



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
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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.

(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**

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

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

(65) **Prior Publication Data**

US 2006/0044187 A1 Mar. 2, 2006

(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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Primary Examiner—Douglas W. Owens

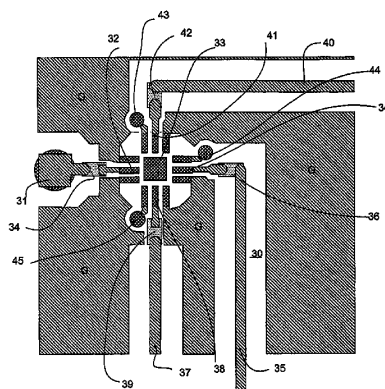
Assistant Examiner—Chue Tran

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

(57) **ABSTRACT**

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 line 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.

10 Claims, 8 Drawing Sheets



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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**

US 2005/0140554 A1 Jun. 30, 2005

(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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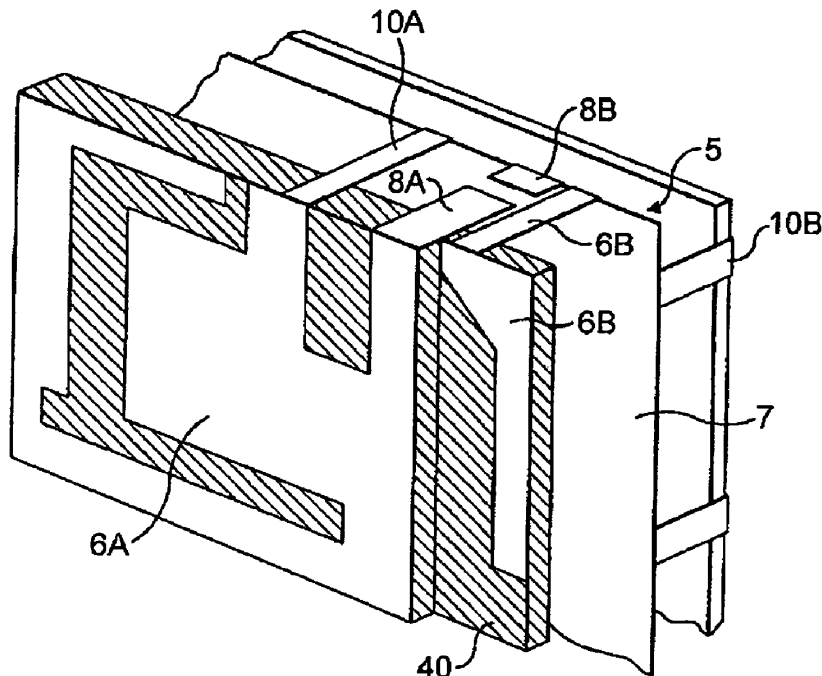
Primary Examiner—Shih-Chao Chen

(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



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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)

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patent is extended or adjusted under 35
U.S.C. 154(b) by 96 days.

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1993, pp. 482-485, XP000420084; figs. 2-5.

(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.

(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.

(56) **References Cited**

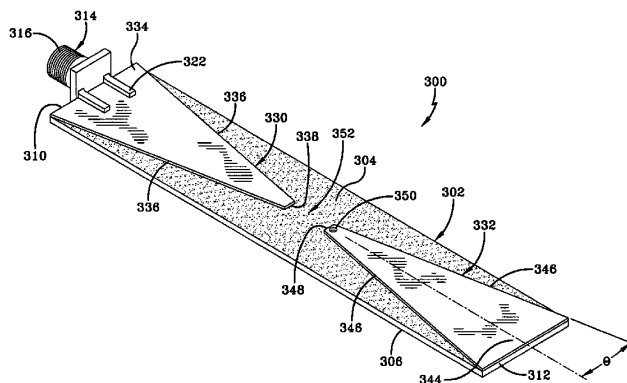
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A biconical antenna includes an entry conic having an entry base opposite an entry vertex and a termination conic having a termination base opposite a termination vertex. The entry and termination conics share substantially the same axis and the entry 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.

16 Claims, 14 Drawing Sheets



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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.

(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**

(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.

(30) **Foreign Application Priority Data**
Sep. 16, 2003 (EP) 03020907

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

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

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

(56) **References Cited**

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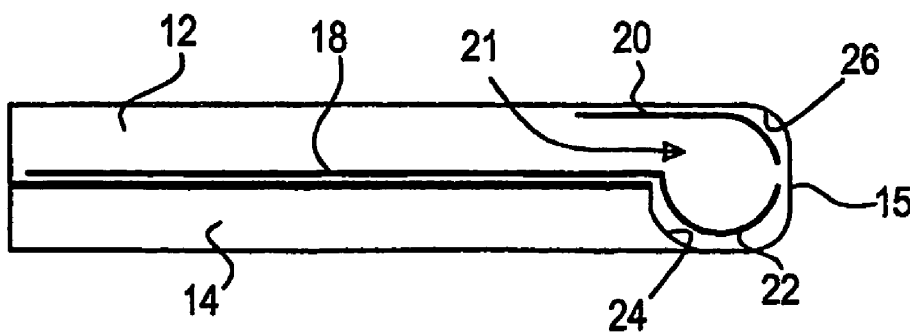
Primary Examiner—Hoanganh Le

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

(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



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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.

(56) **References Cited**

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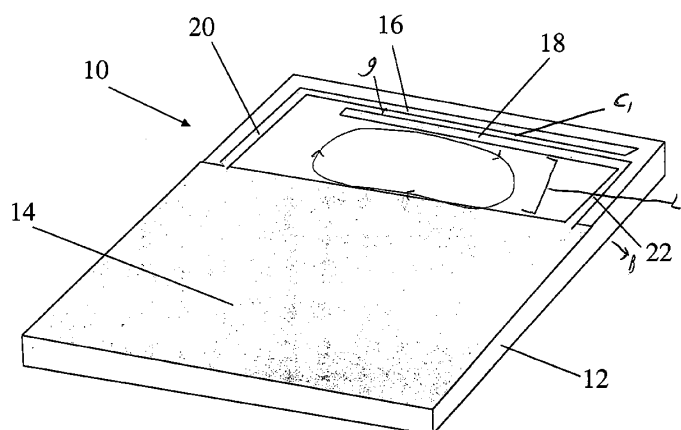
Primary Examiner—Huedung Mancuso

(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



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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**

(75) Inventors: **Il Hwan Park**, Kyungki-do (KR); **Chul
Ho Kim**, Kyungki-do (KR); **Gi Tae Do**,
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Daejeon (KR); **Tae Sung Kim**, Seoul
(KR); **Sae Won Oh**, Kyungki-do (KR);
Hyun Hak Kim, 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 232 days.

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

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

(65) **Prior Publication Data**

US 2006/0192712 A1 Aug. 31, 2006

(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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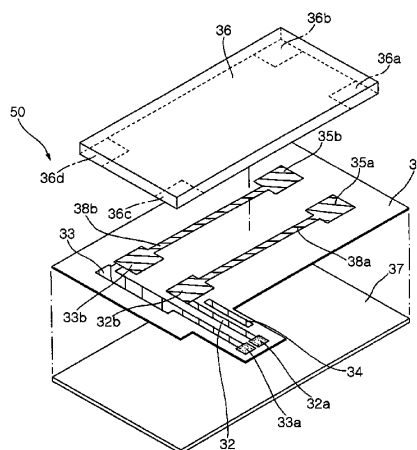
Primary Examiner—Huedung Mancuso

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

(57) **ABSTRACT**

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.

13 Claims, 15 Drawing Sheets



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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)

(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.

(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.

(56) **References Cited**

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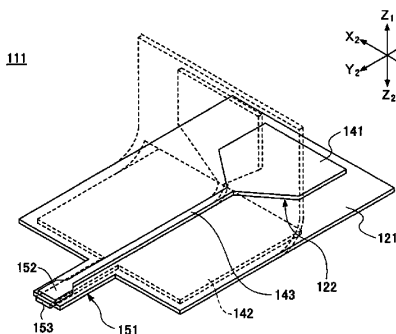
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Primary Examiner—Hoang V. Nguyen
(74) *Attorney, Agent, or Firm*—Staas & Halsey LLP

(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



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(12) **United States Patent**
Jeong

- (54) ANTENNA APPARATUS FOR A PORTABLE TERMINAL

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

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

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

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

(65) **Prior Publication Data**

US 2007/0035456 A1 Feb. 15, 2007

(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**

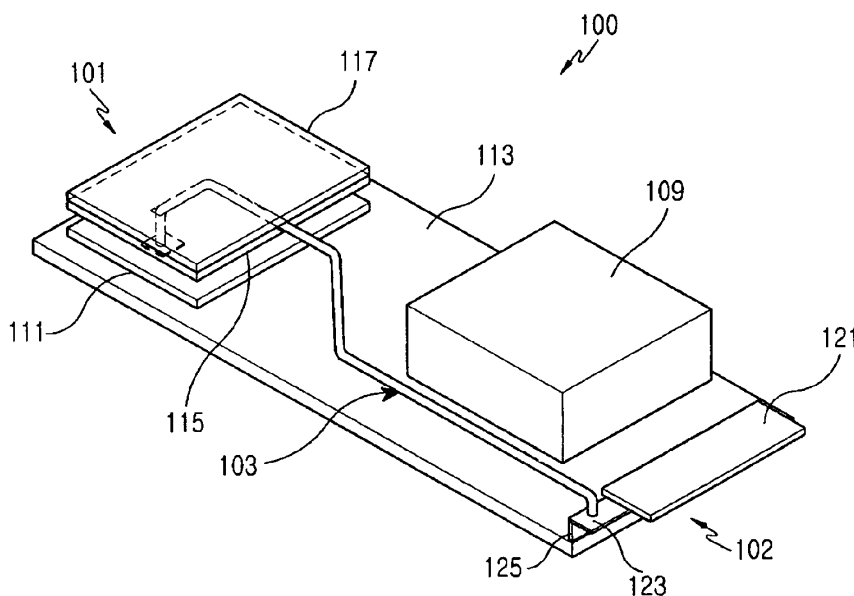
(58) **Field of Classification Search** 343/702,

343/700 MS, 846
See application file for complete search history.

(56) **References Cited**

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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**

US 2007/0085749 A1 Apr. 19, 2007

(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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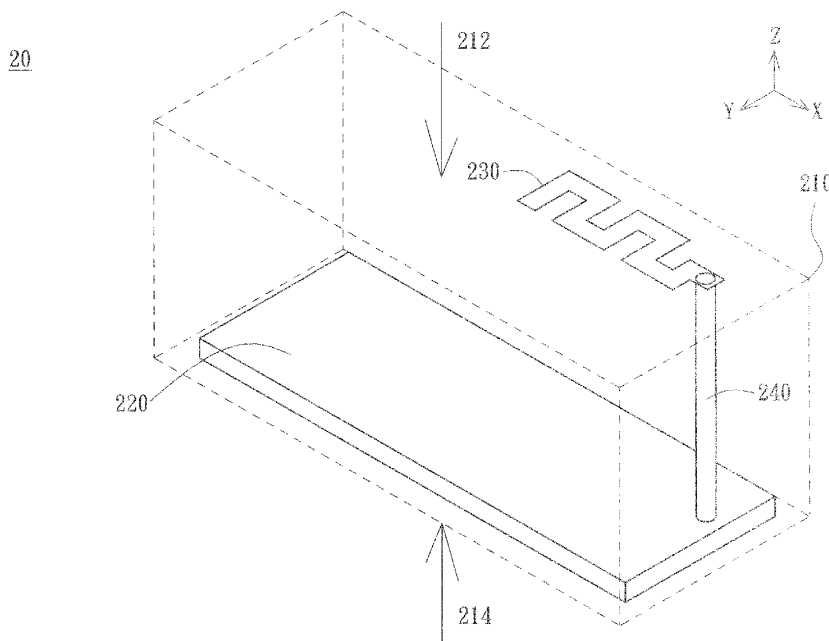
Primary Examiner—Hoang V Nguyen

(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



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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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Primary Examiner—Trinh Vo Dinh

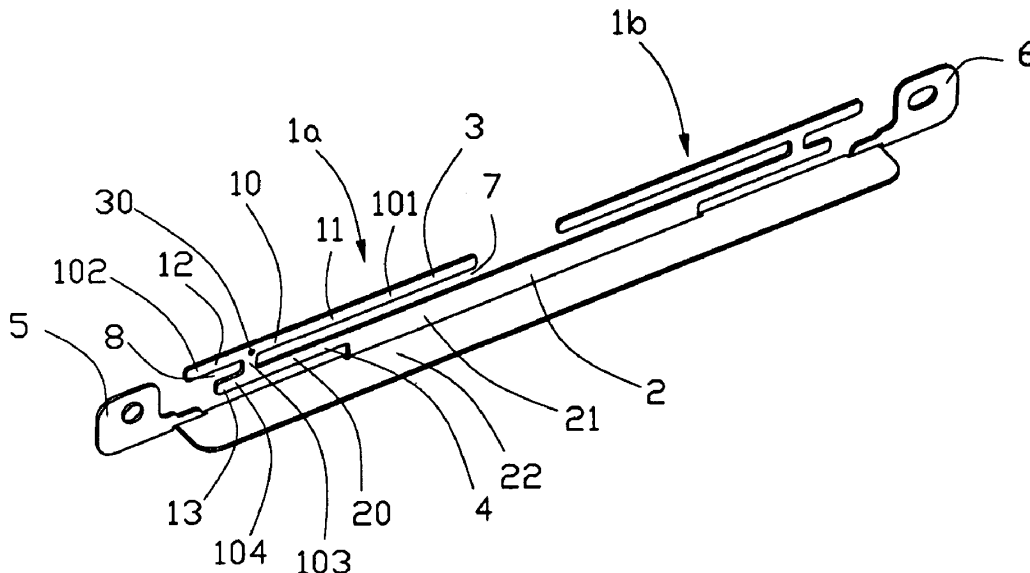
(74) *Attorney, Agent, or Firm*—Wei Te Chung

(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

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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 Gregg 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.

(56) **References Cited**

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Primary Examiner—Hoang V. Nguyen

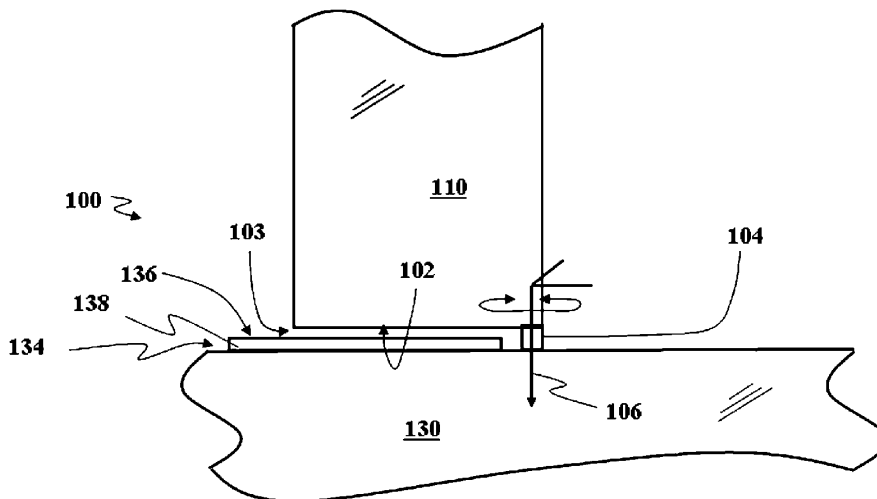
Assistant Examiner—Robert Karacsony

(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



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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.

(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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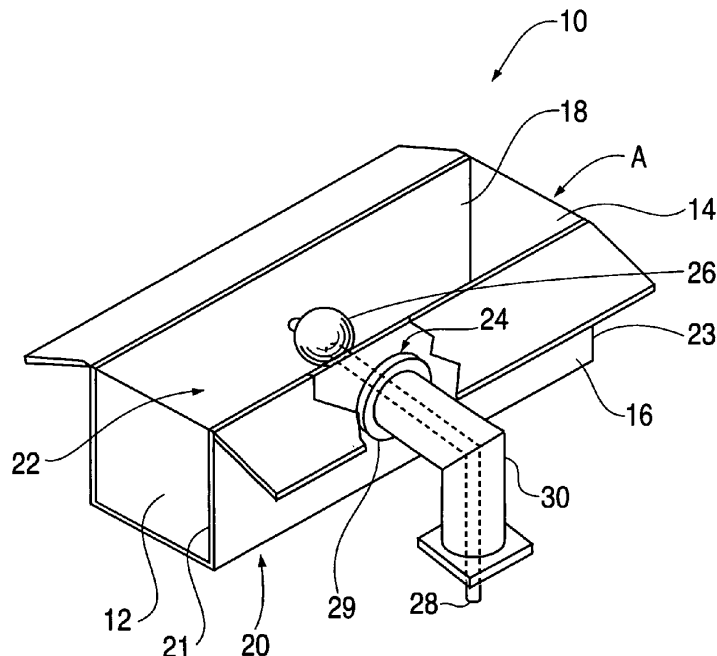
Primary Examiner—Michael C. Wimer

(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



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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.

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

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

Oct. 1950, R. W. P. King, "Asymmetrically Driven Antennas and the
Sleeve Dipole," Proc. IRE, vol. 38, pp. 1154-1164.

(65) **Prior Publication Data**

US 2007/0132650 A1 Jun. 14, 2007

(Continued)

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

Primary Examiner—Tho Phan

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

(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.

(57) **ABSTRACT**

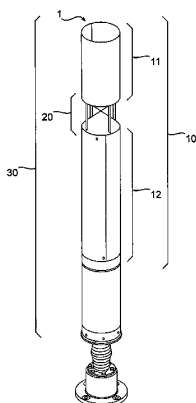
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4,959,657 A * 9/1990 Mochizuki 343/725
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An ultra-broadband antenna system is disclosed. The antenna system is a single tubular antenna structure comprising an asymmetrical dipole fed with a biconical 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



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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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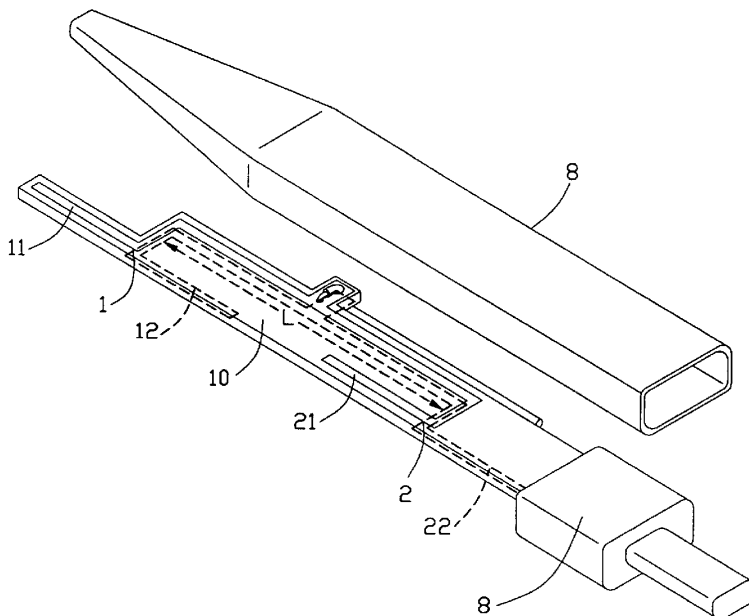
Primary Examiner—Tan Ho

(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



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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

JP 2000-124733 4/2000

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

(Continued)

(*) 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**

(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.

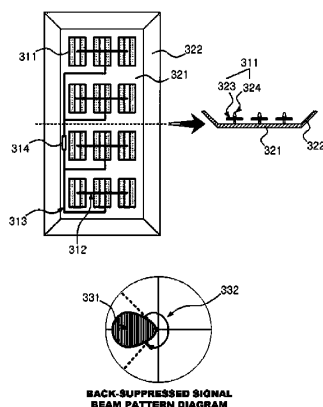
(56) **References Cited**

U.S. PATENT DOCUMENTS

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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 sold pattern outputting step for providing result of arrangement signal distribution and synthesis of the y axis to a contact means outside the antenna device.

(Continued)

4 Claims, 6 Drawing Sheets

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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



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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**

- (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.

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

(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.

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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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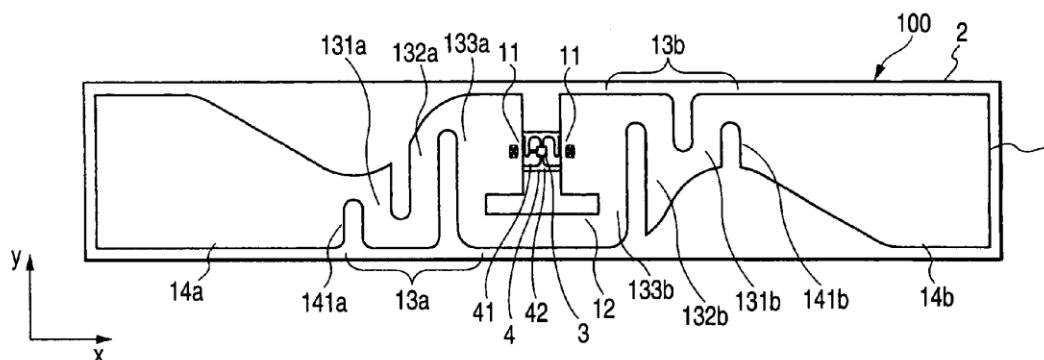
Primary Examiner—Tho Phan

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

(57) **ABSTRACT**

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 power feeding parts **11**, respectively, a pair of 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.

8 Claims, 9 Drawing Sheets



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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.

(30) **Foreign Application Priority Data**

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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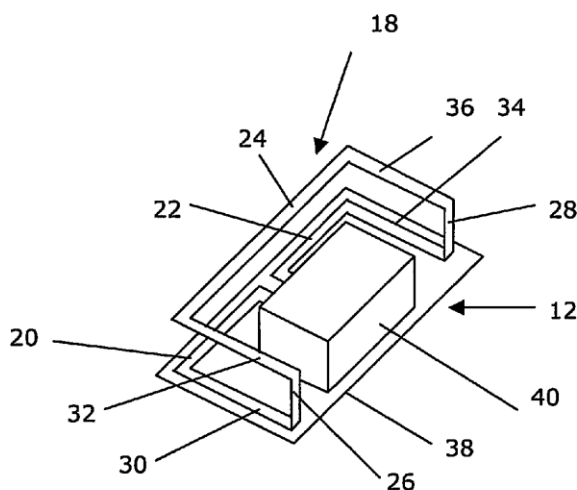
Primary Examiner—Tho Phan

(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



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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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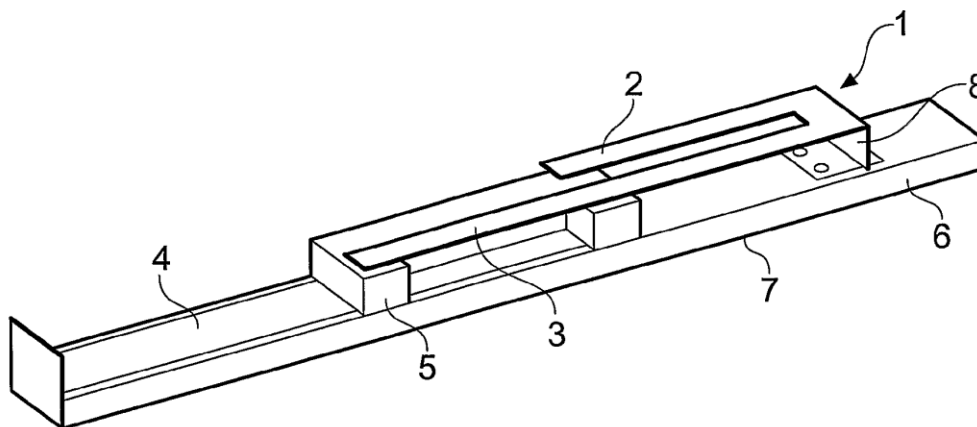
Primary Examiner—Hoang V. Nguyen

(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



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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)

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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 123 days.

(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

(57) **ABSTRACT**

(30) **Foreign Application Priority Data**

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

(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**

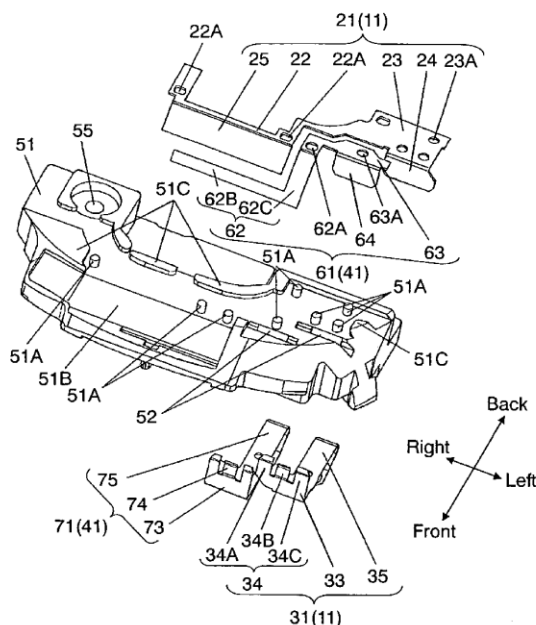
See application file for complete search history.

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12 Claims, 9 Drawing Sheets



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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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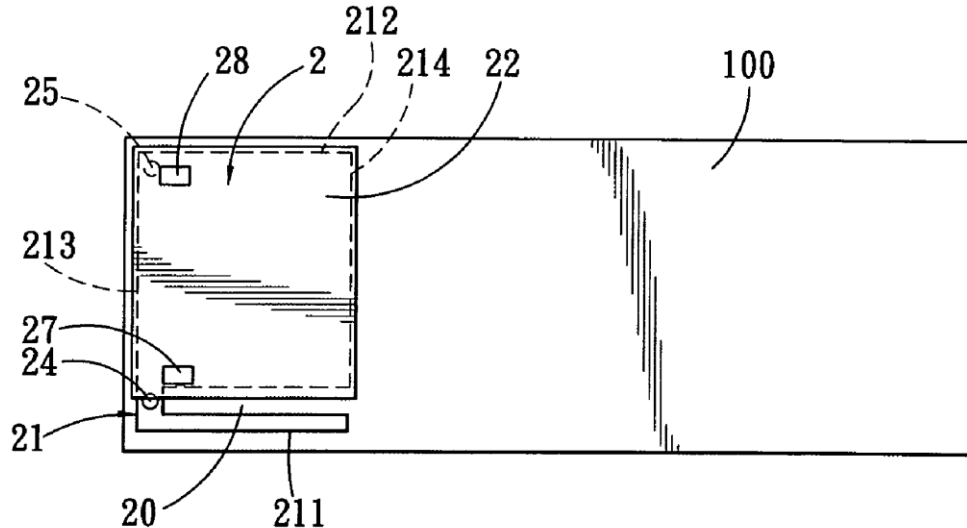
Primary Examiner—Huedung Mancuso

(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. 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



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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**

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

(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.: **11/307,927**

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

(65) **Prior Publication Data**

US 2007/0200772 A1 Aug. 30, 2007

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

(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.

(56) **References Cited**

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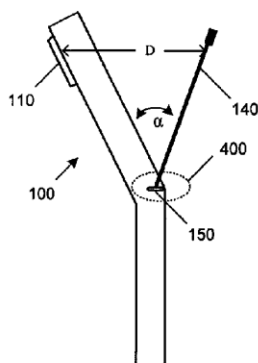
Primary Examiner—Tan Ho

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

(57) **ABSTRACT**

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.

7 Claims, 4 Drawing Sheets



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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**

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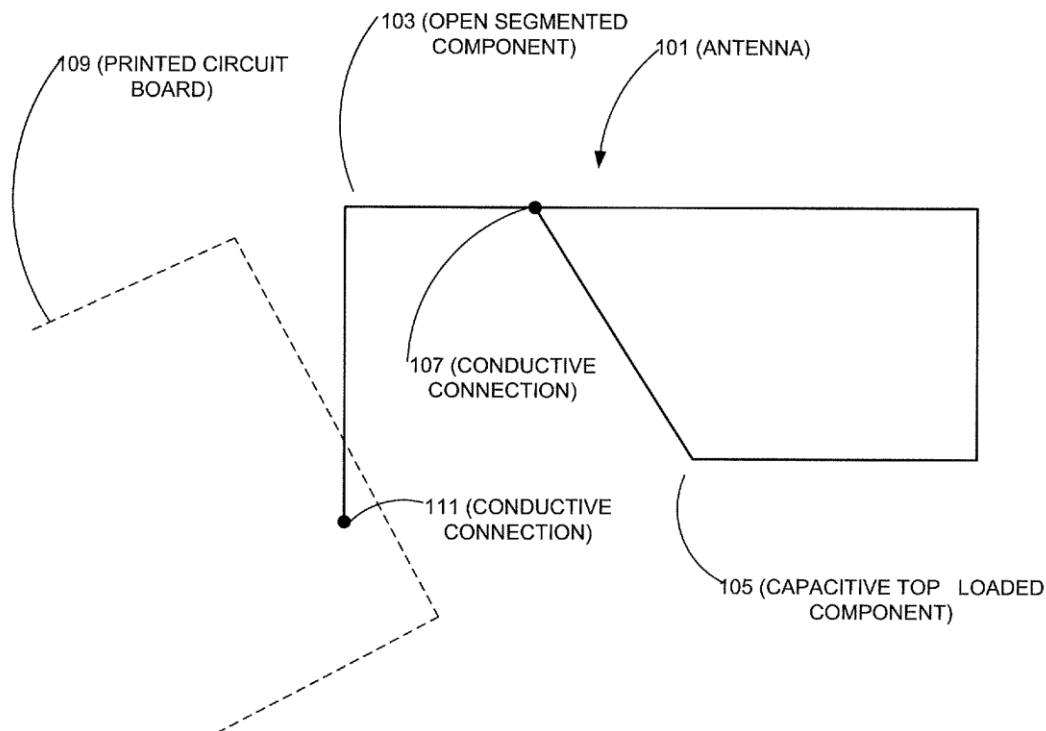
Primary Examiner—Hoang V Nguyen

(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



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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); **Akihide 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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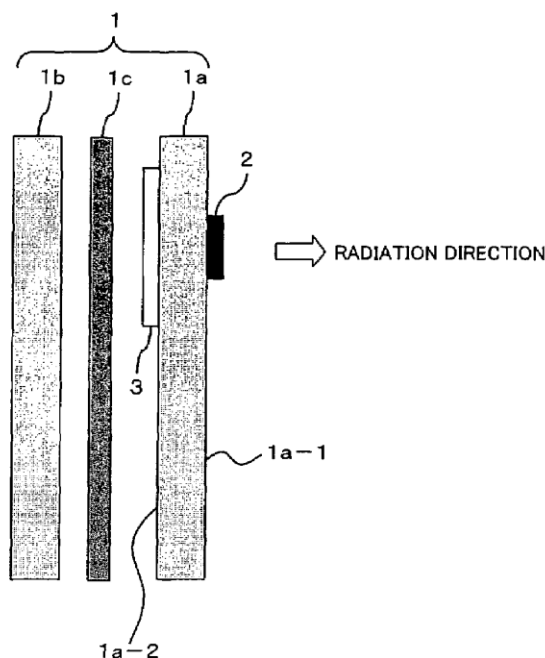
Primary Examiner—Hoang V. Nguyen

(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



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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**

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6,570,490 B1 * 5/2003 Saitoh et al.

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(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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Primary Examiner—Michael C. Wimer

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

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

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

(65) **Prior Publication Data**

US 2003/0063034 A1 Apr. 3, 2003

(30) **Foreign Application Priority Data**

Sep. 28, 2001 (JP) 2001-301401

(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.

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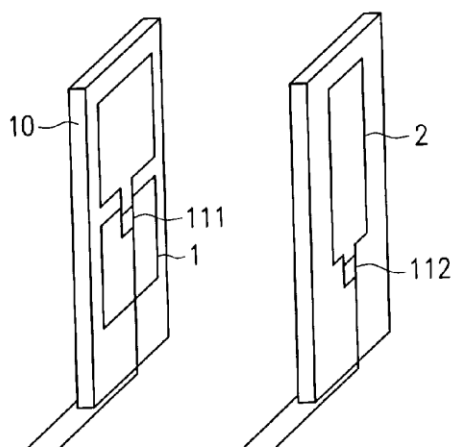
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4,679,046 A 7/1987 Curtis et al.
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(57) **ABSTRACT**

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.

38 Claims, 22 Drawing Sheets



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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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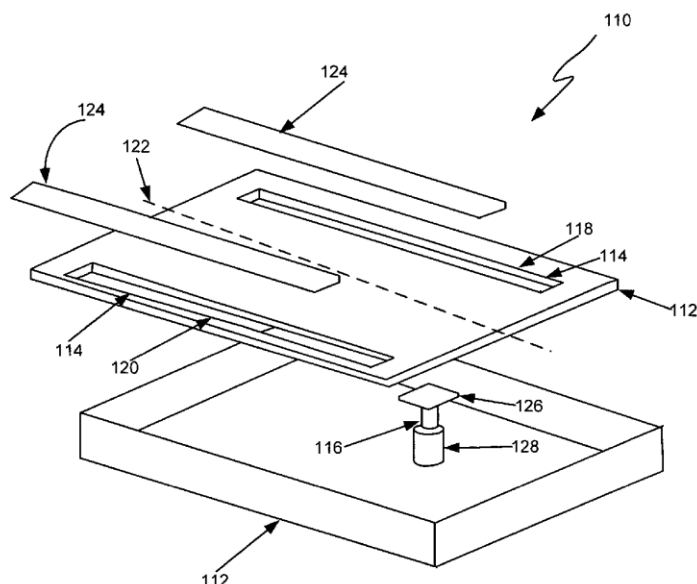
Primary Examiner—Michael C. Wimer

(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



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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**

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

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

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

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

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

(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.

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Primary Examiner—Cathron C. Brooks

Assistant Examiner—Austin Murphy

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

(57) **CLAIM**

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

DESCRIPTION

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;

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

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;

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;

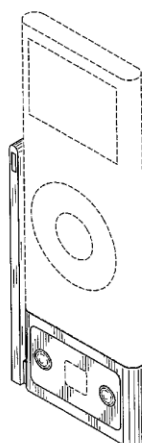
FIG. 7 is a bottom plan view of the radio transmitter with an external antenna of FIG. 1 attached to a portable media player;

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.

1 Claim, 7 Drawing Sheets



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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**

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

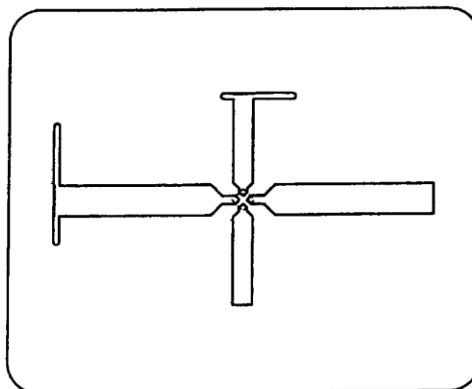
(57) **CLAIM**

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



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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**

Related U.S. Patent Documents

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.

(56) **References Cited**

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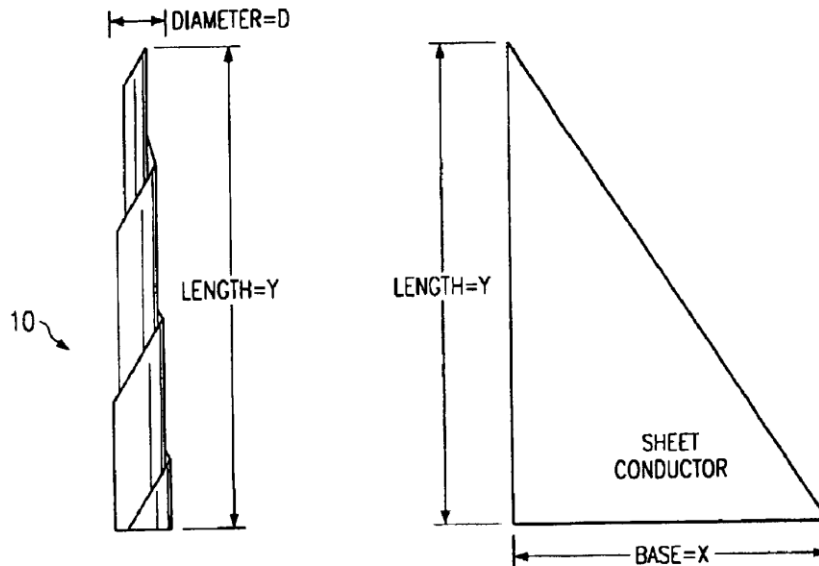
Primary Examiner—Tan Ho

(74) *Attorney, Agent, or Firm*—Baker Botts LLP

(57) **ABSTRACT**

A wideband multi-mode antenna having low VSWR operating characteristics. The antenna 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



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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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Related U.S. Application Data

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

Primary Examiner—Douglas W. Owens

Assistant Examiner—Ephrem Alemu

(74) Attorney, Agent, or Firm—Winstead PC

(51) **Int. Cl.**

H01Q 21/00 (2006.01)

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

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

(57)

ABSTRACT

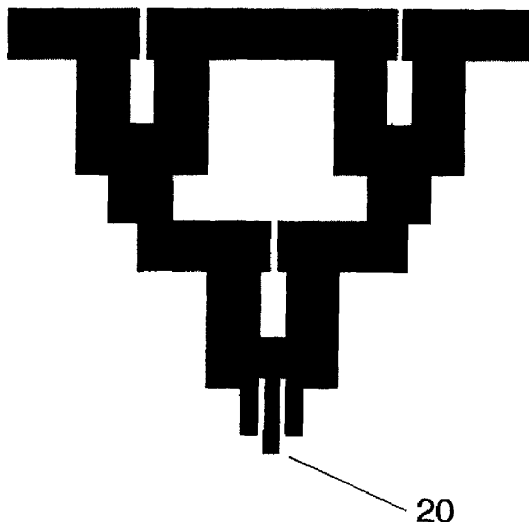
A monopole or dipole antenna includes a radiating element having at least one notch. The at least one notch intersects at least at one point on an edge of the radiating element wherein the intersecting point is located at a distance to a feeding point. The distance being shorter than half a length of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



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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);
Juderk 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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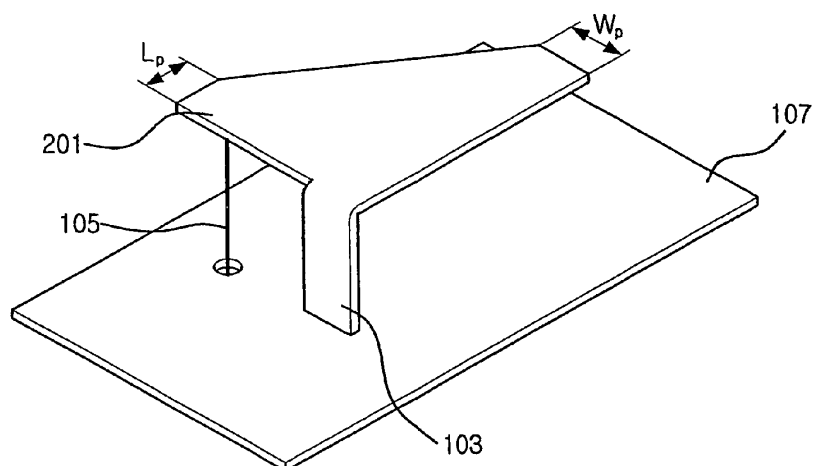
Primary Examiner—Michael C. Wimer

(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



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(12) **United States Patent**
Wielsma

- (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.

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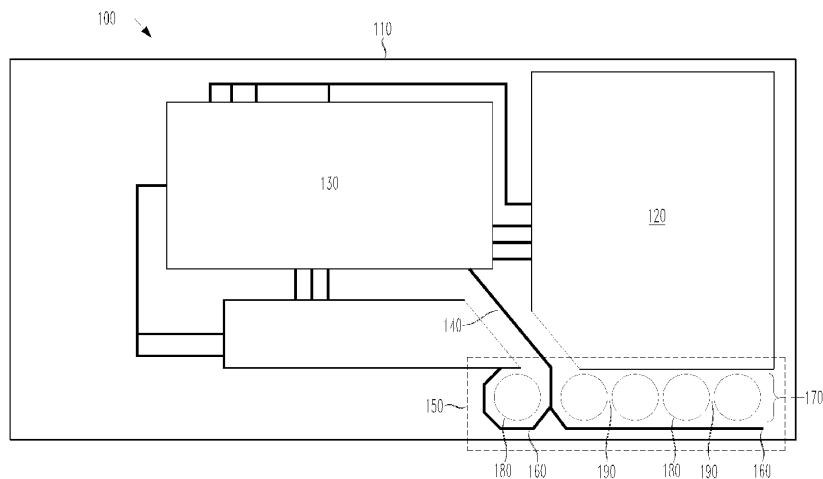
Primary Examiner—Trinh Vo Dinh

- (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.

(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



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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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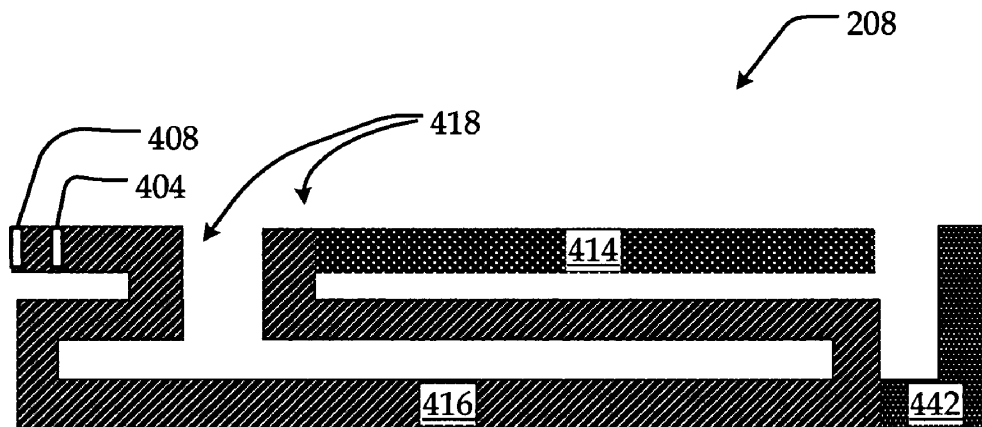
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Primary Examiner—Hoanganh Le

(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



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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)

(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.

(21) Appl. No.: **11/272,055**

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

(65) **Prior Publication Data**

US 2006/0109187 A1 May 25, 2006

(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.

(56) **References Cited**

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Primary Examiner—Hoang V. Nguyen

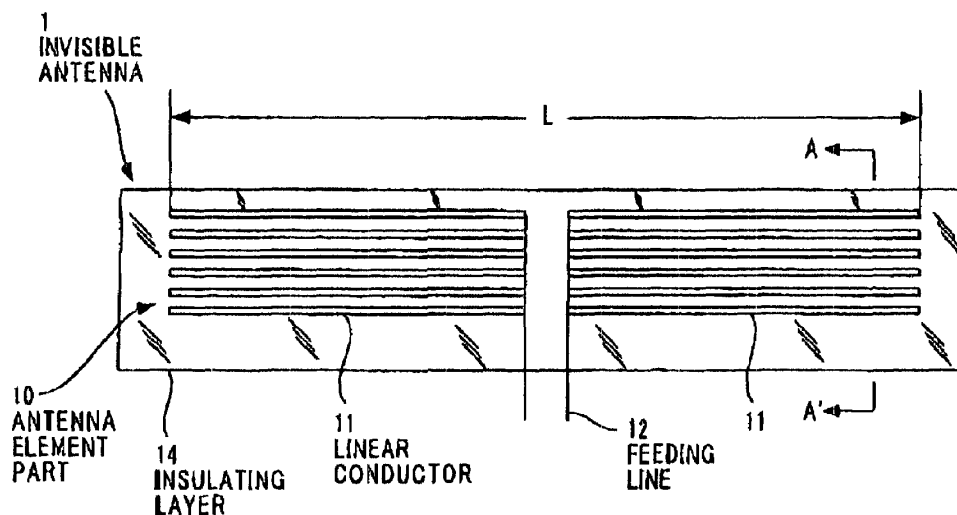
Assistant Examiner—Robert Karacsony

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

(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.

11 Claims, 8 Drawing Sheets



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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.

(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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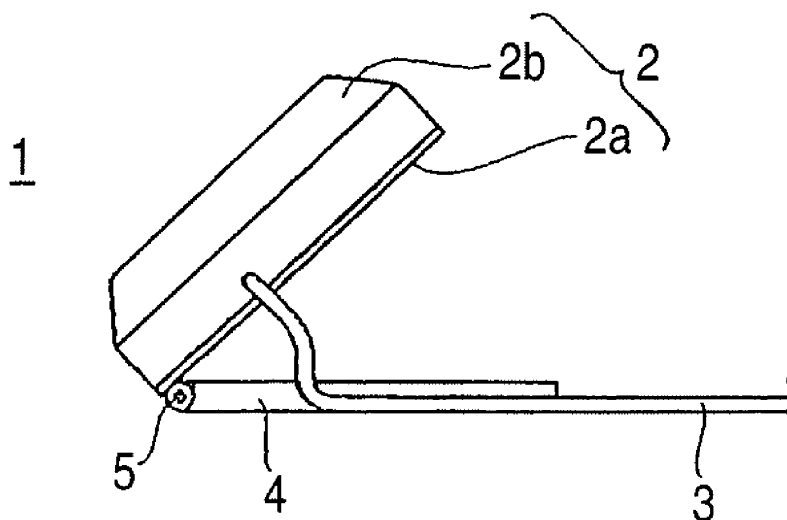
Primary Examiner—Huedung Mancuso

(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



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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.

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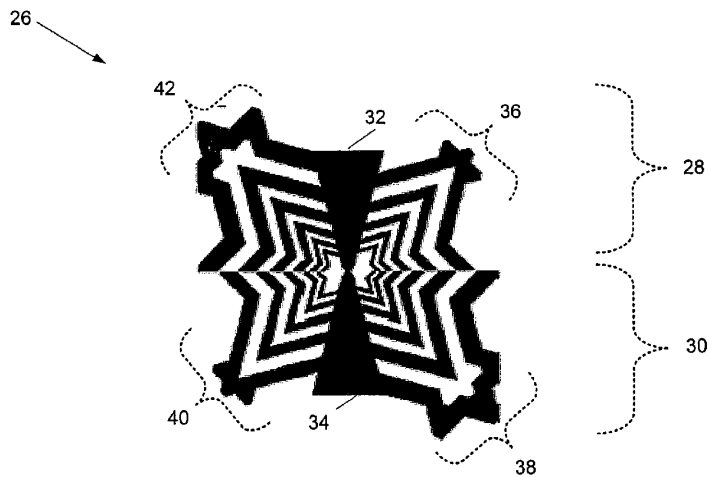
Primary Examiner—Trinh Vo Dinh

(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



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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**

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

(73) Assignee: **Sony Corporation**, 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.

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

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

(86) PCT No.: **PCT/JP2004/003214**

§ 371 (c)(1),

(2), (4) Date: **Jun. 21, 2006**

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

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

(65) **Prior Publication Data**

US 2006/0238430 A1 Oct. 26, 2006

(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.

(56) **References Cited**

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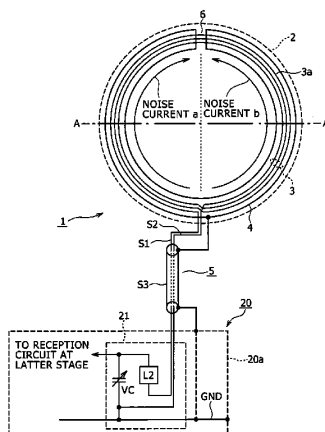
Primary Examiner—Hoang V. Nguyen

(74) *Attorney, Agent, or Firm*—Finnegan, Henderson,
Farabow, Garrett & Dunner, L.L.P.

(57) **ABSTRACT**

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.

7 Claims, 6 Drawing Sheets



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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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ters, pp. 147-150, vol. 2, 2003.

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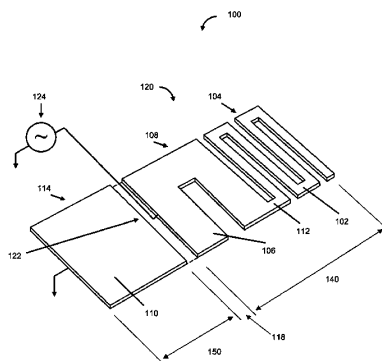
Primary Examiner—Huedung Mancuso

(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 configura-
tion 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 intercon-
nected 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 encap-
sulated into a package containing the antenna.

8 Claims, 7 Drawing Sheets



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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** 2002/0018026 A1* 2/2002 Noro 343/895
2006/0022891 A1* 2/2006 O'Neill et al. 343/895
(75) Inventors: **Junichi Noro**, Akita (JP); **Takao Kato**,
Akita (JP) 2006/0202901 A1 9/2006 Noro et al.
2006/0202902 A1 9/2006 Noro et al.
(73) Assignee: **Mitsumi Electric Co., Ltd.**, Tokyo (JP) 2006/0202903 A1 9/2006 Noro et al.
(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 87 days.

(Continued)

(21) Appl. No.: **11/318,411**

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(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**

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Mar. 10, 2005 (JP) 2005-067073

Related U.S. Appl. No. 11/318,409, filed Dec. 22, 2005; Inventor:
J. Noro et al.

(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

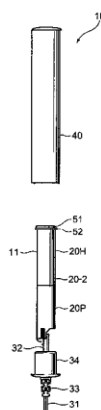
See application file for complete search history.

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6,628,241 B1 * 9/2003 Fukushima et al. 343/895
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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

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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**

U.S. PATENT DOCUMENTS

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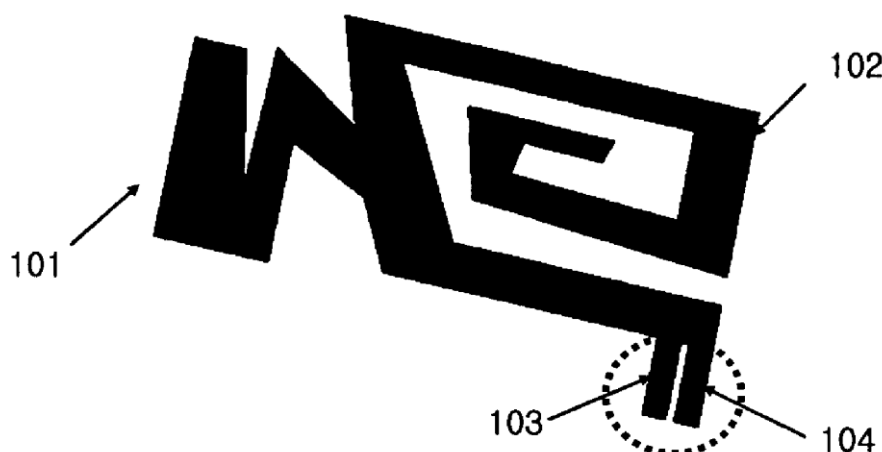
Primary Examiner—Tan Ho

(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



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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.

(21) Appl. No.: **11/427,776**

(22) Filed: **Jun. 29, 2006**

(65) **Prior Publication Data**

US 2007/0001925 A1 Jan. 4, 2007

(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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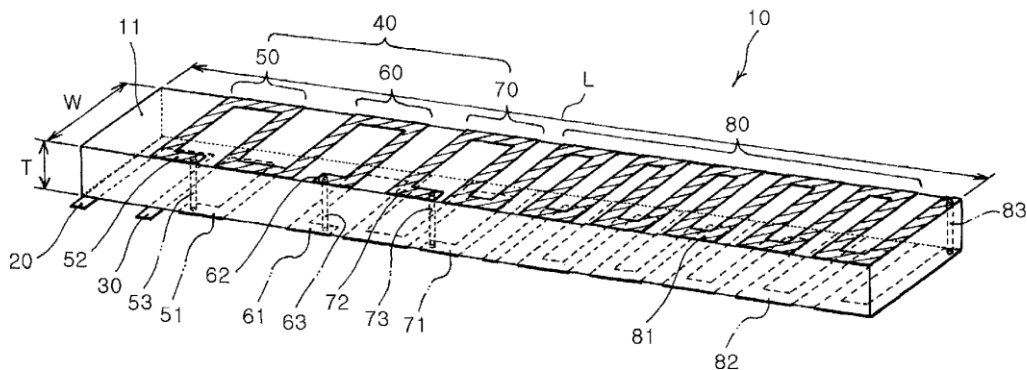
Primary Examiner—Tho Phan

(74) *Attorney, Agent, or Firm*—Lowe Hauptman Ham & Berner

(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.

9 Claims, 4 Drawing Sheets



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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.

(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.

(56) **References Cited**

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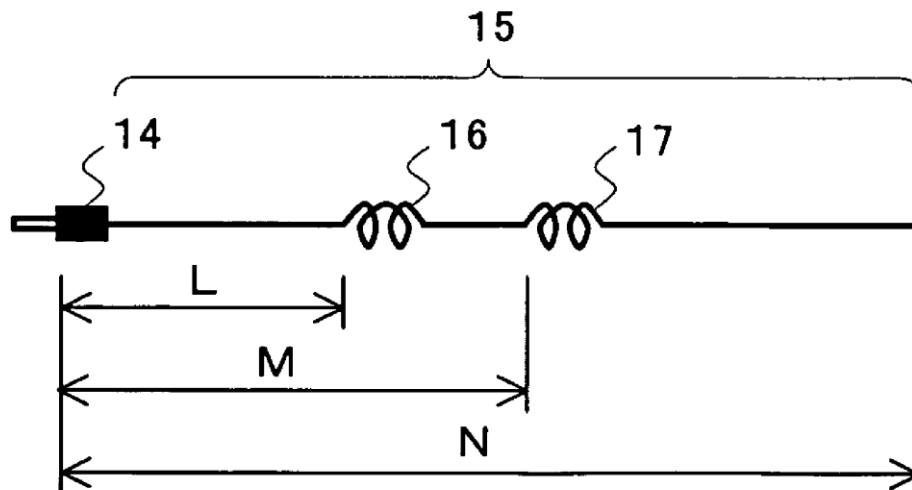
Primary Examiner—Huedung Mancuso

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

(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



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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)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 224 days.

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

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

(65) **Prior Publication Data**

US 2006/0214851 A1 Sep. 28, 2006

(30) **Foreign Application Priority Data**

Mar. 28, 2005 (JP) 2005-091304

(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.

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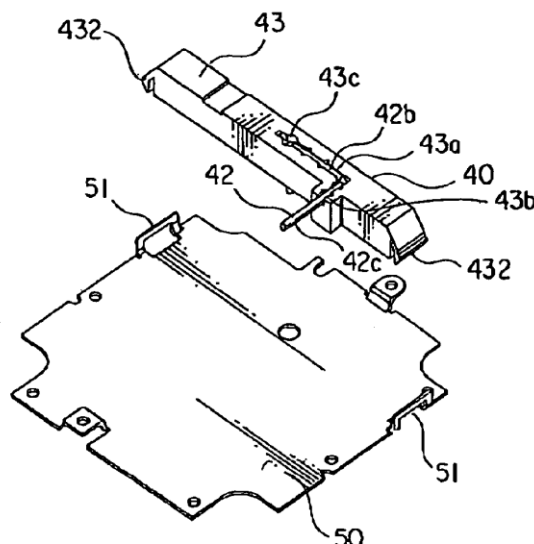
Primary Examiner—Tho Phan

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

(57) **ABSTRACT**

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.

4 Claims, 7 Drawing Sheets



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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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2003/0062963 A1 * 4/2003 Aikawa et al. 331/177 V
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)

FOREIGN PATENT DOCUMENTS

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

GB 2304464 A 3/1997
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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

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

Assistant Examiner—Angela M Lie

(74) *Attorney, Agent, or Firm*—Kevin A. Reif

(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.

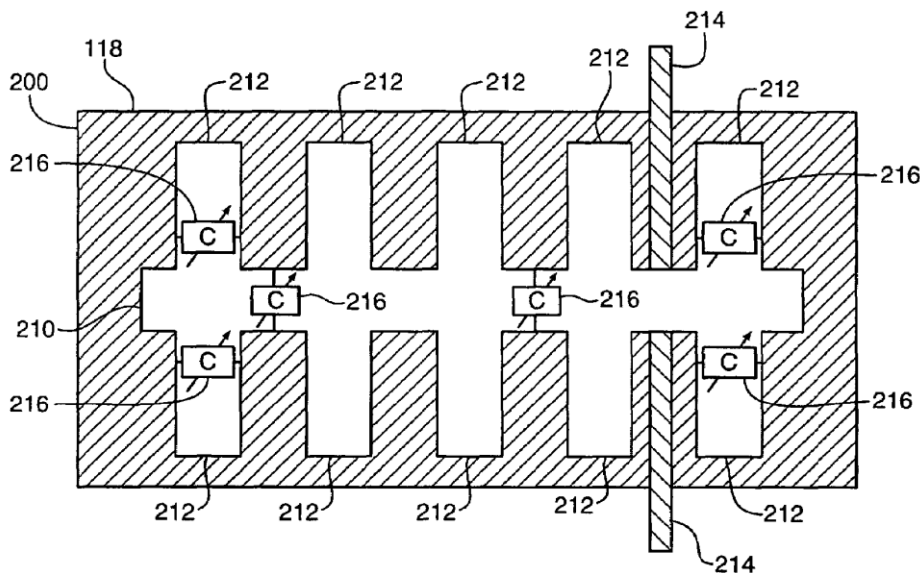
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6,028,561 A * 2/2000 Takei 343/767
6,355,534 B1 3/2002 Cheng et al.
6,593,672 B2 7/2003 Ma et al.

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.

20 Claims, 4 Drawing Sheets



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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**

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

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

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

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

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

(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.

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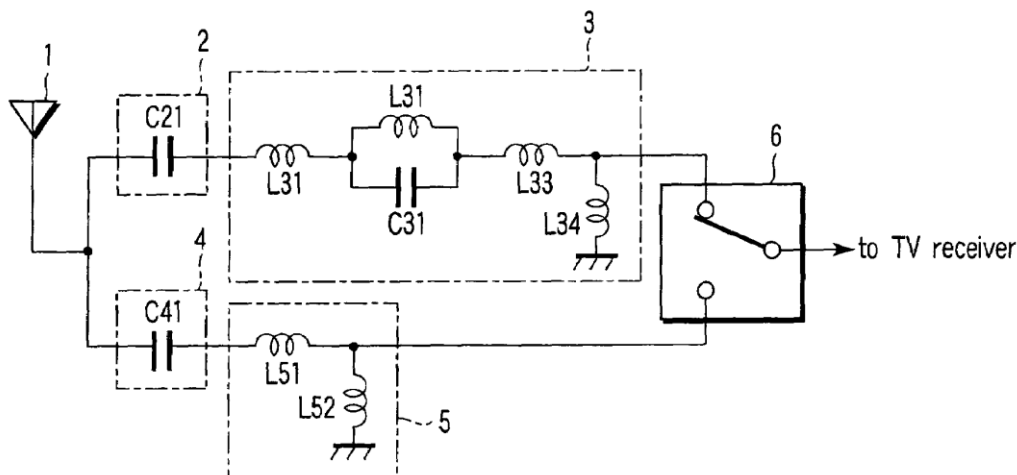
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(57) **ABSTRACT**

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.

20 Claims, 9 Drawing Sheets



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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)

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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.

(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

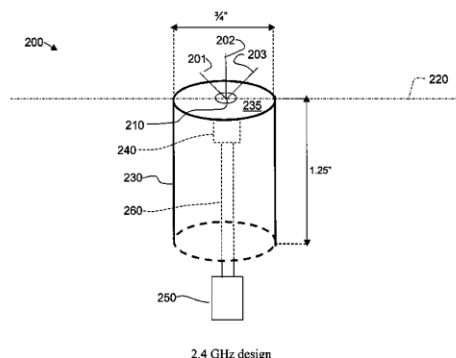
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Mak Rose & Anderson PC

(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 inter-
secting the apex point. The antenna also includes an elec-
trically conductive, non-planar ground reference located at
and/or to a second side of the imaginary plane.

26 Claims, 8 Drawing Sheets



2.4 GHz design



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