



US008089411B2

(12) **United States Patent**
Shimasaki et al.

(10) **Patent No.:** **US 8,089,411 B2**
(45) **Date of Patent:** ***Jan. 3, 2012**

(54) **INFORMATION EQUIPMENT WITH A PLURALITY OF RADIO COMMUNICATION ANTENNAS**

(75) Inventors: **Hiroshi Shimasaki**, Hamura (JP); **Masao Teshima**, Kunitachi (JP); **Satoshi Mizoguchi**, Ome (JP); **Anwar Sathath**, Ome (JP); **Toshiyuki Hirota**, Hino (JP)

(73) Assignee: **Kabushiki Kaisha Toshiba**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 200 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **12/274,711**

(22) Filed: **Nov. 20, 2008**

(65) **Prior Publication Data**
US 2009/0073060 A1 Mar. 19, 2009

Related U.S. Application Data

(63) Continuation of application No. 11/802,149, filed on May 21, 2007, now Pat. No. 7,522,109.

(30) **Foreign Application Priority Data**

May 29, 2006 (JP) 2006-148799

(51) **Int. Cl.**
H01Q 1/24 (2006.01)

(52) **U.S. Cl.** **343/702**; 343/700 MS; 343/872

(58) **Field of Classification Search** 343/702, 343/720, 858, 876, 700 MS, 872; 455/455, 455/509, 552.1, 553.1

See application file for complete search history.

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Primary Examiner — Douglas W Owens

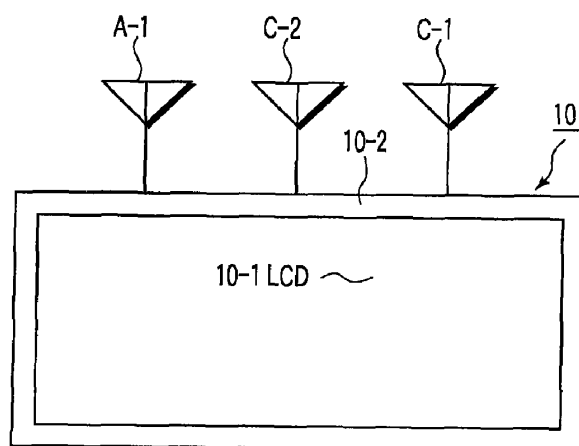
Assistant Examiner — Chuc Tran

(74) *Attorney, Agent, or Firm* — Pillsbury Winthrop Shaw Pittman, LLP

(57) **ABSTRACT**

Information equipment according to an embodiment includes a display housing with a display unit, a first radio communication antenna disposed at an end part of the display housing, a second radio communication antenna using a frequency band adjacent to or overlapped with that of the first radio communication antenna, and a third radio communication antenna disposed at an end part between the first and the second radio communication antennas, and uses a frequency band not adjacent to nor overlapped with those of the first and the second radio communication antennas.

9 Claims, 5 Drawing Sheets



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US008089412B2

(12) **United States Patent**
Nishio

(10) **Patent No.:** **US 8,089,412 B2**
(45) **Date of Patent:** **Jan. 3, 2012**

(54) **ANTENNA DEVICE AND RADIO COMMUNICATION DEVICE**

(75) Inventor: **Masaki Nishio**, Tokyo (JP)

(73) Assignee: **Kabushiki Kaisha Toshiba**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 351 days.

(21) Appl. No.: **12/289,093**

(22) Filed: **Oct. 20, 2008**

(65) **Prior Publication Data**

US 2009/0167617 A1 Jul. 2, 2009

(30) **Foreign Application Priority Data**

Dec. 27, 2007 (JP) 2007-336557

(51) **Int. Cl.**
H01Q 1/24 (2006.01)

(52) **U.S. Cl.** **343/702**

(58) **Field of Classification Search** 343/702,
343/876, 846, 818, 833-834
See application file for complete search history.

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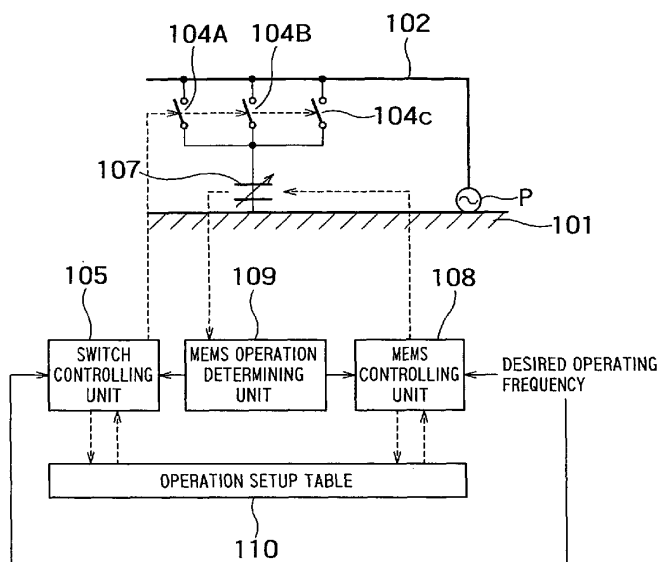
Primary Examiner — Huedung Mancuso

(74) *Attorney, Agent, or Firm* — Nixon & Vanderhye, P.C.

(57) **ABSTRACT**

There is provided with an antenna device includes a conductive ground plane; an antenna including a radiating element; at least one variable capacitor having one end connected to the conductive ground plane; a plurality of switch elements having one ends connected to the other end of said at least one variable capacitor and other ends connected to the antenna at different locations; a switch controlling unit configured to control an ON/OFF state of each of the switch elements; and a capacitor controlling unit configured to control a capacitance of said at least one variable capacitor.

10 Claims, 13 Drawing Sheets



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(10) **Patent No.:** US 8,089,413 B2
(45) **Date of Patent:** Jan. 3, 2012

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| Primary Examiner — Hoanganh Le | | | | | |
| (74) Attorney, Agent, or Firm — Holtz, Holtz, Goodman & Chick, PC | | | | | |
| (57) | | | | | |
| ABSTRACT | | | | | |
| <p>A radio apparatus having a casing and an antenna is provided. The casing has first, second and third faces. The second face and the third face correspond to a side face and another side face of the first face, respectively. The antenna is formed by a conductive line in such a way that the conductive line forms a first loop shape, a second loop shape and a third loop shape, that the first loop shape includes a first portion and a second portion positioned adjacent to a third portion of the second loop shape and a fourth portion of the third loop shape, respectively, that directions of currents distributed on the first portion and the third portion if the antenna is fed are almost same, and that directions of currents distributed on the second portion and the fourth portion if the antenna is fed are almost same.</p> | | | | | |
| 12 Claims, 4 Drawing Sheets | | | | | |



US008089414B2

(12) **United States Patent**
Feldstein et al.

(10) **Patent No.:** **US 8,089,414 B2**
(45) **Date of Patent:** ***Jan. 3, 2012**

(54) **WALL-MOUNTED ELECTRICAL DEVICE
WITH MODULAR ANTENNA BEZEL FRAME**

(75) Inventors: **George Feldstein**, Cresskill, NJ (US);
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(73) Assignee: **Crestron Electronics Inc.**, Rockleigh, NJ
(US)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
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This patent is subject to a terminal dis-
claimer.

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(21) Appl. No.: **13/037,709**

(22) Filed: **Mar. 1, 2011**

(65) **Prior Publication Data**

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Related U.S. Application Data

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(51) **Int. Cl.**
H01Q 1/24 (2006.01)

(52) **U.S. Cl.** **343/702**

(58) **Field of Classification Search** **343/702,**
343/700 MS, 745-748, 907
See application file for complete search history.

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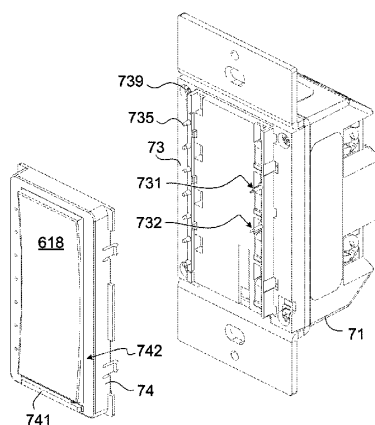
(Continued)

Primary Examiner — Huedung Mancuso

(57) **ABSTRACT**

An electrical device comprises a bezel frame that is configured to fit within a faceplate. The bezel frame includes an antenna element. The electrical device further comprises a radio frequency circuitry component in electrical communication with the antenna element and configured to receive a control signal from the antenna element and a housing, which includes a housing cover. The housing cover is located between the antenna element and the radio frequency circuitry component. The electrical device further comprises one or more connectors configured to place the antenna element and the radio frequency circuitry component in electrical communication. The one or more connectors protrude through the housing cover.

20 Claims, 11 Drawing Sheets



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US008089416B2

(12) **United States Patent**
Chung et al.

(10) **Patent No.:** **US 8,089,416 B2**
(45) **Date of Patent:** **Jan. 3, 2012**

(54) **DIPOLE ANTENNA**

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(73) Assignee: **Industrial Technology Research
Institute**, Hsinchu (TW)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
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(21) Appl. No.: **12/371,900**

(22) Filed: **Feb. 16, 2009**

(65) **Prior Publication Data**
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(30) **Foreign Application Priority Data**
Dec. 23, 2008 (TW) 97150318 A

(51) **Int. Cl.**
H01Q 9/16 (2006.01)
(52) **U.S. Cl.** **343/793; 343/822**
(58) **Field of Classification Search** 343/793,
343/795, 822
See application file for complete search history.

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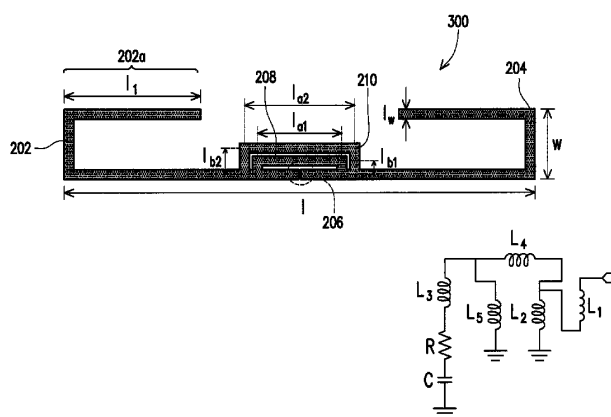
Primary Examiner — Tan Ho

(74) *Attorney, Agent, or Firm* — Jianq Chyun IP Office

(57) **ABSTRACT**

A dipole antenna used in an operation frequency includes a
dipole radiation main body, a first semi-loop metal line and a
second semi-loop metal line is provided. The dipole radiation
main body has a first radiation line arm and a second radiation
line arm aligned in a straight line, wherein a gap exists there-
between to form a feeding terminal. The first semi-loop
metal line has two ends respectively connected to the first
radiation line arm and the second radiation line arm to form a
first matching loop covering the feeding terminal. The second
semi-loop metal line has two ends respectively connected to
the first radiation line arm and the second radiation line arm to
form a second matching loop, which is larger than the first
matching loop.

17 Claims, 11 Drawing Sheets



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US008090329B2

(12) **United States Patent**
Viorel et al.

(10) **Patent No.:** **US 8,090,329 B2**
(45) **Date of Patent:** **Jan. 3, 2012**

(54) **SELF-INSTALLABLE SWITCHABLE ANTENNA**

(75) Inventors: **Dorin G. Viorel**, Calgary (CA); **Ronald G. Murias**, Calgary (CA); **Jagan N. Seshadri**, Calgary (CA)

(73) Assignee: **Wi-LAN, Inc.** (CA)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **12/852,247**

(22) Filed: **Aug. 6, 2010**

(65) **Prior Publication Data**

US 2010/0315312 A1 Dec. 16, 2010

Related U.S. Application Data

(63) Continuation of application No. 11/609,722, filed on Dec. 12, 2006, now Pat. No. 7,792,559.

(60) Provisional application No. 60/749,401, filed on Dec. 12, 2005, provisional application No. 60/763,196, filed on Jan. 27, 2006, provisional application No. 60/774,428, filed on Feb. 17, 2006.

(51) **Int. Cl.**
H04B 7/02 (2006.01)

(52) **U.S. Cl.** **455/101**; 370/208

(58) **Field of Classification Search** 455/101, 455/423, 67.13; 370/208, 210
See application file for complete search history.

(56) **References Cited**

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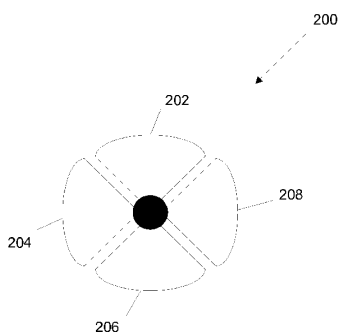
Primary Examiner — Tu X Nguyen

(74) *Attorney, Agent, or Firm* — Procopio, Cory, Hargreaves & Savitch LLP

(57) **ABSTRACT**

A system, method, and apparatus for selecting a set of antennas, for use during operation of a radio system, from a plurality of antennas. The system, method and apparatus may include selecting one antenna that is part of an array of antennas. Then measuring characteristics of radio signals received at the antenna. The selection and measuring of characteristic is repeated for a desired number of antennas in the array. Then, the measurements are combined, and the combinations of antennas are ranked based upon the combined measurement. From the ranking combinations of antennas are selected for use during operation of a radio system.

32 Claims, 8 Drawing Sheets



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US008090407B2

(12) **United States Patent**
Bashan et al.

(10) **Patent No.:** **US 8,090,407 B2**
(45) **Date of Patent:** **Jan. 3, 2012**

(54) **CONTACTLESS SMART SIM**
(75) Inventors: **Oded Bashan**, Rosh-Pina (IL); **Ronnle Gilboa**, Moshav Beit Hilel (IL); **Guy Shafran**, Rosh-Pina (IL)
(73) Assignee: **On Track Innovations Ltd.**, Rosh-Pina (IL)
(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1119 days.

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(21) Appl. No.: **11/890,909**

(22) Filed: **Aug. 6, 2007**

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US 2009/0005117 A1 Jan. 1, 2009

(30) **Foreign Application Priority Data**

Jun. 27, 2007 (IL) 184260

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(51) **Int. Cl.**
H04B 1/38 (2006.01)

(52) **U.S. Cl.** **455/558**; 455/575.1; 455/575.2;
455/575.3; 455/575.4; 455/575.5

(58) **Field of Classification Search** 455/575.1,
455/575.2, 575.3, 575.4, 575.5

See application file for complete search history.

Primary Examiner — Nimesh Patel

(74) *Attorney, Agent, or Firm* — Abelman Frayne & Schwab

(57) **ABSTRACT**

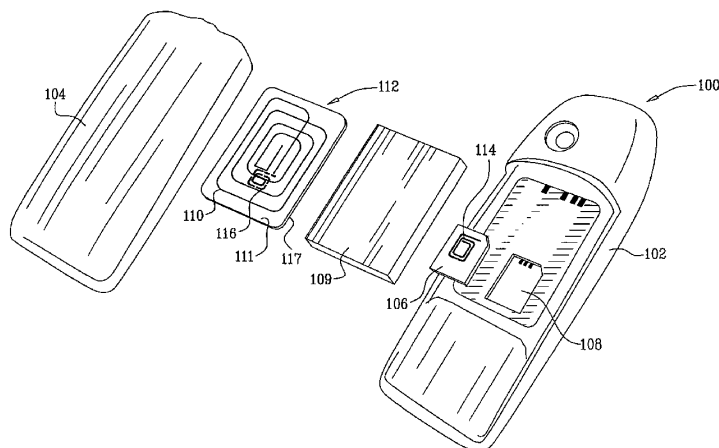
A mobile communicator including a housing including a main portion and a removable portion, cellular telephone circuitry located within the main portion of the housing, a SIM card mounted in the main portion of the housing, a battery mounted between the removable portion of the housing and the SIM card and a contactless functionality antenna mounted intermediate the removable portion and the battery and communicating with the SIM card.

3 Claims, 9 Drawing Sheets

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(12) **United States Patent**
Ochi et al.

(10) **Patent No.:** **US 8,090,408 B2**
(45) **Date of Patent:** **Jan. 3, 2012**

- (54) **PORTABLE WIRELESS DEVICE**
- (75) Inventors: **Takahiro Ochi**, Sendai (JP); **Haruhiko Kakitsu**, Sendai (JP)
- (73) Assignee: **Panasonic Corporation**, Osaka (JP)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 185 days.

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Primary Examiner — Quochien B Vuong

(74) *Attorney, Agent, or Firm* — Seed IP Law Group PLLC

- (21) Appl. No.: **12/672,988**
- (22) PCT Filed: **Aug. 10, 2007**
- (86) PCT No.: **PCT/JP2007/065746**
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H04M 1/00 (2006.01)
H04B 1/38 (2006.01)
- (52) **U.S. Cl.** **455/558; 455/575.7**
- (58) **Field of Classification Search** 455/90.3,
455/558, 575.1, 575.7, 575.8, 347
See application file for complete search history.

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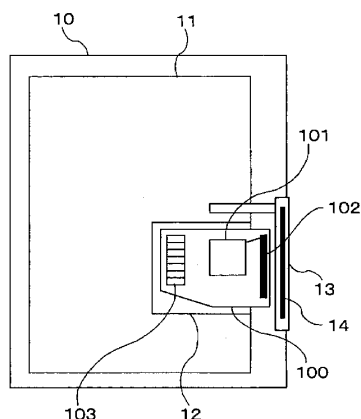
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(57) **ABSTRACT**

A portable wireless device has no externally projecting part even when a card type functional medium has been therein inserted, and allows downsizing and obtaining high antenna performance.

The portable wireless device includes a card slot (12) in a substrate (11) of a lower housing (10), and includes a slot cover (13) that can block an opening portion of the card slot (12). The slot cover (13) is integrally provided with a parasitic element (14). The parasitic element (14) is, when an SDIO card (100) is inserted, arranged so as to be in proximity substantially parallel with the antenna element (102) of the SDIO card (100), has an electrical length which is approximately one-half wavelength of a driving frequency of an RF circuit (101) of the SDIO card (100), and electromagnetically couples with the antenna element (102) to operate as a parasitic element.

7 Claims, 5 Drawing Sheets



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US008090419B2

(12) **United States Patent**
Isoda et al.

(10) **Patent No.:** **US 8,090,419 B2**
(45) **Date of Patent:** **Jan. 3, 2012**

(54) **FOLDING PORTABLE WIRELESS APPARATUS**

(75) Inventors: **Yutaka Isoda**, Kanagawa (JP);
Nobuharu Mashima, Toyama (JP);
Akito Sakamoto, Kanagawa (JP)

(73) Assignee: **Panasonic Corporation**, Osaka (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1097 days.

(21) Appl. No.: **11/569,881**

(22) PCT Filed: **Jun. 2, 2005**

(86) PCT No.: **PCT/JP2005/010153**

§ 371 (c)(1),
(2), (4) Date: **Dec. 1, 2006**

(87) PCT Pub. No.: **WO2005/120021**

PCT Pub. Date: **Dec. 15, 2005**

(65) **Prior Publication Data**

US 2009/0181732 A1 Jul. 16, 2009

(30) **Foreign Application Priority Data**

Jun. 4, 2004 (JP) 2004-167138

(51) **Int. Cl.**
H04M 1/00 (2006.01)

(52) **U.S. Cl.** **455/575.3**; 455/575.1; 455/575.7;
455/272

(58) **Field of Classification Search** 455/575.3,
455/73, 269, 277.1, 272, 575; 343/702, 893;
361/600-837

See application file for complete search history.

(56) **References Cited**

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Primary Examiner — Lester Kincaid

Assistant Examiner — Daniel Lai

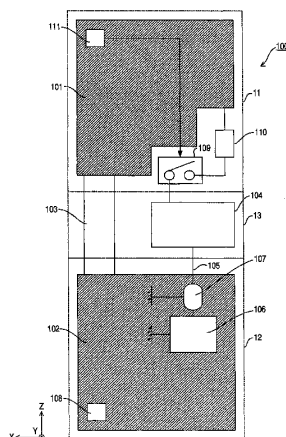
(74) *Attorney, Agent, or Firm* — Seed IP Law Group, PLLC

(57) **ABSTRACT**

An object of the invention is to provide a folding-type portable wireless equipment which can obtain good antenna characteristics in each of opened and closed states with a simple configuration without spoiling miniaturization.

A folding-type portable wireless equipment (100) having a first case (11) and a second case (12) includes a first circuit board (101) disposed at the first case (11), a second circuit board (102) disposed at the second case (12), a bendable coupling portion (103) which mechanically couples the first case (11) and the second case (12), a flexible coupling element (103) which electrically couples the first circuit board (101) and the second circuit board (102), a radio circuit portion (106) provided at the second circuit board (102), an antenna element (104) coupled to the radio circuit portion (106) via a feeder line (105), and a switching portion (109) which selectively connects and disconnects between the first circuit board (101) and the antenna element (104) in accordance with an opened/closed state of the folding-type portable wireless equipment (100), wherein the antenna element (104) and the feeder line 105 are disposed at positions almost along the coupling portion (103).

10 Claims, 4 Drawing Sheets



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US008090423B2

(12) **United States Patent**
NA et al.

(10) **Patent No.:** **US 8,090,423 B2**
(45) **Date of Patent:** **Jan. 3, 2012**

(54) **MOBILE TERMINAL**

(75) Inventors: **Young Soo NA**, Seoul (KR); **Chang Il Kim**, Seoul (KR)

(73) Assignee: **LG Electronics Inc.**, Seoul (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 487 days.

(21) Appl. No.: **12/409,206**

(22) Filed: **Mar. 23, 2009**

(65) **Prior Publication Data**

US 2010/0137042 A1 Jun. 3, 2010

(30) **Foreign Application Priority Data**

Nov. 28, 2008 (KR) 10-2008-0119542

(51) **Int. Cl.**
H04M 1/00 (2006.01)

(52) **U.S. Cl.** **455/575.5; 455/117**

(58) **Field of Classification Search** **455/117, 455/550.1, 575.1, 575.5, 575.7, 575.8**

See application file for complete search history.

(56) **References Cited**

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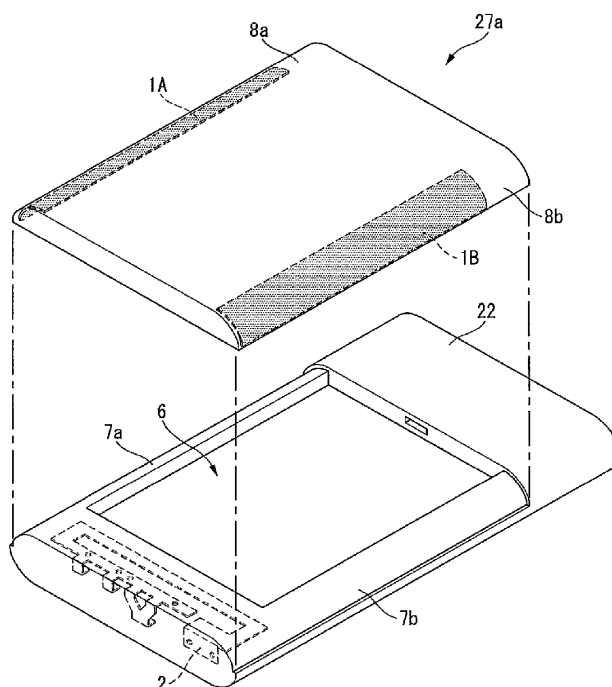
Primary Examiner — Don Le

(74) *Attorney, Agent, or Firm* — Birch, Stewart, Kolasch & Birch, LLP

(57) **ABSTRACT**

A mobile terminal comprises a front case and a rear case which are fastened with a printed circuit board (PCB) and an antenna connected with the PCB interposed therebetween; a battery protection cover opening and closing a battery receiving space provided on the rear case; and a conductive coupling element formed on one of the rear case and the battery protection cover such that the conductive coupling element is overlapped with at least one of one edge and the other edge of the antenna.

20 Claims, 9 Drawing Sheets



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US008094076B2

(12) **United States Patent**
Zhang et al.

(10) **Patent No.:** **US 8,094,076 B2**
(45) **Date of Patent:** **Jan. 10, 2012**

(54) **MULTIBAND ANTENNA**

(56) **References Cited**

(75) Inventors: **Chong Zhang**, Shenzhen (CN); **Cho-Ju Chung**, Taipei Hsien (TW)

U.S. PATENT DOCUMENTS

(73) Assignees: **Ambit Microsystems (Shanghai) Ltd.**,
Shanghai (CN); **Hon Hai Precision**
Industry Co., Ltd., Tu-Cheng, New
Taipei (TW)

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 345 days.

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Primary Examiner — Trinh Dinh

(74) Attorney, Agent, or Firm — Altis Law Group, Inc.

(21) Appl. No.: **12/582,783**

(22) Filed: **Oct. 21, 2009**

(65) **Prior Publication Data**

US 2011/0032166 A1 Feb. 10, 2011

(30) **Foreign Application Priority Data**

Aug. 6, 2009 (CN) 2009 2 0307494 U

(51) **Int. Cl.**
H01Q 1/38 (2006.01)

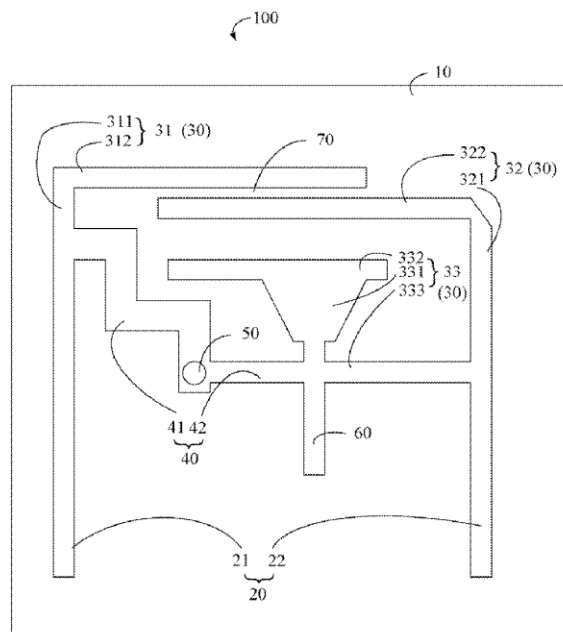
(52) **U.S. Cl.** **343/700 MS**; 343/824; 343/826;
343/846; 343/829; 343/752

(58) **Field of Classification Search** None
See application file for complete search history.

(57) **ABSTRACT**

A multiband antenna includes a feed portion, a radiating portion, and a ground via. The feed portion includes a first feed section and a second feed section paralleled to each other. The radiating portion includes a first radiator, a second radiator and a third radiator. The first radiator is L shaped with a free end. The second radiator is L shaped with a free end. The free ends of the second radiator and the first radiator extend toward to each other and partially overlap to define a slot therebetween. The third radiator includes a trapezoid section and a connecting section. The short portion includes a first short section and a second short section. The first short section connects the first radiator to the ground via, and the second short section connects the second radiator and the third radiator to the ground via.

11 Claims, 3 Drawing Sheets



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US008094078B2

(12) **United States Patent**
Huang

(10) **Patent No.:** **US 8,094,078 B2**
(45) **Date of Patent:** **Jan. 10, 2012**

(54) **MONOPOLE ANTENNA**

(75) Inventor: **Chang-Ching Huang**, Tu-Cheng (TW)

(73) Assignee: **Chi Mei Communication Systems, Inc.**, Tu-Cheng, New Taipei (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 455 days.

(21) Appl. No.: **12/401,728**

(22) Filed: **Mar. 11, 2009**

(65) **Prior Publication Data**

US 2010/0123638 A1 May 20, 2010

(30) **Foreign Application Priority Data**

Nov. 18, 2008 (CN) 2008 1 0305618

(51) **Int. Cl.**
H01Q 1/24 (2006.01)

(52) **U.S. Cl.** **343/702; 343/700 MS**

(58) **Field of Classification Search** **343/700 MS, 343/702**

See application file for complete search history.

(56) **References Cited**

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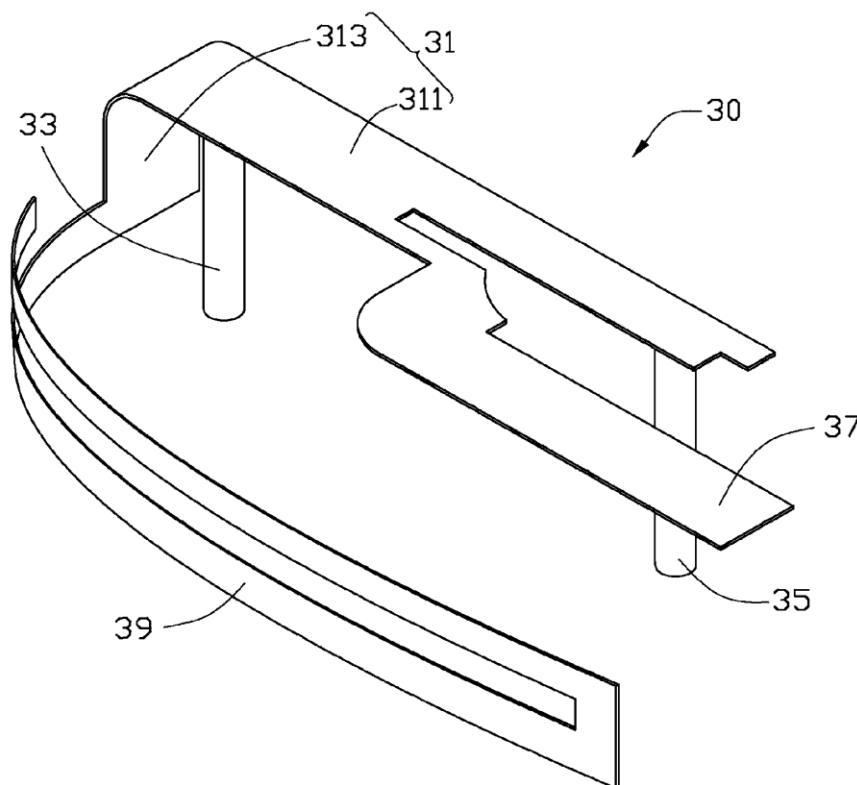
Primary Examiner — Hoanganh Le

(74) *Attorney, Agent, or Firm* — Altis Law Group, Inc.

(57) **ABSTRACT**

The invention discloses a monopole antenna for assembly within a wireless communication device to transmit and exchange data signals. The monopole antenna includes a main body, a feed portion, a grounding portion, a first transmitting body and a second transmitting body. The feed portion and the grounding portion are disposed on the main body. A first transmitting body is a high frequency path extending outwardly from the main body and a second transmitting body is a low frequency path extending outwardly from the main body.

11 Claims, 6 Drawing Sheets



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US008094079B2

(12) **United States Patent**
Schlub et al.

(10) **Patent No.:** **US 8,094,079 B2**
(45) **Date of Patent:** ***Jan. 10, 2012**

(54) **HANDHELD ELECTRONIC DEVICES WITH ISOLATED ANTENNAS**

(75) Inventors: **Robert W. Schlub**, Campbell, CA (US);
Robert J. Hill, Salinas, CA (US); **Juan Zavala**, Watsonville, CA (US); **Ruben Caballero**, San Jose, CA (US)

(73) Assignee: **Apple Inc.**, Cupertino, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 23 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **12/541,874**

(22) Filed: **Aug. 14, 2009**

(65) **Prior Publication Data**

US 2009/0303139 A1 Dec. 10, 2009

Related U.S. Application Data

(63) Continuation of application No. 11/650,071, filed on Jan. 4, 2007, now Pat. No. 7,595,759.

(51) **Int. Cl.**
H01Q 1/24 (2006.01)

(52) **U.S. Cl.** **343/702**; 343/700 MS; 343/846

(58) **Field of Classification Search** 343/702,
343/700 MS, 725, 767, 846
See application file for complete search history.

(56) **References Cited**

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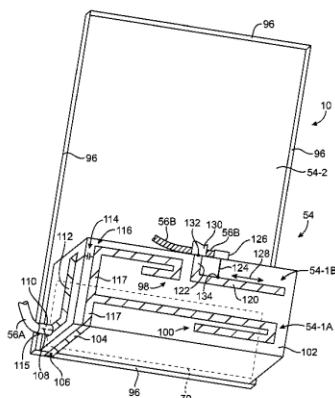
Primary Examiner — Tho G Phan

(74) *Attorney, Agent, or Firm* — Treyz Law Group; G. Victor Treyz; David C. Kellogg

(57) **ABSTRACT**

Handheld electronic devices are provided that contain wireless communications circuitry having at least first and second antennas. An antenna isolation element reduces signal interference between the antennas, so that the antennas may be used in close proximity to each other. A planar ground element may be used as a ground by the first and second antennas. The first antenna may be formed using a hybrid planar-inverted-F and slot arrangement in which a planar resonating element is located above a rectangular slot in the planar ground element. The second antenna may be formed from an L-shaped strip. The planar resonating element of the first antenna may have first and second arms. The first arm may resonate at a common frequency with the second antenna and may serve as the isolation element. The second arm may resonate at approximately the same frequency as the slot portion of the hybrid antenna.

15 Claims, 12 Drawing Sheets



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US008094080B2

(12) **United States Patent**
Komura

(10) **Patent No.:** **US 8,094,080 B2**
(45) **Date of Patent:** **Jan. 10, 2012**

(54) **ANTENNA AND RADIO COMMUNICATION APPARATUS**

(75) Inventor: **Ryo Komura**, Kanazawa (JP)

(73) Assignee: **Murata Manufacturing Co., Ltd.**,
Kyoto (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 340 days.

(21) Appl. No.: **12/542,731**

(22) Filed: **Aug. 18, 2009**

(65) **Prior Publication Data**

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Related U.S. Application Data

(63) Continuation of application No. PCT/JP2008/051506, filed on Jan. 31, 2008.

(30) **Foreign Application Priority Data**

Mar. 23, 2007 (JP) 2007-076659

(51) **Int. Cl.**
H01Q 1/24 (2006.01)

(52) **U.S. Cl.** **343/702; 343/700 MS**

(58) **Field of Classification Search** **343/702, 343/700 MS**
See application file for complete search history.

(56) **References Cited**

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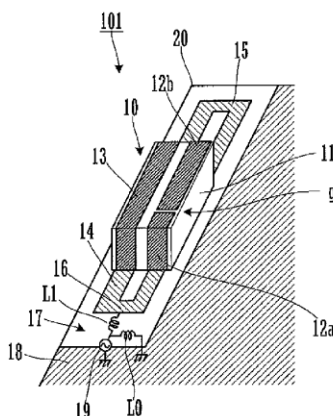
Primary Examiner — Dieu H Duong

(74) *Attorney, Agent, or Firm* — Keating & Bennett, LLP

(57) **ABSTRACT**

An antenna includes linear electrodes disposed on a surface of a substrate. A surface-mount antenna element including a capacitor is disposed in a non-ground region of a mount board. The capacitor is arranged such that portions of at least one of two linear electrodes face each other with a predetermined distance therebetween. The non-ground region includes a first radiation electrode and linear electrode portions of a second radiation electrode. The linear electrodes of the surface-mount antenna element are individually connected to the radiation electrodes. A chip reactive element is disposed at the first radiation electrode and the linear electrode portions of the second radiation electrode as appropriate.

12 Claims, 16 Drawing Sheets



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US008094082B2

(12) **United States Patent**
Rudant et al.

(10) **Patent No.:** **US 8,094,082 B2**
(45) **Date of Patent:** **Jan. 10, 2012**

(54) **POLARIZATION DIVERSITY
MULTI-ANTENNA SYSTEM**

(75) Inventors: **Lionel Rudant**, Grenoble (FR);
Christophe Delaveaud, Saint Jean de
Moirans (FR)

(73) Assignee: **Commissariat a l'Energie Atomique**,
Paris (FR)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 349 days.

(21) Appl. No.: **12/439,750**

(22) PCT Filed: **Sep. 3, 2007**

(86) PCT No.: **PCT/EP2007/059197**

§ 371 (c)(1),

(2), (4) Date: **Mar. 6, 2009**

(87) PCT Pub. No.: **WO2008/028892**

PCT Pub. Date: **Mar. 13, 2008**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

Sep. 4, 2006 (FR) 06 53562

(51) **Int. Cl.**
H01Q 21/24 (2006.01)

(52) **U.S. Cl.** **343/725; 343/700 MS; 343/767**

(58) **Field of Classification Search** **343/700 MS,**
343/725, 727, 767, 846
See application file for complete search history.

(56) **References Cited**

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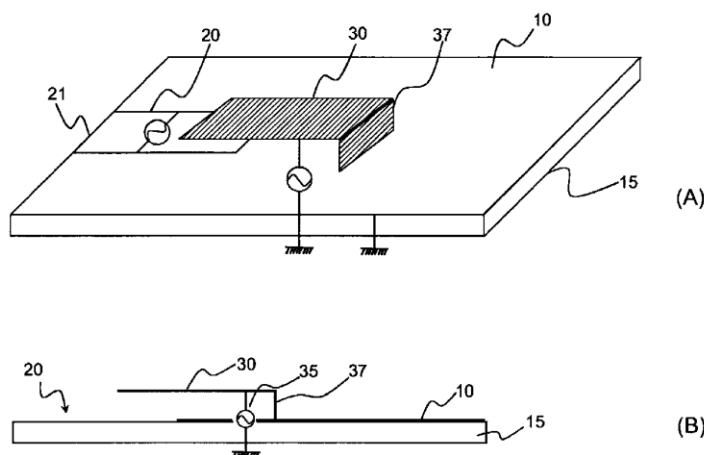
Primary Examiner — Tho G Phan

(74) Attorney, Agent, or Firm — Pearne & Gordon LLP

(57) **ABSTRACT**

The invention relates to a polarization diversity multi-antenna system comprising a first slot type antenna (20) and at least one second patch type antenna (30), said first and second antennas sharing the same ground plane (10), the slot of the first antenna being laid out in said ground plane and the patch of the second antenna being at least partly plumb with said slot.

10 Claims, 10 Drawing Sheets



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US008094088B2

(12) **United States Patent**
Shinkawa et al.

(10) **Patent No.:** **US 8,094,088 B2**
(45) **Date of Patent:** **Jan. 10, 2012**

(54) **ANTENNA APPARATUS**

(75) Inventors: **Tomohiro Shinkawa**, Tokyo (JP);
Masaaki Miyata, Tokyo (JP);
Hisamatsu Nakano, Tokyo (JP)

(73) Assignee: **Mitsumi Electric Co., Ltd.**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 459 days.

(21) Appl. No.: **12/372,222**

(22) Filed: **Feb. 17, 2009**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

Feb. 18, 2008 (JP) P2008-036551
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(51) **Int. Cl.**
H01Q 1/36 (2006.01)

(52) **U.S. Cl.** **343/895**; 343/700 MS; 343/793

(58) **Field of Classification Search** 343/700 MS,
343/895, 793, 821, 713

See application file for complete search history.

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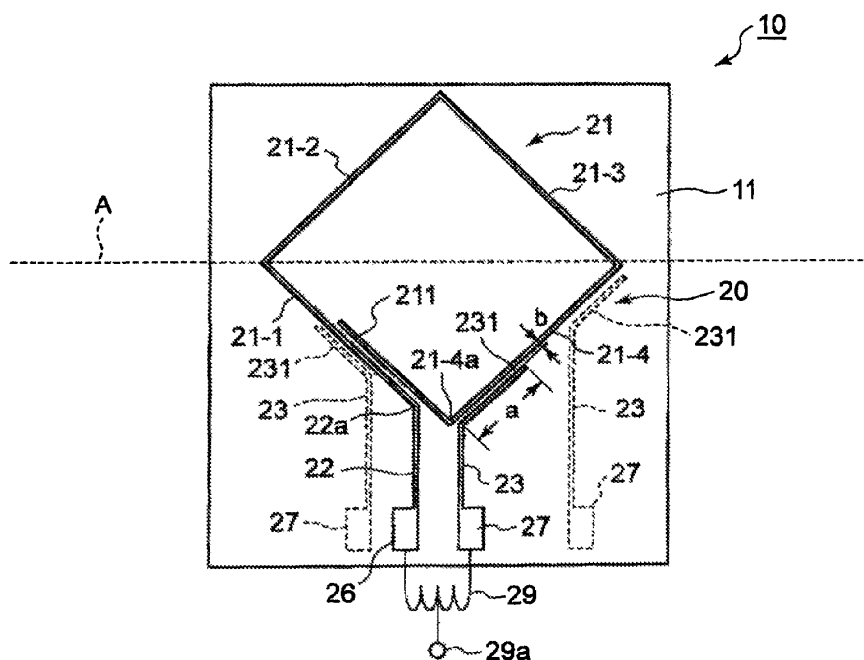
Primary Examiner — Tan Ho

(74) *Attorney, Agent, or Firm* — Whitham Curtis
Christofferson & Cook, PC

(57) **ABSTRACT**

In an antenna apparatus, a radiation element includes a perturbation element. A first power feeding line has a first end connected to the radiation element and is configured to feed power to the radiation element. A second power feeding line has a first end configured to feed power to the radiation element through electromagnetic coupling. The radiation element, the first power feeding line and the second power feeding line are arranged on a same plane to constitute a balance type antenna.

13 Claims, 8 Drawing Sheets



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US008094457B2

(12) **United States Patent**
Fujii

(10) **Patent No.:** **US 8,094,457 B2**
(45) **Date of Patent:** **Jan. 10, 2012**

(54) **ELECTRONIC APPARATUS**

(75) Inventor: **Tomoharu Fujii**, Nagano (JP)

(73) Assignee: **Shinko Electric Industries Co., Ltd.**,
Nagano-shi (JP)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
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(21) Appl. No.: **11/847,796**

(22) Filed: **Aug. 30, 2007**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

Sep. 27, 2006 (JP) 2006-263083

(51) **Int. Cl.**
H05K 5/00 (2006.01)

(52) **U.S. Cl.** **361/750**; 361/816; 361/818; 257/789;
257/795; 257/796

(58) **Field of Classification Search** 361/750,
361/818; 257/789, 795, 796; 347/742, 702,
347/867

See application file for complete search history.

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Primary Examiner — Yuriy Semenenko

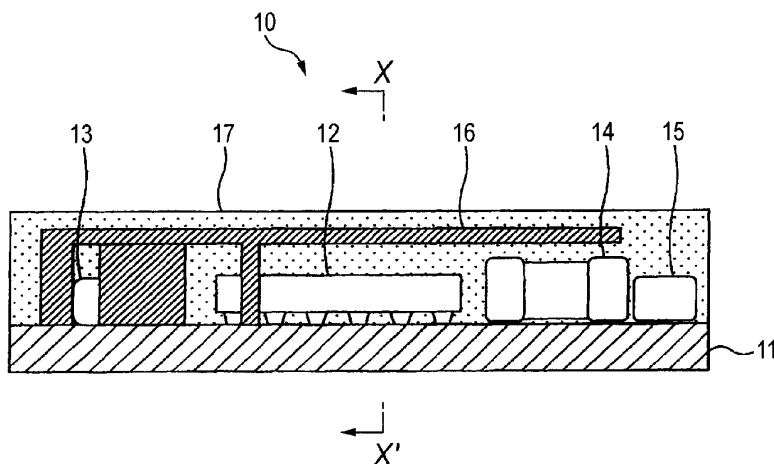
Assistant Examiner — Andargie M Aychillhum

(74) *Attorney, Agent, or Firm* — Rankin, Hill & Clark LLP

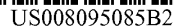
(57) **ABSTRACT**

An electronic apparatus includes a substrate, electronic components mounted on the substrate, an antenna mounted on the substrate, and a resin material containing a dielectric constant adjusting material added therein, and sealing the electronic components and the antenna.

16 Claims, 4 Drawing Sheets



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(10) **Patent No.:** US 8,095,085 B2
(45) **Date of Patent:** Jan. 10, 2012

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- Primary Examiner — Lee Nguyen

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H03C 1/52 (2006.01)
H04K 3/00 (2006.01)

- (52) **U.S. Cl.** **455/107; 455/126**

- (58) **Field of Classification Search** 455/107,
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See application file for complete search history.

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(57) **ABSTRACT**

A closed-loop controlled antenna tuning unit (ATU) system includes a return loss detector connected to sample an RF signal generated by a signal source to provide a return loss signal. A matching state searching circuit is connected to receive the return loss signal and, in response, selectively store a return loss value and an impedance matching state. A central controller is connected to provide a switch control signal and apply an optimum matching state to the impedance synthesizer at the conclusion of the matching state search. An impedance synthesizer is responsive to the switch control signal for coupling a radio frequency signal and matching the impedance of an antenna to a signal source.

20 Claims, 11 Drawing Sheets

