



US007339527B2

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

(10) **Patent No.:** **US 7,339,527 B2**
(45) **Date of Patent:** **Mar. 4, 2008**

(54) **CONTROLLABLE ANTENNA ARRANGEMENT**
(75) Inventors: **Mads Sager**, Roedovre (DK); **Jens Troelsen**, Copenhagen SV (DK)

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(73) Assignee: **Nokia Corporation**, Espoo (FI)
(*) 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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(21) Appl. No.: **10/535,737**

(22) PCT Filed: **Nov. 20, 2002**

(86) PCT No.: **PCT/EP02/12985**

§ 371 (c)(1),
(2), (4) Date: **May 18, 2005**

(Continued)

Primary Examiner—Douglas W. Owens
Assistant Examiner—Chuc Tran
(74) *Attorney, Agent, or Firm*—Harrington & Smith, PC

(87) PCT Pub. No.: **WO2004/047220**

PCT Pub. Date: **Jun. 3, 2004**

(57) **ABSTRACT**

(65) **Prior Publication Data**

US 2006/0044187 A1 Mar. 2, 2006

An antenna (11) includes a patch antenna element (22) capacitively coupled to a load patch (27). A switch (33) connects the load patch (27) to one of one or more strip lines (35, 37, 40), each of which has a different length. Each strip lines causes the load patch (27) to have a different impedance, with one causing a short circuit, one causing an open circuit, and one causing an impedance in between these extremes. Different impedances of the load patch (27) cause different frequencies of operation of the antenna patch (22) by virtue of the capacitive coupling therebetween. The antenna (11) is thereby tuneable to three separate frequencies. Other frequency bands are unaffected by virtue of the location of the load patch (27) relative to the antenna patch (22). By allowing tuning by way of controlling the impedance of the load patch (27), the antenna arrangement can be made smaller than a corresponding passive antenna operable at the same frequencies. By using an N throw switch, N strip lines of different lengths can be connected, each giving rise to a different operating frequency.

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

(52) **U.S. Cl.** 343/700 MS; 343/745; 343/815; 343/816; 343/817; 343/846

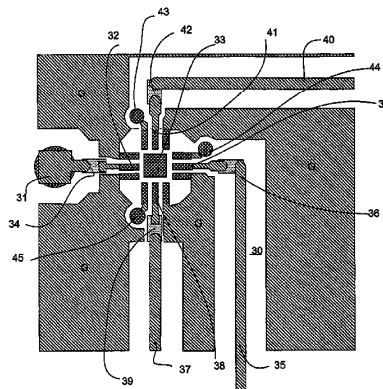
(58) **Field of Classification Search** 343/700 MS, 343/702, 787, 829, 846, 848
See application file for complete search history.

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10 Claims, 8 Drawing Sheets





US007339528B2

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

(10) **Patent No.:** **US 7,339,528 B2**
(45) **Date of Patent:** **Mar. 4, 2008**

(54) **ANTENNA FOR MOBILE COMMUNICATION TERMINALS**

(75) Inventors: **Hanyang Wang**, Witney (GB); **Stuart Williams**, Fleet (GB)

(73) Assignee: **Nokia Corporation**, Espoo (FI)

(*) 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.: **11/019,412**

(22) Filed: **Dec. 21, 2004**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

Dec. 24, 2003 (GB) 0330052.2

(51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 19/00 (2006.01)
H01Q 1/48 (2006.01)

(52) **U.S. Cl.** **343/700 MS**: 343/833;
343/846

(58) **Field of Classification Search** 343/700 MS,
343/702, 833, 844, 846, 848

See application file for complete search history.

(56) **References Cited**

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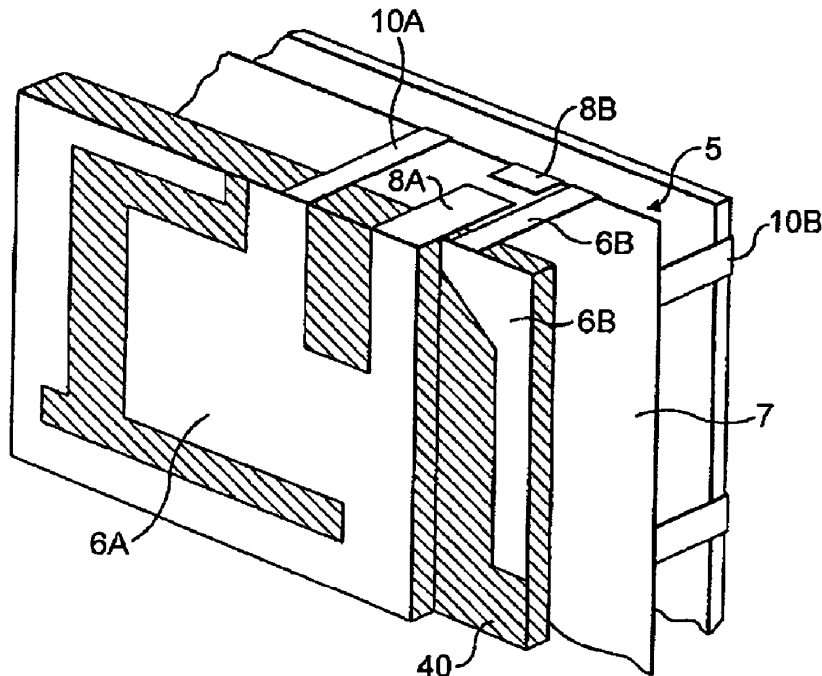
Primary Examiner—Shih-Chao Chen

(74) *Attorney, Agent, or Firm*—Harrington & Smith, PC

(57) **ABSTRACT**

An antenna including: a first substantially planar ground plate; a first substantially planar resonator positioned in a plane substantially parallel to the first ground plate; a second substantially planar ground plate positioned in a plane substantially parallel to the first ground plate; two or more connectors for electrically connecting the second ground plate to ground; and one or more connectors for electrically connecting the first resonator to the second ground plate; wherein the first resonator and the second ground plate are connected to at least one of receiver means and transmitter means by antenna feeding means.

31 Claims, 5 Drawing Sheets





US007339529B2

(12) **United States Patent**
Martek

(10) **Patent No.:** **US 7,339,529 B2**
(45) **Date of Patent:** **Mar. 4, 2008**

(54) **WIDE BAND BICONICAL ANTENNAS WITH AN INTEGRATED MATCHING SYSTEM**

FOREIGN PATENT DOCUMENTS

(75) Inventor: **Gary A. Martek**, Blythewood, SC (US)

CA 2 307 515 A1 10/2000

(73) Assignee: **Shakespeare Company LLC**, Greer, SC (US)

(Continued)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 96 days.

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(21) Appl. No.: **11/223,576**

Primary Examiner—Hoang V Nguyen

(22) Filed: **Sep. 9, 2005**

(74) *Attorney, Agent, or Firm*—Renner Kenner Greive Bobak Taylor & Weber

(65) **Prior Publication Data**

(57) **ABSTRACT**

US 2006/0017644 A1 Jan. 26, 2006

Related U.S. Application Data

(63) Continuation-in-part of application No. 10/683,063, filed on Oct. 10, 2003, now Pat. No. 7,142,166.

A biconical antenna includes an entry conic having an entry base opposite an entry vertex and a termination conic having a termination base opposite a termination vertex. The entry and termination conics share substantially the same axis and the entry vertex is adjacent the termination vertex. The transmission line is received by the entry conic and terminated in the termination conic. Together, the entry conic and the termination conic phase correct energy emanating from the transmission line. Another embodiment of the antenna comprises an entry conic having at least two sub-conics and a termination conic having at least two sub-conics. Each of the sub-conics having an integer multiple of a half-angle. The biconical antenna may also include a multi-conductor transmission line, wherein the biconical antennas are arranged in a co-linear relationship. Each of the multi-conductors is coupled to at least one of the plurality of biconical antennas. The biconical antennas may also be constructed on a circuit board substrate.

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

(52) **U.S. Cl.** **343/700 MS; 343/795; 343/846**

(58) **Field of Classification Search** **343/700 MS, 343/795, 850, 860, 773, 846, 820, 822**
See application file for complete search history.

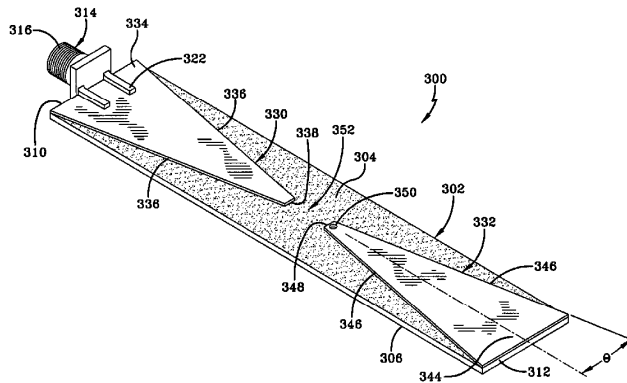
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16 Claims, 14 Drawing Sheets





US007339530B2

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

(10) **Patent No.:** **US 7,339,530 B2**
(45) **Date of Patent:** **Mar. 4, 2008**

(54) **ANTENNA FOR A PORTABLE COMMUNICATION DEVICE EQUIPPED WITH A HINGE**
(75) Inventors: **Zhinong Ying**, Lund (SE); **Göran Schack**, Åhus (SE); **Mats Kleverman**, Helsingborg (SE)
(73) Assignee: **Sony Ericsson Mobile Communications AB**, Lund (SE)
(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 162 days.

(52) **U.S. Cl.** **343/702; 343/700 MS**
(58) **Field of Classification Search** **343/702, 343/846, 848, 700 MS, 906**
See application file for complete search history.

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(21) Appl. No.: **10/572,197**
(22) PCT Filed: **Aug. 12, 2004**
(86) PCT No.: **PCT/EP2004/009030**
§ 371 (c)(1),
(2), (4) Date: **Mar. 15, 2006**
(87) PCT Pub. No.: **WO2005/027264**
PCT Pub. Date: **Mar. 24, 2005**

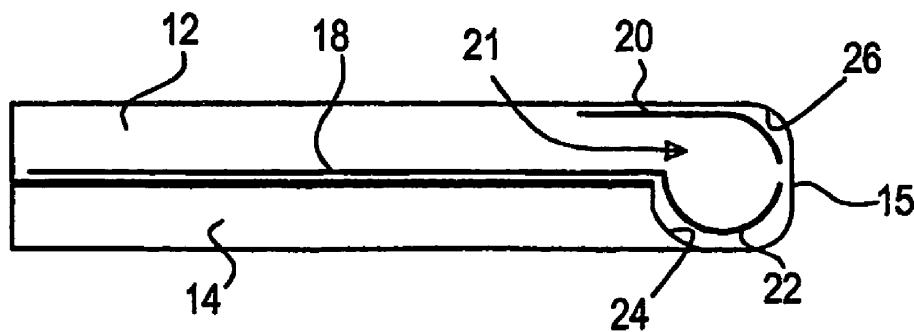
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Primary Examiner—Hoanganh Le
(74) *Attorney, Agent, or Firm*—Myers Bigel Sibley & Sajovec, P.A.

(65) **Prior Publication Data**
US 2007/0115185 A1 May 24, 2007
Related U.S. Application Data
(60) Provisional application No. 60/505,391, filed on Sep. 23, 2003.
Foreign Application Priority Data
(30) Sep. 16, 2003 (EP) 03020907
(51) **Int. Cl.**
H01Q 1/24 (2006.01)

(57) **ABSTRACT**
A portable communication device and an antenna system include a part having a ground plane located within and extending through the part. A hinging section is joined to the part and stretches along an end of the part for providing rotation of the part in relation to another part around an axis and providing a hinge cavity inside the hinging section surrounding the axis. An antenna element is at least partly provided inside the hinge cavity and the ground plane extends from the part into the hinge cavity at a distance from the antenna element.

13 Claims, 2 Drawing Sheets





US007339531B2

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

(10) **Patent No.:** **US 7,339,531 B2**
(45) **Date of Patent:** **Mar. 4, 2008**

(54) **MULTI FREQUENCY MAGNETIC DIPOLE ANTENNA STRUCTURES AND METHOD OF REUSING THE VOLUME OF AN ANTENNA**

(75) Inventors: **Laurent Desclos**, San Diego, CA (US); **Gregory Poilasne**, San Diego, CA (US); **Jeff Shamblin**, San Marcos, CA (US); **Sebastian Rowson**, San Diego, CA (US)

(73) Assignee: **Ethertronics, Inc.**, San Diego, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 249 days.

(21) Appl. No.: **10/756,884**

(22) Filed: **Jan. 14, 2004**

(65) **Prior Publication Data**
US 2004/0233111 A1 Nov. 25, 2004

Related U.S. Application Data
(63) Continuation-in-part of application No. 10/253,016, filed on Sep. 23, 2002, now Pat. No. 7,012,568, which is a continuation of application No. 09/892,928, filed on Jun. 26, 2001, now Pat. No. 6,456,243.

(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, 846, 895, 741, 866**
See application file for complete search history.

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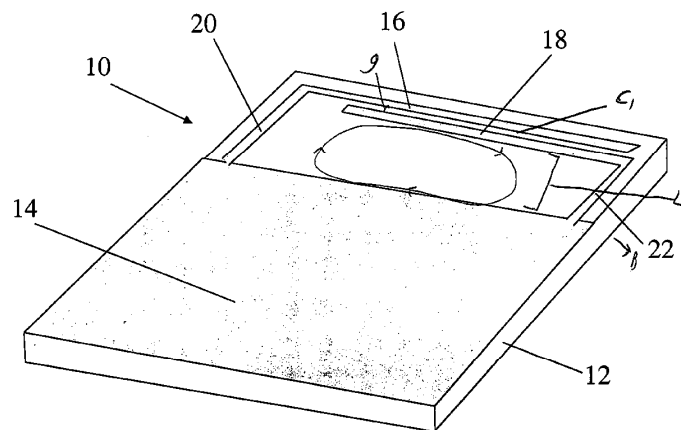
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Primary Examiner—Huedung Mancuso
(74) *Attorney, Agent, or Firm*—Foley and Lardner LLP

(57) **ABSTRACT**

Various resonant modes of a multiresonant antenna structure share at least portions of the structure volume. The basic antenna element has a substantially planar structure with a planar conductor and a pair of parallel elongated conductors, each having a first end electrically connected to the planar conductor. Additional elements may be coupled to the basic element in an array. In this way, individual antenna structures share common elements and volumes, thereby increasing the ratio of relative bandwidth to volume.

17 Claims, 24 Drawing Sheets





US007339532B2

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

(10) **Patent No.:** **US 7,339,532 B2**
(45) **Date of Patent:** **Mar. 4, 2008**

(54) **ANTENNA MODULE AND ELECTRONIC DEVICE USING THE SAME**

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(75) Inventors: **Il Hwan Park**, Kyungki-do (KR); **Chul Ho Kim**, Kyungki-do (KR); **Gi Tae Do**, Kyungki-do (KR); **Duk Woo Lee**, Kyungki-do (KR); **Jeong Sik Seo**, Daejeon (KR); **Tae Sung Kim**, Seoul (KR); **Sae Won Oh**, Kyungki-do (KR); **Hyun Hak Kim**, Kyungki-do (KR)

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(73) Assignee: **Samsung Electro-Mechanics Co., Ltd.**, Kyungki-Do (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 232 days.

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Primary Examiner—Huedung Mancuso

(74) *Attorney, Agent, or Firm*—McDermott Will & Emery LLP

(21) Appl. No.: **11/311,255**

(22) Filed: **Dec. 20, 2005**

(57) **ABSTRACT**

(65) **Prior Publication Data**

US 2006/0192712 A1 Aug. 31, 2006

The present invention relates to an antenna module which can minimize the occupying space in an electronic device, enhancing degrees of freedom to increase efficiency in space utilization, thereby accommodating miniaturization and multi-functionality of the electronic device, and an electronic device having the same. The antenna module includes a flexible substrate, an antenna element having a feeder part, a first fixing part, and a radiation part. The antenna module further includes a feeder line connected to the feeder part having a feeder pad, a first fixing pad connected to the first fixing part, and a pad coupling element. In the invention, signals are processed via interaction between the resonance of the current running through the feeder line to the radiation part and the resonance of the current coming into the pad coupling element.

(30) **Foreign Application Priority Data**

Feb. 25, 2005 (KR) 10-2005-0016103

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

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

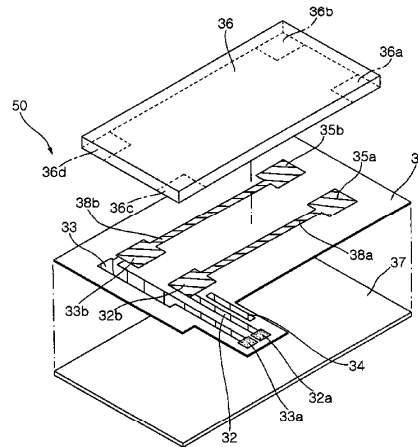
(58) **Field of Classification Search** 343/702, 343/700 MS, 873; 455/90, 90.3, 90.6
See application file for complete search history.

(56) **References Cited**

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13 Claims, 15 Drawing Sheets





US007339533B2

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

(10) **Patent No.:** **US 7,339,533 B2**
(45) **Date of Patent:** **Mar. 4, 2008**

(54) **ANTENNA APPARATUS AND ELECTRONIC DEVICE**
(75) Inventors: **Shigemi Kurashima**, Shinagawa (JP); **Masahiro Yanagi**, Shinagawa (JP); **Hideki Iwata**, Shinagawa (JP); **Takashi Arita**, Shinagawa (JP); **Takashi Yuba**, Shinagawa (JP); **Kazuhiko Ikeda**, Iiyama (JP); **Yuriko Segawa**, Shinagawa (JP)

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(73) Assignee: **Fujitsu Component Limited**, Tokyo (JP)
(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 33 days.

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KR 10-2004-0085358 10/2004
WO 96/38879 12/1996

(21) Appl. No.: **11/341,368**

(22) Filed: **Jan. 30, 2006**

(65) **Prior Publication Data**

US 2006/0170597 A1 Aug. 3, 2006

(30) **Foreign Application Priority Data**

Jan. 31, 2005 (JP) 2005-023846
Jul. 11, 2005 (JP) 2005-202154
Aug. 24, 2005 (JP) 2005-243040
Nov. 14, 2005 (JP) 2005-328514

(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, 873**

See application file for complete search history.

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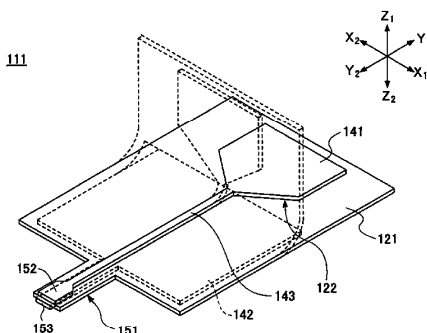
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Primary Examiner—Hoang V. Nguyen
(74) *Attorney, Agent, or Firm*—Staas & Halsey LLP

(57) **ABSTRACT**

The present invention discloses an antenna apparatus including a dielectric substrate on which an element including a conductive material pattern is formed. The dielectric substrate is a film.

30 Claims, 62 Drawing Sheets





US007339534B2

(12) **United States Patent**
Jeong

(10) **Patent No.:** **US 7,339,534 B2**
(45) **Date of Patent:** **Mar. 4, 2008**

(54) **ANTENNA APPARATUS FOR A PORTABLE TERMINAL**

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(75) Inventor: **Sung-Hun Jeong**, Daegu (KR)

(73) Assignee: **Samsung Electronics Co., Ltd.**,
Suwon-si, Gyeonggi-do (KR)

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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 0 days.

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Primary Examiner—Hoang V. Nguyen
(74) *Attorney, Agent, or Firm*—Roylance, Abrams, Berdo & Goodman, LLP

(21) Appl. No.: **11/418,370**

(22) Filed: **May 5, 2006**

(57) **ABSTRACT**

(65) **Prior Publication Data**

US 2007/0035456 A1 Feb. 15, 2007

An antenna apparatus for a portable terminal includes an antenna device contained in a housing of the terminal and a coaxial cable for connecting the antenna device to circuitry of the terminal. The coaxial cable connects a power feed and a ground of the antenna device to a power feed and a ground of the circuitry, respectively. The antenna apparatus for a portable terminal is advantageous in that, since the coaxial cable supplies power to the antenna device, which is spaced apart from the RF circuitry, and grounds are provided to the circuitry, which includes the RF circuitry, and to the antenna device, respectively, the connection properties and antenna characteristics are stable. Thus, even when an additional component (such as a camera module) is installed and the circuit configuration is changed, the antenna device, which is positioned on the upper end of the terminal, still exhibits optimal radiation performance.

(30) **Foreign Application Priority Data**

Aug. 10, 2005 (KR) 10-2005-0073278

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

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

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

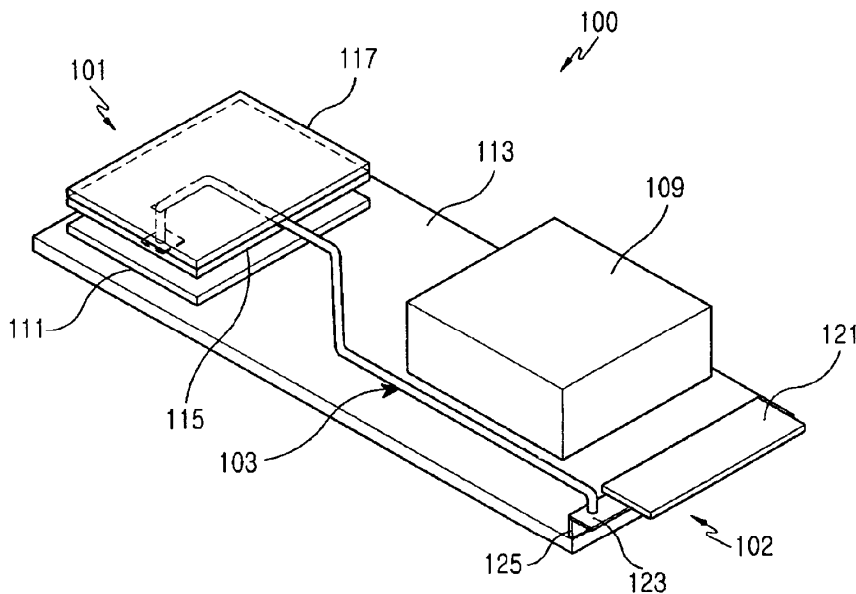
See application file for complete search history.

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17 Claims, 2 Drawing Sheets





US007339535B2

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

(10) **Patent No.:** **US 7,339,535 B2**
(45) **Date of Patent:** **Mar. 4, 2008**

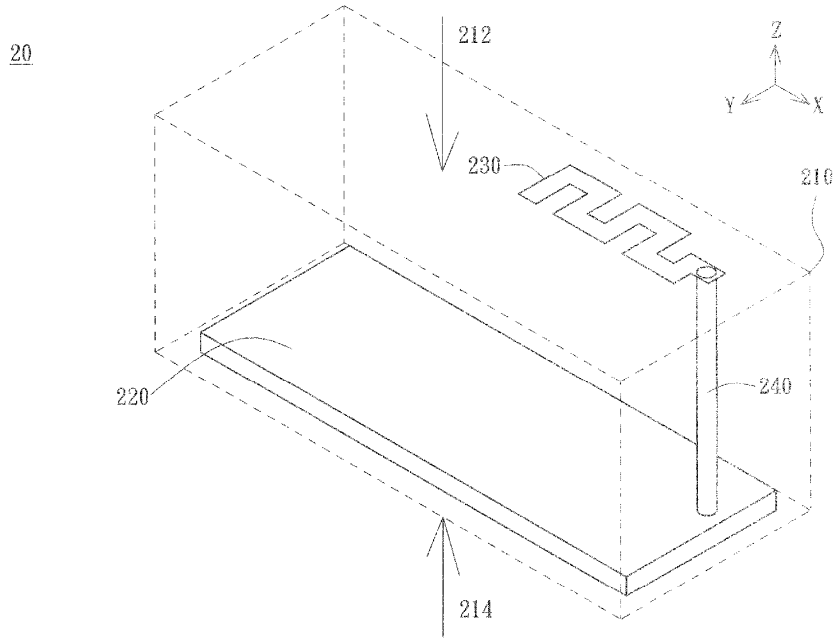
- (54) **ELECTRONIC APPARATUS HAVING ANTENNA DEVICE**
- (75) Inventors: **Jia-Haur Liang**, Kaohsiung (TW);
Ting-Yi Tsai, Taipei (TW)
- (73) Assignee: **Accton Technology Corporation**,
Hsinchu (TW)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.
- (21) Appl. No.: **11/537,666**
- (22) Filed: **Oct. 2, 2006**
- (65) **Prior Publication Data**
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- (30) **Foreign Application Priority Data**
Oct. 14, 2005 (TW) 94135944 A
- (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, 846**
See application file for complete search history.

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- Primary Examiner*—Hoang V Nguyen
- (74) *Attorney, Agent, or Firm*—Thomas, Kayden, Horstemeyer & Risley

(57) **ABSTRACT**

An electronic apparatus having an antenna device. The electronic apparatus includes a housing, a circuit board, an antenna device and a feeding device. The circuit board is placed inside the housing. The antenna device disposed on a surface of the housing transmits and receives a wireless signal. The feeding device has one end electrically connected to the circuit board and the other end electrically connected to the antenna device.

18 Claims, 5 Drawing Sheets





US007339536B2

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

(10) **Patent No.:** **US 7,339,536 B2**
(45) **Date of Patent:** **Mar. 4, 2008**

(54) **MULTI-BAND ANTENNA**

(75) Inventors: **Chen-Ta Hung**, Tu-Cheng (TW);
Shu-Yean Wang, Tu-Cheng (TW);
Hsien-Sheng Tseng, Tu-Cheng (TW)

(73) Assignee: **Hon Hai Precision Ind. Co., Ltd.**,
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 0 days.

(21) Appl. No.: **11/593,213**

(22) Filed: **Nov. 6, 2006**

(65) **Prior Publication Data**
US 2007/0103370 A1 May 10, 2007

(30) **Foreign Application Priority Data**
Nov. 4, 2005 (TW) 94138687 A

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

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

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

(56) **References Cited**

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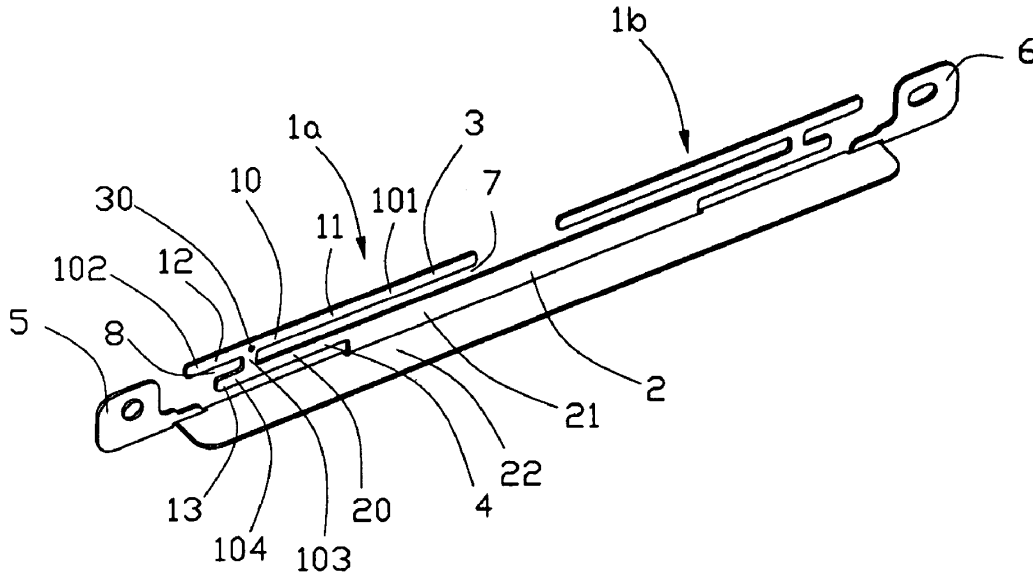
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Primary Examiner—Trinh Vo Dinh
(74) *Attorney, Agent, or Firm*—Wei Te Chung

(57) **ABSTRACT**

A multi-band antenna (1) includes a first antenna (1a), a second antenna (1b) and a grounding element (2). The first antenna (1a) includes a radiating element (10), a connecting element (20) connecting the radiating element (10) and the grounding element (2) and a feeding line. The radiating element (10) includes a first radiating section (11) working at a lower frequency, a second radiating (12) section working at a higher frequency and a third radiating section (13).

20 Claims, 7 Drawing Sheets





US007339537B2

(12) **United States Patent**
Hunsberger

(10) **Patent No.:** **US 7,339,537 B2**
(45) **Date of Patent:** **Mar. 4, 2008**

(54) **CAPACITIVE DRIVE ANTENNA AND AN AIR VEHICLE SO EQUIPPED**

(75) Inventor: **Harold Kregg Hunsberger**, Simi Valley, CA (US)

(73) Assignee: **Alliant Techsystems Inc.**, Edina, MN (US)

(*) 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.: **11/163,271**

(22) Filed: **Oct. 12, 2005**

(65) **Prior Publication Data**

US 2007/0091001 A1 Apr. 26, 2007

Related U.S. Application Data

(60) Provisional application No. 60/623,336, filed on Oct. 28, 2004.

- (51) **Int. Cl.**
- H01Q 1/28** (2006.01)
- F41G 7/00** (2006.01)
- F41G 9/00** (2006.01)
- F41G 7/20** (2006.01)
- F42B 10/00** (2006.01)
- F42B 15/00** (2006.01)
- F42B 15/04** (2006.01)
- F42B 15/01** (2006.01)
- G06F 19/00** (2006.01)

(52) **U.S. Cl.** **343/705**; 343/705; 343/708; 244/3.1; 244/3.11; 244/3.12; 244/3.13; 244/3.14; 244/3.15; 244/3.16; 244/3.17; 244/3.18; 244/3.19; 244/3.24

(58) **Field of Classification Search** 343/705, 343/708, 718, 763; 244/3.1, 3.11-3.19, 3.24
See application file for complete search history.

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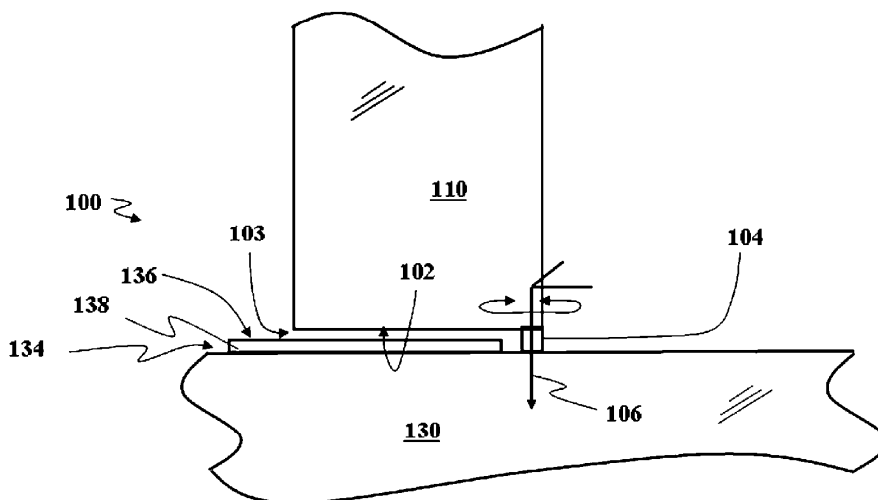
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Primary Examiner—Hoang V. Nguyen
Assistant Examiner—Robert Karacsony
(74) *Attorney, Agent, or Firm*—TraskBritt

(57) **ABSTRACT**

Disclosed are antenna embodiments and air vehicles so equipped that include a first antenna component, and a second antenna component, separated by a free space gap, where the antenna embodiments are adapted to capacitively couple the first antenna component and the second antenna component across one or more portions of the free space gap and where the first antenna component member has a degree or axis of rotation, relative to the second antenna component.

15 Claims, 24 Drawing Sheets





US007339541B2

(12) **United States Patent**
Schadler

(10) **Patent No.:** **US 7,339,541 B2**
(45) **Date of Patent:** **Mar. 4, 2008**

- (54) **WIDEBAND CAVITY-BACKED ANTENNA**
- (75) Inventor: **John L. Schadler**, Raymond, ME (US)
- (73) Assignee: **SPX Corporation**, Charlotte, NC (US)
- (*) 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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- (21) Appl. No.: **10/819,961**
- (22) Filed: **Apr. 8, 2004**

- (65) **Prior Publication Data**
US 2004/0189539 A1 Sep. 30, 2004

- Related U.S. Application Data**
- (63) Continuation-in-part of application No. 10/252,429, filed on Sep. 24, 2002, now Pat. No. 6,756,949.

- (51) **Int. Cl.**
H01Q 1/12 (2006.01)
H01Q 13/00 (2006.01)
- (52) **U.S. Cl.** **343/772; 343/891**
- (58) **Field of Classification Search** **343/789, 343/771, 772, 776, 890, 891, 786**
See application file for complete search history.

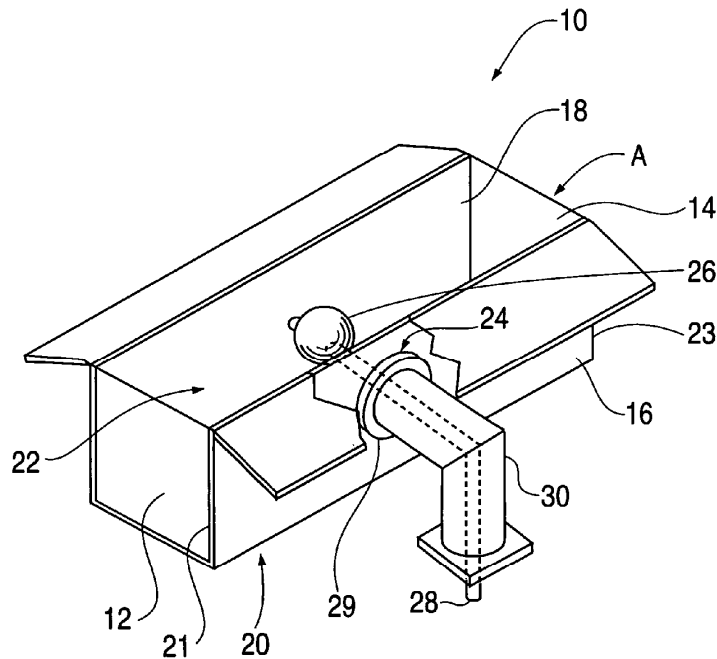
- (56) **References Cited**
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Primary Examiner—Michael C. Wimer
 (74) *Attorney, Agent, or Firm*—Baker & Hostetler LLP

(57) **ABSTRACT**

An antenna system is disclosed that includes a mast, waveguides positioned about the mast, and a feed system positioned external to the mast and between adjacent waveguides, such the feed system can be easily serviced. The waveguides include radiator elements that are easy to manufacture, and thus reduce the cost associated with wideband cavity-backed antennas. Further, adjustable disc-like and spherical radiating elements for exciting the fields in the waveguides are also disclosed. DC voltage buildup on the radiating elements are grounded by an easily attachable coaxial structure.

9 Claims, 7 Drawing Sheets





US007339542B2

(12) **United States Patent**
Lalezari

(10) **Patent No.:** **US 7,339,542 B2**
(45) **Date of Patent:** **Mar. 4, 2008**

(54) **ULTRA-BROADBAND ANTENNA SYSTEM
COMBINING AN ASYMMETRICAL DIPOLE
AND A BICONICAL DIPOLE TO FORM A
MONOPOLE**

(75) Inventor: **Farzin Lalezari**, Boulder, CO (US)

(73) Assignee: **FIRST RF Corporation**, Boulder, CO
(US)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 232 days.

(21) Appl. No.: **11/298,482**

(22) Filed: **Dec. 12, 2005**

(65) **Prior Publication Data**

US 2007/0132650 A1 Jun. 14, 2007

(51) **Int. Cl.**
H01Q 13/00 (2006.01)

(52) **U.S. Cl.** **343/773; 343/730; 343/792**

(58) **Field of Classification Search** **343/725,**
343/729, 730, 756, 773, 774, 790, 791, 792,
343/793

See application file for complete search history.

(56) **References Cited**

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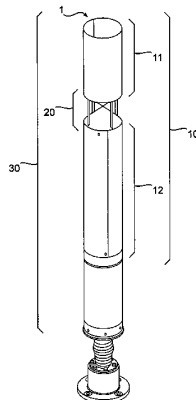
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Primary Examiner—Tho Phan
(74) *Attorney, Agent, or Firm*—Intelle Tech PLLC;
Katharine I. Matthews

(57) **ABSTRACT**

An ultra-broadband antenna system is disclosed. The antenna system is a single tubular antenna structure comprising an asymmetrical dipole fed with a biconical dipole. The biconical dipole covers the high frequency spectrum, while the asymmetrical dipole covers intermediate frequencies. The invention further relates to a combination of the two dipole structures such that together they act as a monopole to cover the low frequency spectrum. A first RF connector attaches to the asymmetrical dipole and the biconical dipole, and a second RF connector excites the combination of the two dipoles as one large monopole. A choke minimizes interference between the asymmetrical/biconical dipoles and the monopole. The resulting frequency span is greater than 500:1, providing operation over the range of 20 MHz to 10 GHz.

21 Claims, 18 Drawing Sheets





US007339543B2

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

(10) **Patent No.:** **US 7,339,543 B2**
(45) **Date of Patent:** **Mar. 4, 2008**

(54) **ARRAY ANTENNA WITH LOW PROFILE**

(75) Inventors: **Shu-Yean Wang**, Tu-Cheng (TW);
Shang-Jen Chen, Tu-Cheng (TW);
Wen-Fong Su, Tu-Cheng (TW);
Yun-Long Ke, Tu-Cheng (TW)

(73) Assignee: **Hon Hai Precision Ind. Co., Ltd.**,
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 183 days.

(21) Appl. No.: **11/213,506**

(22) Filed: **Aug. 26, 2005**

(65) **Prior Publication Data**

US 2006/0232488 A1 Oct. 19, 2006

(30) **Foreign Application Priority Data**

Apr. 19, 2005 (CN) 2005 2 0070984 U

(51) **Int. Cl.**
H01Q 9/28 (2006.01)

(52) **U.S. Cl.** **343/795**; 343/700 MS

(58) **Field of Classification Search** 343/700 MS,
343/795, 846

See application file for complete search history.

(56) **References Cited**

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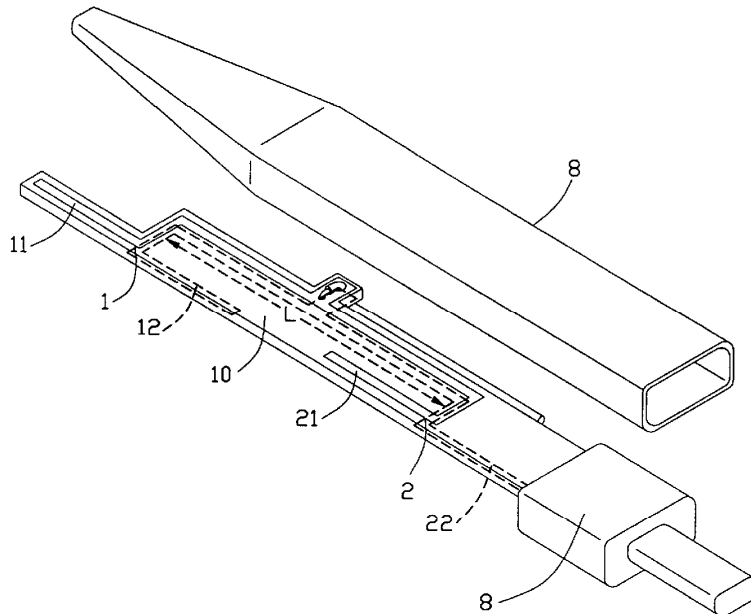
Primary Examiner—Tan Ho

(74) *Attorney, Agent, or Firm*—Wei Te Chung

(57) **ABSTRACT**

An array antenna includes a dielectric substrate (10) having an upper and a lower surfaces (101, 102), a first and a second radiating elements (11, 21), a first connecting portion (31) connecting the two radiating elements arranged on the upper surface of the dielectric substrate, a first and a second grounding elements (12, 22), and a second connecting portion (32) connecting the two grounding elements arranged on the lower surface of the dielectric substrate. A feeding point (4) is disposed on the first connecting portion and a grounding point (6) is disposed on the second connecting point. A coaxial cable (7) has an inner conductor (71) coupled to the feeding point and an outer conductor (72) coupled to the grounding point.

20 Claims, 7 Drawing Sheets





US007339544B2

(12) **United States Patent**
Jeung

(10) **Patent No.:** **US 7,339,544 B2**
(45) **Date of Patent:** **Mar. 4, 2008**

(54) **ARRAY ANTENNA FOR SUPPRESSING BACK SIGNAL AND METHOD FOR DESIGNING THE SAME**

FOREIGN PATENT DOCUMENTS

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(76) Inventor: **Ha Jae Jeung**, 307-101 Buyeong Apt. 3-Danji, Donong-Dong, Namyangju-Si, Gyeonggi-Do 472-793 (KR)

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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 0 days.

Primary Examiner—Hoang V. Nguyen
(74) *Attorney, Agent, or Firm*—IPLA P.A.; James E. Bame

(57) **ABSTRACT**

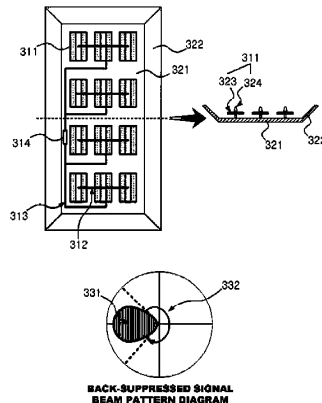
(21) Appl. No.: **10/598,863**
(22) PCT Filed: **Jun. 24, 2005**
(86) PCT No.: **PCT/KR2005/001983**
§ 371 (c)(1),
(2), (4) Date: **Sep. 13, 2006**
(87) PCT Pub. No.: **WO2006/001662**
PCT Pub. Date: **Jan. 5, 2006**

The present invention provides a method for designing a front directional array antenna for suppressing a back signal used in a wireless communication, comprising: (a) an analogous pattern element arranging step for arranging, on a reflecting panel which is a conductor at a predetermined interval, elements having mutual analogous emission pattern characteristic for a short axis (x axis) in which the number of arrangements is small and for a long axis (y axis) which is a perpendicular direction to the x axis; (b) a reception balancing step for forming, in the edge of the reflecting panel, reflecting surfaces having a predetermined angle and length which are symmetric centering on the front surface to direction of electric wave arrived to the elements located in the edge; (c) an x-axis direction signal suppressing step, by x-axis series distribution and synthesis, for performing as many series distribution and synthesis suppressing transfer characteristic in an x-axis direction as the number of y rows, for output distribution and synthesis for the x axis arrangement, in synthesizing a signal of the array antenna after the step (b); (d) a y-axis direction signal suppressing step, by y-axis series distribution and synthesis, for performing series distribution and synthesis suppressing transfer characteristic in a y-axis direction in finally performing distribution and synthesis in the y-axis direction, for output distribution and synthesis for the x axis arrangement; and (e) a back-suppressed signal pattern outputting step for providing result of arrangement signal distribution and synthesis of the y axis to a contact means outside the antenna device.

(65) **Prior Publication Data**
US 2007/0182635 A1 Aug. 9, 2007
(30) **Foreign Application Priority Data**
Jun. 28, 2004 (KR) 10-2004-0048743
(51) **Int. Cl.**
H01Q 21/00 (2006.01)
(52) **U.S. Cl.** **343/817**; 343/810; 343/754
(58) **Field of Classification Search** 343/810,
343/815, 817, 818, 819, 833, 754
See application file for complete search history.
(56) **References Cited**
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(Continued)

4 Claims, 6 Drawing Sheets





US007339545B2

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

(10) **Patent No.:** **US 7,339,545 B2**
(45) **Date of Patent:** **Mar. 4, 2008**

(54) **IMPEDANCE MATCHING MEANS
BETWEEN ANTENNA AND TRANSMISSION
LINE**

(75) Inventors: **Wen Fong Su**, Tu-Chen (TW);
Yun-Long Ke, Tu-Chun (TW);
Yao-Shien Huang, Tu-Chun (TW)

(73) Assignee: **Hon Hai Precision Ind. Co., Ltd.**,
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 0 days.

(21) Appl. No.: **11/159,983**

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

(65) **Prior Publication Data**
US 2006/0103584 A1 May 18, 2006

(30) **Foreign Application Priority Data**
Nov. 18, 2004 (CN) 2004 1 0065529

(51) **Int. Cl.**
H01Q 1/50 (2006.01)
H01Q 1/38 (2006.01)
H01Q 21/12 (2006.01)

(52) **U.S. Cl.** **343/860**; 343/700 MS;
343/815

(58) **Field of Classification Search** 343/700 MS,
343/846, 848, 815, 860
See application file for complete search history.

(56) **References Cited**

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et al. 343/700 MS

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Primary Examiner—Shih-Chao Chen
(74) *Attorney, Agent, or Firm*—Wei Te Chung

(57) **ABSTRACT**

An impedance matching means according to the present invention is used with an antenna and is realized by a parasitic element (3) for tuning an impedance of the antenna. The antenna comprises a grounding plate (2), an radiating body (1) arranged on the grounding plate (2) and a transmission line (4) coupled to said radiating body (1) and grounding plate (2). The parasitic element (3) formed of a narrow metal sheet and configured as a bridge shape is arranged on the grounding plate (2). The parasitic element (3) has a first and a second ends (311, 321), both of which are electrically connected to the grounding plate (2). The arrangement of the parasitic element (3) results in a change of the impedance of the antenna, so the impedance matching between the antenna and the transmission line (4) can be achieved.

20 Claims, 6 Drawing Sheets



US007339550B2

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

(10) **Patent No.:** **US 7,339,550 B2**
(45) **Date of Patent:** **Mar. 4, 2008**

(54) **ANTENNA AND RFID TAG**

OTHER PUBLICATIONS

- (75) Inventors: **Kosuke Hayama**, Kyoto (JP); **Keisuke Saito**, Kyoto (JP)
- (73) Assignee: **Omron Corporation**, Kyoto (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.

Feb. 14, 2006 Press Release, Omron Corporation, RFID Business Development Department & Translation.
 Article in Business & Technology, Feb. 15, 2006, and Translation.
 Submission of Certificate for Exceptions to Lack of Novelty & Translation citing Internet cite, no dated!.

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Primary Examiner—Tho Phan

(74) *Attorney, Agent, or Firm*—Dickstein Shapiro LLP

(21) Appl. No.: **11/588,273**

(57) **ABSTRACT**

(22) Filed: **Oct. 27, 2006**

(65) **Prior Publication Data**

US 2007/0200782 A1 Aug. 30, 2007

(30) **Foreign Application Priority Data**

Feb. 24, 2006 (JP) P2006-047867

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

(52) **U.S. Cl.** **343/895; 343/795; 340/572.7**

(58) **Field of Classification Search** **343/700 MS, 343/795, 895; 340/572.5, 572.7; 235/492**
See application file for complete search history.

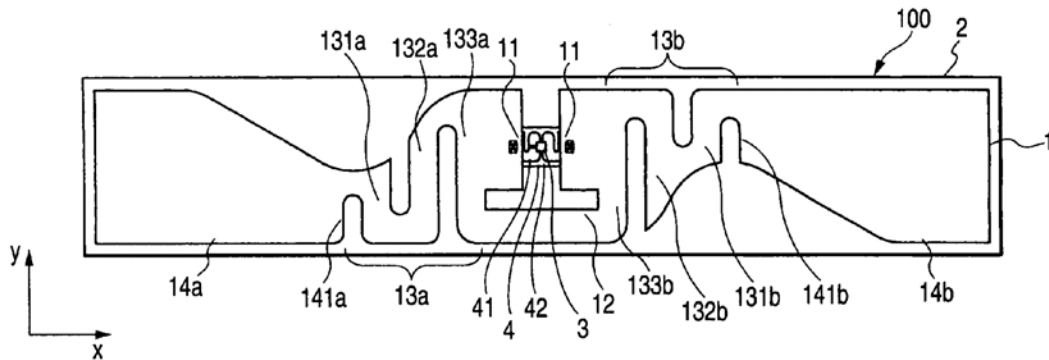
An antenna for an RFID tag includes each power feeding parts **11** that is formed of a conductor, meandering parts **13a** and **13b** that are formed of conductors shaped as a pair of meandering lines, connected to the power feeding parts **11**, and extend from the power feeding parts **11** toward both ends of the radiating parts **14a** and **14b** that are formed of conductors and connected to outer ends of the pair of meandering parts **13a** and **13b**, respectively. The meandering parts **13a** and **13b** include a plurality of sides arranged in a longitudinal direction where the meandering parts **13a** and **13b** extend. Further, the lengths of portions, where the ends of the radiating parts **14a** and **14b** facing the meandering parts **13a** and **13b** face the sides closest to the radiating parts **14a** and **14b** among the plurality of sides of the meandering parts **13a** and **13b** in a direction orthogonal to the longitudinal direction, are smaller than the widths of the widest portions of the radiating parts.

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8 Claims, 9 Drawing Sheets





US007342539B2

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

(10) **Patent No.:** **US 7,342,539 B2**
(45) **Date of Patent:** **Mar. 11, 2008**

- (54) **WIDEBAND LOOP ANTENNA**
- (75) Inventors: **Hans Rosenberg**, Dwingeloo (NL);
Henrik Jidhage, Alingsas (SE); **Bengt Svensson**, Molndal (SE)
- (73) Assignee: **Sony Ericsson Mobile Communications AB**, Lund (SE)
- (*) 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.: **10/533,033**
- (22) PCT Filed: **Oct. 17, 2003**
- (86) PCT No.: **PCT/EP03/11532**

§ 371 (c)(1),
(2), (4) Date: **Oct. 24, 2005**

- (87) PCT Pub. No.: **WO2004/040697**
PCT Pub. Date: **May 13, 2004**
- (65) **Prior Publication Data**
US 2006/0109183 A1 May 25, 2006

Related U.S. Application Data

- (60) Provisional application No. 60/424,400, filed on Nov. 7, 2002.

Foreign Application Priority Data

- (30) Oct. 31, 2002 (EP) 02024241

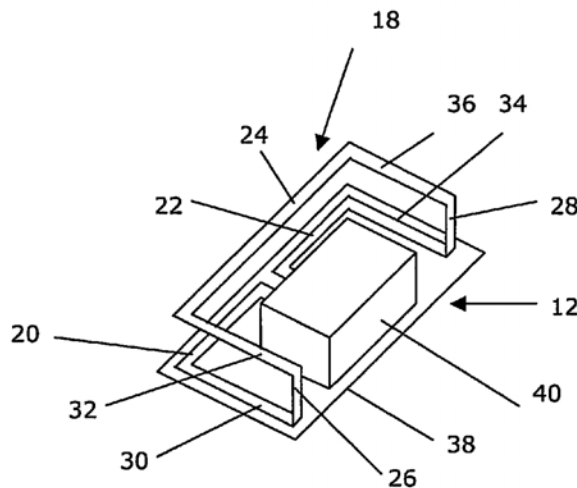
- (51) **Int. Cl.**
H01Q 1/24 (2006.01)
 - (52) **U.S. Cl.** **343/702; 343/741; 343/866**
 - (58) **Field of Classification Search** **343/702, 343/741, 742, 866, 700 MS, 867**
- See application file for complete search history.

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- Primary Examiner*—Tho Phan
(74) *Attorney, Agent, or Firm*—Myers, Bigel, Sibley & Sajovec, P.A.

(57) **ABSTRACT**

The present invention relates to a wireless communication device and an antenna arrangement in such a device, where a loop antenna element (18) comprises: a first section (20) provided in and extending a length in first plane, a second section (22) spaced from, provided in and extending a length in the first plane, a third section (24) in a second plane parallel to the first plane, aligned with the first and second sections, and a fourth (26) and a fifth section (28) interconnecting antenna sections in the first and second planes. The sections form a three-dimensional structure having a substantial two-dimensional extension in at least one of the first and second planes. The second section extends along the same line as the first section or has a curvature, which is a continuation of the curvature of the first section. Thereby a small wideband antenna requiring a small ground plane is obtained.

15 Claims, 2 Drawing Sheets





US007342540B2

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

(10) **Patent No.:** **US 7,342,540 B2**
(45) **Date of Patent:** **Mar. 11, 2008**

(54) **DUAL BAND DIVERSITY WLAN ANTENNA SYSTEM FOR LAPTOP COMPUTERS, PRINTERS AND SIMILAR DEVICES**

(75) Inventors: **Vijay Nahar**, Cambridge (GB); **Brian Collins**, Cambridge (GB)

(73) Assignee: **Antenova Ltd.**, Cambridge (GB)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 34 days.

(21) Appl. No.: **10/586,155**

(22) PCT Filed: **Jan. 14, 2005**

(86) PCT No.: **PCT/GB2005/000105**

§ 371 (c)(1),
(2), (4) Date: **Jul. 14, 2006**

(87) PCT Pub. No.: **WO2005/069433**

PCT Pub. Date: **Jul. 28, 2005**

(65) **Prior Publication Data**

US 2007/0164904 A1 Jul. 19, 2007

(30) **Foreign Application Priority Data**

Jan. 16, 2004 (GB) 0400925.4

(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, 846**
See application file for complete search history.

(56) **References Cited**

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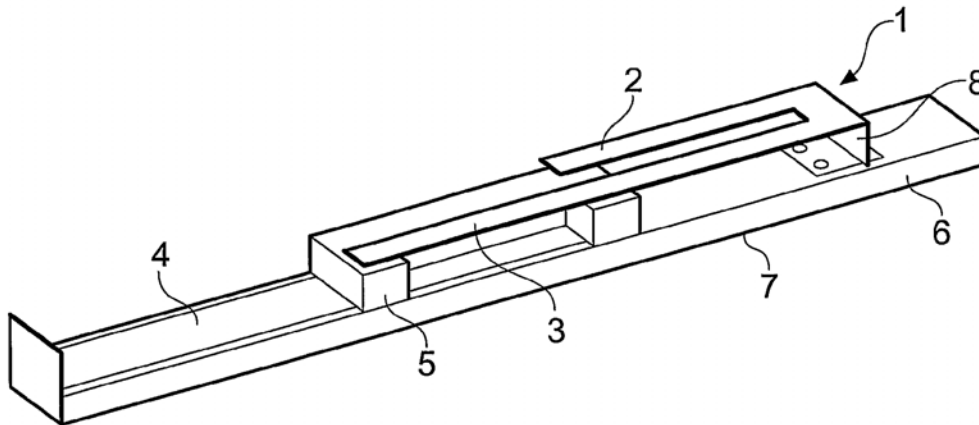
(Continued)

Primary Examiner—Hoang V. Nguyen
(74) *Attorney, Agent, or Firm*—Pearl Cohen Zedek Latzer, LLP

(57) **ABSTRACT**

There is disclosed a dual band antenna device including a dielectric substrate (6) having opposed first and second surfaces and a groundplane (7) on the second surface. A microstrip transmission line (4) is provided on the first surface, and a dielectric pellet (5) is mounted on the first surface on the microstrip transmission line (4). A bifurcated planar inverted-L antenna (PILA) component (1) is also mounted on the first surface, the PILA component (1) having first (2) and second (3) arms which extend over and contact a surface of the dielectric pellet (5). The first arm (3) contacts a different area of the surface of the dielectric pellet (5) than the second arm (2). The antenna device provides good operation at both 2.4 GHz and 5.5 GHz frequency bands.

7 Claims, 4 Drawing Sheets





US007342542B2

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

(10) **Patent No.:** US 7,342,542 B2
(45) **Date of Patent:** Mar. 11, 2008

(54) **ANTENNA** 6,885,347 B2 * 4/2005 Zheng et al. 343/702
7,151,493 B2 * 12/2006 Wen et al. 343/700 MS
(75) Inventors: **Hidetoshi Sadamori**, Okayama (JP);
Yoshinobu Nakagawa, Osaka (JP);
Setsuo Takesako, Osaka (JP)

(73) Assignee: **Matsushita Electric Industrial Co., Ltd.**, Osaka (JP)
(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 123 days.

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(21) Appl. No.: **11/285,626**

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(22) Filed: **Nov. 22, 2005**

Primary Examiner—Trinh Dinh
Assistant Examiner—Dieu Hien T Duong

(65) **Prior Publication Data**

US 2006/0139219 A1 Jun. 29, 2006

(74) *Attorney, Agent, or Firm*—RatnerPrestia

(30) **Foreign Application Priority Data**

Dec. 27, 2004 (JP) 2004-376046
Apr. 27, 2005 (JP) 2005-129281

(57) **ABSTRACT**

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

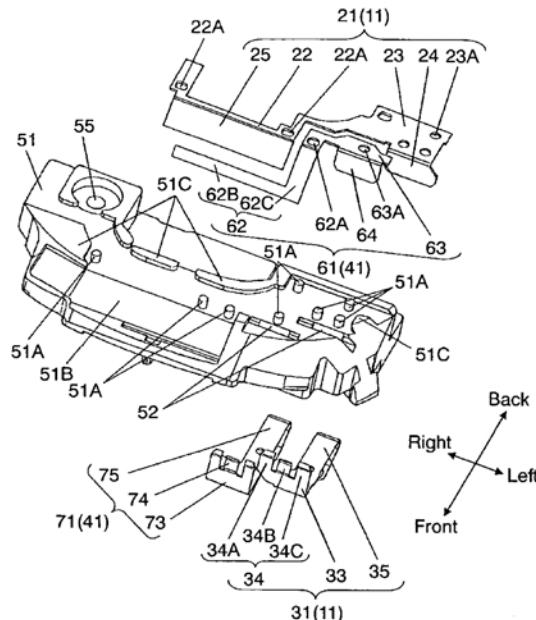
A first antenna element is formed by a press-fitting first member and a second member to each other, and a second antenna element is formed by press-fitting a first member and a second member to each other. Respective members are fixed to a base by riveting, thereby achieving the antenna. This structure allows determining arbitrarily splitting positions and shapes of members of the first antenna element and the members of the second antenna element. The antenna can be obtained at an inexpensive cost even if an external appearance of the antenna is specified to be an irregular shape.

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12 Claims, 9 Drawing Sheets





US007342544B2

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

(10) **Patent No.:** **US 7,342,544 B2**
(45) **Date of Patent:** **Mar. 11, 2008**

(54) **ANTENNA WITH OVERLAPPING FIRST AND SECOND RADIATING ELEMENTS**

(75) Inventors: **Tiao-Hsing Tsai**, Yungho (TW);
Chieh-Ping Chiu, Yunlin Shien (TW)

(73) Assignee: **Quanta Computer, Inc.**, Tao Yuan Shien (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 81 days.

(21) Appl. No.: **11/304,252**

(22) Filed: **Dec. 14, 2005**

(65) **Prior Publication Data**
US 2007/0057847 A1 Mar. 15, 2007

(30) **Foreign Application Priority Data**
Sep. 9, 2005 (TW) 94131136 A

(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, 725-729**

See application file for complete search history.

(56) **References Cited**

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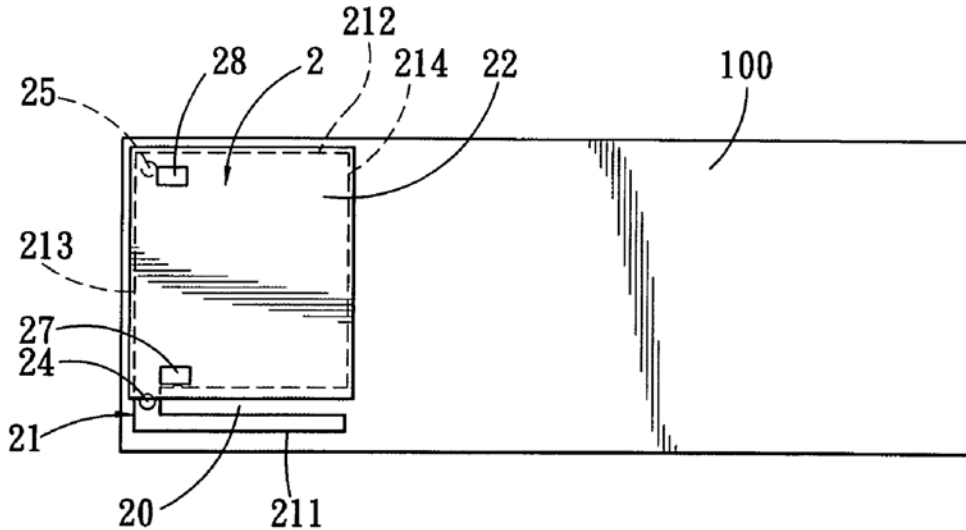
Primary Examiner—Huedung Mancuso

(74) *Attorney, Agent, or Firm*—Ladas & Parry LLP

(57) **ABSTRACT**

An antenna includes a first radiating element, a feeding point, a grounding point, a second radiating element, and first and second conductive elements. The first radiating element has opposite first and second sides. The feeding point is provided on the first side of the first radiating element, and is disposed adjacent to the first side of the first radiating element. The grounding point is provided on the first radiating element, and is disposed adjacent to the second side of the first radiating element. The second radiating element is spaced apart from and overlaps the first radiating element. The first conductive element is disposed adjacent to the feeding point, and interconnects the first and second radiating elements. The second conductive element is disposed adjacent to the grounding point, and interconnects the first and second radiating elements.

8 Claims, 5 Drawing Sheets





US007342545B2

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

(10) **Patent No.:** **US 7,342,545 B2**
(45) **Date of Patent:** **Mar. 11, 2008**

(54) **ANTENNA SYSTEM CONFIGURATION FOR MOBILE PHONES**

EP	0613206	8/1994
EP	1069641	1/2001
EP	1505727	2/2005
JP	2001257514	9/2001

(75) Inventors: **Minh Chau Huynh**, Morrisville, NC (US); **Gerard James Hayes**, Wake Forest, NC (US)

(73) Assignee: **Sony Ericsson Mobile Communications AB**, Lund (SE)

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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 0 days.

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Sony Ericsson Mobile Communications AB, International Application No. PCT/US06/060029, "Partial International Search Report", Mar. 15, 2007.

(21) Appl. No.: **11/307,927**

(22) Filed: **Feb. 28, 2006**

* cited by examiner

(65) **Prior Publication Data**

US 2007/0200772 A1 Aug. 30, 2007

Primary Examiner—Tan Ho

(74) *Attorney, Agent, or Firm*—Frederick D. Bailey; Moore & Van Allen, PLLC

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

(57) **ABSTRACT**

(52) **U.S. Cl.** **343/702**; 343/860

(58) **Field of Classification Search** 343/702, 343/860; 455/90.3

See application file for complete search history.

An antenna configuration for a flip type mobile phone is disclosed. The antenna configuration is designed to reduce, to a hearing aid compatibility (HAC) M3 rating or better, any scattered EM field effects that can cause interference to an active hearing aid. The antenna configuration comprises a halfwave type antenna extendable from the lower portion of the mobile phone. The antenna does not share the same vertical axis as the lower portion of the mobile phone when extended. Rather, it forms a tilt angle (α) that extends the antenna away from the upper portion of the mobile phone creating a greater separation distance between the speaker and the antenna. An antenna feed contact couples the antenna to components within the mobile phone. An antenna matching network can tune and attenuate the antenna configuration to enhance operation in the GSM frequency bands.

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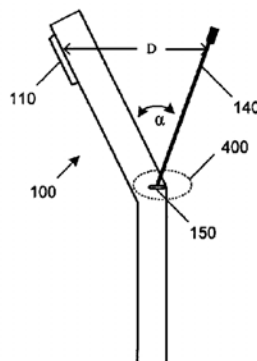
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DE 19639642 4/1997

7 Claims, 4 Drawing Sheets





US007342546B1

(12) **United States Patent**
Stanton

(10) **Patent No.:** US 7,342,546 B1
(45) **Date of Patent:** Mar. 11, 2008

(54) **ANTENNA IN A WIRELESS SYSTEM**

(75) Inventor: **Kevin Patrick Stanton**, Glenview, IL (US)

(73) Assignee: **Shure Acquisition Holdings, Inc.**, Niles, IL (US)

(*) 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.: **11/534,802**

(22) Filed: **Sep. 25, 2006**

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

(52) **U.S. Cl.** **343/702; 343/749**

(58) **Field of Classification Search** **343/702, 343/866, 741, 700 MS, 846, 749**

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,680,708 B2 * 1/2004 Yamaki 343/741

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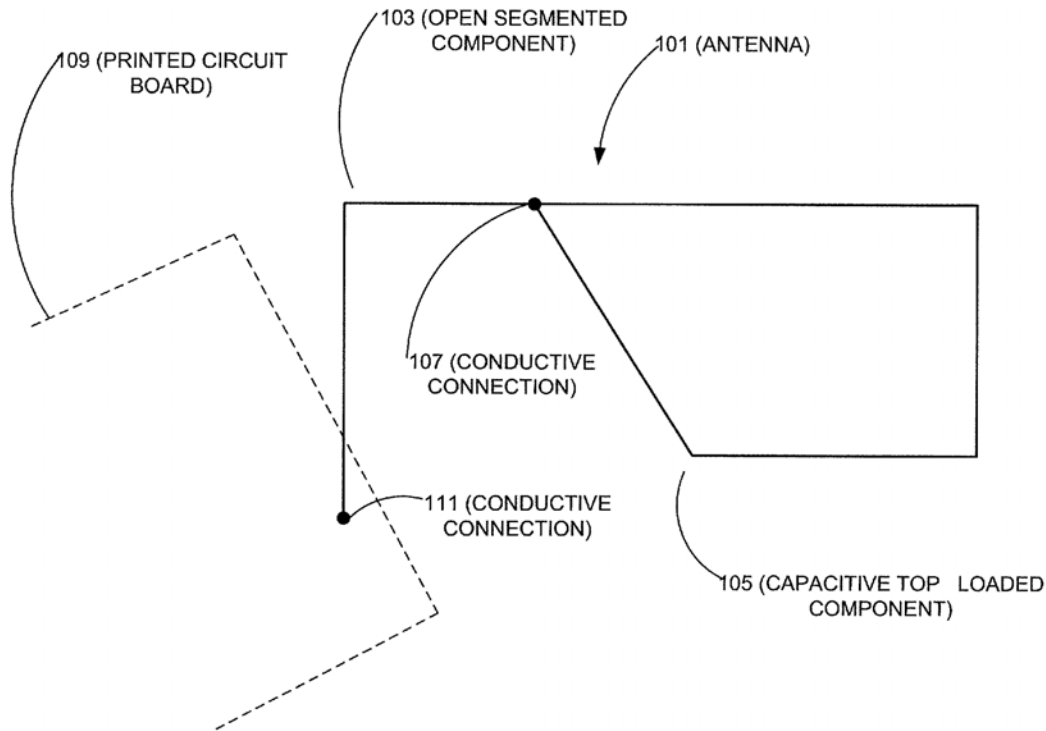
Primary Examiner—Hoang V Nguyen

(74) *Attorney, Agent, or Firm*—Banner & Witcoff, Ltd.

(57) **ABSTRACT**

The present invention provides apparatuses and methods for an antenna in a wireless receiving system. The antenna includes an opened segmented component that is electrically coupled to a printed circuit board and a capacitive top loaded component that provides a capacitive load. The vertical profile of the antenna may be reduced sufficiently so that the antenna may be internally located in the same enclosure as the printed circuit board. The capacitive top loaded component is situated away from a ground plane of a printed circuit board to reduce the capacitive coupling is reduced, and consequently the required voltage standing wave ration (VSWR) is maintained over a broad operating range. The capacitive top loaded component includes a closed shape that provides a capacitive load. In order to tune the antenna to operate with a desired characteristic (e.g., within a VSWR criterion), the closed shape may be modified.

22 Claims, 7 Drawing Sheets





US007342547B2

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

(10) **Patent No.:** **US 7,342,547 B2**
(45) **Date of Patent:** **Mar. 11, 2008**

(54) **GLASS ANTENNA AND MANUFACTURING METHOD FOR THE SAME**

(75) Inventors: **Toru Maniwa**, Kawasaki (JP); **Andrey Andrenko**, Kawasaki (JP); **Shigekazu Kimura**, Kawasaki (JP); **Shigeru Hashimoto**, Inagi (JP); **Toshiaki Ibi**, Inagi (JP); **Akihito Sano**, Tokyo (JP)

(73) Assignees: **Fujitsu Limited**, Kawasaki (JP); **Fujitsu Frontech Limited**, Inagi (JP); **Nippon Sheet Glass 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 16 days.

(21) Appl. No.: **11/342,669**

(22) Filed: **Jan. 31, 2006**

(65) **Prior Publication Data**
US 2007/0057848 A1 Mar. 15, 2007

(30) **Foreign Application Priority Data**
Sep. 12, 2005 (JP) 2005-263996

(51) **Int. Cl.**
H01Q 1/32 (2006.01)

(52) U.S. Cl. **343/713; 343/711**

(58) **Field of Classification Search** 343/713, 343/711, 700 MS, 846
See application file for complete search history.

(56) **References Cited**

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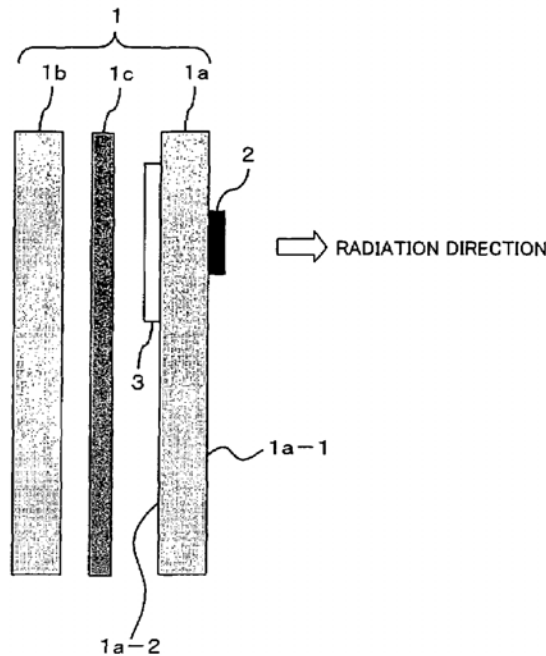
Primary Examiner—Hoang V. Nguyen

(74) *Attorney, Agent, or Firm*—Bingham McCutchen LLP

(57) **ABSTRACT**

Either one or both of the antenna pattern and a ground pattern, which reflects a radiated radio wave radiated from the antenna pattern, are buried inside the glass substrate. As a result, it is possible to provide high-gain, low-loss glass antennas in which glass is used as their substrates.

17 Claims, 12 Drawing Sheets





US007342548B2

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

(10) **Patent No.:** **US 7,342,548 B2**
(45) **Date of Patent:** **Mar. 11, 2008**

(54) **RADIO GUIDANCE ANTENNA, DATA COMMUNICATION METHOD, AND NON-CONTACT DATA COMMUNICATION APPARATUS**

6,166,706 A * 12/2000 Gallagher et al. 343/867
6,570,490 B1 * 5/2003 Saitoh et al.

FOREIGN PATENT DOCUMENTS

(75) Inventors: **Michiaki Taniguchi**, Kyoto (JP);
Toshiya Kitagawa, Kyoto (JP)
(73) Assignee: **Omron Corporation** (JP)
(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 580 days.

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JP	11-050343	9/2000

(21) Appl. No.: **10/254,835**

* cited by examiner

(22) Filed: **Sep. 26, 2002**

Primary Examiner—Michael C. Wimer

(65) **Prior Publication Data**

US 2003/0063034 A1 Apr. 3, 2003

(74) *Attorney, Agent, or Firm*—Dickstein Shapiro LLP

(30) **Foreign Application Priority Data**

Sep. 28, 2001 (JP) 2001-301401

(57) **ABSTRACT**

(51) **Int. Cl.**
H01Q 11/12 (2006.01)
H01Q 21/00 (2006.01)

(52) **U.S. Cl.** 343/742; 343/867; 340/572.7

(58) **Field of Classification Search** 343/742,
343/867; 340/572.7
See application file for complete search history.

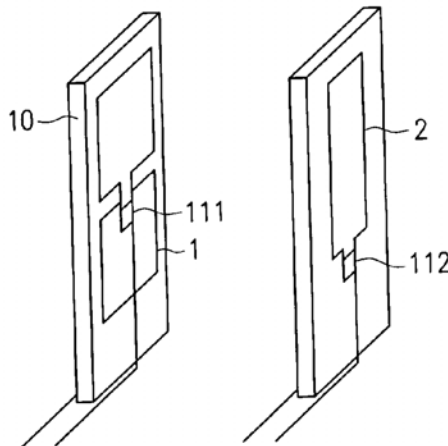
A radio guidance antenna in which the sum of mutual inductances of antennas is minimized. The radio guidance antenna includes a first antenna which is divided into upper and lower half regions by antenna conductors, and a second antenna which is composed of an antenna conductor and formed on the same plane as or a plane parallel to a plane of the first antenna. The second antenna is not connected to the first antenna at any points where it intersects the first antenna, but rather is inductively coupled to the upper and lower halves of the first antenna through mutual inductance regions. The first antenna is supplied with electric power from a first feeding point, and the second antenna is supplied with electric power from a second feeding point. The invention also includes a data communication method and a non-contact data communication apparatus which make use of the radio guidance antenna.

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38 Claims, 22 Drawing Sheets



RIGHT OBLIQUE DIRECTION



US007342550B2

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

(10) **Patent No.:** **US 7,342,550 B2**
(45) **Date of Patent:** **Mar. 11, 2008**

(54) **RUGGED, METAL-ENCLOSED ANTENNA**

7,136,024 B2 * 11/2006 Yuanzhu et al. 343/767

(75) Inventors: **John Sanford**, Encinitas, CA (US);
Athanasios Petropoulos, Lowell, MA (US)

(73) Assignee: **Cushcraft Corporation**, Manchester, NH (US)

(*) 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.: **11/155,082**

(22) Filed: **Jun. 17, 2005**

(65) **Prior Publication Data**
US 2006/0284778 A1 Dec. 21, 2006

(51) **Int. Cl.**
H01Q 13/10 (2006.01)

(52) **U.S. Cl.** **343/771**

(58) **Field of Classification Search** **343/767, 343/770, 771, 789**

See application file for complete search history.

(56) **References Cited**

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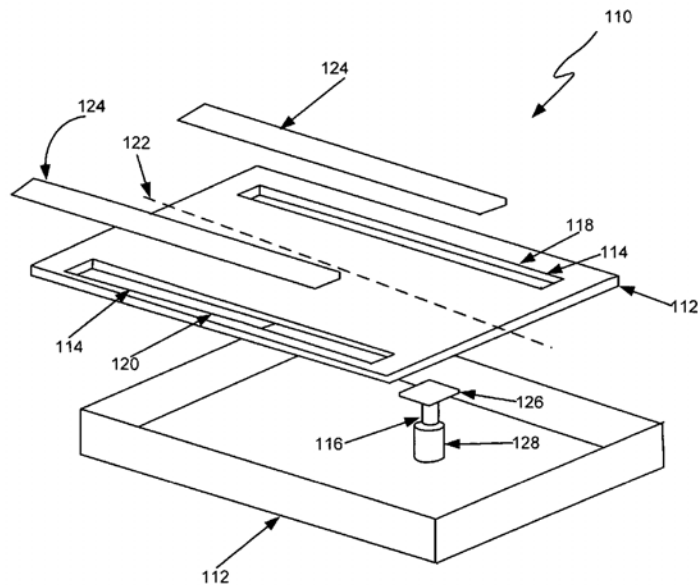
Primary Examiner—Michael C. Wimer

(74) *Attorney, Agent, or Firm*—Harness, Dickey & Pierce, P.L.C.

(57) **ABSTRACT**

The antenna includes a metallic enclosure having a height dimension. At least one slotted opening is formed along the metallic enclosure. Each slotted opening has a slotted opening length and a slotted opening width. The slotted opening length is at least twice as long as the slotted opening width is wide. The slotted opening width is less than one wavelength wide and the slotted opening width is within a half wavelength of the height dimension. At least one feed is provided at least partially within the enclosure.

13 Claims, 6 Drawing Sheets





US00D563380S

(12) **United States Design Patent** (10) **Patent No.:** **US D563,380 S**
Bart (45) **Date of Patent:** **** Mar. 4, 2008**

(54) **RADIO TRANSMITTER WITH AN EXTERNAL ANTENNA**

(74) *Attorney, Agent, or Firm*—Blackwell Sanders LLP

(75) Inventor: **Gary F. Bart**, Weston, FL (US)

(57) **CLAIM**

(73) Assignee: **Xtreme Accessories LLC**, Weston, FL (US)

The ornamental design for a radio transmitter with an external antenna, as shown and described.

(**) Term: **14 Years**

DESCRIPTION

(21) Appl. No.: **29/280,400**

FIG. 1 is a right perspective view of the radio transmitter with an external antenna attached to a portable media player showing my new design;

(22) Filed: **May 25, 2007**

FIG. 2 is a front elevational view of the radio transmitter with an external antenna of FIG. 1 attached to a portable media player;

(51) **LOC (8) Cl.** **14-03**

(52) **U.S. Cl.** **D14/155**

(58) **Field of Classification Search** D14/167, D14/154, 168, 188, 496, 156, 218, 160, 161, D14/162, 163, 164, 165, 191, 192; D16/208; D26/38; D10/104; 455/350, 351

See application file for complete search history.

FIG. 3 is a rear elevational view of the radio transmitter with an external antenna of FIG. 1 attached to a portable media player;

FIG. 4 is a left elevational view of the radio transmitter with an external antenna of FIG. 1 attached to a portable media player;

(56) **References Cited**

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FIG. 5 is a right elevational view of the radio transmitter with an external antenna of FIG. 1 attached to a portable media player;

FIG. 6 is a top plan view of the radio transmitter with an external antenna of FIG. 1 attached to a portable media player;

FIG. 7 is a bottom plan view of the radio transmitter with an external antenna of FIG. 1 attached to a portable media player;

FIG. 8 is a right perspective view of the radio transmitter with an external antenna of FIG. 1; and,

FIG. 9 is a left perspective view of the radio transmitter with an external antenna of FIG. 1 with the antenna in a second position.

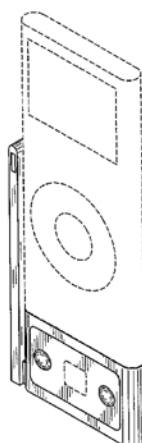
The broken lines shown in the drawings form no part of the claimed design.

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Primary Examiner—Cathron C. Brooks

Assistant Examiner—Austin Murphy

1 Claim, 7 Drawing Sheets





US00D563397S

(12) **United States Design Patent** (10) **Patent No.:** **US D563,397 S**
Oliver (45) **Date of Patent:** **** Mar. 4, 2008**

- (54) **RADIO FREQUENCY IDENTIFICATION TAG ANTENNA ASSEMBLY**
- (75) Inventor: **Ronald A. Oliver**, Seattle, WA (US)
- (73) Assignee: **Impinj, Inc.**, Seattle, WA (US)
- (**) Term: **14 Years**
- (21) Appl. No.: **29/285,844**
- (22) Filed: **Apr. 11, 2007**

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Related U.S. Application Data

- (60) Division of application No. 29/220,493, filed on Dec. 30, 2004, now abandoned, which is a continuation-in-part of application No. 10/812,493, filed on Mar. 29, 2004, now abandoned, and a continuation-in-part of application No. 10/815,474, filed on Mar. 31, 2004, now abandoned.

- (51) **LOC (8) Cl.** **14-03**
- (52) **U.S. Cl.** **D14/230**
- (58) **Field of Classification Search** D14/138, D14/230-238, 299, 358; D12/42, 43; 343/700 R-705, 343/871-908, 795, 840, 711-713, 819, 846; 455/90.2, 90.3, 91, 128, 269, 344, 347, 562.1
See application file for complete search history.

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Primary Examiner—Stella M. Reid
Assistant Examiner—John Windmuller
(74) *Attorney, Agent, or Firm*—Thelen Reid Brown Raysman & Steiner LLP; David B. Ritchie

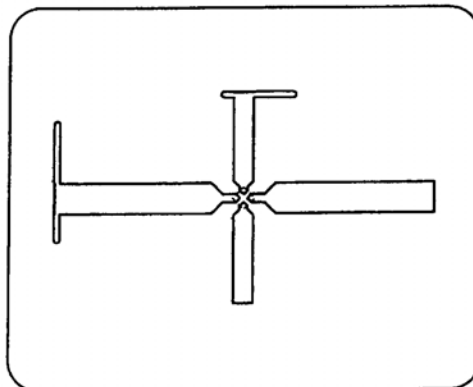
(57) **CLAIM**

The ornamental design for a radio frequency identification tag antenna assembly, as shown and described.

DESCRIPTION

The FIGURE is a top plan view of a radio frequency identification tag antenna assembly showing my new design.

1 Claim, 1 Drawing Sheet





US00RE40129E

(19) **United States**
(12) **Reissued Patent**
Warnagiris

(10) **Patent Number:** **US RE40,129 E**
(45) **Date of Reissued Patent:** ***Mar. 4, 2008**

- (54) **WIDE BANDWIDTH MULTI-MODE ANTENNA**
- (75) Inventor: **Thomas J. Warnagiris**, San Antonio, TX (US)
- (73) Assignee: **Southwest Research Institute**, San Antonio, TX (US)
- (*) Notice: This patent is subject to a terminal disclaimer.
- (21) Appl. No.: **10/758,564**
- (22) Filed: **Jan. 15, 2004**

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- Reissue of:
- (64) Patent No.: **6,339,409**
 - Issued: **Jan. 15, 2002**
 - Appl. No.: **09/768,433**
 - Filed: **Jan. 24, 2001**
 - (51) **Int. Cl.**
H01Q 1/36 (2006.01)
 - (52) **U.S. Cl.** **343/895; 343/793**
 - (58) **Field of Classification Search** **343/793, 343/79.5, 796, 872, 895**
See application file for complete search history.

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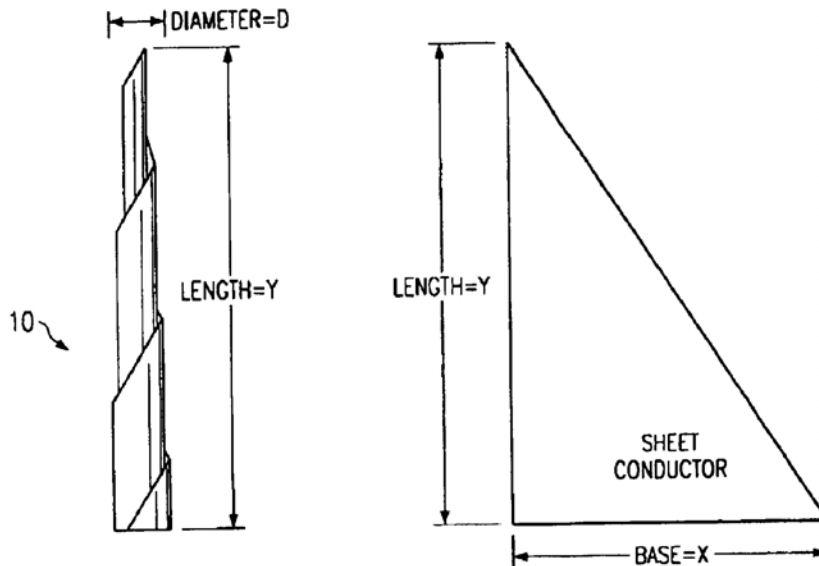
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Primary Examiner—Tan Ho
(74) *Attorney, Agent, or Firm*—Baker Botts LLP

(57) **ABSTRACT**

A wideband multi-mode antenna having low VSWR operating characteristics. The antenna is has a shape similar to a helical antenna, but is formed from a right-triangularly shaped piece of conductive material. The result is a rolled planar antenna having a height and diameter predetermined to provide optimum VSWR for a given frequency range.

64 Claims, 5 Drawing Sheets





US007342553B2

(12) **United States Patent**
Soler Castany et al.

(10) **Patent No.:** **US 7,342,553 B2**
(45) **Date of Patent:** **Mar. 11, 2008**

- (54) **NOTCHED-FED ANTENNA**
- (75) Inventors: **Jordi Soler Castany**, Sant Cugat del Valles (ES); **Carles Puente Baliarda**, Sant Cugat del Valles (ES)
- (73) Assignee: **Fractus, S. A.**, Barcelona (ES)
- (*) 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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(21) Appl. No.: **11/033,788**

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(22) Filed: **Jan. 12, 2005**

EP 0 892 459 1/1999

(65) **Prior Publication Data**

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(63) Continuation of application No. PCT/EP02/07837, filed on Jul. 15, 2002.

(Continued)

(51) **Int. Cl.**
H01Q 21/00 (2006.01)

Primary Examiner—Douglas W. Owens
Assistant Examiner—Ephrem Alemu
(74) *Attorney, Agent, or Firm*—Winstead PC

(52) **U.S. Cl.** **343/853**; 343/700 MS;
343/846; 343/702

(57) **ABSTRACT**

(58) **Field of Classification Search** 343/700 MS,
343/853, 846, 749, 830, 702
See application file for complete search history.

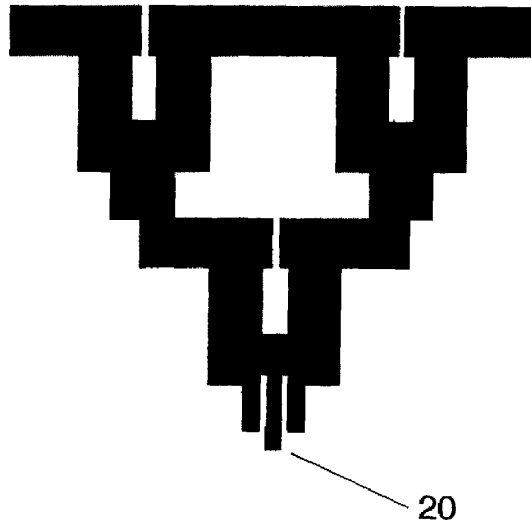
A monopole or dipole antenna includes a radiating element having at least one notch. The at least one notch intersects at least at one point on an edge of the radiating element wherein the intersecting point is located at a distance to a feeding point. The distance being shorter than half a length of a longest edge of the radiating element. A maximum width of the at least one notch is narrower than a half of a longest length of the at least one notch.

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22 Claims, 7 Drawing Sheets





US007345631B2

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

(10) **Patent No.:** **US 7,345,631 B2**
(45) **Date of Patent:** **Mar. 18, 2008**

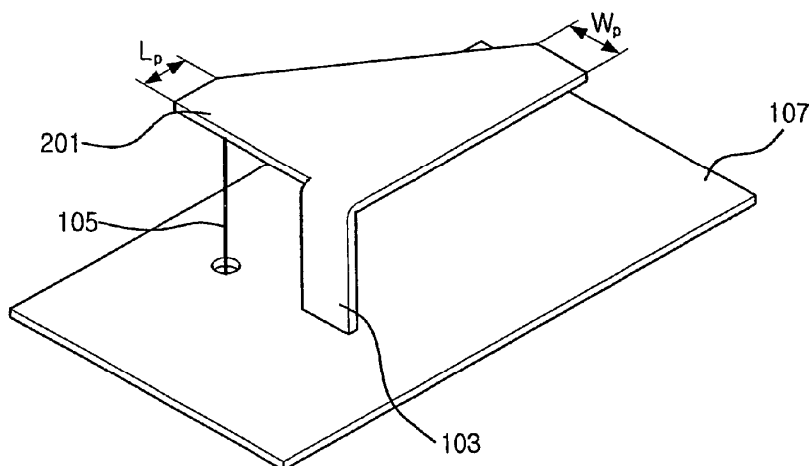
- (54) **RADIATION DEVICE FOR PLANAR INVERTED F ANTENNA**
 - (75) Inventors: **Byung Chan Kim**, Daejon (KR); **Judeok Park**, Daejon (KR); **Hyung Do Chol**, Seoul (KR); **Jong-Suk Chae**, Daejon (KR)
 - (73) Assignee: **Electronics and Telecommunications Research Institute**, Daejon (KR)
 - (*) Notice: 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.: **10/526,078**
 - (22) PCT Filed: **Aug. 28, 2003**
 - (86) PCT No.: **PCT/KR03/01750**
§ 371 (c)(1), (2), (4) Date: **Jul. 28, 2005**
 - (87) PCT Pub. No.: **WO2004/021514**
PCT Pub. Date: **Mar. 11, 2004**
 - (65) **Prior Publication Data**
US 2006/0001573 A1 Jan. 5, 2006
 - (30) **Foreign Application Priority Data**
Aug. 28, 2002 (KR) 10-2002-0051039
 - (51) **Int. Cl.**
H01Q 1/38 (2006.01)
 - (52) **U.S. Cl.** **343/700 MS; 343/829**
 - (58) **Field of Classification Search** **343/700 MS, 343/702, 829, 846**
- See application file for complete search history.

- (56) **References Cited**
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- Primary Examiner—Michael C. Wimer
- (74) Attorney, Agent, or Firm—Lowe Hauptman Ham & Berner LLP

(57) **ABSTRACT**

A radiation patch having a shape of linearly-tapered rectangle for a planar inverted F antenna is disclosed. The planar inverted F antenna having a radiation patch includes: a ground unit for grounding a radiation patch; a short unit for shorting the radiation patch; a feeding unit for supplying an electric power to the radiation patch; and a radiation patch for radiating electric power from the feeding unit, wherein the radiation patch having a shape of linearly tapered rectangle and a length and width of tapered sides of radiation patch is determined according to a resonate frequency. As mentioned above, the present invention can be easier to be designed and provide wider bandwidth by providing a linearly tapered rectangle shape of radiation patch in a planar inverted F antenna.

5 Claims, 3 Drawing Sheets





US007345633B2

(12) **United States Patent**
Wielsma

(10) **Patent No.:** **US 7,345,633 B2**
(45) **Date of Patent:** ***Mar. 18, 2008**

- (54) **LOW-LOSS SUBSTRATE ANTENNA STRUCTURE AND METHOD OF MANUFACTURE THEREOF**
- (75) Inventor: **Jan Wielsma**, Culemborg (NL)
- (73) Assignee: **Agere Systems, Inc.**, Allentown, PA (US)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **11/428,724**

(22) Filed: **Jul. 5, 2006**

(65) **Prior Publication Data**
US 2006/0238421 A1 Oct. 26, 2006

Related U.S. Application Data
(63) Continuation of application No. 11/108,326, filed on Apr. 18, 2005, now Pat. No. 7,113,132, which is a continuation of application No. 10/675,195, filed on Sep. 30, 2003, now Pat. No. 6,977,626, which is a continuation of application No. 10/609,980, filed on Jun. 30, 2003, now Pat. No. 6,940,456, which is a continuation of application No. 10/126,600, filed on Apr. 19, 2002, now Pat. No. 6,759,984.

(60) Provisional application No. 60/295,191, filed on Jun. 1, 2001.

(51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 1/36 (2006.01)

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

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

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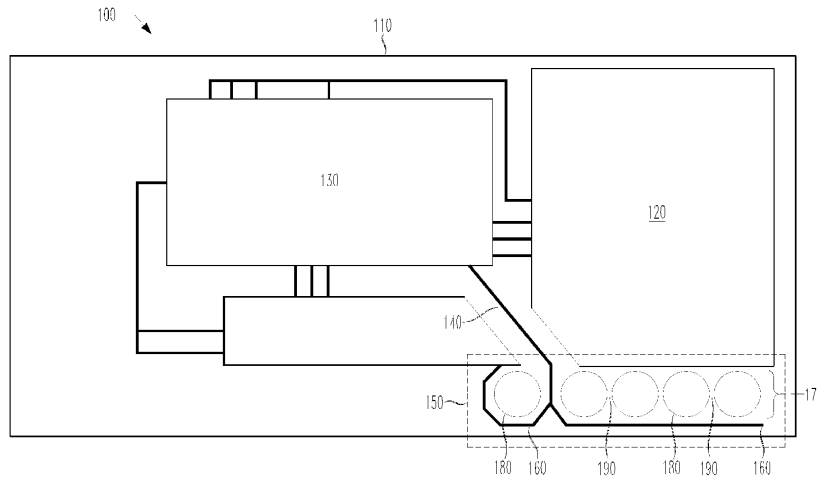
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Primary Examiner—Trinh Vo Dinh

(57) **ABSTRACT**

The present invention provides a method of manufacturing an antenna structure. In one embodiment, the method includes forming an antenna trace on a substrate proximate a ground plane of the substrate. In addition, the method includes creating an insulation region extending through the substrate and located between the antenna trace and the ground plane.

9 Claims, 2 Drawing Sheets





US007345634B2

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

(10) **Patent No.:** **US 7,345,634 B2**
(45) **Date of Patent:** **Mar. 18, 2008**

(54) **PLANAR INVERTED “F” ANTENNA AND METHOD OF TUNING SAME**

(75) Inventors: **Mete Ozkar**, San Diego, CA (US);
Gregory Poilasne, San Diego, CA (US)

(73) Assignee: **Kyocera Corporation**, Kyoto (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 167 days.

(21) Appl. No.: **10/922,353**

(22) Filed: **Aug. 20, 2004**

(65) **Prior Publication Data**

US 2006/0038721 A1 Feb. 23, 2006

(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, 847, 846, 848**
See application file for complete search history.

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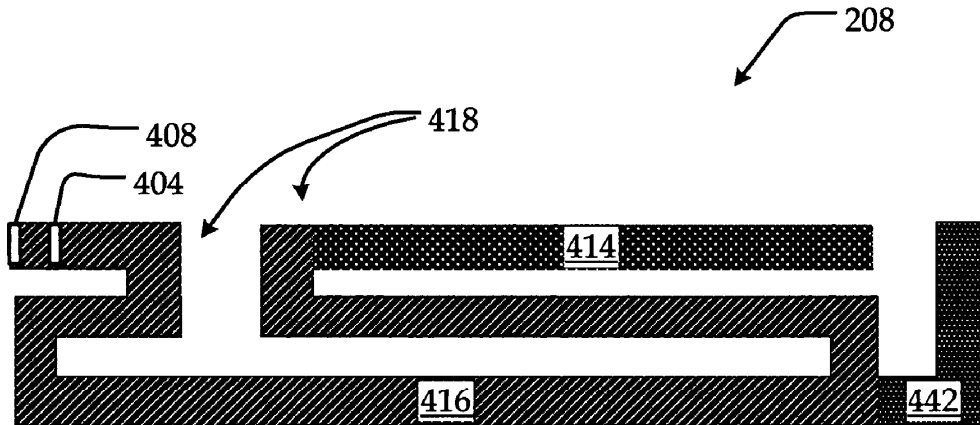
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Primary Examiner—Hoanganh Le

(57) **ABSTRACT**

A multiband planar inverted F antenna (PIFA) can provide improved performance and operating efficiency, and utilizes a capacitive element configured to provide high efficiency operation, and a tuning area that allows the antenna to be tuned independently of the capacitive element. As a result of this feature, the antenna can be tuned to the desired operating frequencies, while allowing the capacitive element to remain configured for optimal operating efficiency. The antenna can be configured in a loop for effective utilization of a given volume and can therefore be relatively small in size and high efficiency. A capacitive loading section can be included to allow improved antenna efficiency and radiation. Additionally, tuning section can be provided to allow the antenna to be tuned without adjusting the capacitive loading section. To obtain operation at an additional frequency band, a parasitic element or a slot configuration can be included.

13 Claims, 4 Drawing Sheets





US007345638B1

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

(10) **Patent No.:** **US 7,345,638 B1**
(45) **Date of Patent:** **Mar. 18, 2008**

(54) **COMMUNICATIONS ASSEMBLY AND ANTENNA RADIATOR ASSEMBLY**

(75) Inventors: **Yu Chee Tan**, Singapore (SG); **Chao Feng**, Singapore (SG); **Swee (Gary) Hui Quek**, Singapore (SG); **Yew (Roger) Siow Tay**, Singapore (SG)

(73) Assignee: **Motorola Inc.**, Schaumburg, IL (US)

(*) 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.: **11/611,975**

(22) Filed: **Dec. 18, 2006**

(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, 846, 848**

See application file for complete search history.

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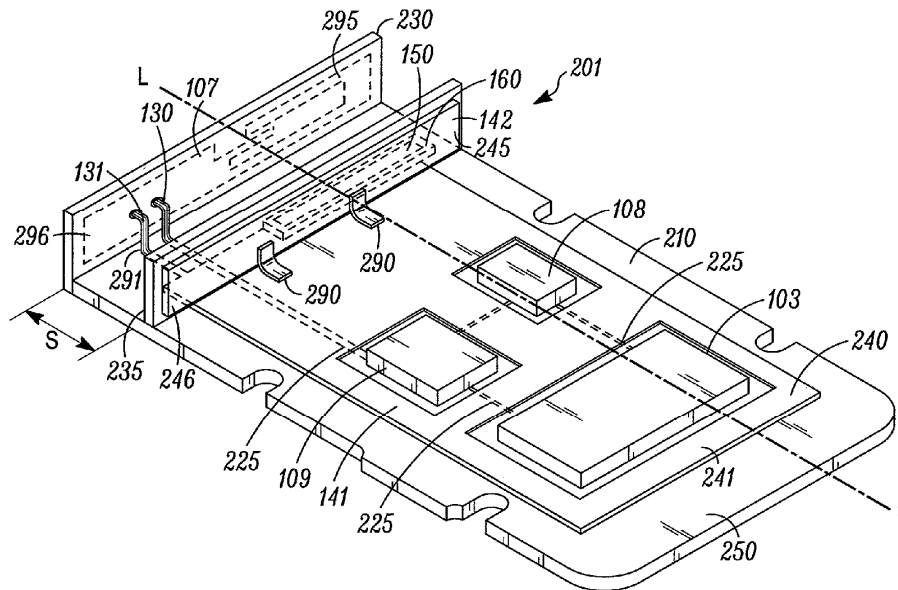
Primary Examiner—Tan Ho

(74) *Attorney, Agent, or Firm*—Steven Cosgrove

(57) **ABSTRACT**

An antenna radiator assembly (201) and radio communications assembly (200) comprising a circuit board (210) supporting electrical conductors, at least one of the electrical conductors being coupled to a feed point (130). There is a ground plane (140) with a first planar element (141) and a second planar element (142), the first planar element (141) element being supported by the circuit board (210) and having a first planar element plane (240) parallel to a surface (250) of the circuit board (210), and the second planar element (142) having a second planar element plane (245) lateral to the first planar element plane (240). A ground connector is coupled to the ground plane (140) and the antenna radiator element (107) is coupled to both the ground connector and the feed point. The antenna radiator element (107) is spaced from the ground plane the antenna radiator element (107) has an antenna radiator element plane (295) is lateral to the first planar element plane (240).

19 Claims, 3 Drawing Sheets





US007345640B2

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

(10) **Patent No.:** **US 7,345,640 B2**
(45) **Date of Patent:** **Mar. 18, 2008**

(54) **INVISIBLE ANTENNA**
(75) Inventors: **Toru Watari**, Matsudo (JP); **Toshiyuki Ando**, Hitachi (JP); **Toshiyuki Takano**, Hitachi (JP)

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(73) Assignee: **Hitachi Cable, 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 44 days.

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(21) Appl. No.: **11/272,055**
(22) Filed: **Nov. 14, 2005**

(65) **Prior Publication Data**
US 2006/0109187 A1 May 25, 2006

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Primary Examiner—Hoang V. Nguyen
Assistant Examiner—Robert Karacsony
(74) *Attorney, Agent, or Firm*—McGinn IP Law Group, PLLC

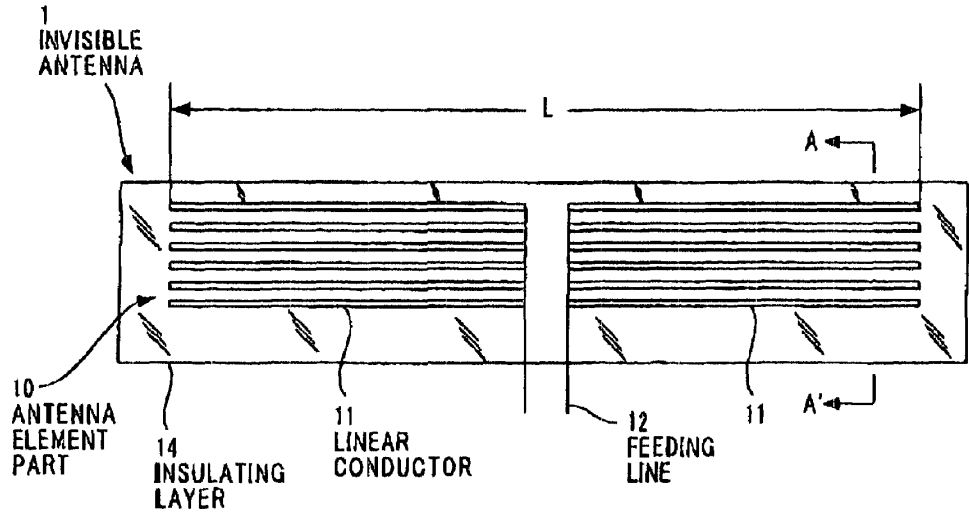
(30) **Foreign Application Priority Data**
Nov. 12, 2004 (JP) 2004-328839

(51) **Int. Cl.**
H01Q 1/32 (2006.01)
H01Q 1/02 (2006.01)
(52) **U.S. Cl.** 343/713; 343/711; 343/704
(58) **Field of Classification Search** 343/713, 343/704, 711
See application file for complete search history.

(57) **ABSTRACT**
An invisible antenna with excellent antenna characteristics that cannot be visually recognized by naked eyes. A pair of linear conductors **11** are connected to a feeding line **12**, and a plurality of the linear conductors **11** are disposed on and/or within a transparent insulating layer **14**. The linear conductor **11** cannot be visually recognized by human naked eyes.

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11 Claims, 8 Drawing Sheets





US007345641B2

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

(10) **Patent No.:** **US 7,345,641 B2**
(45) **Date of Patent:** **Mar. 18, 2008**

- (54) **ANTENNA APPARATUS**
- (75) Inventors: **Junichi Noro**, Akita (JP); **Kumeo Sasaki**, Akita (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 0 days.

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(21) Appl. No.: **11/420,117**

(22) Filed: **May 24, 2006**

(65) **Prior Publication Data**

US 2006/0244666 A1 Nov. 2, 2006

Related U.S. Application Data

(63) Continuation of application No. 10/700,620, filed on Nov. 5, 2003, now Pat. No. 7,071,885.

(30) **Foreign Application Priority Data**

Nov. 5, 2002	(JP)	P2002-321515
Sep. 4, 2003	(JP)	P2003-312215

(51) **Int. Cl.**
H01Q 1/32 (2006.01)

(52) **U.S. Cl.** **343/713**

(58) **Field of Classification Search** 343/700 MS, 343/702, 765, 766, 705, 711-713
See application file for complete search history.

(56) **References Cited**

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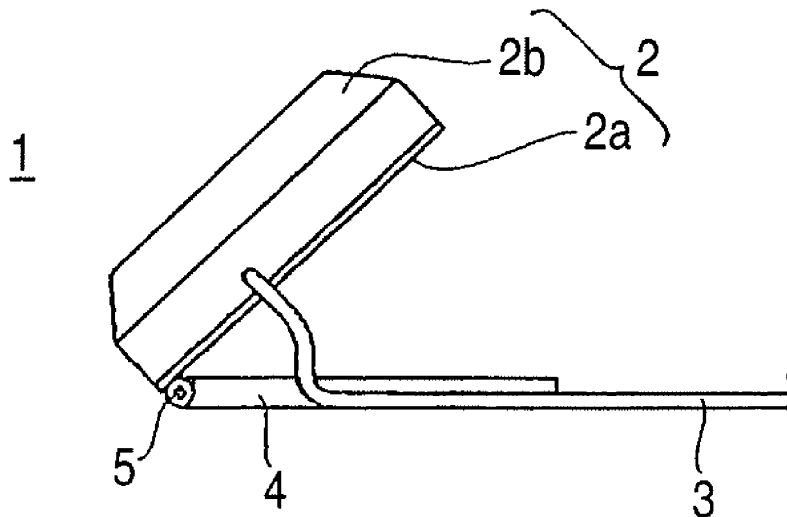
Office Action issued by the Japanese Patent Office on Jul. 17, 2007, 2007, with a translation, pp. 1 to 13.

Primary Examiner—Huedung Mancuso
(74) *Attorney, Agent, or Firm*—Whitham Curtis Christofferson & Cook, P.C.

(57) **ABSTRACT**

An antenna apparatus includes an antenna element having directivity in a vertex direction, an antenna case containing the antenna element, an antenna base coupled to the antenna case, and attached onto an installation face, and an angle regulator adjusting a relative angle between the antenna case and the antenna base.

18 Claims, 9 Drawing Sheets





US007345642B2

(12) **United States Patent**
Cohen

(10) **Patent No.:** **US 7,345,642 B2**
(45) **Date of Patent:** ***Mar. 18, 2008**

(54) **ANTENNA SYSTEM FOR RADIO
FREQUENCY IDENTIFICATION**

(75) Inventor: **Nathan Cohen**, Belmont, MA (US)

(73) Assignee: **Fractal Antenna Systems, Inc.**,
Bedford, WA (US)

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

This patent is subject to a terminal dis-
claimer.

(21) Appl. No.: **11/327,982**

(22) Filed: **Jan. 9, 2006**

(65) **Prior Publication Data**

US 2006/0119520 A1 Jun. 8, 2006

Related U.S. Application Data

(63) Continuation of application No. 10/971,815, filed on
Oct. 22, 2004, now Pat. No. 6,985,122.

(60) Provisional application No. 60/513,497, filed on Oct.
22, 2003.

(51) **Int. Cl.**

H01Q 9/16 (2006.01)

H01Q 1/36 (2006.01)

(52) **U.S. Cl.** **343/793; 343/795; 343/792.5;**
343/895; 343/700 MS

(58) **Field of Classification Search** 343/793,
343/795, 700 MS, 895, 767, 770
See application file for complete search history.

(56) **References Cited**

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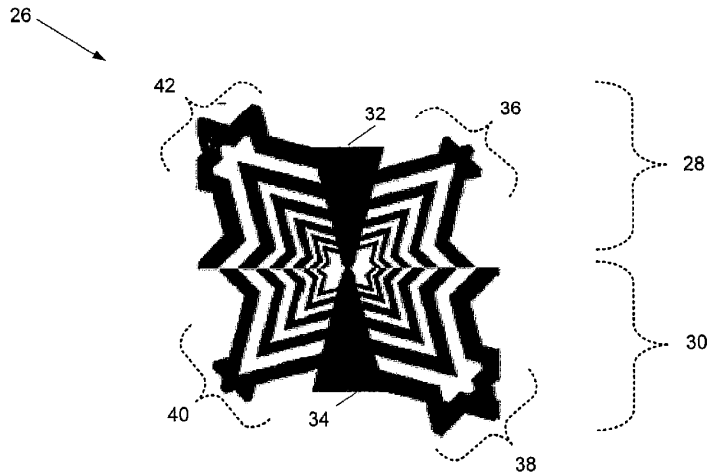
Primary Examiner—Trinh Vo Dinh

(74) *Attorney, Agent, or Firm*—McDermott Will & Emery,
LLP

(57) **ABSTRACT**

An antenna including an electrically conductive portion
defined substantially by a self-similar geometry present at
multiple resolutions. The electrically conductive portion
includes two or more angular bends and is configured to
radiate broadband electromagnetic energy. The antenna fur-
ther includes an electrically non-conductive portion that
structurally supports the electrically conductive portion.

18 Claims, 4 Drawing Sheets





US007345644B2

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

(10) **Patent No.:** **US 7,345,644 B2**
(45) **Date of Patent:** **Mar. 18, 2008**

(54) **ANTENNA DEVICE, AND METHOD OF MANUFACTURING ANTENNA DEVICE**

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(75) Inventors: **Susumu Morioka**, Saitama (JP);
Takashi Takano, Tokyo (JP); **Shigeru Saegusa**, Tokyo (JP)

(73) Assignee: **Sony Corporation**, Tokyo (JP)

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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 0 days.

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(21) Appl. No.: **10/549,671**

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(22) PCT Filed: **Mar. 11, 2004**

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§ 371 (c)(1),
(2), (4) Date: **Jun. 21, 2006**

Primary Examiner—Hoang V. Nguyen
(74) *Attorney, Agent, or Firm*—Finnegan, Henderson, Farabow, Garrett & Dunner, L.L.P.

(87) PCT Pub. No.: **WO2004/084348**

PCT Pub. Date: **Sep. 30, 2004**

(57) **ABSTRACT**

(65) **Prior Publication Data**

US 2006/0238430 A1 Oct. 26, 2006

A loop antenna device includes a loop antenna having a high noise resistance performance. In a loop antenna having a shield member covering a looped conductor portion formed in a loop shape from a conductive wire, a non-covered portion where the looped conductor portion is not covered is formed in correspondence with a portion of the conductive wire including a reference position for the symmetry of two terminals for connection between the antenna device and a reception circuit. This provides a balanced shield structure. Besides, a line for connecting one end of the conductive wire to the ground potential and a line for connecting the shield member to the ground potential are individually separate from each other, whereby reception of a voltage fall due to common impedance by the antenna is suppressed.

(30) **Foreign Application Priority Data**

Mar. 19, 2003 (JP) 2003-076426

(51) **Int. Cl.**
H01Q 7/00 (2006.01)

(52) **U.S. Cl.** 343/866; 343/741; 343/841

(58) **Field of Classification Search** 343/741, 343/742, 866, 870, 841, 867

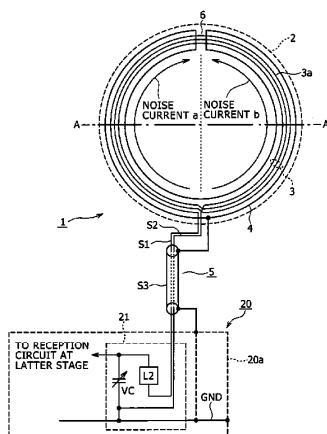
See application file for complete search history.

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7 Claims, 6 Drawing Sheets





US007345647B1

(12) **United States Patent**
Rodenbeck

(10) **Patent No.:** **US 7,345,647 B1**
(45) **Date of Patent:** **Mar. 18, 2008**

- (54) **ANTENNA STRUCTURE WITH DISTRIBUTED STRIP**
- (75) Inventor: **Christopher T. Rodenbeck**, Albuquerque, NM (US)
- (73) Assignee: **Sandia Corporation**, Albuquerque, NM (US)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 80 days.

- (21) Appl. No.: **11/243,860**
- (22) Filed: **Oct. 5, 2005**
- (51) **Int. Cl.**
H01Q 1/36 (2006.01)
- (52) **U.S. Cl.** **343/895**; 343/700 MS
- (58) **Field of Classification Search** 343/895, 343/700 MS, 702, 846, 767
See application file for complete search history.

- (56) **References Cited**
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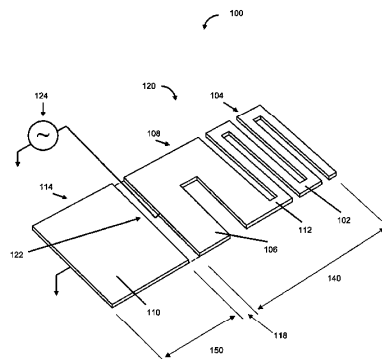
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Primary Examiner—Huedung Mancuso
(74) *Attorney, Agent, or Firm*—William R. Conley

(57) **ABSTRACT**

An antenna comprises electrical conductors arranged to form a radiating element including a folded line configuration and a distributed strip configuration, where the radiating element is in proximity to a ground conductor. The folded line and the distributed strip can be electrically interconnected and substantially coplanar. The ground conductor can be spaced from, and coplanar to, the radiating element, or can alternatively lie in a plane set at an angle to the radiating element. Embodiments of the antenna include conductor patterns formed on a printed wiring board, having a ground plane, spacedly adjacent to and coplanar with the radiating element. Other embodiments of the antenna comprise a ground plane and radiating element on opposed sides of a printed wiring board. Other embodiments of the antenna comprise conductors that can be arranged as free standing "foils". Other embodiments include antennas that are encapsulated into a package containing the antenna.

8 Claims, 7 Drawing Sheets





US007345648B2

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

(10) **Patent No.:** US 7,345,648 B2
(45) **Date of Patent:** Mar. 18, 2008

- (54) **ANTENNA UNIT**
- (75) Inventors: **Junichi Noro**, Akita (JP); **Takao Kato**, Akita (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 87 days.

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- (21) Appl. No.: **11/318,411**
- (22) Filed: **Dec. 22, 2005**

JP 2001-339227 A 12/2001

- (65) **Prior Publication Data**
US 2006/0202904 A1 Sep. 14, 2006

(Continued)

- (30) **Foreign Application Priority Data**
Mar. 10, 2005 (JP) 2005-067073

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- (51) **Int. Cl.**
H01Q 1/36 (2006.01)
H01Q 1/42 (2006.01)

(Continued)

- (52) **U.S. Cl.** **343/895**; 343/872; 343/789; 343/906

Primary Examiner—Trinh Vo Dinh
(74) *Attorney, Agent, or Firm*—Frishauf, Holtz, Goodman & Chick, P.C.

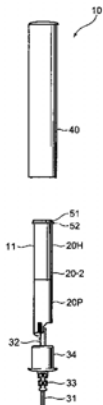
- (58) **Field of Classification Search** 343/895, 343/906
See application file for complete search history.

(57) **ABSTRACT**

- (56) **References Cited**
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An antenna unit comprises a hollow cylindrical member obtained by forming a flexible insulating film member into a hollow cylinder and an antenna pattern composed of a plurality of conductors formed on a peripheral surface of said hollow cylindrical member. A phase shifter pattern is formed on the peripheral surface of the hollow cylindrical member so as to be electrically connected to the antenna pattern. The antenna unit further comprises a hollow cylindrical cover case covering the hollow cylindrical member and a characteristic adjusting member for adjusting an antenna frequency characteristic.

11 Claims, 13 Drawing Sheets





US007345649B2

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

(10) **Patent No.:** **US 7,345,649 B2**
(45) **Date of Patent:** **Mar. 18, 2008**

(54) **SPIRAL-PATTERNED INTERNAL ANTENNA HAVING OPEN STUB AND PERSONAL MOBILE TERMINAL EQUIPPED WITH THE SAME**

(75) Inventors: **Young-Joon Ko**, Seoul (KR);
Hong-Teuk Kim, Youngin-si (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 0 days.

(21) Appl. No.: **11/344,636**

(22) Filed: **Jan. 31, 2006**

(65) **Prior Publication Data**

US 2006/0170611 A1 Aug. 3, 2006

(30) **Foreign Application Priority Data**

Feb. 1, 2005 (KR) 10-2005-0009170

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

(52) **U.S. Cl.** 343/895; 343/702

(58) **Field of Classification Search** 343/702,
343/895

See application file for complete search history.

(56) **References Cited**

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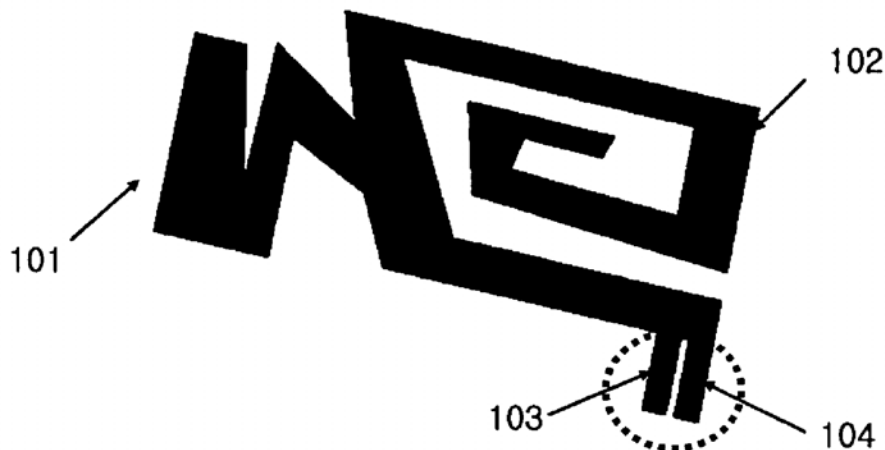
Primary Examiner—Tan Ho

(74) *Attorney, Agent, or Firm*—Lee, Hong, Degerman, Kang & Schmadeka

(57) **ABSTRACT**

The present invention relates generally to a spiral-patterned internal antenna having an open stub and a personal mobile terminal equipped with the same and, more particularly, to the pattern of an open stub. The spiral-patterned internal antenna of the present invention includes a main part having a spiral pattern; and an open stub connected to the main part. According to the present invention, an antenna for a terminal can be constituted regardless of the shape of a rear casing by using a spiral-patterned antenna having an open stub, and a highly efficient antenna can be formed using the suggested open stub.

7 Claims, 8 Drawing Sheets





US007345650B2

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

(10) **Patent No.:** **US 7,345,650 B2**
(45) **Date of Patent:** **Mar. 18, 2008**

- (54) **INTERNAL CHIP ANTENNA**
- (75) Inventors: **Seok Bae**, Kyungki-do (KR); **Mano Yasuhiko**, Kyungki-do (KR)
- (73) Assignee: **Samsung Electro-Mechanics Co., Ltd.**, Kyungki-Do (KR)
- (*) 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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Primary Examiner—Tho Phan
(74) *Attorney, Agent, or Firm*—Lowe Hauptman Ham & Berner

- (21) Appl. No.: **11/427,776**
- (22) Filed: **Jun. 29, 2006**

- (65) **Prior Publication Data**
US 2007/0001925 A1 Jan. 4, 2007

(57) **ABSTRACT**

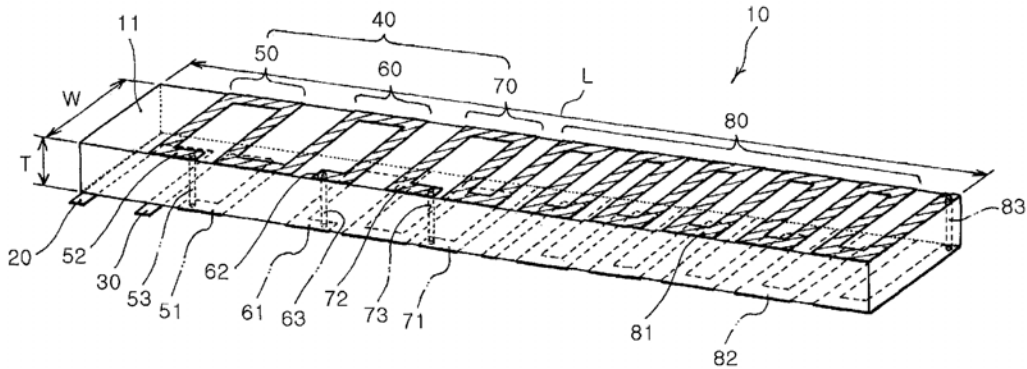
The invention provides a chip antenna installed inside a mobile telecommunication terminal, which can process a low band signal. In the chip antenna, a substrate is prepared. A first radiator is formed in a spiral shape inside or on the substrate, and includes at least one spiral radiating part. The first radiator controls inductance of the antenna. Also, a second radiator is connected to the first radiator, and includes an upper meander radiating part disposed in a length direction of the substrate and a lower meander radiating part overlapping and opposing the upper meander in a lower part of the upper meander part. The second radiator controls capacitance of the antenna. In addition, a feeding part is connected to the first radiator, and receives a high frequency current of a given band.

- (30) **Foreign Application Priority Data**
Jun. 30, 2005 (KR) 10-2005-0058272

- (51) **Int. Cl.**
H01Q 1/36 (2006.01)
- (52) **U.S. Cl.** **343/895**; 343/700 MS; 343/702
- (58) **Field of Classification Search** 343/700 MS, 343/702, 829, 846, 873, 895
See application file for complete search history.

- (56) **References Cited**
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9 Claims, 4 Drawing Sheets





US007345651B2

(12) **United States Patent**
Numoto

(10) **Patent No.:** **US 7,345,651 B2**
(45) **Date of Patent:** **Mar. 18, 2008**

(54) **ANTENNA**
(75) Inventor: **Tatsuhiko Numoto**, Osaka (JP)
(73) Assignee: **Matsushita Electric Industrial Co., Ltd.**, Osaka (JP)
(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 6 days.

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Primary Examiner—Huedung Mancuso

(74) *Attorney, Agent, or Firm*—McDermott Will & Emery LLP

(21) Appl. No.: **11/407,052**
(22) Filed: **Apr. 20, 2006**

(65) **Prior Publication Data**
US 2006/0238431 A1 Oct. 26, 2006

(30) **Foreign Application Priority Data**
Apr. 21, 2005 (JP) 2005-123227

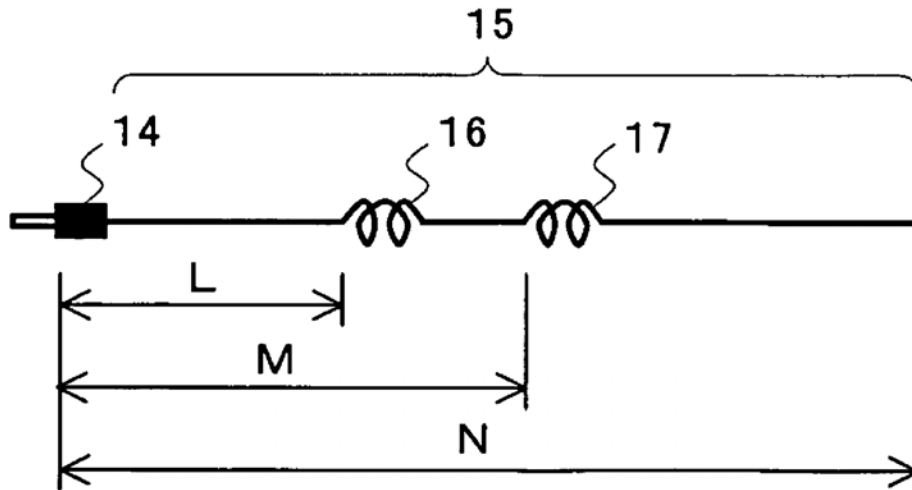
(51) **Int. Cl.**
H01Q 1/36 (2006.01)
(52) **U.S. Cl.** **343/897**
(58) **Field of Classification Search** 343/700 MS,
343/702, 897, 795, 745, 749-752
See application file for complete search history.

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6,529,170 B1* 3/2003 Nishizawa et al. 343/795

(57) **ABSTRACT**

An antenna having excellent receiving sensitivity for radio waves of two or more different frequency bands is achieved with a relatively simple configuration using a single cord. The antenna of the present invention is made up of a single cord which has one end connected to a plug and includes at least one inductor inserted at a certain point of the cord. A length from one end to the other end of the cord and a length from the one end to a position where one of the inductors is connected are $n/4$ (n represents 1, 2, 3 or 4) of a wavelength at the center frequency of one of the two or more frequency bands or a frequency around the center frequency, and the at least one inductor has a self-resonant frequency matching with the center frequency of the frequency band corresponding to the length from the one end to the position where the inductor is connected or matching with a frequency around the center frequency.

4 Claims, 3 Drawing Sheets





US007348925B2

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

(10) **Patent No.:** US 7,348,925 B2
(45) **Date of Patent:** Mar. 25, 2008

(54) **ANTENNA UNIT AND FEEDING COMPONENT**

(75) Inventors: **Junichi Noro**, Akita (JP); **Kyuichi Sato**, Akita (JP); **Nobuaki Monma**, Akita (JP); **Shozo Miyamoto**, Akita (JP); **Takumi Suzuki**, Akita (JP)

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(73) Assignee: **Mitsumi Electric Co., Ltd.**, Tama-shi (JP)

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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 224 days.

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(21) Appl. No.: **11/320,081**

Primary Examiner—Tho Phan
(74) *Attorney, Agent, or Firm*—Frishauf, Holtz, Goodman & Chick, P.C.

(22) Filed: **Dec. 28, 2005**

(65) **Prior Publication Data**

US 2006/0214851 A1 Sep. 28, 2006

(57) **ABSTRACT**

(30) **Foreign Application Priority Data**

Mar. 28, 2005 (JP) 2005-091304

An antenna unit includes a feeding component **40** and a metal plate **50** on which the feeding component **40** is mounted. The feeding component **40** has an attaching member **43** made of resin to support a feeding line against the metal plate. The metal plate **50** has a pair of cut and raised parts **51** at both ends thereof while the attaching member **43** has a pair of locking hooks **432** at both ends thereof. The locking hooks are partly inserted into the cut and raised parts and thereby the feeding component is attached to the metal plate without projecting any parts of the attaching member from a rear surface of the metal plate.

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

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

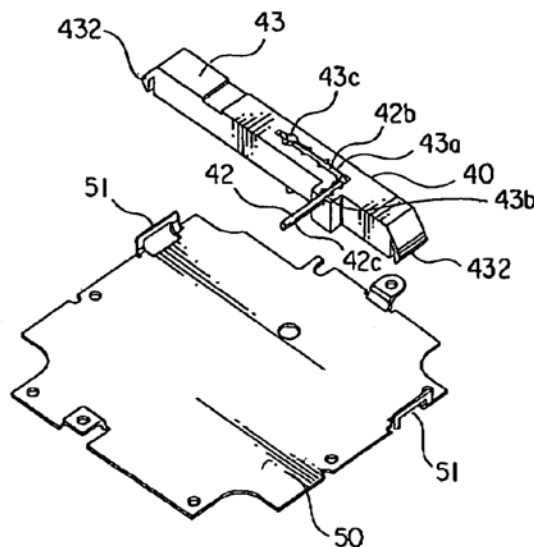
(58) **Field of Classification Search** 343/700 MS, 343/702, 829, 846, 848
See application file for complete search history.

(56) **References Cited**

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4 Claims, 7 Drawing Sheets





US007348928B2

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

(10) **Patent No.:** **US 7,348,928 B2**
(45) **Date of Patent:** **Mar. 25, 2008**

(54) **SLOT ANTENNA HAVING A MEMS VARACTOR FOR RESONANCE FREQUENCY TUNING**

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2006/0079177 A1* 4/2006 Okubora 455/25

(75) Inventors: **Qing Ma**, San Jose, CA (US); **Xintian Eddie Lin**, Mountain View, CA (US); **Al Bettner**, Los Gatos, CA (US)

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(73) Assignee: **Intel Corporation**, Santa Clara, CA (US)

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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 0 days.

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(21) Appl. No.: **11/013,594**

Primary Examiner—Don Wong
Assistant Examiner—Angela M Lie
(74) *Attorney, Agent, or Firm*—Kevin A. Reif

(22) Filed: **Dec. 14, 2004**

(65) **Prior Publication Data**

(57) **ABSTRACT**

US 2006/0125703 A1 Jun. 15, 2006

(51) **Int. Cl.**
H01Q 13/10 (2006.01)

(52) **U.S. Cl.** **343/770; 343/767; 343/768**

(58) **Field of Classification Search** **343/768, 343/770**

See application file for complete search history.

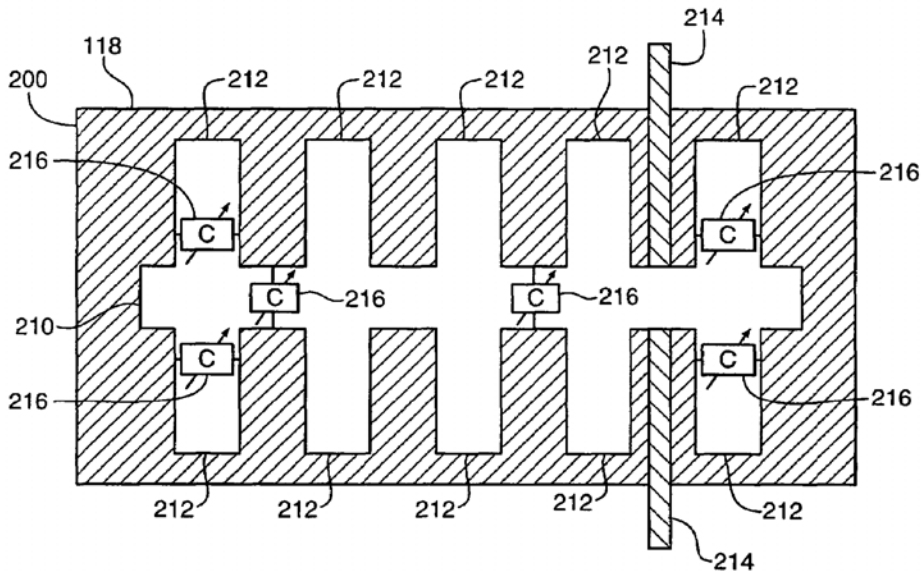
Briefly, in accordance with one embodiment of the invention, a slot antenna may include a primary slot and one or more secondary slots. The size of the antenna may be reduced by adding one or more of the secondary slots which may add additional inductance to the antenna. Furthermore, the size of the antenna may be reduced by increasing the inductance of the secondary slots via increasing the length of the slots or by changing the shape of the slots. The antenna may include one or more MEMS varactors coupled to one or more of the secondary slots. The resonant frequency of the slot antenna may be tuned to a desired frequency by changing the capacitance value of one or more of the MEMS varactors to a desired capacitance value.

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20 Claims, 4 Drawing Sheets





US007348931B2

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

(10) **Patent No.:** **US 7,348,931 B2**
(45) **Date of Patent:** **Mar. 25, 2008**

(54) **UNBALANCED POWER FEEDING ANTENNA DEVICE FOR MAKING RADIO COMMUNICATIONS**

2004/0130667 A1* 7/2004 Hibino et al. 348/731
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2007/0066243 A1* 3/2007 Yamauchi et al. 455/78
2007/0190954 A1* 8/2007 Murakami et al. 455/132

(75) Inventors: **Hiromichi Suzuki**, Hamura (JP); **Isao Ohba**, Hachioji (JP); **Takayuki Shibuya**, Sagamihara (JP); **Yusuke Okada**, Hachioji (JP); **Kenji Matsuzaki**, Akiruno (JP)

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

JP 2003-347959 A 12/2003

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 30 days.

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Primary Examiner—Tan Ho
(74) Attorney, Agent, or Firm—Frishauf, Holtz, Goodman & Chick, P.C.

(21) Appl. No.: **11/497,737**

(22) Filed: **Aug. 2, 2006**

(57) **ABSTRACT**

(65) **Prior Publication Data**

US 2007/0241985 A1 Oct. 18, 2007

(30) **Foreign Application Priority Data**

Apr. 13, 2006 (JP) 2006-111297

(51) **Int. Cl.**
H01Q 1/50 (2006.01)

(52) **U.S. Cl.** **343/850**; 343/860; 343/822;
333/168; 455/180.2

(58) **Field of Classification Search** 343/822,
343/850, 860; 333/17.3, 32, 168, 170; 455/150.1,
455/179.1, 180.2

See application file for complete search history.

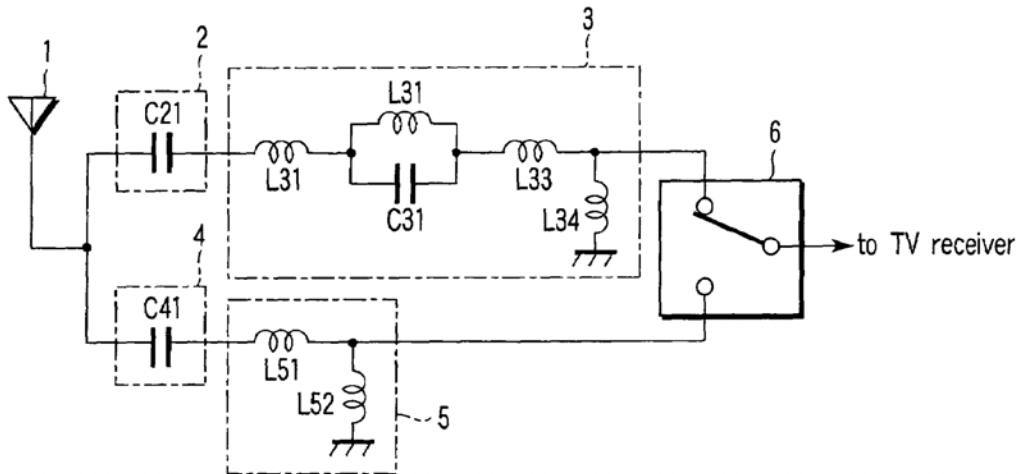
An antenna device which is connected to a radio module performing radio communications with a system using a first band and a system using a second band, has an antenna element which transmits/receives radio signals in the first and second bands. The antenna device has first and second matching circuits corresponding to the first and second bands, and also disposes a switching circuit between the first and second bands and the radio module. A first filter circuit is connected between the first matching circuit and the antenna element. The first filter circuit passes the radio signal in the first band and also attenuates the radio signal in the second band. Meanwhile, a second filter circuit is connected between the second matching circuit and the antenna element. The second filter circuit passes the radio signal in the second band and also attenuates the radio signal in the first band.

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20 Claims, 9 Drawing Sheets





US007348933B2

(12) **United States Patent**
Nilsson

(10) **Patent No.:** **US 7,348,933 B2**
(45) **Date of Patent:** **Mar. 25, 2008**

(54) **COMPACT MULTI-POLARIZED ANTENNA FOR PORTABLE DEVICES**

(75) Inventor: **Jack Nilsson**, Medina, OH (US)

(73) Assignee: **WiFi Plus, Inc.**, Brunswick Hills, OH (US)

(*) 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.: **10/786,731**

(22) Filed: **Feb. 25, 2004**

(65) **Prior Publication Data**

US 2004/0164917 A1 Aug. 26, 2004

Related U.S. Application Data

(63) Continuation-in-part of application No. 10/294,420, filed on Nov. 14, 2002, now Pat. No. 6,806,841, which is a continuation-in-part of application No. 09/803,245, filed on Mar. 9, 2001, now Pat. No. 6,496,152.

(60) Provisional application No. 60/188,464, filed on Mar. 10, 2000.

(51) **Int. Cl.**
H01Q 1/36 (2006.01)
H01Q 1/42 (2006.01)
H01Q 9/04 (2006.01)
H01Q 9/44 (2006.01)

(52) **U.S. Cl.** **343/895**; 343/789; 343/791; 343/805; 343/908

(58) **Field of Classification Search** 343/895, 343/789, 791, 805, 908, 906, 773, 765, 882, 343/900, 797, 807, 835, 833, 824, 792, 901, 343/846

See application file for complete search history.

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Primary Examiner—Don Wong

Assistant Examiner—Marie Antoinette Cabucos

(74) *Attorney, Agent, or Firm*—Robert J. Rose; Sheldon Mak Rose & Anderson PC

(57) **ABSTRACT**

A compact multi-polarized antenna for transmitting and/or receiving radio frequency (RF) signals, and a method for constructing same, is disclosed. The antenna comprises at least two radiative antenna elements each having a first end and a second end. The second ends of the antenna elements are electrically connected at an apex point and are disposed outwardly away from the apex point at an acute angle relative to and to a first side of an imaginary plane intersecting the apex point. The antenna also includes an electrically conductive, non-planar ground reference located at and/or to a second side of the imaginary plane.

26 Claims, 8 Drawing Sheets

