclosure Form	U.S. Department of Commerce Patent and Trademark Office	Attorney Docket No. 01997-0359015	Application No. 12/649,635
Information Disclosure Statement by Applicant (Use several sheets if necessary) (37 CFR §1.98(b))		Applicant John D. Joannopoulos et al.	
		Filing Date December 30, 2009	Group Art Unit 2836

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	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

Substitute Disclosure Form	U.S. Department of Commerce Patent and Trademark Office	Attorney Docket No. 01997-0359015	Application No. 12/649,635
Information Disclosure Statement by Applicant (Use several sheets if necessary) (37 CFR §1.98(b))		Applicant John D. Joannopoulos et al.	
		Filing Date December 30, 2009	Group Art Unit 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	Date Considered
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(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11)

EP 1 524 010 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
20.04.2005 Bulletin 2005/16

(51) Int Cl.7: **A61N 1/372, A61N 1/378,**
H04L 27/36

(21) Application number: **04256364.3**

(22) Date of filing: **15.10.2004**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IT LI LU MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL HR LT LV MK

(30) Priority: **17.10.2003 US 512036 P**

(71) Applicant: **Alfred E. Mann Foundation for**
Scientific Research
Santa Clarita, CA 91380-9005 (US)

(72) Inventors:

- **Gord, John C.**
Venice, CA 90291 (US)
- **Arcos-Burgos, Maria Isabel**
Valencia, CA 91354 (US)
- **Cosendai, Gregoire**
Cudrefin 1588 (CH)

(74) Representative: **Paget, Hugh Charles Edward et al**
Mewburn Ellis LLP
York House
23 Kingsway
London WC2B 6HP (GB)

(54) **Method and apparatus for efficient power/data transmission**

(57) A system, method and power/data transmission device comprising a coil having a high Q, a low-voltage driver and a high-voltage driver switchably coupled to the coil. The low-voltage driver and the high-voltage driver are controlled by a microcontroller and switch

at about the same time thereby providing a modulated data signal for transmission. Furthermore, the system includes at least one implantable microstimulator coupled to the transmission device.

EP 1 524 010 A1

Printed by Jouve, 75001 PARIS (FR)

BNSDOCID: <EP 1524010A1_1>

Description

[0001] This application claims the benefit of U.S. Provisional Application No. 60/512,036 filed on October 17, 2003.

Field of the invention

[0002] The present invention is generally directed to an implantable medical device system, and more particularly to a method and apparatus for efficient modulation of data signals and power transmission to the implantable medical device.

Background of the invention

[0003] Transmission of data or information signals is generally achieved through modulation of a carrier signal. The type of modulation, for example, may be amplitude modulation (AM), frequency modulation (FM), or phase modulation. Any of the foregoing modulations can be used depending on the application of the transmission.

[0004] A class of implantable medical devices known in the art are small microstimulators and/or sensors. These small microstimulators or sensors, which are hereafter referred to as BION™ devices, are described more fully in the following U.S. Patents: US Pat. No. 5,193,539, entitled "Implantable Microstimulator"; U.S. Pat. No. 5,193,540, entitled "Structure and Method of Manufacture of an Implantable Microstimulator"; U.S. Pat. No. 5,312,439 entitled "Implantable Device Having an Electrolytic Storage Electrode"; U.S. Pat. No. 6,164,284, entitled "System of implantable devices for monitoring and/or affecting body parameters"; U.S. Pat. No. 6,185,452, entitled "Battery-powered patient implantable device"; U.S. Pat. No. 6,208,894, entitled "System of implantable devices for monitoring and/or affecting body parameters"; U.S. Pat. No. 6,315,721, entitled "System of implantable devices for monitoring and/or affecting body parameters"; 6,564,807, entitled "System of implantable devices for monitoring and/or affecting body parameters, each of which patents are incorporated herein by reference. These BION devices are generally small enough to be implanted in a minimally invasive manner through a lumen of a needle, or a similar sized cannula. These BION devices or microstimulators when implanted can provide the appropriate electrical stimulation to the appropriate nerves or muscles in order to rehabilitate or contribute to the functionality of the intended body parts.

[0005] Communication with the microstimulators is achieved through a wireless medium. This communication can be through an electromagnetic or RF link or magnetic/inductive coupling of an external device with the microstimulators. In the case of the inductive coupling the external device generally referred to as a BION control unit (BCU) comprises a charger and a controller

wherein the functionality of the charger and the controller may be combined and provided through a multi-turn loop antenna in the form of a single coil. This BCU coil is in turn coupled with the coil in the microstimulator providing the inductive coupling and transmission of power and modulated signal to the microstimulator. The communication between the BCU and the BION is through digital communication or pulse modulation of the carrier signal. It has been realized that the sharpness (rise time and/or fall time) of the square wave digital signal can have a direct effect on the communication and the ability of the BION device to properly receive and decode the modulated digital signal. Although a high power modulation amplifier may be used to overcome the problem associated with the low rise time and fall time of a digital square wave pulse modulated signal, however, this would not be compatible with the low power requirements of an implantable microstimulator. It has been further realized that when utilizing a single coil for the transmission of power and modulated signal to microstimulator the use of a high Q coil provides an optimal transmission of power to the microstimulator. However, the use of a high Q coil will adversely affect the modulation signal in that the rise time and the fall time of the signal will be very slow, therefore resulting in an unreliable reception of the modulated signal by the microstimulator. Thus there is a need in the art for an apparatus that comprises a high Q coil and also provides reliable modulation wherein the rise time and the fall time of the modulation signal are adequate for the proper reception by the microstimulator.

Brief Description of the Drawings**[0006]**

FIG. 1 is an illustration of a functional block diagram of an implantable microstimulator system in accordance with the present invention.

FIG. 2 is an illustration of the slow rise and fall times associated with modulated data signals when utilizing a high-Q coil for transmission of both power and data to the microstimulator.

FIG. 3 is an illustration of a block diagram representation of the control unit and the external coil in accordance with the present invention.

FIG. 4 is an illustration of a high-level schematic representation of the control unit and the external coil in accordance with the present invention.

FIG. 5 is an illustration of a detailed schematic representation of the control unit and the external coil in accordance with the present invention.

FIG. 6 is an illustration of the waveforms associated

with the voltages of the low-voltage driver and the high-voltage driver, and their corresponding modulation of the external coil current in accordance to the principle of the present invention.

[0007] Corresponding numerals indicate corresponding elements throughout the several views of the drawings.

Detailed Description of the Preferred Embodiments

[0008] The following description is of the best mode presently contemplated for carrying out the invention. This description is not to be taken in a limiting sense, but is made merely for the purpose of describing the general principles of the invention. The scope of the invention should be determined with reference to the claims.

[0009] A functional block diagram of an implantable microstimulator/medical device system is illustrated in FIG. 1 in accordance with an embodiment of the present invention. As shown, a control unit 10 is positioned external to the skin of a patient and at least one microstimulator 20 in the form of a BION-type device is provided subcutaneously in the patient's body. The BION devices are approximately less than 6 mm in lateral dimension and less than 60 mm in longitudinal dimension. In the embodiment of the present invention, it is contemplated that the BION devices are less than 2.5 mm in lateral dimension and less than 16 mm in longitudinal dimension. The control unit 10 generally referred to as BION Control Unit (BCU) provides the power and data signals to the microstimulator 20 through a multi-turn loop antenna generally referred to as the external coil 12. In the embodiment of the present invention, the external coil 12 is a high-Q-type coil with low equivalent series resistance. The external coil 12 is made of LITZ wire or any other type of wire known in the art that can provide the high-Q characteristic required for efficient power transmission in an inductively-coupled system. The LITZ wire is characterized as having about 150 strands of 44 gauge electrically conductive wire encased in a silk sheath. One of the design constraints that must be considered when using an implantable device system as shown in FIG. 1 is the efficient transfer of energy to the microstimulator 20. In general, the efficient transfer of energy through an external coil 12 to an internal coil 14 requires the use of a high Q resonant circuit to couple the two coils. A resonant circuit may be described as one containing both inductance (L) and capacitance (C) in which the capacitive reactance is equal to the inductive reactance. This condition occurs at only one frequency in a circuit with fixed constants, and the circuit is said to be "tuned" to this frequency. The "Q" of a resonant circuit may be defined as a figure of merit of the tuned LC circuit, where Q is generally equal to X/R , where X is the reactance of the circuit, and R is the resistance. Because the resistance in a resonant circuit

typically represents an energy loss (the loss occurring due to ohmic heating), a more efficient energy transfer occurs when the resistance is low, or the Q is high. Hence, a preferred circuit for coupling energy between a primary coil and an implanted coil will utilize a resonant circuit having a relatively high Q, e.g., a Q greater than or equal to 10. A Q value of twenty or higher is preferred.

[0010] When a high Q circuit is used to couple energy between an external coil and an internal coil, the high Q properties of the circuit make it difficult to perform rapid modulation of the carrier signal. Hence, any data modulation signal that also must pass through the high Q resonant circuit tends to exhibit very slow rise and fall times. Disadvantageously, in the context of an implanted medical device system, the integrity of the data transmission (i.e., the ability of the system to reliably detect the data that is transmitted) is significantly adversely affected in proportion to the slowness of the rise and fall times of the modulated data signal.

[0011] FIG. 2 is an illustration of the contrast between the slow rise and fall times waveform associated with modulated data signals utilizing a high-Q coil for transmission of both power and data to the microstimulator and the proper/desired square waveform for transmission of the data signals. The high-Q coil is highly efficient in transmitting power to the internal coil; however, it is inefficient with respect to the modulation of a data signal for transmission, namely, the higher Q of coil results in the slow rise and fall time of the modulated signal. This in turn adversely affects the sharpness of the modulated data signal which can result in the unreliability of received data signal by the microstimulator 20.

[0012] In the present invention, it is contemplated that Manchester encoding may be used to assure reliability. In such encoding, there is always a transition, from high to low or vice versa, at the end of sixteen cycles, which is the bit time. If there is a transition at 8 cycles, the state time, the bit may be termed a "1". If there is no transition at 8 cycles, the bit is then a "0". The Manchester encoding is further discussed in U. S. Patent No. 5,193, 539 which is incorporated herein by reference. The preferred signal modulation in the embodiment of the present invention is amplitude modulation; however, other types of signal modulations can be implemented for various applications.

[0013] FIG. 3 is an illustration of a block diagram representation of the control unit and the external coil in accordance with the present invention. The control unit 10 includes a high-voltage driver 16, a low-voltage driver 18, an auto-tuning circuit 22, and a tuning/adjustable capacitor 24. The auto-tuning circuit 22, for example, can be implemented in the form described in pending Patent Application Serial No. 10/429,427 filed on May 5, 2003, titled: "System and Method for Automatic Tuning of a Magnetic Field Generator" which is incorporated herein by reference. In the embodiment of the present invention, the auto-tuning circuit 22, tuning/adjustable capacitor 24 and the external coil 12 form a tuned circuit which

is preferably set at 2 MHz of resonant frequency; however, other resonant frequency values may be used depending on the carrier frequency utilized for power transmission. It should be noted that the low equivalent series resistance of the external coil 12 is the resistance that is less than $1/Q$ times the reactance of the coil at 2 MHz. For example, for a coil of 40 microHenries, the reactance ($2\pi fL$) is about 500 ohms so a coil equivalent series resistance of well less than 5 ohms is appropriate if the desired overall Q is 100. In this example, the equivalent series resistance of less than 5 ohms is desired in order to allow for the other resistances in the circuit such as the impedance of the low and high voltage drivers. The control unit 10 is connected to the external coil 12. The high voltage driver 16 and the low-voltage driver 18 through the tuning capacitor 24 drive the external coil 12.

[0014] Traditionally, only a single voltage-driver has been utilized to drive a coil in an inductively-coupled transmission system, especially in an implantable medical device system. As described above, when a high-Q coil is used for both power and data transmission, the modulation of the carrier signal for data signal transmission is adversely affected. The present invention provides a control unit driving a high-Q external coil with a low-voltage and a high-voltage driver concurrently. This arrangement provides for a more reliable modulation of the carrier signal by providing sharp rise times and fall times in square wave data signals.

[0015] FIG. 4 is an illustration of a high-level schematic representation of the control unit and the external coil in accordance with the present invention. The low-voltage driver 18 is connected to an auto-tuned circuit broadly represented as adjustable capacitor 24. The low-voltage driver 18 generally includes a switching circuit 26 having at least one switch-mode transistor having a low internal impedance represented by the resistor 28. The adjustable capacitor 24 is controlled by an auto-tuning circuit (not shown). The high-voltage driver 16 generally includes a switching circuit 29 also of a switch-mode transistor type with low impedance that provides the high-voltage input to the external coil 12. As shown in FIG. 4, the external coil 12 includes a parasitic capacitance and resistance. In the embodiment of the present invention, the high-Q external coil 12 has low parasitic capacitance and resistance. The value of the low parasitic capacitance is dependent on the value of the carrier frequency and should be a capacitance that results in a self-resonant frequency well above the carrier frequency. The switching circuits 26 and 29 may be switch-mode transistors or any other switching elements known to those skilled in the art.

[0016] FIG. 5 is an illustration of a detailed schematic representation of the control unit and the external coil in accordance with the present invention. Referring to FIG. 5, the low-voltage driver 18 provides a change in voltage between approximately 10 volts to the ground and approximately 9 volts to the ground. For example, the Vcc

in the circuitry of the low-voltage driver is set at 10 volts. When the switch circuit 30 is closed and the switch circuit 32 is open, then the voltage at the output 36 would be at about 10 volts. In contrast, when the switch circuit 30 is open and the switch circuit 32 is closed, then the output voltage at the output 36 would be at about 9 volts. This transition between 10 volts and 9 volts provides the low-voltage driver modulation to the external coil. The output of the low-voltage modulation is provided to the external coil through the adjustable capacitor 24 which is controlled by the auto-tuning circuit. It should be noted that the tuning of the adjustable capacitor to the external coil may be achieved as described above or through various techniques known to those skilled in the relevant art.

[0017] Furthermore, referring to FIG. 5, another advantage of an embodiment of the present invention is achieved wherein the high-voltage driver 16 derives power from a voltage-controlled source 38 which in turn taps off, i.e., is connected to, the transmit resonant circuit. The transmit resonant circuit in the embodiment of the present invention is essentially the combination of the low-voltage driver impedance 28, the adjustable capacitor 24, the external coil 12 including its inductance, parasitic capacitance and parasitic resistance, and the high-voltage driver impedance. The voltage-controlled source 38 is broadly comprised of a capacitor-voltage-division circuitry with the arrangement shown in FIG. 5. It should be noted that the voltage supplied to the high-voltage driver 16 by the voltage-controlled source 38 is dependent on and changes as the impedance of the external coil and hence the Q of the coil changes. The impedance of the external coil changes as the external coil is flexed in various shapes when placed on or near a patient's body. The high-voltage driver provides a proportionately high voltage to the coil based on the Q value of the transmit resonant circuit. For example, if the Q of the external coil is 100, when the external coil is in certain position, and the output voltage of the low-voltage driver is 10 volts, then the voltage at node 37 would be $10 \times Q = 1000$ volts. According to the embodiment of the present invention, the modulation provided by the low-voltage driver is about 1 volt which is the difference between the 10 volts and the 9 volts resulting from switching of the switches 30 and 32 (as described above). The 1 volt modulation is 10% modulation of the 10 volts signal of the low-voltage driver 18. Since the high-voltage driver 16 should provide a modulation level corresponding to and concurrently with the modulation provided by the low-voltage driver 18, then the modulation level by the high-voltage driver 16 should also be 10% of the voltage value at node 37. Therefore, in the embodiment of the present invention, the controlled-voltage source 38 provides a voltage division of 10% of the available voltage at node 37 and such that the voltage supplied to the high-voltage driver 16 would be 100 volts. Hence, the high-voltage driver 16 would provide a modulation between 0 volts and 100 volts which is 10% of the voltage

supplied as a result of the $Q=100$ of the transmit resonant circuit. As can be realized from the foregoing example, the voltage supplied by the controlled-voltage source 38 changes with and is dependent on the impedance of the external coil 12 and in turn the Q value of the external coil/transmit resonant circuit. This voltage control of the high-voltage driver insures that the modulation level by the high-voltage driver 16 is appropriate and minimizes transmission error of the modulated data signal. It must be noted that the microcontroller 40 enables the synchronization of the switching of the low-voltage driver 18 and the high-voltage driver 16 in order to provide the proper modulation of the carrier signal. In order to achieve an efficient modulation of the carrier signal, the low-voltage driver and the high-voltage driver should be switched at or near the zero-crossing of the AC coil current.

[0018] FIG. 6 is an illustration of the waveforms associated with the voltages of the low-voltage driver and the high-voltage driver, and their corresponding modulation of the external coil current in accordance to the principle of the present invention. As shown in FIG. 6, the voltage at the output of the low-voltage driver (VL) is provided at the carrier frequency of about 2 MHz. In contrast, the voltage at the output of the high-voltage driver (VH) is provided at a lower frequency corresponding to the modulation frequency of about 125KHz. According to an embodiment of the present invention, it is contemplated that the high-voltage driver switches at about the same time as one of the switching edges of the low-voltage driver voltage signal. This is accomplished by the microcontroller 40 synchronizing the switching operation of the high-voltage driver and the low-voltage driver such that the high-voltage driver, when modulating, switches at about the same time as one of the switching edges of the low-voltage driver voltage signal. As a result of the foregoing technique, the current through the external coil (I_{coil}) is accordingly modulated. For example, VL changes from 9 volts to 10 volts (as shown by the edge 602) and at about the same time VH changes from 0 volt to 100 volts (as shown by the edge 604) causing the modulation of the I_{coil} by a corresponding increase of 10% change in the amplitude of the external coil current. Similarly, at the edge 606, VL changes from 10 volts to 9 volts and VH at about the same time changes to 0 volts causing a corresponding decrease of 10% change in the amplitude of the external coil current.

[0019] While the invention has been described by means of specific embodiments and applications thereof, it is understood that numerous modifications and variations could be made thereto by those skilled in the art without departing from the spirit and scope of the invention. It is therefore to be understood that within the scope of the claims, the invention may be practiced otherwise than as specifically described herein.

Claims

1. A power/data transmission device, comprising:
 - a coil having a high Q ;
 - a low-voltage driver switchably coupled to the coil; and
 - a high-voltage driver switchably coupled to the coil.
2. The power/data transmission device of claim 1, wherein the coil has a low parasitic capacitance.
3. The power/data transmission device of claim 2, wherein the coil is a LITZ wire.
4. The power/data transmission device of claim 3, wherein the low-voltage driver and the high-voltage driver provide a modulated data signal through the coil for transmission to a receiving device.
5. The power/data transmission device of claim 4, wherein the coil is provided with a carrier frequency of about 2 MHz.
6. The power/data transmission device of claim 5, wherein the low-voltage driver comprises:
 - at least one switched-mode transistor for providing the modulated data signal and wherein the at least one switched-mode transistor has low impedance.
7. The power/data transmission device of claim 6, wherein the high-voltage driver comprises:
 - at least one switched-mode transistor for providing the modulated data signal and wherein the at least one switched-mode transistor has low impedance.
8. The power/data transmission device of claim 7, wherein the low-voltage driver and the high-voltage driver are synchronized to produce the modulated data signal.
9. The power/data transmission device of claim 8, wherein the data signal is amplitude-modulated.
10. The power/data transmission device of claim 7, wherein the high-voltage driver receives power from a transmit resonant circuit.
11. A method of power/data transmission, comprising:
 - providing a high Q coil;
 - providing a low-voltage driver switchably coupled to the coil;

providing a high-voltage driver switchably coupled to the coil; and
modulating a carrier signal with data using the low-voltage and the high-voltage driver.

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12. The method of claim 11, wherein the modulating comprises:

switching the low-voltage driver and the high-voltage driver coupled to the coil, thereby modulating the carrier signal.

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13. The method of claim 12, wherein the modulating comprises:

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synchronizing the switching of the low-voltage driver and the high-voltage driver coupled to the coil, thereby producing a data signal.

14. The method of claim 13, wherein the carrier frequency is at about 2 MHz.

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15. The method of claim 13, further comprising:

amplitude modulating the data signal.

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16. An implantable medical device system comprising:

at least one implantable microstimulator;
a transmission device comprising:

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a high-voltage driver switchably coupled to the coil;
a coil having a high Q; and
a low-voltage driver switchably coupled to the coil.

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17. The implantable medical device system of claim 16, wherein the at least one microstimulator is less than 60 mm in longitudinal and less than 6 mm in lateral dimension:

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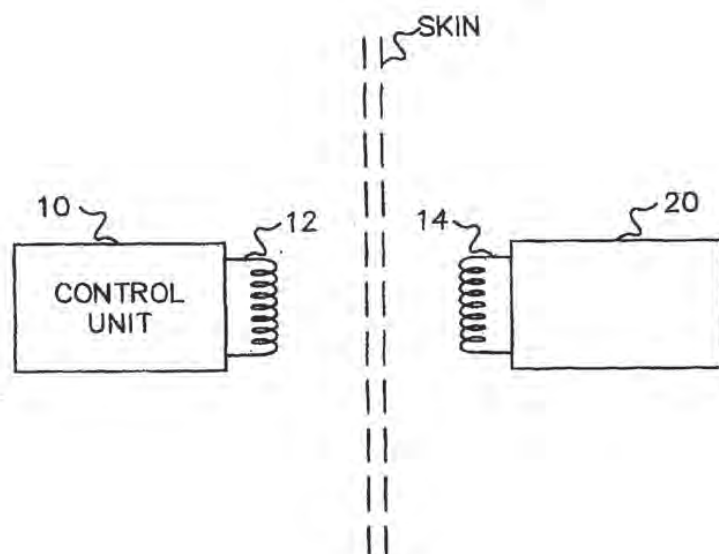


FIG. 1

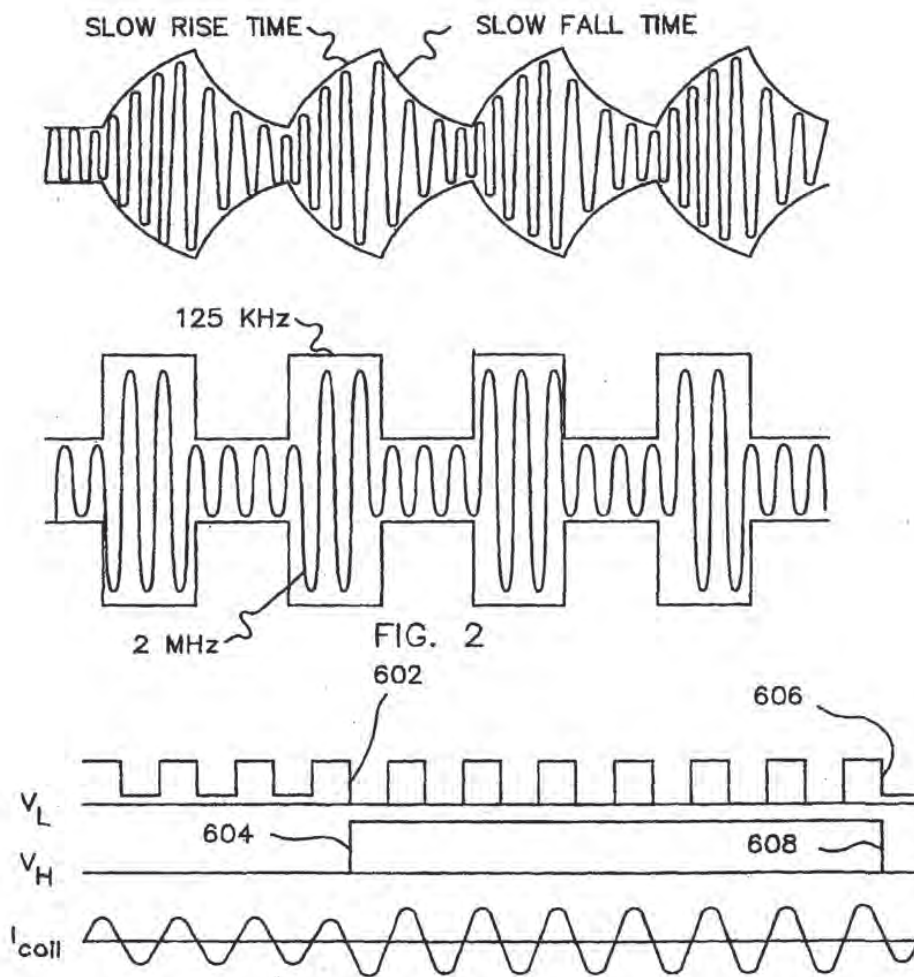


FIG. 6

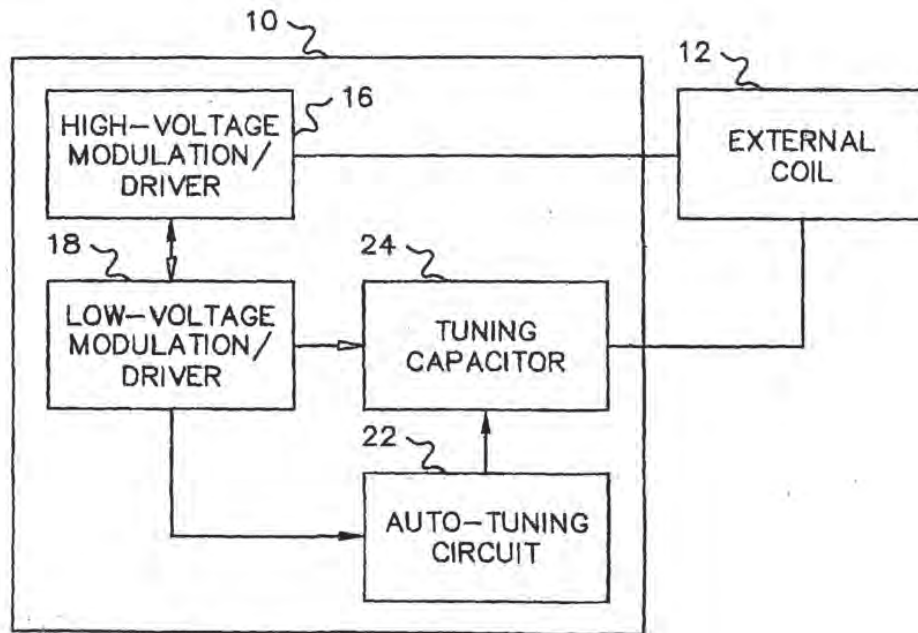


FIG. 3

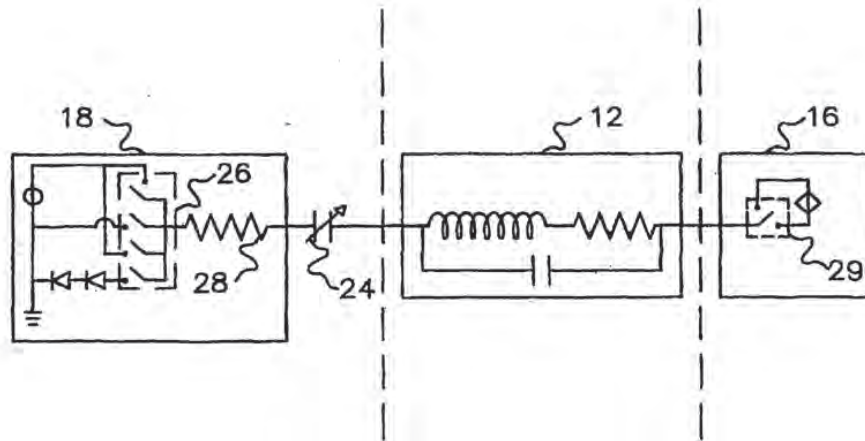


FIG. 4

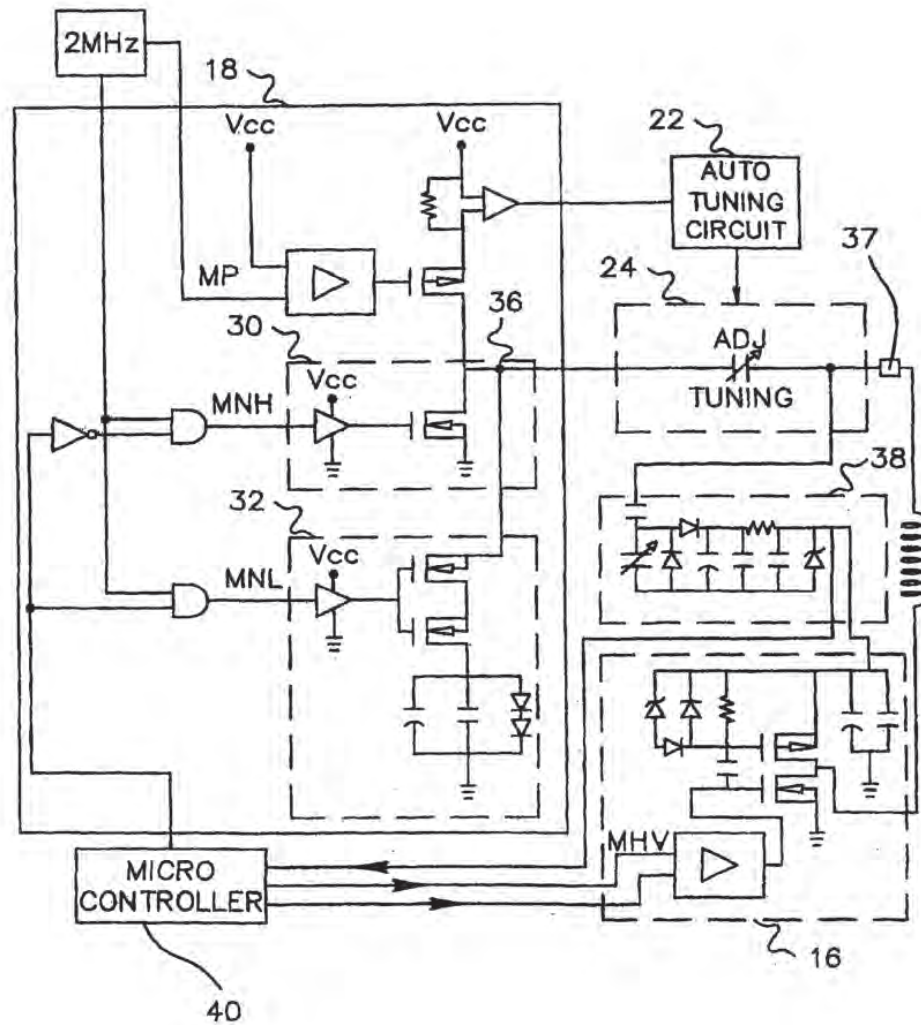


FIG. 5

European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 04 25 6364

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 16 February 2005	Examiner Wetzig, T
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 04 25 6364

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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For more details about this annex see Official Journal of the European Patent Office, No. 12/82

Electronic Acknowledgement Receipt	
EFS ID:	17615613
Application Number:	12649635
International Application Number:	
Confirmation Number:	5891
Title of Invention:	WIRELESS ENERGY TRANSFER TO A MOVING DEVICE BETWEEN HIGH-Q RESONATORS
First Named Inventor/Applicant Name:	John D. Joannopoulos
Customer Number:	26161
Filer:	Marc M. Wefers/Cheryl Forrest
Filer Authorized By:	Marc M. Wefers
Attorney Docket Number:	01997-0359015 / MIT 11757
Receipt Date:	10-DEC-2013
Filing Date:	30-DEC-2009
Time Stamp:	14:18:11
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment		no			
File Listing:					
Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		359015-IDS.pdf	124831 41114a00ec5216094769ed1172800a0b838b98c2	yes	4

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34	Non Patent Literature	32.pdf	413802 072221a1b5025f0b9988054f08ee5f0bce1e972e01	no	5
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37	Non Patent Literature	35.pdf	45119 01269e7eb623753e73176f49faa89bb809e053	no	2
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38	Non Patent Literature	36.pdf	178444 576b5cc660c72d810a4c9c122aa580b191a0ab1	no	4
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : John D. Joannopoulos et al. Art Unit : 2836
Serial No. : 12/649,635 Examiner : Fritz Fleming
Filed : December 30, 2009 Conf. No. : 5891
Title : WIRELESS ENERGY TRANSFER TO A MOVING DEVICE BETWEEN HIGH-
Q RESONATORS

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.
Copies of communications from foreign patent offices in counterpart applications are also enclosed.

This statement is being filed after the filing of a Request for Continued Examination and before the receipt of a first Office Action on the merits. Please apply any necessary charges or credits to Deposit Account 06-1050, referencing the above attorney docket number.

Respectfully submitted,

Date: December 10, 2013

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

Marc M. Wefers
Reg. No. 56,842

Customer Number 26161
Fish & Richardson P.C.
Telephone: (617) 542-5070
Facsimile: (877) 769-7945

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Substitute Disclosure Form	U.S. Department of Commerce Patent and Trademark Office	Attorney Docket No. 01997-0359015	Application No. 12/649,635
Information Disclosure Statement by Applicant (Use several sheets if necessary) (37 CFR §1.98(b))		Applicant John D. Joannopoulos et al.	
		Filing Date December 30, 2009	Group Art Unit 2836

U.S. Patent Documents							
Examiner Initial	Desig. ID	Document Number	Publication Date	Patentee	Class	Subclass	Filing Date If Appropriate
	1	6,176,433	1/23/2001	Uesaka 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	JP 9-182323	7/11/1997	Japan	H02J	17/00	Machine Translation	

Other Documents (include Author, Title, Date, and Place of Publication)		
Examiner Initial	Desig. ID	Document
	3	Chinese Office Action, Application No. 201110311000.X; mailed December 6, 2013; Applicant: Massachusetts Institute of Technology; 20 pages
	4	Canadian Office Action, Application No. 2,682,284; mailed November 25, 2013; Applicant: Massachusetts Institute of Technology; 3 pages
	5	European Office Action, Application No. 11 184 066.6; mailed December 3, 2013; Applicant: Massachusetts Institute of Technology; 5 pages

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

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Espacenet
Bibliographic data: JPH09182323 (A) — 1997-07-11
NON-CONTACT TYPE ELECTRIC POWER TRANSMISSION DEVICE

No documents available for this priority number.

Inventor(s): HAYASHI HIROSHI ± (HAYASHI HIROSHI)

Applicant(s): ROHM CO LTD ± (ROHM CO LTD)

Classification: - international: **H02J1/00; H02J17/00; H02J7/00; H02M3/28; H02M7/06;** (IPC1-7): H02J1/00; H02J17/00; H02M3/28; H02M7/06

- cooperative:

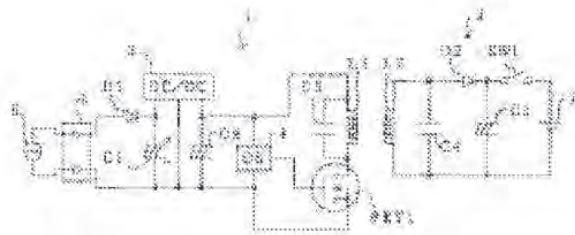
Application number: JP19950342615 19951228

Priority number(s): JP19950342615 19951228

Abstract of JPH09182323 (A)

PROBLEM TO BE SOLVED: To reduce favorably the inductance value of a resonance means, by reducing the voltage of a rectification power through a DC/DC converter to feed it to the resonance means. SOLUTION: When feeding, e.g. a commercial power with signal-phase AC 100V from a commercial power supply 6 to a non-contract type electric power transmission device 1, rectifying this power by a rectification means comprising a diode D1 and a capacitor C1 to reduce its voltage to a predetermined one by a DC/DC converter 3, the reduced voltage is smoothed by a smoothing means comprising a capacitor C2 to be fed both to a resonance means comprising an inductor L1 and a capacitor C3 and to an oscillator 4. Thereby, from the oscillator 4, a pulse signal with a predetermined frequency is fed to the gate of a field effect transistor FET1 to switch on/off the FET1 at the predetermined frequency. Therefore, since the loss of the FET1 by switching is reduced, the switching frequency can be made high enough. As a result, the inductance value of the inductor L1 can be enough reduced.

Last updated: 11.12.2013 Worldwide Database 5.8.15; 92p



(19) 日本国特許庁 (J P)

(12) 公開特許公報 (A)

(11) 特許出願公開番号

特開平9-182323

(43) 公開日 平成9年(1997)7月11日

(51) Int.Cl. ⁸	識別記号	片内整理番号	F I	技術表示箇所
H 0 2 J 17/00			H 0 2 J 17/00	B
1/00	3 0 6		1/00	3 0 6 L
H 0 2 M 3/28			H 0 2 M 3/28	H
7/06		8726-5H	7/06	L

審査請求 未請求 請求項の数 3 O L (全 5 頁)

(21) 出願番号 特願平7-342615

(22) 出願日 平成7年(1995)12月28日

(71) 出願人 000116024

ローム株式会社

京都府京都市右京区西院溝崎町21番地

(72) 発明者 林 宏

京都市右京区西院溝崎町21番地 ローム株式会社内

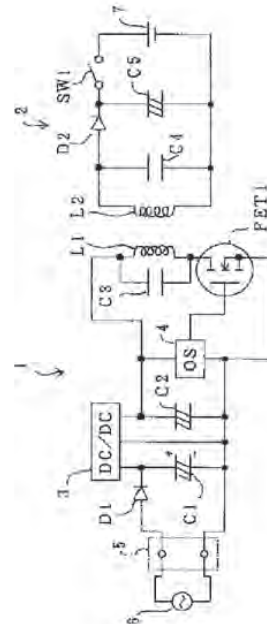
(74) 代理人 弁理士 吉田 稔 (外 1 名)

(54) 【発明の名称】 非接触式電力伝達装置

(57) 【要約】

【課題】 共振手段のインダクタンスを良好に小さくできる非接触式電力伝達装置を提供する。

【解決手段】 商用電源6からの電力を整流し、その整流電力を所定周波数でスイッチングしてインダクタL1を含む共振手段に供給することにより、インダクタL1に電磁氣的に結合可能なインダクタL2を含む2次側回路2に非接触で電力を伝達する非接触式電力伝達装置1であって、整流電力の電圧を所定値に降圧させるDC/DCコンバータ3を設けた。



【特許請求の範囲】

【請求項1】 商用電源からの電力を整流し、その整流電力を所定周波数でスイッチングしてインダクタを含む共振手段に供給することにより、前記インダクタに電磁氣的に結合可能なインダクタを含む2次側回路に非接触で電力を伝達する非接触式電力伝達装置であって、前記整流電力の電圧を所定値に降圧させる降圧手段を設けたことを特徴とする、非接触式電力伝達装置。

【請求項2】 前記整流電力のスイッチングは、前記整流電力を電源とする発振器と、この発振器からの発振出力に応じて前記共振手段に供給される前記整流電力をスイッチングするトランジスタとにより行われることを特徴とする、請求項1に記載の非接触式電力伝達装置。

【請求項3】 前記2次側回路は、充電式電池を含み、非接触で伝達された電力により前記充電式電池が充電されることを特徴とする、請求項1または請求項2に記載の非接触式電力伝達装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本願発明は、商用電源から得た電力を2次側回路に非接触で伝達する非接触式電力伝達装置に関する。

【0002】

【従来の技術】近年、コードレス電話、液晶テレビ、電動歯ブラシ、工作器具など、電力を使用する各種の携帯機器が日常的に多数使用されている。このような携帯機器は、通常、充電式の電池を内蔵しており、適宜充電する必要がある。この充電には、各種の方法が採用されているが、携帯機器に充電用のアダプタやコードなどを接続することなく、携帯機器を単に充電器台の上などに載置するだけで充電が行われるようにするのが最も便利である。

【0003】そこで、電磁誘導を利用した非接触式電力伝達装置が提案されているが、従来の非接触式電力伝達装置は、商用電源からの電力を整流し、その整流電力を所定周波数でスイッチングしてインダクタを含む共振手段に供給することにより、共振手段のインダクタに電磁氣的に結合可能なインダクタを含む2次側回路に非接触で電力を伝達する構成であった。

【0004】しかし、従来の非接触式電力伝達装置では、商用電力を全波整流した整流電力を共振回路に直接供給するので、整流電力の電圧が高く、このため共振回路に接続されたスイッチング用のトランジスタの損失が大きいことから、スイッチング周波数を十分に高くすることができず、この結果、共振回路のインダクタンスを小さくすることができない。たとえば、商用電源の電圧が100ボルトの場合、全波整流した整流電力の電圧のピーク値は141ボルト程度であり、スイッチング周波数は数KHz～百数十KHz程度以下となつて、インダクタンスは数mH程度（たとえば7.05mH）と大き

な値になる。また、スイッチング用のトランジスタに印加される電圧のピーク値も、たとえば442ボルトと大きな値になる。

【0005】したがって、共振回路のインダクタが大型化し、インダクタを基板上にパターン化することができないので、非接触式電力伝達装置の小型・軽量化の妨げとなるとともに、インダクタを個別部品として基板に実装する必要があり、生産性が悪いという課題があった。しかも、スイッチング用のトランジスタとして、高耐圧のものをを用いる必要があった。

【0006】

【発明の開示】本願発明は、上記した事情のもとで考え出されたものであって、共振手段のインダクタンスを良好に小さくできる非接触式電力伝達装置を提供することをその課題とする。

【0007】上記の課題を解決するため、本願発明では、次の技術的手段を講じている。

【0008】本願発明の第1の側面によれば、商用電源からの電力を整流し、その整流電力を所定周波数でスイッチングしてインダクタを含む共振手段に供給することにより、共振手段のインダクタに電磁氣的に結合可能なインダクタを含む2次側回路に非接触で電力を伝達する非接触式電力伝達装置であつて、整流電力の電圧を所定値に降圧させる降圧手段を設けた非接触式電力伝達装置が提供される。

【0009】降圧手段により整流電力の電圧を所定値に降圧させて共振手段に供給するので、スイッチングの損失が軽減され、この結果、スイッチング周波数を十分に高くできる。しかも、共振手段のインダクタに印加される電圧が十分に低い。したがって、共振手段のインダクタンスを良好に小さくでき、たとえば、インダクタを基板上にパターン化できる。したがって、装置の小型・軽量化を実現できるとともに、インダクタを個別部品として基板に実装する必要がなくなり、生産性の向上を図ることができる。もちろん、スイッチング周波数を十分に高くできることから、2次側回路のインダクタンスも小さくでき、2次側回路についても同様の効果が得られる。

【0010】商用電源からの電力を整流する整流手段としては、たとえば全波整流回路、あるいは半波整流回路などを用いることができる。

【0011】インダクタを含む共振手段としては、たとえばインダクタとキャパシタとの並列共振回路、あるいはインダクタとキャパシタとの直列共振回路などを用いることができる。

【0012】好ましい実施の形態によれば、整流電力のスイッチングが、整流電力を電源とする発振器と、この発振器からの発振出力に応じて共振手段に供給される整流電力をスイッチングするトランジスタとにより行われる。

【0013】トランジスタとしては、電界効果トランジスタあるいはバイポーラトランジスタなどを用いることができる。電界効果トランジスタの場合、ゲートが発振器の出力端に接続され、ソース・ドレイン間が共振手段と直列に接続される。バイポーラトランジスタの場合、ベースが発振器の出力端に接続され、コレクタ・エミッタ間が共振手段と直列に接続される。降圧手段により整流電力を降圧するので、スイッチング用のトランジスタとして、耐圧の低いものを用いることができ、製造コストの低減を図ることができる。

【0014】別の好ましい実施の形態によれば、2次側回路は、充電式電池を含み、非接触で伝達された電力により充電式電池が充電される。

【0015】充電式電池としては、たとえばニッケル・カドミウム電池、ニッケル・水素電池、リチウムイオン電池などを用いることができる。

【0016】本願発明のその他の特徴および利点は、添付図面を参照して以下に行う詳細な説明によって、より明らかとなろう。

【0017】

【発明の実施の形態】以下、本願発明の好ましい実施の形態を、図面を参照して具体的に説明する。

【0018】図1は、本願発明に係る非接触式電力伝達装置の回路図であって、図1においては、非接触式電力伝達装置1の他に、非接触式電力伝達装置1から非接触で電力を伝達される2次側回路2も含めて図示している。なお、図示していないが、2次側回路2は、コードレス電話、液晶テレビ、電動歯ブラシ、工作器具など、電力を使用する各種の携帯機器に内蔵されており、非接触式電力伝達装置1は、それらの携帯機器の充電器台に内蔵されている。この非接触式電力伝達装置1は、DC/DCコンバータ3、発振器4、電源プラグ5、ダイオードD1、キャパシタC1〜C3、インダクタL1、および電界効果トランジスタFET1を備えており、電源プラグ5は商用電源6に電気的に接続される。

【0019】また、2次側回路2は、インダクタL2、キャパシタC4、C5、ダイオードD2、スイッチSW1、および充電式電池7を備えている。

【0020】商用電源6の一端は、電源プラグ5を介してダイオードD1のアノードに接続されており、ダイオードD1のカソードは、DC/DCコンバータ3の入力端とキャパシタC1の一端とに接続されている。DC/DCコンバータ3の出力端は、キャパシタC2、C3の一端と発振器4の電源入力端とインダクタL1の一端とに接続されており、発振器4の出力端は、電界効果トランジスタFET1のゲートに接続されている。インダクタL1の他端は、キャパシタC3の他端と電界効果トランジスタFET1のドレインとに接続されており、キャパシタC1、C2の他端とDC/DCコンバータ3および発振器4の接地端と電界効果トランジスタFET1の

ソースとは、電源プラグ5を介して商用電源6の他端に接続されている。

【0021】インダクタL2の一端は、キャパシタC4の一端およびダイオードD2のアノードに接続されており、ダイオードD2のカソードは、キャパシタC5の一端とスイッチSW1の一端とに接続されている。スイッチSW1の他端は、充電式電池7の正極端に接続されており、充電式電池7の負極端とキャパシタC4、C5の他端とは、インダクタL2の他端に接続されている。

10 【0022】ダイオードD1と電解コンデンサからなるキャパシタC1とは、たとえば単相交流100ボルトの商用電源6からの電力を整流する整流手段を構成している。DC/DCコンバータ3は、ダイオードD1およびキャパシタC1からなる整流手段により整流された整流電力の電圧を所定電圧に降圧する降圧手段を構成している。このDC/DCコンバータ3の具体的な回路は周知であるので、図示および説明を省略する。キャパシタC2は、電解コンデンサからなり、DC/DCコンバータ3により降圧された整流電力を平滑化する平滑手段を構成している。発振器4と電界効果トランジスタFET1とは、キャパシタC2により平滑化された整流電力を所定周波数でスイッチングするスイッチング手段を構成している。すなわち、発振器4は、DC/DCコンバータ3により降圧された整流電力を電源として動作し、予め設定された所定周波数のパルス信号を電界効果トランジスタFET1のゲートに供給する。これにより電界効果トランジスタFET1のチャネルすなわちドレイン・ソース間が、発振器4からのパルス信号の周波数に応じて導通状態と非導通状態との間の反転を繰り返し、インダクタL1とキャパシタC3とからなる共振手段に供給されるDC/DCコンバータ3からの整流電力を断続させる。なお、発振器4の具体的な回路は周知であるので、図示および説明を省略する。また、電界効果トランジスタFET1は、nチャネルエンハンスメントモードMOS-FETである。インダクタL1とキャパシタC3とは、並列共振回路からなる共振手段を構成しており、この並列共振回路の共振条件をほぼ満足するように、発振器4の発振周波数が設定されている。

40 【0023】2次側回路2のインダクタL2とキャパシタC4とは、並列共振回路を構成しており、インダクタL2を非接触式電力伝達装置1のインダクタL1による磁束と鎖交する状態に位置させることにより、インダクタL2に電磁誘導による起電力が発生する。この並列共振回路は、電磁誘導によりインダクタL2に発生する起電力により共振するように回路条件が設定されている。ダイオードD2と電解コンデンサからなるキャパシタC5とは、インダクタL2とキャパシタC4とからなる並列共振回路からの誘導電力を整流する整流回路を構成している。スイッチSW1は、ダイオードD2とキャパシタC5とからなる整流回路からの整流電力を充電式電池

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7に供給するスイッチ手段を構成している。充電式電池7は、スイッチSW1からなるスイッチ手段を介して供給される整流電力により充電され、携帯機器の制御回路および駆動回路などの各種回路(図示せず)に直流電力を供給する電源を構成している。

【0024】次に動作を説明する。電源プラグ5を商用電源6のコンセント(図示せず)に挿入すると、商用電源6から非接触式電力伝達装置1にたとえば単相交流100ボルトの商用電力が供給され、この商用電力は、ダイオードD1とキャパシタC1とからなる整流手段により整流され、DC/DCコンバータ3により所定電圧に降圧されて、キャパシタC2からなる平滑手段により平滑化され、インダクタL1とキャパシタC3とからなる共振手段および発振器4に供給される。これにより発振器4が、所定周波数のパルス信号を電界効果トランジスタFET1のゲートに供給し、電界効果トランジスタFET1が所定周波数でオン・オフする。したがって、インダクタL1とキャパシタC3とからなる共振手段に供給される整流電力が所定周波数で断続され、共振手段が共振して、インダクタL1により磁束が発生する。このとき、DC/DCコンバータ3により整流電力を適切に降圧しているため、スイッチングによる電界効果トランジスタFET1の損失が良好に軽減されることから、スイッチング周波数を十分に高くできる。この結果、インダクタL1のインダクタンスを十分に小さくでき、インダクタL1を基板上にパターン化することが可能になる。

【0025】たとえば、商用電源6の電圧を100ボルトとし、DC/DCコンバータ3により整流電力の電圧のピーク値を数ボルト〜数十ボルト(たとえば12ボルト)に降圧した場合、電界効果トランジスタFET1のスイッチングによる損失が許容限度になるまでスイッチングの周波数を高くすると、数百kHz〜数MHzの周波数でスイッチングすることが可能になる。したがって、インダクタL1のインダクタンスをたとえば60μH程度に小さくできる。この結果、インダクタL1を基板上でパターン化できることから、装置の小型・軽量化を実現できるとともに、インダクタL1を個別部品として基板に実装する必要がなくなり、生産性の向上を実現できる。しかも、電界効果トランジスタFET1のドレ

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インに印加される電圧のピーク値もたとえば37.7ボルト程度に小さくなり、電界効果トランジスタFET1として耐圧の低いものを用いることができる。

【0026】非接触式電力伝達装置1を内蔵した充電器台の上に2次側回路2を内蔵した携帯機器を載置すると、非接触式電力伝達装置1のインダクタL1により発生した磁束が、2次側回路2のインダクタL2に鎖交するように、インダクタL1、L2が配置されているので、インダクタL1により発生した磁束により、インダクタL2に起電力が発生し、これによりインダクタL2とキャパシタC4とからなる並列共振回路が共振し、誘導電力がダイオードD2とキャパシタC5とからなる整流回路により整流されて、スイッチSW1が閉成していれば、充電式電池7に供給され、充電式電池7が充電される。

【0027】すなわち、商用電源6からの電力が、インダクタL1とインダクタL2との電磁的結合により、非接触式電力伝達装置1から2次側回路2に非接触で伝達され、充電式電池7が充電される。なお、インダクタL1に印加される整流電力のスイッチング周波数を高くしているため、インダクタL1により発生する磁束の周波数も高いことから、2次側回路2のインダクタL2のインダクタンスも小さくできる。したがって、インダクタL2も基板上にパターン化できるので、2次側回路2の小型・軽量化を実現できるとともに、インダクタL2を個別部品として基板に実装する必要がなくなり、生産性の向上を実現できる。以上の結果、携帯機器やその充電器台を小型・軽量化することも可能になる。

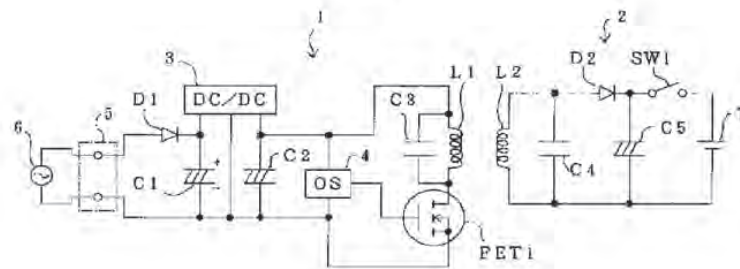
【図面の簡単な説明】

【図1】本願発明に係る非接触式電力伝達装置の回路図である。

【符号の説明】

- 1 非接触式電力伝達装置
- 2 2次側回路
- 3 DC/DCコンバータ
- 4 発振器
- 7 充電式電池
- FET1 電界効果トランジスタ
- L1, L2 インダクタ
- C3, C4 キャパシタ

【図1】



DERWENT- 1997-409644

ACC-NO:

DERWENT- 199738

WEEK:

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TITLE: Non-contacting type power transmission apparatus for portable equipment e.g. cordless telephone, liquid crystal TV includes DC-DC converter which provides predetermined voltage drop, when suitable current flows through inductor of primary circuit

INVENTOR: HAYASHI H

PATENT-ASSIGNEE: ROHM CO LTD[ROHL]

PRIORITY-DATA: 1995JP-342615 (December 28, 1995)

PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE
JP 09182323 A	July 11, 1997	JA

APPLICATION-DATA:

PUB-NO	APPL- DESCRIPTOR	APPL-NO	APPL-DATE
JP 09182323A	N/A	1995JP-342615	December 28, 1995

INT-CL-CURRENT:

TYPE	IPC DATE
CIPP	H02J17/00 20060101
CIPS	H02J1/00 20060101
CIPS	H02J7/00 20060101
CIPS	H02M3/28 20060101
CIPS	H02M7/06 20060101

ABSTRACTED-PUB-NO: JP 09182323 A

BASIC-ABSTRACT:

The apparatus has commutator to alter direction of electric power from main power supply (6). The frequency of commutation is fixed at predetermined level and is fed to an inductor (L1) in primary circuit (1). Due to flow of current

through the inductor in primary circuit, an inductor in secondary circuit (2) is coupled by electromagnetic field and transmits electric power.

A DC-DC converter (3) provides predetermined voltage drop across it.

USE/ADVANTAGE - For electrically driven toothbrush, construction equipments. Provides minimum inductance value.

CHOSEN- Dwg.1/1

DRAWING:

TITLE- NON CONTACT TYPE POWER TRANSMISSION APPARATUS

TERMS: PORTABLE EQUIPMENT CORD TELEPHONE LIQUID CRYSTAL
TELEVISION DC CONVERTER PREDETERMINED VOLTAGE DROP
SUIT CURRENT FLOW THROUGH INDUCTOR PRIMARY CIRCUIT

ADDL- ELECTRIC TOOTHBRUSH CONSTRUCTION APPLIANCE

INDEXING-

TERMS:

DERWENT-CLASS: U24 W01 W03 X16 X27

EPI- U24-D02B1; U24-H; W01-C01D; W01-C01E5A; W03-A07A;

CODES: W03-G02; X16-G01; X27-A02A3A;

SECONDARY-ACC-NO:

Non-CPI Secondary Accession Numbers: 1997-341061

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Notes:

1. Untranslatable words are replaced with asterisks (* * * * *).
2. Text in the figures are not translated and shown as it is.

Translated: 07:50:04 JST (09/30/2013)

Dictionary: Last updated 09/27/2013 / Priority: 1. Electronic engineering / 2. Automobile

FULL CONTENTS

[Claim(s)]

[Claim 1][by supplying a resonance means which rectifies electric power from commercial power, switches the rectification electric power with predetermined frequency and contains an inductor] Noncontact type power transmission equipment providing a pressure-lowering means to be noncontact type power transmission equipment which transmits electric power to a secondary side circuit containing an inductor combinable with the aforementioned inductor in electromagnetism by non-contact, and to make a specified value lower the pressure of voltage of the aforementioned rectification electric power.

[Claim 2]The noncontact type power transmission equipment according to claim 1, wherein switching of the aforementioned rectification electric power is performed with an oscillator which uses the aforementioned rectification electric power as a power supply, and a transistor which switches the aforementioned rectification electric power supplied to the aforementioned resonance means according to an oscillation output from this oscillator.

[Claim 3]The noncontact type power transmission equipment according to claim 1 or 2 with which the aforementioned secondary side circuit is characterized by charging the aforementioned storage battery by electric power transmitted by non-contact including a storage battery.

[Detailed Description of the Invention]

[0001]

[Field of the Invention]The invention in this application relates to the noncontact type power transmission equipment which transmits the electric power obtained from commercial power to a secondary side circuit by non-contact.

[0002]

[Description of the Prior Art]In recent years, a majority of various kinds of portable devices which use electric power, such as a cordless telephone, a liquid crystal television, an electric toothbrush, and a work instrument, are used daily. Such a portable device usually contains a rechargeable battery.

It is necessary to charge suitably.

Although various kinds of methods are adopted as this charge, it is most convenient that charge is made to be performed only by placing a portable device on a charger stand etc., without connecting an adapter, a code, etc. for charge to a portable device.

[0003]Then, although the noncontact type power transmission equipment using electromagnetic induction is proposed, [by supplying the resonance means which conventional noncontact type power transmission equipment rectifies the electric power from commercial power, switches the rectification electric power with predetermined frequency, and contains an inductor] It was the composition which

transmits electric power to the secondary side circuit containing an inductor combinable with the inductor of a resonance means in electromagnetism by non-contact.

[0004]However, since direct supply of the rectification electric power which carried out full wave rectification of the commercial electric power is carried out to a resonant circuit in conventional noncontact type power transmission equipment, Since the voltage of rectification electric power is high and the loss of the transistor for switching which was connected to the resonant circuit for this reason is large, switching frequency cannot be made sufficient high and, as a result, the inductance of a resonant circuit cannot be made small. when the voltage of commercial power is 100 volts, the peak value of the voltage of the rectification electric power which carried out full wave rectification is about 141 volts -- switching frequency -- severalkilohertz-100 -- being set to about tens of kHz or less -- an inductance -- several -- it becomes mH degree (for example, 7.05mH) and a big value. The peak value of the voltage applied to the transistor for switching also turns into 442 volts and a big value, for example.

[0005]Therefore, since the inductor of the resonant circuit could not be enlarged and an inductor could not be patternized on the substrate, while becoming the hindrance of the small size and the weight saving of noncontact type power transmission equipment, it needed to mount in the substrate by having used the inductor as the discrete part, and the problem that productivity was bad occurred. And the thing of high withstand pressure needed to be used as a transistor for switching.

[0006]

[Description of the Invention]The invention in this application makes it the problem to be invented under the above-mentioned circumstances and to provide the noncontact type power transmission equipment which can make the inductance of a resonance means small good.

[0007]In order to solve the above-mentioned problem, the following technical means are provided in the invention in this application.

[0008] by supplying the resonance means which rectifies the electric power from commercial power, switches the rectification electric power with predetermined frequency, and contains an inductor according to the first side surface of the invention in this application] It is noncontact type power transmission equipment which transmits electric power to the secondary side circuit containing an inductor combinable with the inductor of a resonance means in electromagnetism by non-contact, and the noncontact type power transmission equipment which provided a pressure-lowering means to make a specified value lower the pressure of the voltage of rectification electric power is provided.

[0009]Since a specified value is made to lower the pressure of the voltage of rectification electric power by a pressure-lowering means and a resonance means is supplied, the loss of switching is reduced and, as a result, switching frequency can be made sufficient high. And the voltage applied to the inductor of a resonance means is sufficiently low. Therefore, the inductance of a resonance means can be made small good, for example, an inductor can be patternized on a substrate. Therefore, while the small size and the weight saving of equipment are realizable, it becomes unnecessary to mount in a substrate by the ability to use an inductor as a discrete part, and improvement in productivity can be aimed at. Of course, since switching frequency can be made sufficient high, the inductance of a secondary side circuit can also be made small and an effect with the same said of a secondary side circuit is acquired.

[0010]As a rectification means which rectifies the electric power from commercial power, a full wave rectifying circuit or a half wave rectifier circuit can be used, for example.

[0011]As a resonance means containing an inductor, the parallel resonant circuit of an inductor and a capacitor or the series resonant circuit of an inductor and a capacitor can be used, for example.

[0012]According to the preferable embodiment, switching of rectification electric power is performed by the oscillator which uses rectification electric power as a power supply, and the transistor which switches the rectification electric power supplied to a resonance means according to the oscillation output from this oscillator.

[0013]As a transistor, a field-effect transistor or a bipolar transistor can be used. In the case of a field-effect transistor, a gate is connected to the outgoing end of an oscillator and between source drains is connected to a resonance means and series. In the case of a bipolar transistor, a base is connected to the outgoing end of an oscillator and between collector emitters is connected to a resonance means and series. Since the pressure of rectification electric power is lowered by a pressure-lowering means, a pressure-proof low thing can be used as a transistor for switching, and reduction of a manufacturing cost can be aimed at.

[0014]According to another preferable embodiment, a storage battery is charged by the electric power by which the secondary side circuit was transmitted by non-contact including the storage battery.

[0015]As a storage battery, a nickel-cadmium battery, a nickel hydride battery, a lithium ion battery, etc. can be used, for example.

[0016]The other characteristics and advantages of the invention in this application will become clearer by the detailed description performed to below with reference to an accompanying drawing.

[0017]

[Mode for carrying out the invention]Hereafter, the preferable embodiment of the invention in this application is specifically described with reference to Drawings.

[0018]Fig. 1 is a circuit diagram of the noncontact type power transmission equipment concerning the invention in this application, and is illustrating electric power in Fig. 1 also including the secondary side circuit 2 transmitted by no contacting [the noncontact type power transmission equipment 1 to] other than the noncontact type power transmission equipment 1. Although not illustrated, the secondary side circuit 2 is built in various kinds of portable devices which use electric power, such as a cordless telephone, a liquid crystal television, an electric toothbrush, and a work instrument.

The noncontact type power transmission equipment 1 is built in a charger stand of those portable devices.

This noncontact type power transmission equipment 1 is provided with DC to DC converter 3, oscillator 4, power source plug 5, diode D1, capacitor C1-C3, inductor L1, and field-effect transistor FET1.

The power source plug 5 is electrically connected to the commercial power 6.

[0019]The secondary side circuit 2 is provided with inductor L2, capacitor C4, C5, diode D2, and switch SW1 and the storage battery 7.

[0020]An end of the commercial power 6 is connected to an anode of the diode D1 via the power source plug 5.

A cathode of the diode D1 is connected to an input terminal of DC to DC converter 3, and an end of the capacitor C1.

An outgoing end of DC to DC converter 3 is connected to the capacitor C2, an end of C3, a power supply input end of the oscillator 4, and an end of the inductor L1.

An outgoing end of the oscillator 4 is connected to a gate of field-effect transistor FET1.

The other end of the inductor L1 is connected to the other end of the capacitor C3, and a drain of field-effect transistor FET1.

A ground edge of the capacitor C1, the other end of C2 and DC to DC converter 3, and the oscillator 4 and a source of field-effect transistor FET1 are connected to the other end of the commercial power 6 via the power source plug 5.

[0021]An end of the inductor L2 is connected to an end of the capacitor C4, and an anode of the diode D2.

A cathode of the diode D2 is connected to an end of the capacitor C5, and an end of switch SW1.

The other end of switch SW1 is connected to a positive electrode end of the storage battery 7.

An anode end of the storage battery 7, and the capacitor C4 and the other end of C5 are connected to the other end of the inductor L2.

[0022]The capacitor C1 consisting of the diode D1 and an electrolytic capacitor constitutes the rectification means which rectifies the electric power from the

commercial power 6 of 100 volts of single-phase alternative currents, for example. DC to DC converter 3 constitutes a pressure-lowering means to lower the pressure of the voltage of the rectification electric power rectified by the rectification means which consists of the diode D1 and the capacitor C1 to prescribed voltage. Since the specific circuit of this DC to DC converter 3 is well-known, illustration and a description are omitted. The capacitor C2 consists of electrolytic capacitors, and constitutes the smoothing means which smooths the rectification electric power whose pressure was lowered by DC to DC converter 3. The oscillator 4 and field-effect transistor FET1 constitute the switching means which switches the rectification electric power smoothed by the capacitor C2 with predetermined frequency. That is, the oscillator 4 operates considering the rectification electric power whose pressure was lowered by DC to DC converter 3 as a power supply, and supplies the pulse signal of the predetermined frequency set up previously to the gate of field-effect transistor FET1. By this, [between the channels of field-effect transistor FET1 i.e., a drain source,] Reversal between continuity and non-continuity is repeated according to the frequency of the pulse signal from the oscillator 4, and the rectification electric power from DC to DC converter 3 supplied to the resonance means which consists of the inductor L1 and the capacitor C3 is made intermittent. Since the specific circuit of the oscillator 4 is well-known, illustration and a description are omitted. Field-effect transistor FET1 is n channel enhancement mode MOS-FET. The inductor L1 and the capacitor C3 constitute the resonance means which consists of parallel resonant circuits, and the oscillated frequency of the oscillator 4 is set up to satisfy the resonance condition of this parallel resonant circuit substantially.

[0023]The inductor L2 and the capacitor C4 of the secondary side circuit 2 constitute the parallel resonant circuit, and the electromotive force by electromagnetic induction generates them in the inductor L2 by making the inductor L2 be placed at the state of interlinking with the magnetic flux by the inductor L1 of the noncontact type power transmission equipment 1. Circuit conditions are set up so that this parallel resonant circuit may resonate with the electromotive force generated in the inductor L2 by electromagnetic induction. The capacitor C5 consisting of the diode D2 and an electrolytic capacitor constitutes the rectifier circuit which rectifies the guidance electric power from the parallel resonant circuit consisting of the inductor L2 and the capacitor C4. Switch SW1 constitutes the switching means which supplies the rectification electric power from the rectifier circuit which consists of the diode D2 and the capacitor C5 to the storage battery 7. It charges with the rectification electric power supplied via the switching means which consists of switch SW1, and the storage battery 7 constitutes the power supply which supplies direct current power to various circuits (not shown), such as a control circuit of a portable device, and a drive circuit.

[0024]Next, operation is described. If the power source plug 5 is inserted in the electric socket (not shown) of the commercial power 6, From the commercial power 6, it is supplied to the noncontact type power transmission equipment 1 by the commercial electric power of 100 volts of single-phase alternative currents, and, [this commercial electric power] It is rectified by the rectification means which consists of the diode D1 and the capacitor C1, the pressure is lowered by prescribed voltage with DC to DC converter 3, it smooths by the smoothing means which consists of the capacitor C2, and the resonance means and the oscillator 4 consisting of the inductor L1 and the capacitor C3 are supplied. Thereby, the oscillator 4 supplies the pulse signal of predetermined frequency to the gate of field-effect transistor FET1, and field-effect transistor FET1 turns on and turns off with predetermined frequency. Therefore, the rectification electric power supplied to the resonance means which consists of the inductor L1 and the capacitor C3 is intermittent with predetermined frequency, a resonance means resonates, and magnetic flux occurs by the inductor L1. Since the pressure of rectification electric power is appropriately lowered with DC to DC converter 3 at this time and the loss of field-effect transistor FET1 by switching is reduced good, switching frequency can be made sufficient high. As a result, the inductance of the inductor L1 can be made sufficient small, and it becomes possible to patternize the inductor L1 on a substrate.

[0025]For example, when it was considered as the voltage with 100 volts of the

commercial power 6 and the pressure of the peak value of the voltage of rectification electric power is lowered with DC to DC converter 3 to several volts - tens of volts (for example, 12 volts), If frequency of switching is made high until the loss by switching of field-effect transistor FET1 becomes a tolerance limit, it will become possible to switch on the frequency of hundreds of kHz - several MHz. Therefore, the inductance of the inductor L1 can be made small to about 60 microhenries. As a result, since the inductor L1 can be patternized on a substrate, while the small size and the weight saving of equipment are realizable, it becomes unnecessary to mount in a substrate by using the inductor L1 as a discrete part, and improvement in productivity can be realized. And it becomes small at about 37.7 volts, and the peak value of the voltage applied to the drain of field-effect transistor FET1 can also use a pressure-proof low thing as field-effect transistor FET1.

[0026]If the portable device which contained the secondary side circuit 2 on the charger stand having the noncontact type power transmission equipment 1 is placed, so that it may interlink to the inductor L of the secondary side circuit 2. [the magnetic flux generated by the inductor L1 of the noncontact type power transmission equipment 1] Since the inductor L1 and L2 are arranged, with the magnetic flux generated by the inductor L1, Electromotive force occurs in the inductor L2, and the parallel resonant circuit which consists of the inductor L2 and the capacitor C4 by this resonates, If guidance electric power is rectified by the rectifier circuit which consists of the diode D2 and the capacitor C5 and switch SW1 is closing, the storage battery 7 will be supplied and the storage battery 7 will be charged.

[0027]That is, the electric power from the commercial power 6 is transmitted to the secondary side circuit 2 by the electromagnetic coupling of the inductor L1 and the inductor L2 by non-contact from the noncontact type power transmission equipment 1, and the storage battery 7 is charged. Since switching frequency of the rectification electric power applied to the inductor L1 is made high, and the frequency of the magnetic flux generated by the inductor L1 is also high, the inductance of the inductor L2 of the secondary side circuit 2 can also be made small. Therefore, since the inductor L2 can also be patternized on a substrate, while the small size and the weight saving of the secondary side circuit 2 are realizable, it becomes unnecessary to mount in a substrate by using the inductor L2 as a discrete part, and improvement in productivity can be realized. The above result also becomes possible about a portable device or its charger stand small size and to carry out a weight saving.

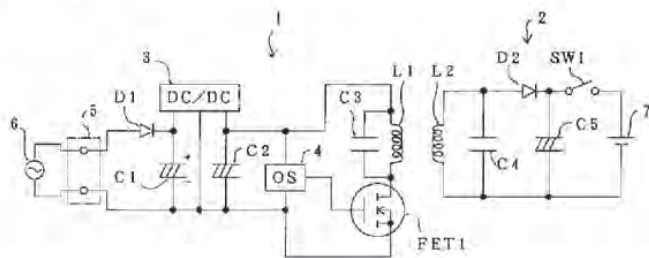
[Brief Description of the Drawings]

[Drawing 1]It is a circuit diagram of the noncontact type power transmission equipment concerning the invention in this application.

[Explanations of letters or numerals]

- 1 Noncontact type power transmission equipment
- 2 Secondary side circuit
- 3 DC to DC converter
- 4 Oscillator
- 7 Storage battery
- FET1 field-effect transistor
- L1 and L2 Inductor
- C3 and C4 Capacitor

[Drawing 1]



[Translation done.]

Report Misinformation

Japanese (Article Document in PDF)

Electronic Acknowledgement Receipt	
EFS ID:	18106022
Application Number:	12649635
International Application Number:	
Confirmation Number:	5891
Title of Invention:	WIRELESS ENERGY TRANSFER TO A MOVING DEVICE BETWEEN HIGH-Q RESONATORS
First Named Inventor/Applicant Name:	John D. Joannopoulos
Customer Number:	26161
Filer:	Marc M. Wefers/Cheryl Forrest
Filer Authorized By:	Marc M. Wefers
Attorney Docket Number:	01997-0359015 / MIT 11757
Receipt Date:	04-FEB-2014
Filing Date:	30-DEC-2009
Time Stamp:	12:22:13
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment		no			
File Listing:					
Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		359015-IDS.pdf	125279 d5297f117a3c088e70acc5c2701c8b31910101450a	yes	2

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New International Application Filed with the USPTO as a Receiving Office

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : John D. Joannopoulos et al. Art Unit : 2836
Serial No. : 12/649,635 Examiner : Fritz Fleming
Filed : December 30, 2009 Conf. No. : 5891
Title : WIRELESS ENERGY TRANSFER TO A MOVING DEVICE BETWEEN HIGH-
Q RESONATORS

MAIL STOP AMENDMENT

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

INFORMATION DISCLOSURE STATEMENT

Please consider the references listed on the enclosed PTO-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. Copies of communications from foreign patent offices in counterpart applications are also enclosed.

This statement is being filed after a request for continued examination and before the mailing of a first Office Action. Please apply any necessary charges or credits to Deposit Account 06-1050, referencing the above attorney docket number.

Respectfully submitted,

Date: February 4, 2014

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

Marc M. Wefers

Reg. No. 56,842

Customer Number 26161
Fish & Richardson P.C.
Telephone: (617) 542-5070
Facsimile: (877) 769-7945

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/649,635	12/30/2009	John D. Joannopoulos	01997-0359015 / MIT 11757	5891
26161 7590 02/27/2014 FISH & RICHARDSON P.C. (BO) P.O. BOX 1022 MINNEAPOLIS, MN 55440-1022			EXAMINER FLEMING, FRITZ M	
			ART UNIT 2836	PAPER NUMBER
			NOTIFICATION DATE 02/27/2014	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

Office Action Summary	Application No. 12/649,635	Applicant(s) JOANNOPOULOS ET AL.	
	Examiner FRITZ M. FLEMING	Art Unit 2836	AIA (First Inventor to File) Status No

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

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) ☒ Responsive to communication(s) filed on 11/20/13.
☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.

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

4) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☒ Claim(s) 1-3,5-7 and 9-48 is/are pending in the application.
5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☒ Claim(s) 1-3,5-7,9-20,23-34,40 and 44-48 is/are rejected.

8) ☒ Claim(s) 21,22,35-39 and 41-43 is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

10) ☐ The specification is objected to by the Examiner.

11) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

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

Certified copies:

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

1. ☐ Certified copies of the priority documents have been received.

2. ☐ Certified copies of the priority documents have been received in Application No. _____.

3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☒ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b)
Paper No(s)/Mail Date 11/20/13,12/10/13,2/4/14

3) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date: _____

4) ☐ Other: _____

1. The present application is being examined under the pre-AIA first to invent provisions.

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 11/20/13 has been entered.

Response to Arguments

2. Applicant's arguments with respect to claims 1-3,5-7,9-48 have been considered but are moot because the arguments do not apply to any of the references being used in the current rejection.

A search of the IEEE database has revealed the article to Yates et al. (referred to as Yates), which teaches the use of "high-Q" reactive near field power transfer via a loop antenna. The boundary of the reactive near field in which energy is stored is $r = \lambda/2\pi$ (1), wherein the reactive near field is a magnetic near field per the reference to Ahmadian et al. (referred to as Ahmadian).

The Staelin reference was provided by applicants.

The "critical acclaim" as indicia of non-obviousness is still not exactly correlated to what is claimed. For example, claims 1 and 8 are in rather broad terms with no specific frequency, power, distance, resonator structure or Q beyond $Q > 100$. Contrast this to

applicants' discussion of the details of the Science Paper not found in the claims. Likewise, the discussion of Stewart mentions a moderate radio frequency, a tunnel, carefully chosen parameters (Q would just be one parameter), and two meters are all not in the claims. It would appear that applicants have made a significant contribution to advancing the state of the art, but the claims at hand do not embrace the technical details of such.

The double patenting rejections are maintained, as they were not argued.

Double Patenting

1. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

2. Claims 1-3,5-7,9-48 are provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-10,12-32,34-50 of copending Application No. 12/639,963. Although the conflicting claims are not identical, they are not patentably distinct from each other because the pending claims broadly recite electromagnetic energy with first and second and third resonators, Q's greater than 100, and other features such as k and loss rates and ranges. The copending application claims similar subject matter in different combinations, except for the third resonator. An addition of an extra resonator is seen as an obvious duplication of parts, as it is desirable to power multiple loads with a single source. Other features such as optimized k for ranges is seen as further defining the concept of what is in the copending application, as finding where things work best is the result of routine experimentation. The addition of feedback in general terms is the addition of well known control principles, as feedback is a desirable control element.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

Claim Rejections - 35 USC § 103

3. The following is a quotation of pre-AIA 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under pre-AIA 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating

obviousness or nonobviousness.

5. This application currently names joint inventors. In considering patentability of the claims under pre-AIA 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to

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consider the applicability of pre-AIA 35 U.S.C. 103(c) and potential pre-AIA 35 U.S.C. 102(e), (f) or (g) prior art under pre-AIA 35 U.S.C. 103(a).

6. Claims 1-3,5-7,9-20,23-34,40,44-48 rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Yates in view of Ahmadian and Staelin.

First turning to Yates, it is noted per the abstract the “high-Q” is used in both near and far field short range wireless link power transfer. A loop antenna is used, and the arena of use is in adhoc mobile networks, which clearly means that the source and load are relatively movable and free to move within the near-field range. See for example page 1406 and the antenna field regions and the equivalent circuit model of the multi-turn loop antenna using lumped parameters, page 1408 modeling of the near-field transmission to include radiation and loss resistances as well as series/parallel tuned resonant coils in the transmitter and receiver, page 1409 which discusses a wireless link that is peer-to-peer in which the transmitting and receiving antennas are identical, and page 1412 for a Q of about 300 for a loop antenna radius of 5mm. Taking all of this together, one of ordinary skill in the art readily appreciates the use of high-Q (300 is over 100) identical tuned resonant loop antenna circuits in both the transmitter and receiver (thus having resonant frequencies being the same for identical tuned circuits), the use of the near field for wireless peer-to-peer link for power transfer for freely movable objects within the near field (ubiquitous), wherein the near field range is greater than the largest characteristic size of 5mm radius (see Figures 9 and 10). An energy source is the Colpitts oscillator, and the load can be for battery charging. Yates lacks specific mention of the third resonator, and the term resonator.

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In the same field of endeavor, Ahmadian page 3028 shows that it is well known and old in the art to use a magnetic antenna to generate a magnetic field in the near field, such as the distance between the transmitter and receiver is less than one meter at a maximum frequency of 50MHz.

Staelin is a valuable reference to conclude that a high-Q tuned resonant circuit is a resonator and can store electromagnetic energy with a defined Q of $\omega/2\alpha$, wherein α corresponds to the intrinsic loss rates. See for example the summary of section 8-10, as well as the in depth treatment of the discrete element resonator circuits in section 8.4.

Therefore it would have been obvious to one having ordinary skill in the art at the time that the invention was made to modify the Yates teachings by those of Ahmadian and Staelin to realize use in an alternating magnetic/electromagnetic near field environment via a discrete element resonator, as doing so allows for the use of a high-Q (each being 300 which is over 100 and over 200) source to load wireless power coupling with the use of resonators, and achieves the stated goal of ubiquitous computing. The use of identical tuned resonant circuits entails resonant frequencies and loss rates that would also be identical (claims 1-3,5-7,9,10,23,24,40,44). As far as the third resonator (claims 13,14,27,28) is concerned, it is noted that the claims do not require temporally simultaneous coupling of all three resonators. This in mind, it is obviously clear that in Yates, more than two loads and sources are contemplated, as the ubiquitous computing paradigm envisages devices being embedded in everyday objects, and also being worn or carried and possibly even implanted in users and theses devices are capable of

forming adhoc networks. The repeated use of "devices" renders a third resonator source/load obvious, either simultaneously or not coupled to the source and the second resonator at given distances, each with its respective resonant frequency (not required to be different) and Q over 100, located at a given distance, and coupled to transfer wirelessly electromagnetic energy to provide useful energy/power at the load/energy drain device in the form of an exemplary cell phone or PDA (claims 11,12,25,26). The efficiency of claims 19 and 33 being 20% is a matter of design criteria, as ultra-low power adhoc networks would need the efficiency to be as high as possible. For claims 45-48, Yates teaches near field resistive and radiative loss components (page 1408). For claims 15 and 29 the use of tuned resonant circuits in Yates requires tunable resonators as defined by Staelin. For claims 16-18 and 30-32, the mobile adhoc networks of Yates entails free movement over a range of distances as the distances are shown to be in the near and far field, and thus obviously encompass including 5,10 and 30cm as seen in the various Figures, especially Figures 9 and 10 showing .5 and 1m transmission distance. Finally, for claims 20 and 34, the addition of feedback in general terms is the addition of well known control principles, as feedback is a desirable control element, noting the claims do not go beyond the function of providing feedback to correct for detuning. Given the voluminous number of references made of record, the examiner takes official notice that this broadly recited technical feature is well known in the art, and the use of such represents an improvement to correct for possible frequency drift due to component aging or manufacturing tolerances.

Allowable Subject Matter

7. Claims 21,22,35-39,41-43 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.
8. The following is a statement of reasons for the indication of allowable subject matter: The art of record does not teach the particular claimed configured to be driven/adjustably tuned for the varying k.
9. Applicants' representative is cordially invited to contact me to discuss possible alternative claim amendments that could place the application in condition for allowance, noting the comments above regarding the critical acclaim.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to FRITZ M. FLEMING whose telephone number is (571)272-4145. The examiner can normally be reached on M-F, 0900-1730.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jared Fureman can be reached on 571-272-2391. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

FRITZ M FLEMING
Primary Examiner
Art Unit 2836

/FRITZ M FLEMING/
Primary Examiner, Art Unit 2836

Notice of References Cited	Application/Control No. 12/649,635	Applicant(s)/Patent Under Reexamination JOANNOPOULOS ET AL.	
	Examiner FRITZ M. FLEMING	Art Unit 2836	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
	A	US-			
	B	US-			
	C	US-			
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Search Notes 	Application/Control No. 12649635	Applicant(s)/Patent Under Reexamination JOANNOPOULOS ET AL.
	Examiner FRITZ M FLEMING	Art Unit 2836

CPC- SEARCHED		
Symbol	Date	Examiner

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner
307	104	12/17/2012	FMF

SEARCH NOTES		
Search Notes	Date	Examiner
EAST,PLUSupdated search.	12/17/20126/17/2013	FMFFMF

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner

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Index of Claims 	Application/Control No. 12649635	Applicant(s)/Patent Under Reexamination JOANNOPOULOS ET AL.
	Examiner FRITZ M FLEMING	Art Unit 2836

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant				☐ CPA		☐ T.D.		☐ R.1.47	
CLAIM		DATE							
Final	Original	12/17/2012	06/17/2013						
	1	✓	✓						
	2	✓	✓						
	3	✓	✓						
	4	✓	-						
	5	✓	✓						
	6	✓	✓						
	7	✓	✓						
	8	✓	-						
	9	✓	✓						
	10	✓	✓						
	11	✓	✓						
	12	✓	✓						
	13	✓	✓						
	14	✓	✓						
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	27	✓	✓						
	28	✓	✓						
	29	✓	✓						
	30	✓	✓						
	31	✓	✓						
	32	✓	✓						
	33	✓	✓						
	34	✓	✓						
	35	✓	✓						
	36	✓	✓						

<i>Index of Claims</i> 	Application/Control No. 12649635	Applicant(s)/Patent Under Reexamination JOANNOPOULOS ET AL.
	Examiner FRITZ M FLEMING	Art Unit 2836

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
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☐ Claims renumbered in the same order as presented by applicant				☐ CPA		☐ T.D.		☐ R.1.47	
CLAIM		DATE							
Final	Original	12/17/2012	06/17/2013						
	37		✓						
	38		✓						
	39		✓						
	40		✓						
	41		✓						
	42		✓						
	43		✓						
	44		✓						

Receipt date: 12/10/2013

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Substitute Disclosure Form	U.S. Department of Commerce Patent and Trademark Office	Attorney Docket No. 01997-0359015	Application No. 12/649,635
Information Disclosure Statement by Applicant (Use several sheets if necessary) (37 CFR §1.98(b))		Applicant John D. Joannopoulos et al.	
		Filing Date December 30, 2009	Group Art Unit 2836

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

Substitute Disclosure Form	U.S. Department of Commerce Patent and Trademark Office	Attorney Docket No. 01997-0359015	Application No. 12/649,635
Information Disclosure Statement by Applicant (Use several sheets if necessary) (37 CFR §1.98(b))		Applicant John D. Joannopoulos et al.	
		Filing Date December 30, 2009	Group Art Unit 2836

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.	

Substitute Disclosure Form

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

Receipt date: 12/10/2013

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Sheet 3 of 3

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

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

Receipt date: 11/20/2013

12649635 - GAU: 2836

Sheet 1 of 2

Substitute Disclosure Form	U.S. Department of Commerce Patent and Trademark Office	Attorney Docket No. 01997-0359015	Application No. 12/649,635
Information Disclosure Statement by Applicant (Use several sheets if necessary) (37 CFR §1.98(b))		Applicant John D. Joannopoulos et al.	
		Filing Date December 30, 2009	Group Art Unit 2836

U.S. Patent Documents							
Examiner Initial	Desig. ID	Document Number	Publication Date	Patentee	Class	Subclass	Filing Date If Appropriate
	1	4,588,978	5/13/1986	Allen			
	2	5,033,295	7/23/1991	Schmid et al.			
	3	5,864,323	1/26/1999	Berthon			
	4	6,563,425	05/13/2003	Nicholson et al.			
	5	6,650,227	11/18/2003	Bradin			
	6	6,839,035	1/4/2005	Addonisio et al.			
	7	7,443,135	10/28/2008	Cho			
	8	7,545,337	6/9/2009	Guenther			
	9	7,863,859	1/4/2011	Soar			
	10	8,131,378	3/6/2012	Greenberg et al.			
	11	2005/0027192	2/3/2005	Govari 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
	12	SG 112842	7/28/2005	Singapore			English Abstract Only	

Other Documents (include Author, Title, Date, and Place of Publication)		
Examiner Initial	Desig. ID	Document
	13	Shanhui Fan et al., "Rate-Equation Analysis of Output Efficiency and Modulation Rate of Photonic-Crystal Light-Emitting Diodes", <u>IEEE Journal of Quantum Electronics</u> , Vol. 36, No. 10, pp. 1123-1130 (October 2000)
	14	Jonathan Fildes, "Wireless Energy Promise Powers Up", <u>BBC News</u> , June 7, 2007 (See http://news.bbc.co.uk/2/hi/6725955.stm)
	15	Klaus Finkenzeller, <u>RFID Handbook - Fundamentals and Applications in Contactless Smart Cards</u> -, Nikkan Kohgyo-sya, Kanno Taihei, first version, pp. 32-37, 253 (8/21/2001),
	16	S. L. Ho et al., "A Comparative Study Between Novel Witricity and Traditional Inductive Magnetic Coupling in Wireless Charging", <u>IEEE Transactions on Magnetics</u> , Vol. 47, No. 5, pp. 1522-1525 (May 2011)
	17	Will Stewart, "The Power to Set you Free", <u>Science</u> , Vol. 317, pp. 55-56 (July 6, 2007)
	18	Copy of Final Office Action with regard to U.S. Application No. 12/639,958 by Examiner Fritz M. Fleming dated June 6, 2013 (18 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./

Receipt date: 11/20/2013

12649635 - GAU: 2836

Sheet 2 of 2

Substitute Disclosure Form	U.S. Department of Commerce Patent and Trademark Office	Attorney Docket No. 01997-0359015	Application No. 12/649,635
Information Disclosure Statement by Applicant (Use several sheets if necessary) (37 CFR §1.98(b))		Applicant John D. Joannopoulos et al.	
		Filing Date December 30, 2009	Group Art Unit 2836

Other Documents (include Author, Title, Date, and Place of Publication)		
Examiner Initial	Desig. ID	Document
	19	Copy of Non-Final Office Action with regard to U.S. Application No. 12/949,580 by Examiner Fritz M. Fleming dated June 17, 2013 (55 pages)
	20	Copy of Final Office Action with regard to U.S. Application No. 12/639,963 by Examiner Fritz M. Fleming dated June 18, 2013 (16 pages)
	21	Copy of Final Office Action with regard to U.S. Application No. 12/649,813 by Examiner Fritz M. Fleming dated June 24, 2013 (17 pages)
	22	Copy of Final Office Action with regard to U.S. Application No. 12/649,777 by Examiner Fritz M. Fleming dated June 26, 2013 (17 pages)
	23	Copy of Final Office Action with regard to U.S. Application No. 12/649,852 by Examiner Fritz M. Fleming dated June 27, 2013 (19 pages)
	24	Copy of Final Office Action with regard to U.S. Application No. 12/649,904 by Examiner Fritz M. Fleming dated September 26, 2013 (23 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./

Receipt date: 02/04/2014

12649635 - GAU: 2836

Sheet 1 of 1

Substitute Disclosure Form	U.S. Department of Commerce Patent and Trademark Office	Attorney Docket No. 01997-0359015	Application No. 12/649,635
Information Disclosure Statement by Applicant (Use several sheets if necessary) (37 CFR §1.98(b))		Applicant John D. Joannopoulos et al.	
		Filing Date December 30, 2009	Group Art Unit 2836

U.S. Patent Documents							
Examiner Initial	Desig. ID	Document Number	Publication Date	Patentee	Class	Subclass	Filing Date If Appropriate
	1	6,176,433	1/23/2001	Uesaka 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	JP 9-182323	7/11/1997	Japan	H02J	17/00	Machine Translation	

Other Documents (include Author, Title, Date, and Place of Publication)		
Examiner Initial	Desig. ID	Document
	3	Chinese Office Action, Application No. 201110311000.X; mailed December 6, 2013; Applicant: Massachusetts Institute of Technology; 20 pages
	4	Canadian Office Action, Application No. 2,682,284; mailed November 25, 2013; Applicant: Massachusetts Institute of Technology; 3 pages
	5	European Office Action, Application No. 11 184 066.6; mailed December 3, 2013; 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./



UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/649,635	12/30/2009	John D. Joannopoulos	01997-0359015 / MIT 11757	5891
26161 7590 04/16/2014 FISH & RICHARDSON P.C. (BO) P.O. BOX 1022 MINNEAPOLIS, MN 55440-1022			EXAMINER FLEMING, FRITZ M	
			ART UNIT 2836	PAPER NUMBER
			NOTIFICATION DATE 04/16/2014	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

<i>Applicant-Initiated Interview Summary</i>	Application No. 12/649,635	Applicant(s) JOANNOPOULOS ET AL.	
	Examiner FRITZ M. FLEMING	Art Unit 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: 1,5,9,21-23,35 and 36.

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 claims 1,5,9,21-23,35 and 36 to include the "objected to" language per the office action., which would place the claims into condition for allowance. We also discussed the language of [0037] 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 or 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 Examiner's 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	12649635		
Filing Date	30-Dec-2009		
First Named Inventor	John Joannopoulos		
Attorney Docket Number	01997-0359015 / MIT 11757		
Title of Invention	WIRELESS ENERGY TRANSFER TO A MOVING DEVICE BETWEEN HIGH-Q RESONATORS		
☒ 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)			
12639963 filed on 12/16/2009 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:		12649635		
Filing Date:		30-Dec-2009		
Title of Invention:		WIRELESS ENERGY TRANSFER TO A MOVING DEVICE BETWEEN HIGH-Q RESONATORS		
First Named Inventor/Applicant Name:		John D. Joannopoulos		
Filer:		Marc M. Wefers		
Attorney Docket Number:		01997-0359015 / 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.: 12649635

Filing Date: 30-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:	18774536
Application Number:	12649635
International Application Number:	
Confirmation Number:	5891
Title of Invention:	WIRELESS ENERGY TRANSFER TO A MOVING DEVICE BETWEEN HIGH-Q RESONATORS
First Named Inventor/Applicant Name:	John D. Joannopoulos
Customer Number:	26161
Filer:	Marc M. Wefers
Filer Authorized By:	
Attorney Docket Number:	01997-0359015 / MIT 11757
Receipt Date:	16-APR-2014
Filing Date:	30-DEC-2009
Time Stamp:	09:59:34
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	8154
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	34196	no	2
			151e21ea66c18d2ac3d9bea19d29fa1achd1bf7		

Warnings:**Information:**

2	Fee Worksheet (SB06)	fee-info.pdf	30609	no	2
			b2ab0a14311b7f4adcd9bc77cd6503a0fba3d1		

Warnings:**Information:****Total Files Size (in bytes):**

64805

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

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : John D. Joannopoulos et al. Art Unit : 2836
Serial No. : 12/649,635 Examiner : Fritz Fleming
Filed : December 30, 2009 Conf. No. : 5891
Title : WIRELESS ENERGY TRANSFER TO A MOVING DEVICE BETWEEN HIGH-
Q RESONATORS

Mail Stop Amendment

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

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 first resonator having a resonant frequency ω_1 and an intrinsic loss rate Γ_1 , and capable of storing electromagnetic energy with an intrinsic quality factor $Q_1 = \omega_1 / (2\Gamma_1)$ greater than 100, and configured to be coupled to an energy source to generate an oscillating near field region; and
a second resonator having a resonant frequency ω_2 and an intrinsic loss rate Γ_2 , and capable of storing electromagnetic energy with an intrinsic quality factor $Q_2 = \omega_2 / (2\Gamma_2)$ greater than 100, and configured to move freely within the near field region of the first resonator,
wherein the first resonator and the second resonator are configured to be coupled to transfer electromagnetic energy from said first resonator to said second resonator when the first resonator is coupled to the energy source as the second resonator moves freely within the near field region, and
further comprising the energy source configured to be coupled to the first resonator and an energy drain configured to be coupled to the second resonator to provide useful power to the energy drain, and wherein the energy source is configured to provide energy to the first resonator at a rate that varies with a rate of wireless energy transfer κ between the first resonator and the second resonator.
2. (Original) The system of claim 1, wherein near field of the near field region is a magnetic field.
3. (Original) The system of claim 1, wherein near field of the near field region is an electromagnetic field.
4. (Canceled)
5. (Currently Amended) A method, comprising:

providing a first resonator having a resonant frequency ω_1 and an intrinsic loss rate Γ_1 , and capable of storing electromagnetic energy with an intrinsic quality factor $Q_1 = \omega_1 / (2\Gamma_1)$ greater than 100, coupled to an energy source, generating an oscillating near field region; and

providing a second resonator having a resonant frequency ω_2 and an intrinsic loss rate Γ_2 , and capable of storing electromagnetic energy with an intrinsic quality factor $Q_2 = \omega_2 / (2\Gamma_2)$, greater than 100, and moving freely within the near field region of the first resonator,

wherein the first resonator and the second resonator are coupled to transfer electromagnetic energy from said first resonator to said second resonator as the second resonator moves freely within the near field region,

wherein an energy drain is coupled to the second resonator to provide useful power to the energy drain, and the method further comprises providing energy to the first resonator at a rate that varies with a rate of wireless energy transfer κ between the first resonator and the second resonator.

6. (Original) The method of claim 5, wherein near field of the near field region is a magnetic field.

7. (Original) The method of claim 5, wherein near field of the near field region is an electromagnetic field.

8. (Canceled)

9. (Currently Amended) A system, comprising:

a first resonator having a resonant frequency ω_1 and an intrinsic loss rate Γ_1 , and capable of storing electromagnetic energy with an intrinsic quality factor $Q_1 = \omega_1 / (2\Gamma_1)$, and configured to be coupled to an energy source to generate a near field region comprising an oscillating magnetic field; and

a second resonator having a resonant frequency ω_2 and an intrinsic loss rate Γ_2 , and capable of storing electromagnetic energy with an intrinsic quality factor $Q_2 = \omega_2 / (2\Gamma_2)$, and configured to move freely within the near field region of the first resonator,

wherein the first resonator and the second resonator are configured to be coupled to wirelessly transfer electromagnetic energy from said first resonator to said second resonator when the first resonator is coupled to the energy source as the second resonator moves freely within the near field region,

wherein $\sqrt{Q_1 Q_2} > 100$, and

further comprising the energy source configured to be coupled to the first resonator and an energy drain configured to be coupled to the second resonator to provide useful power to the energy drain, and wherein the energy source is configured to provide energy to the first resonator at a rate that varies with a rate of wireless energy transfer κ between the first resonator and the second resonator.

10. (Previously Presented) The system of claim 9, where $Q_1 > 100$ and $Q_2 > 100$.
11. (Previously Presented) The system of claim 9, further comprising an energy drain coupled to the second resonator.
12. (Previously Presented) The system of claim 11, wherein the energy drain comprises a robot, vehicle, computer, cell phone, or a portable electronic device.
13. (Previously Presented) The system of claim 9, further comprising a third resonator, optionally coupled to an energy drain, located at a variable distance from the first resonator, and wherein the first resonator and the third resonator are coupled to wirelessly transfer electromagnetic energy from the first resonator to the third resonator.
14. (Previously Presented) The system of claim 9, further comprising a third resonator, optionally coupled to an external power supply, located at a variable distance from the second resonator, and wherein the third resonator and the second resonator are coupled to wirelessly transfer electromagnetic energy from the third resonator to the second resonator.

15. (Previously Presented) The system of claim 9, wherein at least one of the resonators is a tunable resonator.

16. (Previously Presented) The system of claim 9, wherein the energy transfer in the near-field region occurs over a range of distances that includes 5 cm.

17. (Previously Presented) The system of claim 9, wherein the energy transfer in the near-field region occurs over a range of distances that includes 10 cm.

18. (Previously Presented) The system of claim 9, wherein the energy transfer in the near-field region occurs over a range of distances that includes 30 cm.

19. (Previously Presented) The system of claim 9, wherein the efficiency of the wireless energy transfer is at least 20% over a range of distances in the near-field region.

20. (Previously Presented) The system of claim 9, further comprising a feedback mechanism coupled to at least one of the resonators to correct for detuning.

21. (Currently Amended) A system, comprising:
a first resonator having a resonant frequency ω_1 and an intrinsic loss rate Γ_1 , and capable of storing electromagnetic energy with an intrinsic quality factor $Q_1 = \omega_1 / (2\Gamma_1)$, and configured to be coupled to an energy source to generate a near field region comprising an oscillating magnetic field; and

a second resonator having a resonant frequency ω_2 and an intrinsic loss rate Γ_2 , and capable of storing electromagnetic energy with an intrinsic quality factor $Q_2 = \omega_2 / (2\Gamma_2)$, and configured to move freely within the near field region of the first resonator,

wherein the first resonator and the second resonator are configured to be coupled to wirelessly transfer electromagnetic energy from said first resonator to said second resonator when the first resonator is coupled to the energy source as the second resonator moves freely within the near field region,

wherein $\sqrt{Q_1 Q_2} > 100$, and

~~The system of claim 9~~, further comprising the energy drain coupled to the second resonator, and wherein the power supply 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 first resonator and the second resonator.

22. (Currently Amended) A system, comprising:

a first resonator having a resonant frequency ω_1 and an intrinsic loss rate Γ_1 , and capable of storing electromagnetic energy with an intrinsic quality factor $Q_1 = \omega_1 / (2\Gamma_1)$, and configured to be coupled to an energy source to generate a near field region comprising an oscillating magnetic field; and

a second resonator having a resonant frequency ω_2 and an intrinsic loss rate Γ_2 , and capable of storing electromagnetic energy with an intrinsic quality factor $Q_2 = \omega_2 / (2\Gamma_2)$, and configured to move freely within the near field region of the first resonator,

wherein the first resonator and the second resonator are configured to be coupled to wirelessly transfer electromagnetic energy from said first resonator to said second resonator when the first resonator is coupled to the energy source as the second resonator moves freely within the near field region,

wherein $\sqrt{Q_1 Q_2} > 100$, and

The system of claim 9, wherein the first 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 first resonator and the second resonator.

23. (Currently Amended) A method, comprising:

providing a first resonator having a resonant frequency ω_1 and an intrinsic loss rate Γ_1 , and capable of storing electromagnetic energy with an intrinsic quality factor $Q_1 = \omega_1 / (2\Gamma_1)$, coupled to an energy source, generating a near field region comprising an oscillating magnetic field; and

providing a second resonator having a resonant frequency ω_1 and an intrinsic loss rate Γ_1 , and capable of storing electromagnetic energy with an intrinsic quality factor $Q_1 = \omega_1 / (2\Gamma_1)$, and moving freely within the near field region of the first resonator,

wherein the first resonator and the second resonator are coupled to wirelessly transfer electromagnetic energy from said first resonator to said second resonator as the second resonator moves freely within the near field region,

wherein $\sqrt{Q_1 Q_2} > 100$, and

wherein an energy drain is coupled to the second resonator to provide useful power to the energy drain, and the method further comprises providing energy to the first resonator at a rate that varies with a rate of wireless energy transfer κ between the first resonator and the second resonator.

24. (Previously Presented) The method of claim 23, where $Q_1 > 100$ and $Q_2 > 100$.

25. (Previously Presented) The method of claim 23, wherein an energy drain is coupled to the second resonator.

26. (Previously Presented) The method of claim 25, wherein the energy drain comprises a robot, vehicle, computer, cell phone, or a portable electronic device.

27. (Previously Presented) The method of claim 23, wherein a third resonator is optionally coupled to an energy drain and is located at a variable distance from the first resonator, and further comprising wirelessly transferring electromagnetic energy from the first resonator to the third resonator.

28. (Previously Presented) The method of claim 23, wherein a third resonator is optionally coupled to an external power supply and is located at a variable distance from the second resonator, and further comprising wirelessly transferring electromagnetic energy from the third resonator to the second resonator.

29. (Previously Presented) The method system of claim 23, wherein at least one of the resonators is a tunable resonator.

30. (Previously Presented) The method of claim 23, wherein the energy transfer in the near-field region occurs over a range of distances that includes 5 cm.

31. (Previously Presented) The method of claim 23, wherein the energy transfer in the near-field region occurs over a range of distances that includes 10 cm.

32. (Previously Presented) The method of claim 23, wherein the energy transfer in the near-field region occurs over a range of distances that includes 30 cm.

33. (Previously Presented) The method of claim 23, wherein the efficiency of the wireless energy transfer is at least 20% over a range of distances in the near-field region.

34. (Previously Presented) The method of claim 23, wherein a feedback mechanism is coupled to at least one of the resonators to correct for detuning.

35. (Currently Amended) A method, comprising:
providing a first resonator having a resonant frequency ω_1 and an intrinsic loss rate Γ_1 ,
and capable of storing electromagnetic energy with an intrinsic quality factor $Q_1 = \omega_1 / (2\Gamma_1)$,
coupled to an energy source, generating a near field region comprising an oscillating magnetic
field; and
providing a second resonator having a resonant frequency ω_2 and an intrinsic loss rate Γ_2 ,
and capable of storing electromagnetic energy with an intrinsic quality factor $Q_2 = \omega_2 / (2\Gamma_2)$, and
moving freely within the near field region of the first resonator,
wherein the first resonator and the second resonator are coupled to wirelessly transfer
electromagnetic energy from said first resonator to said second resonator as the second resonator
moves freely within the near field region,
wherein $\sqrt{Q_1 Q_2} > 100$, and

~~The method of claim 23~~, wherein the energy drain is coupled to the second resonator, and wherein the power supply and energy drain are driven to increase the ratio of useful-to-lost power for varying wireless energy transfer rates κ between the first resonator and the second resonator.

36. (Currently Amended) A method, comprising:

providing a first resonator having a resonant frequency ω_1 and an intrinsic loss rate Γ_1 , and capable of storing electromagnetic energy with an intrinsic quality factor $Q_1 = \omega_1 / (2\Gamma_1)$, coupled to an energy source, generating a near field region comprising an oscillating magnetic field; and

providing a second resonator having a resonant frequency ω_1 and an intrinsic loss rate Γ_1 , and capable of storing electromagnetic energy with an intrinsic quality factor $Q_1 = \omega_1 / (2\Gamma_1)$, and moving freely within the near field region of the first resonator,

wherein the first resonator and the second resonator are coupled to wirelessly transfer electromagnetic energy from said first resonator to said second resonator as the second resonator moves freely within the near field region,

wherein $\sqrt{Q_1 Q_2} > 100$, and

~~The method of claim 23~~, wherein the first 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 first resonator and the second resonator.

37. Canceled.

38. (Currently Amended) The system of claim [[37]] 9, wherein the energy source is configured to provide energy to the first resonator at a rate that substantially minimizes the energy stored in the first resonator and the second resonator.

39. (Currently Amended) The system of claim [[37]] 9, wherein the energy source is configured to provide energy to the first resonator at a rate that substantially maximizes a ratio of the useful power to lost power from the energy source to the energy drain.

40. (Previously Presented) The system of claim 9, where $Q_1 > 200$ and $Q_2 > 200$.
41. Canceled.
42. (Currently Amended) The method of claim ~~[[41]]~~ 23, wherein the energy source provides energy to the first resonator at a rate that substantially minimizes the energy stored in the first resonator and the second resonator.
43. (Currently Amended) The method of claim ~~[[41]]~~ 23, wherein the energy source provides energy to the first resonator at a rate that substantially maximizes a ratio of the useful power to lost power from the energy source to the energy drain.
44. (Previously Presented) The method of claim 23, where $Q_1 > 200$ and $Q_2 > 200$.
45. (Previously Presented) The system of claim 1, wherein each intrinsic loss rate comprises a resistive component and a radiative component.
46. (Previously Presented) The method of claim 5, wherein each intrinsic loss rate comprises a resistive component and a radiative component.
47. (Previously Presented) The system of claim 9, wherein each intrinsic loss rate comprises a resistive component and a radiative component.
48. (Previously Presented) The method of claim 23, wherein each intrinsic loss rate comprises a resistive component and a radiative component.
49. (New) The system of claim 1, wherein the energy source is configured to provide energy to the first resonator at a rate that substantially minimizes the energy stored in the first resonator and the second resonator,

50. (New) The system of claim 1, wherein the energy source is configured to provide energy to the first resonator at a rate that substantially maximizes a ratio of the useful power to lost power from the energy source to the energy drain.

51. (New) The method of claim 5, wherein the energy source provides energy to the first resonator at a rate that substantially minimizes the energy stored in the first resonator and the second resonator.

52. (New) The method of claim 5, wherein the energy source provides energy to the first resonator at a rate that substantially maximizes a ratio of the useful power to lost power from the energy source to the energy drain.

REMARKS

We thank the Examiner for taking the time to discuss the present application, and related applications 12/649,963, 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 21, 22, 35-39, and 41-43 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, the independent claims 9 and 23 have been amended to include the limitations of allowable dependent claims 37 and 41, respectively, dependent claims 21 and 22 have been rewritten in independent form to include the limitations of independent claim 9, and dependent claims 35, and 36 have been rewritten in independent form to include the limitations of independent claim 23. In addition, independent claims 1 and 5 have been amended to include the subject matter of allowable dependent claims 37 and 41, respectively. Finally, new dependent claims 49-52 have been added and correspond to allowable claims 38, 39, 42, and 43, except that they depend from independent claims 1 or 5, instead of independent claims 9 or 23. Accordingly, all of the claims include subject matter indicated as being allowable.

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

Finally, Applicant notes that though a PTO-892 is referenced and is included in the Office Action dated February 27, 2014, the PTO-892 form is blank. There are no references listed on said document. Applicant respectfully requests that the Examiner make of record both the Yates et al. reference and the Ahmadian et al. reference, both of which are also included in an Information Disclosure Statement (IDS) filed with this Reply.

Applicant : John D. Joannopoulos et al.
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Attorney's Docket No.: 01997-0359015 / MIT Case
No. 11757

In 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.

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

The fees in the amount of \$1,840.00 for excess claims are being paid with this reply on the Electronic Filing System. Apply those fees and 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

Reg. No. 56,842

Customer Number 26161
Fish & Richardson P.C.
Telephone: (617) 542-5070
Facsimile: (877) 769-7945

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : John D. Joannopoulos et al. Art Unit : 2836
Serial No. : 12/649,635 Examiner : Fritz Fleming
Filed : December 30, 2009 Conf. No. : 5891
Title : WIRELESS ENERGY TRANSFER TO A MOVING DEVICE BETWEEN HIGH-
Q RESONATORS

MAIL STOP AMENDMENT

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

INFORMATION DISCLOSURE STATEMENT

Please consider the references listed on the enclosed PTO-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
Reg. No. 56,842

Customer Number 26161
Fish & Richardson P.C.
Telephone: (617) 542-5070
Facsimile: (877) 769-7945

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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. 01997-0359015	Application No. 12/649,635
	First Named Inventor John D. Joannopoulos	
	Filing Date December 30, 2009	Group Art Unit 2836

U.S. Patent Documents							
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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 30, 2009	Group Art Unit 2836

(37 CFR §1.98(b))

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	First Named Inventor John D. Joannopoulos	
	Filing Date December 30, 2009	Group Art Unit 2836

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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

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Plasdoc Punch Codes

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Plasdoc Key Serial Codes

Plasdoc Key Serial Codes

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Enhanced Polymer Indexing

Enhanced Polymer Indexing

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Chemical Fragment Codes

Chemical Fragment Codes

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Legal Status**INPADOC Legal Status**

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Family**Family**

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