



US007570215B2

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

(10) **Patent No.:** **US 7,570,215 B2**
(45) **Date of Patent:** **Aug. 4, 2009**

(54) **ANTENNA DEVICE WITH A CONTROLLED DIRECTIONAL PATTERN AND A PLANAR DIRECTIONAL ANTENNA**

(75) Inventors: **Oleg Jurievich Abramov**, St. Petersburg (RU); **Aleksandr Germanovich Kashkarov**, St. Petersburg (RU); **Farid Ibragimovich Nagaev**, St. Petersburg (RU)

(73) Assignee: **Airgain, Inc.**, Carlsbad, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 241 days.

(21) Appl. No.: **10/536,547**

(22) PCT Filed: **Dec. 2, 2003**

(86) PCT No.: **PCT/RU03/00542**

§ 371 (c)(1),
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PCT Pub. Date: **Jun. 17, 2004**

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(30) **Foreign Application Priority Data**

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(51) **Int. Cl.**
H01Q 1/36 (2006.01)

(52) **U.S. Cl.** **343/700 MS; 343/876**

(58) **Field of Classification Search** **343/700 MS, 343/846, 848, 876**

See application file for complete search history.

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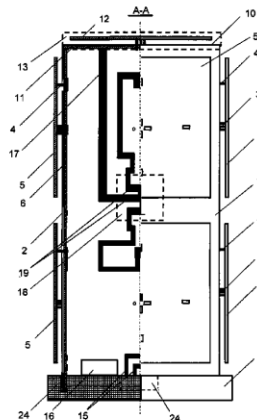
Primary Examiner—HoangAnh T Le

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

(57) **ABSTRACT**

The invention relates to antenna systems used in local wireless communications networks. The antenna system includes planar directional antennas (1), each of which is made as a dielectric plate (2), with an active element (5) of the antenna (1) mounted on said plate. The surface of the plate (2) that faces the active element is metallized and serves as a reflector (6) of the antenna (1). The plates (2) are interconnected along their edges in such a way as to form lateral facets of a hollow frame (9) of the device. The end face (10) is made as a dielectric plate (11) with the external surface metallized and can also contain an active element (12) of the antenna (13). An antenna commutation switch (14) connected to a switch control unit (16) and to active elements (5) of the antennas (1) is mounted on the inner surface of the end face (10) of the frame (9). Active element (5) is mounted on said plate by means of pins cut in the body of the active element (5) and bent during mounting. This invention permits to manufacture structurally simple and inexpensive antennas and antenna systems based on printed circuits and to exclude manual operations from the manufacturing and assembly of said antennas and antenna systems.

12 Claims, 7 Drawing Sheets





US007570218B2

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

(10) **Patent No.:** **US 7,570,218 B2**
(45) **Date of Patent:** **Aug. 4, 2009**

(54) **MOBILE COMMUNICATION TERMINAL**

6,861,986 B2 * 3/2005 Fang et al. 343/700 MS
2008/0303735 A1 * 12/2008 Fujimoto et al. 343/787

(75) Inventors: **Akihiro Tsujimura**, Ome (JP);
Hiroyuki Hotta, Ome (JP); **Takashi Amano**, Soka (JP); **Koichi Sato**, Fuchu (JP)

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(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 472 days.

(21) Appl. No.: **11/496,822**

(22) Filed: **Aug. 1, 2006**

(65) **Prior Publication Data**

US 2007/0241971 A1 Oct. 18, 2007

(30) **Foreign Application Priority Data**

Apr. 13, 2006 (JP) 2006-111296

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/38 (2006.01)
H01Q 1/00 (2006.01)

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Japanese Office Action (and English translations thereof) dated Mar. 18, 2008, issued in a counterpart Japanese Application.

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Primary Examiner—Shih-Chao Chen
(74) *Attorney, Agent, or Firm*—Frishauf, Holtz, Goodman & Chick, P.C.

(52) **U.S. Cl.** **343/702**; 343/700 MS;
343/787

(57) **ABSTRACT**

(58) **Field of Classification Search** 343/700 MS,
343/702, 787, 872
See application file for complete search history.

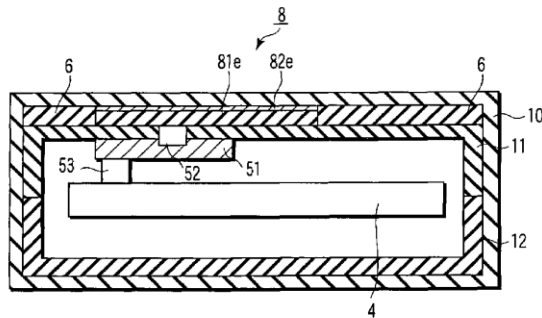
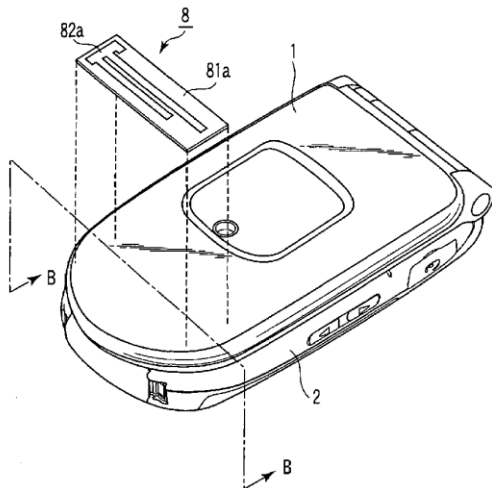
An antenna element made of an electrically conductive material pattern is printed and formed on a face of a casing made of an electrically nonconductive material having a circuit board housed therein, and the antenna element and the circuit board are electrically connected to each other by a connecting element.

(56) **References Cited**

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15 Claims, 12 Drawing Sheets





US007570225B2

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

(10) **Patent No.:** **US 7,570,225 B2**
(45) **Date of Patent:** **Aug. 4, 2009**

(54) **ANTENNA AND NON-CONTACT TAG**

2005/0253685 A1 11/2005 Catteau et al.

(75) Inventors: **Manabu Kai**, Kawasaki (JP); **Toru Maniwa**, Kawasaki (JP); **Takashi Yamagajo**, Kawasaki (JP)

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

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JP 63-059105 A 3/1988

(21) Appl. No.: **11/790,580**

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(22) Filed: **Apr. 26, 2007**

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(65) **Prior Publication Data**
US 2007/0200711 A1 Aug. 30, 2007

“Antenna Technology Handbook” (Ohmsha Ltd.), the Institute of Electronics, Information and Communication Engineers, *IEICE*, Oct. 1980, pp. 112-115.

Related U.S. Application Data

(Continued)

(63) Continuation of application No. PCT/JP2004/018610, filed on Dec. 14, 2004.

Primary Examiner—Douglas W. Owens
Assistant Examiner—Chuc Tran

(51) **Int. Cl.**
H01Q 1/36 (2006.01)

(74) *Attorney, Agent, or Firm*—Fujitsu Patent Center

(52) **U.S. Cl.** **343/895**; 343/741; 343/767; 343/770

(57) **ABSTRACT**

(58) **Field of Classification Search** 343/726, 343/741, 767, 770, 793, 895, 700 MS
See application file for complete search history.

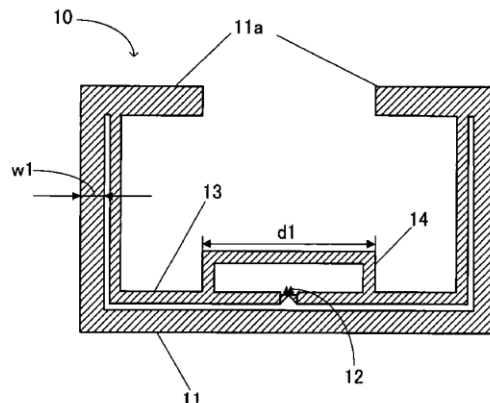
An RFID antenna that can be disposed in a space-saving manner. The RFID antenna comprises an outermost peripheral conductive line that is bent in a manner extending along sides of a generally rectangular shape having a predetermined size, and a power-feeding conductive line that is disposed close to an inner periphery of the outermost peripheral conductive line in a manner extending parallel therewith, and is electrically connected to the outermost peripheral conductive line at ends thereof, the power-feeding conductive line including a portion thereof formed with a feeder part. Therefore, the antenna fits into a rectangle having a predetermined size, such as a card size.

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12 Claims, 15 Drawing Sheets





US007573424B2

(12) **United States Patent**
Mei

(10) **Patent No.:** **US 7,573,424 B2**
(45) **Date of Patent:** ***Aug. 11, 2009**

(54) **DUAL-BAND ANTENNA FOR RADIATING ELECTROMAGNETIC SIGNALS OF DIFFERENT FREQUENCIES**

(75) Inventor: **Chia-Hao Mei**, Shenzhen (CN)

(73) Assignee: **Hon Hai Precision Industry Co., Ltd.**, Tu-Cheng, Taipei Hsien (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 281 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **11/308,575**

(22) Filed: **Apr. 8, 2006**

(65) **Prior Publication Data**
US 2007/0040748 A1 Feb. 22, 2007

(30) **Foreign Application Priority Data**
Jun. 10, 2005 (CN) 2005 1 0035292

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

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

(58) **Field of Classification Search** **343/700 MS, 343/702, 829, 846, 848**
See application file for complete search history.

(56) **References Cited**
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2006/0279464 A1 * 12/2006 Mei 343/700 MS

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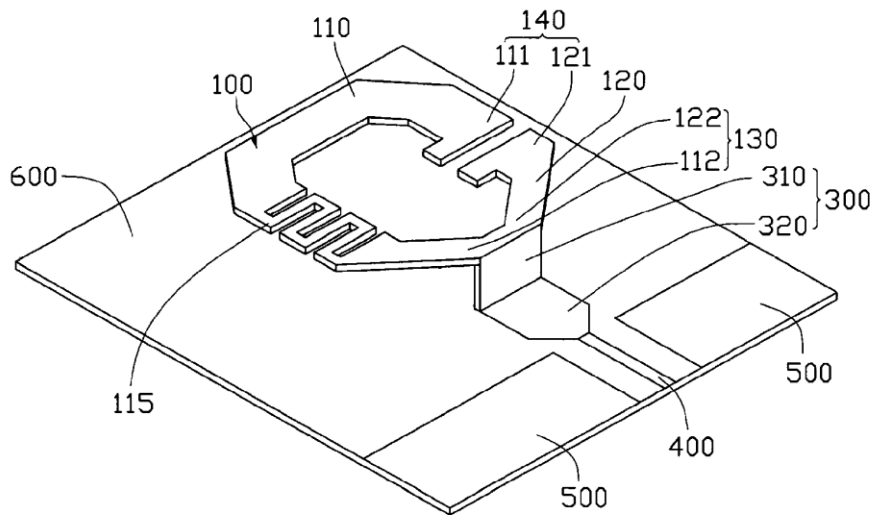
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Primary Examiner—Tho G Phan
(74) *Attorney, Agent, or Firm*—Wei Te Chung

(57) **ABSTRACT**

A dual-band antenna for radiating electromagnetic signals of different frequencies includes a ground portion (500), a feeding part (400), and a body (100). The feeding part (400) is for feeding signals. The body (100) includes a first radiating part (110) and a second radiating part (120). The first radiating part includes a bent portion (115), a first free end (111), and a first connecting end (112). The bent portion (115) is between the first free end (111) and the first connecting end (112). The first connecting end (111) is electronically connected to the feeding part (400). The second radiating part (120) includes a second connecting end (122) and a second free end (121). The second connecting end (122) is connected to the first connecting end (112). The shorting part (200) is between the body (100) and the ground portion (500).

15 Claims, 7 Drawing Sheets





US007573433B2

(12) **United States Patent**
Qin

(10) **Patent No.:** **US 7,573,433 B2**
(45) **Date of Patent:** **Aug. 11, 2009**

- (54) **DUAL-BAND ANTENNA AND MIMO ANTENNA USING THE SAME**
- (75) Inventor: **Xiang-Hong Qin**, Shenzhen (CN)
- (73) Assignees: **Hong Fu Jin Precision Industry (ShenZhen) Co., Ltd.**, Shenzhen, Guangdong Province (CN); **Hon Hai Precision Industry Co., Ltd.**, Tu-Cheng, Taipei Hsien (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 294 days.

- (21) Appl. No.: **11/616,886**
- (22) Filed: **Dec. 28, 2006**

(65) **Prior Publication Data**
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(30) **Foreign Application Priority Data**
Oct. 13, 2006 (CN) 2006 1 0200991

- (51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 9/28 (2006.01)
H01Q 5/01 (2006.01)
- (52) **U.S. Cl.** 343/795; 343/727; 343/829
- (58) **Field of Classification Search** 373/700 MS, 373/727, 795, 829, 846

See application file for complete search history.

(56) **References Cited**

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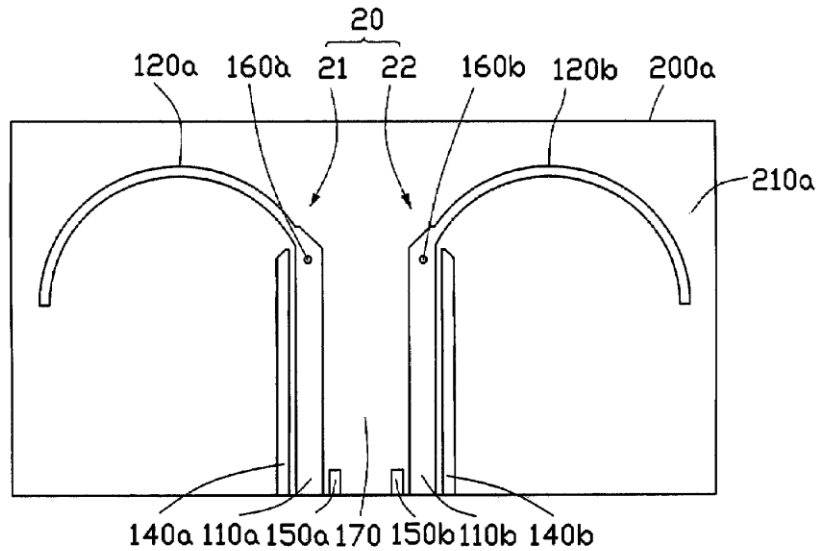
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Primary Examiner—Michael C Wimer
(74) *Attorney, Agent, or Firm*—Wei Te Chung

(57) **ABSTRACT**

A dual-band antenna (10) is disposed on a substrate (200). The substrate includes a first surface (210) and a second surface (220). The dual antenna includes a feeding portion (110), a first radiation portion (120), a second radiation portion (130), a first grounded portion (140), a second grounded portion (150), and a connecting portion (160). The feeding portion is disposed on the first surface, for feeding electromagnetic signals. The first radiation portion, disposed on the first surface, is electronically connected to the feeding portion. The second radiation portion, disposed on the second surface, is electronically connected to the feeding portion. The first grounded portion is disposed on one side of the feeding portion. The second grounded portion is disposed on the other side of the feeding portion. The connecting portion is for electronically connecting the first radiation portion, the second radiation portion, and the feeding portion.

17 Claims, 8 Drawing Sheets





US007576697B2

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

(10) **Patent No.:** **US 7,576,697 B2**
(45) **Date of Patent:** **Aug. 18, 2009**

(54) **DUAL POLARIZATION ANTENNA DEVICE FOR CREATING A DUAL BAND FUNCTION**

(75) Inventors: **Chih-Ming Chen**, Neipu Township, Pingtung County (TW); **Min-Sheng Ma**, Jhunan Township, Miaoli County (TW); **Yuch-Pi Huang**, Jhunan Township, Miaoli County (TW)

(73) Assignee: **Inpaq Technology Co., Ltd.**, Hsinchu (TW)

(*) 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.: **11/905,991**

(22) Filed: **Oct. 9, 2007**

(65) **Prior Publication Data**

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(51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 5/00 (2006.01)
H01Q 9/04 (2006.01)

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

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

(56) **References Cited**

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Primary Examiner—Vibol Tan

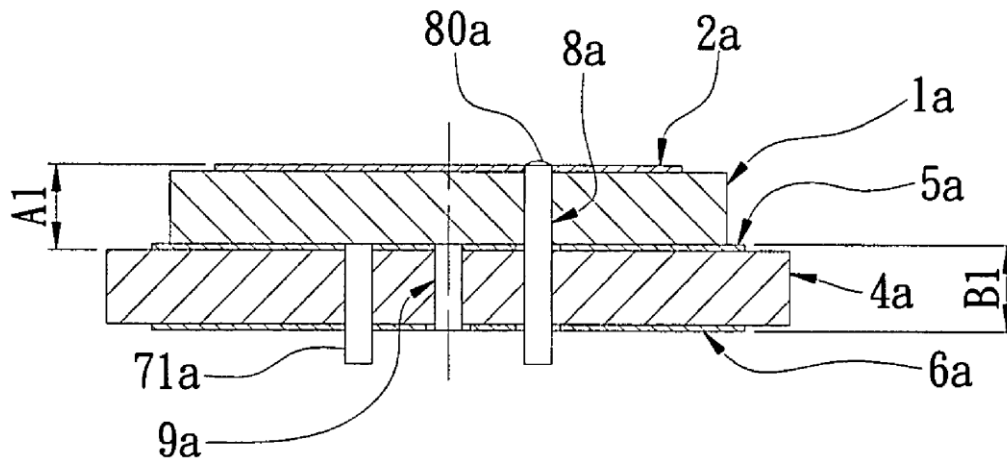
Assistant Examiner—Jason Crawford

(74) *Attorney, Agent, or Firm*—Rosenberg, Klein & Lee

(57) **ABSTRACT**

A dual polarization antenna device for creating a dual band function, includes: a first dielectric body, a patch layer, a first phase difference changing structure, a second dielectric body, a common metal layer, a ground layer, a second phase difference changing structure, a first antenna feed pin, and a second antenna feed pin. The first dielectric body, the patch layer, the first phase difference changing structure, the common metal layer, and the first antenna feed pin are combined together to form an upper polarization antenna structure. The second dielectric body, the common metal layer, the second phase difference changing structure, and the ground layer are combined together to form a lower polarization antenna structure. Therefore, the upper polarization antenna structure and the lower polarization antenna structure are combined to create both the dual polarization and the dual band functions.

16 Claims, 8 Drawing Sheets





US007576698B2

(12) **United States Patent**
Cheng

(10) **Patent No.:** **US 7,576,698 B2**
(45) **Date of Patent:** **Aug. 18, 2009**

(54) **DUAL-BAND ANTENNA**

- (75) Inventor: **Pi-Hsi Cheng**, Hsinchu County (TW)
- (73) Assignee: **Arcadyan Technology Corporation**, Hsinchu (TW)
- (*) 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.: **12/058,237**

(22) Filed: **Mar. 28, 2008**

(65) **Prior Publication Data**
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(30) **Foreign Application Priority Data**
Nov. 21, 2007 (TW) 96144185 A

- (51) **Int. Cl.**
H01Q 1/24 (2006.01)
- (52) **U.S. Cl.** **343/700 MS**; 343/846; 343/895
- (58) **Field of Classification Search** 343/700 MS, 343/846, 702, 829, 895
See application file for complete search history.

(56) **References Cited**

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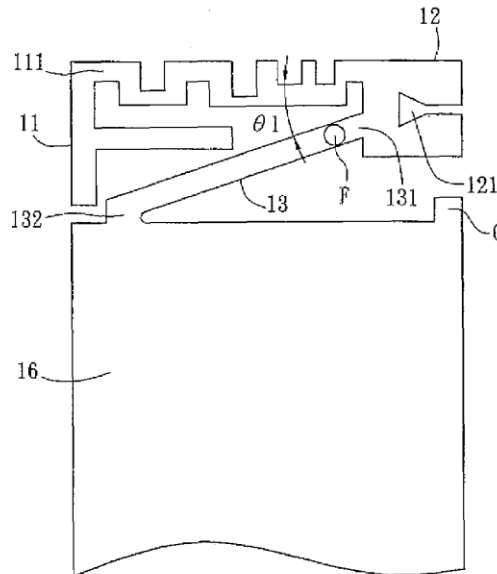
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Primary Examiner—Tho G Phan
(74) *Attorney, Agent, or Firm*—Birch, Stewart, Kolasch & Birch, LLP

(57) **ABSTRACT**

A dual-band antenna includes a first radiating unit, a second radiating unit, a micro-line unit and a grounding unit. The first radiating unit has a zigzag portion. The second radiating unit is connected with the first radiating unit and has a gap. The micro-line unit includes a first terminal, a second terminal and a feeding point. The first terminal is respectively connected with the first radiating unit and the second radiating unit. An acute angle is formed between the first radiating unit and the micro-line unit. The grounding unit is connected with the second terminal of the micro-line unit and has a grounding point.

9 Claims, 4 Drawing Sheets





US007579991B2

(12) **United States Patent**
Mitsui

(10) **Patent No.:** **US 7,579,991 B2**
(45) **Date of Patent:** **Aug. 25, 2009**

(54) **PORTABLE WIRELESS APPARATUS**

(75) Inventor: **Tsutomu Mitsui**, Yokohama-si (JP)

(73) Assignee: **Samsung Electronics Co., Ltd.** (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 113 days.

(21) Appl. No.: **11/641,209**

(22) Filed: **Dec. 19, 2006**

(65) **Prior Publication Data**
US 2007/0171136 A1 Jul. 26, 2007

(30) **Foreign Application Priority Data**
Dec. 19, 2005 (JP) 2005-364723
Jul. 20, 2006 (KR) 10-2006-0068095

(51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 1/48 (2006.01)

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

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

(56) **References Cited**

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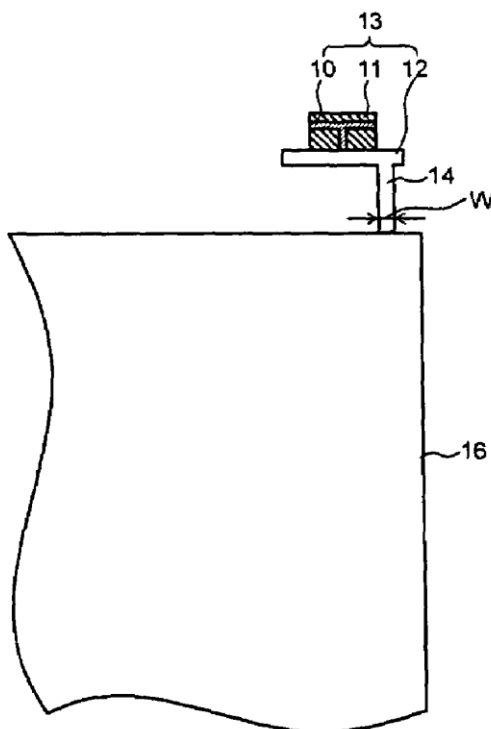
Primary Examiner—Shih-Chao Chen

(74) *Attorney, Agent, or Firm*—McNeely Bodendorf LLP

(57) **ABSTRACT**

Provided is a portable wireless apparatus having a reduced leakage current. The apparatus includes an antenna having an antenna ground plate on which is disposed an antenna element a circuit ground plate having a larger size than the antenna ground plate and included in a circuit substrate, and a connecting conductor connecting the antenna ground plate with the circuit ground plate.

18 Claims, 11 Drawing Sheets





US00757992B2

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

(10) **Patent No.:** **US 7,579,992 B2**
(45) **Date of Patent:** **Aug. 25, 2009**

(54) **MULTI-BAND BUILT-IN ANTENNA FOR INDEPENDENTLY ADJUSTING RESONANT FREQUENCIES AND METHOD FOR ADJUSTING RESONANT FREQUENCIES**

(75) Inventors: **Byung-Hoon Ryou**, Seoul (KR);
Won-Mo Sung, Gyeonggi-do (KR);
Jeong-Pyo Kim, Seoul (KR)

(73) Assignee: **E.M.W. Antenna Co., Ltd.**, Seoul (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 332 days.

(21) Appl. No.: **11/570,769**

(22) PCT Filed: **Jun. 23, 2005**

(86) PCT No.: **PCT/KR2005/001947**

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PCT Pub. Date: **Jan. 5, 2006**

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(30) **Foreign Application Priority Data**

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

(58) **Field of Classification Search** 343/700 MS,
343/702, 846

See application file for complete search history.

(56) **References Cited**

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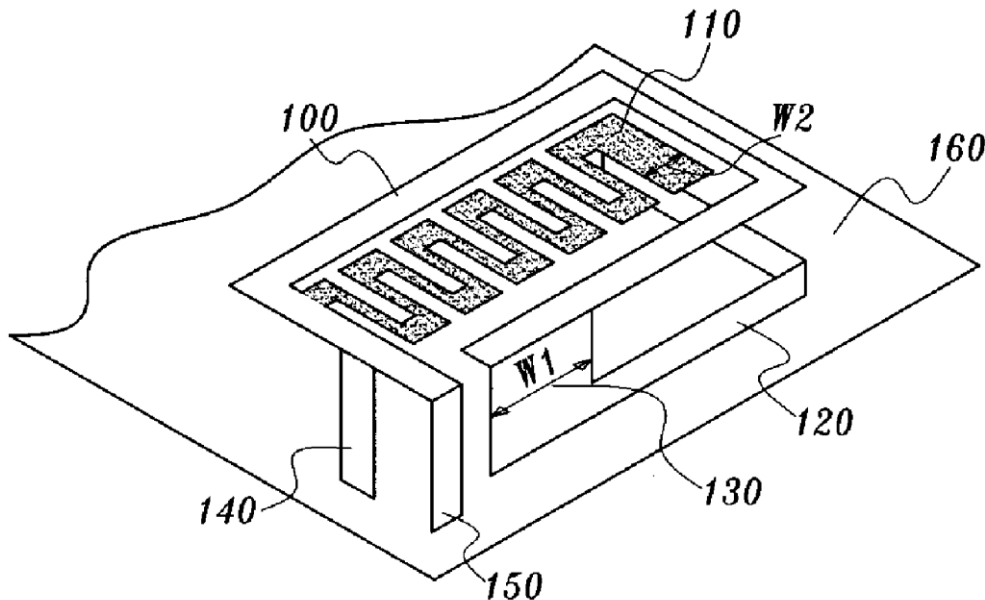
Primary Examiner—HoangAnh T Le

(74) *Attorney, Agent, or Firm*—patenttm.us

(57) **ABSTRACT**

The invention relates to built-in antenna. Specifically, a multi-band built-in antenna having plurality of resonant frequencies and a method for adjusting resonant frequencies are provided, wherein resonant frequencies are able to be adjusted independently without affecting one another, for each resonant frequencies are adjusted separately through separate radiating elements.

11 Claims, 6 Drawing Sheets





US00757993B2

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

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(54) **ELECTRONIC DEVICE DETACHABLE ANTENNA ASSEMBLY**

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See application file for complete search history.

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(57) **ABSTRACT**

An electronic device detachable antenna assembly comprises a connector member coupled to an electronic device and configured to receive an external antenna in pluggable engagement therewith, the antenna and the connector member movable between a stored position on the electronic device and an extended position relative to the electronic device.

20 Claims, 1 Drawing Sheet

