



US007158082B2

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

(10) **Patent No.:** **US 7,158,082 B2**
(45) **Date of Patent:** **Jan. 2, 2007**

(54) **LOW-HEIGHT DUAL OR MULTI-BAND ANTENNA, IN PARTICULAR FOR MOTOR VEHICLES**

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(75) Inventors: **Frank Mierke**, Rosenheim (DE); **Peter Karl Prassmayer**, Grosskarolinenfeld (DE)

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(73) Assignee: **Kathrein-Werke KG**, Rosenheim (DE)

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

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(21) Appl. No.: **10/521,094**

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(22) PCT Filed: **Jun. 12, 2003**

(Continued)

(86) PCT No.: **PCT/EP03/06199**

Primary Examiner—Michael C. Wimer

§ 371 (c)(1),
(2), (4) Date: **Jul. 13, 2005**

(74) *Attorney, Agent, or Firm*—Nixon & Vanderhye PC

(87) PCT Pub. No.: **WO2004/008573**

(57) **ABSTRACT**

PCT Pub. Date: **Jan. 22, 2004**

The invention relates to an improved, low-height dual or multi-band antenna comprising surface transmitters, whose size varies in accordance with the frequency band to be transmitted. Said antenna is configured from a smaller surface transmitter that is located on top of a larger surface transmitter. The antenna is characterized by the following improved features: the dual or multi-band antenna is essentially configured as a one-piece punched and bent metal part; as a one-piece component, said antenna consists of at least two surface transmitters, which are electrically connected via a short-circuit; and at least the lowest surface transmitter for transmission in a lower frequency band and/or at least a surface transmitter that is lower than the surface transmitter for transmission in the highest frequency band have transmitter wings lying adjacent to their transmitter surface. When the antenna is viewed from above, the respective surface transmitter for transmission in a higher frequency band lies between the wings of said lower frequency band transmitters.

(65) **Prior Publication Data**

US 2006/0012524 A1 Jan. 19, 2006

(30) **Foreign Application Priority Data**

Jul. 15, 2002 (DE) 102 31 961

(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, 343/829, 846

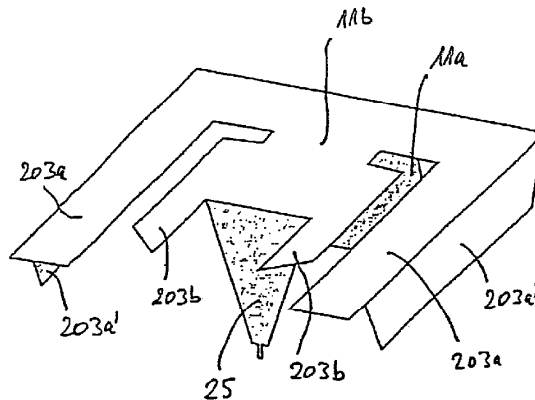
See application file for complete search history.

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16 Claims, 13 Drawing Sheets





US007158084B2

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

(10) **Patent No.:** **US 7,158,084 B2**
(45) **Date of Patent:** **Jan. 2, 2007**

(54) **VARIABLE ANTENNA APPARATUS FOR A MOBILE TERMINAL**

(75) Inventors: **Dong-Hwan Kim**, Hwaseong-si (KR);
Byung-Duck Cho, Seoul (KR);
Wan-Jin Choi, Suwon-si (KR)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 25 days.

(21) Appl. No.: **10/946,819**

(22) Filed: **Sep. 22, 2004**

(65) **Prior Publication Data**

US 2005/0237242 A1 Oct. 27, 2005

(30) **Foreign Application Priority Data**

Apr. 22, 2004 (KR) 10-2004-0027728

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

(52) **U.S. Cl.** **343/702**; 343/714; 343/736;
343/869; 343/881

(58) **Field of Classification Search** 343/702,
343/829

See application file for complete search history.

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Primary Examiner—Don Wong

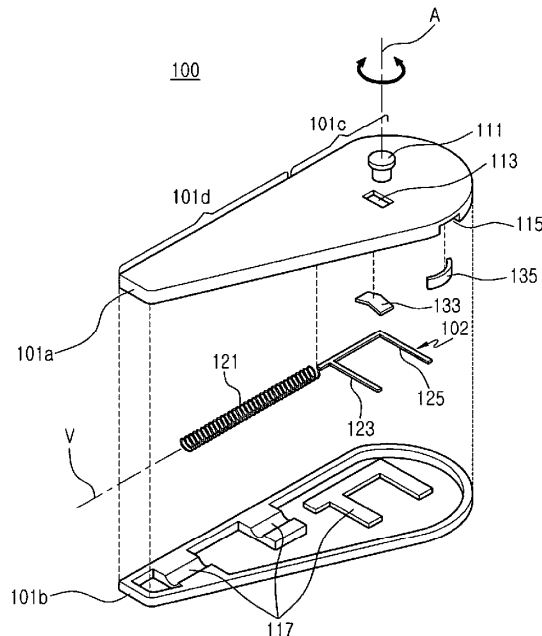
Assistant Examiner—Binh Van Ho

(74) *Attorney, Agent, or Firm*—The Farrell Law Firm

(57) **ABSTRACT**

A variable antenna apparatus for a mobile terminal. The variable antenna apparatus includes a radiation component that is rotatably coupled with the mobile terminal, a feeding component that is adjacent to a first end part of the radiation component and electrically connected to a radio frequency board of the mobile terminal. A grounding component is adjacent to the first end part of the radiation component and selectively connected to a ground of the radio frequency board as the radiation component is rotated. The antenna apparatus is accommodated in a terminal so that it is possible to conveniently carry the terminal, and the antenna is rotatably protruded from the terminal during a telephone call, such that appropriate antenna gain is achieved.

14 Claims, 5 Drawing Sheets





US007158085B2

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

(10) **Patent No.:** **US 7,158,085 B2**
(45) **Date of Patent:** **Jan. 2, 2007**

(54) **ANTENNA APPARATUS FOR SLIDING-TYPE PORTABLE TERMINAL**

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2001/0009847 A1 7/2001 Kim et al. 455/575.4
2003/0137468 A1* 7/2003 Kim 343/895

(75) Inventors: **Yong-Joo Shin**, Yongin-si (KR);
Wan-Jin Choi, Suwon-si (KR)

FOREIGN PATENT DOCUMENTS

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

EP 0 459 391 5/1991
EP 1 111 712 6/2001
FR 2 802 046 12/1999

(*) 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.: **11/081,215**

Primary Examiner—Shih-Chao Chen
Assistant Examiner—Minh Dieu A
(74) *Attorney, Agent, or Firm*—The Farrell Law Firm

(22) Filed: **Mar. 16, 2005**

(57) **ABSTRACT**

(65) **Prior Publication Data**

US 2005/0264457 A1 Dec. 1, 2005

Disclosed is an antenna apparatus for a sliding-type portable terminal having a first housing and a second housing adapted to slide along the longitudinal direction of the first housing including an external antenna having a stationary antenna portion extending along the longitudinal direction and having an end fixed on the first housing and at least one movable antenna portion extending along the longitudinal direction and having the other end fixed to the second housing so that, as the second housing slides, it retracts in and extends out of the stationary antenna portion. The antenna apparatus for a sliding-type portable terminal has an external antenna which, together with the embedded antenna, compensates for the deteriorated performance of the embedded antenna during a speech mode. In addition, the antenna apparatus does not affect the design of the terminal and provides various types of terminal design, because it does not protrudes out of the terminal.

(30) **Foreign Application Priority Data**

Jun. 1, 2004 (KR) 10-2004-0039596

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

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

(58) **Field of Classification Search** 343/702,
343/882, 889, 903

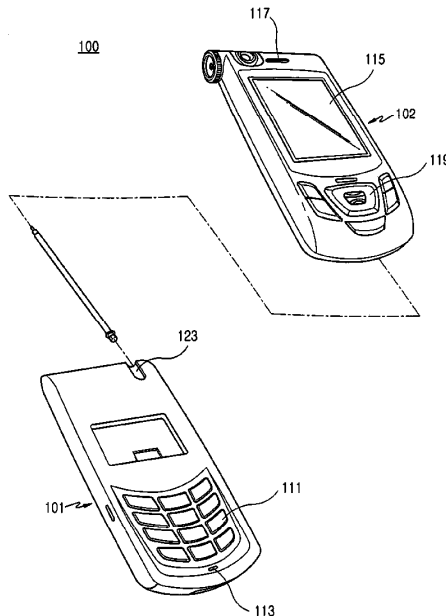
See application file for complete search history.

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5 Claims, 6 Drawing Sheets





US007158086B2

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

(10) **Patent No.:** **US 7,158,086 B2**
(45) **Date of Patent:** **Jan. 2, 2007**

(54) **MONOPOLE ANTENNA**

(75) Inventors: **Susumu Inatsugu**, Hirakata (JP);
Takeshi Masutani, Moriguchi (JP);
Kazuhiko Fujikawa, Kyotanabe (JP);
Masami Segawa, Izumi (JP)

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(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 0 days.

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EP 1 445 828 8/2004
GB 1 546 571 5/1979
JP 2000-059129 2/2000

(21) Appl. No.: **11/069,985**

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(22) Filed: **Mar. 3, 2005**

Primary Examiner—Don Wong

Assistant Examiner—Binh Van Ho

(65) **Prior Publication Data**

US 2005/0195111 A1 Sep. 8, 2005

(74) *Attorney, Agent, or Firm*—Wenderoth, Lind & Ponack, L.L.P.

(30) **Foreign Application Priority Data**

Mar. 4, 2004 (JP) 2004-060364
May 18, 2004 (JP) 2004-147428

(57) **ABSTRACT**

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

(52) **U.S. Cl.** **343/711; 343/700 MS**

(58) **Field of Classification Search** 343/711
See application file for complete search history.

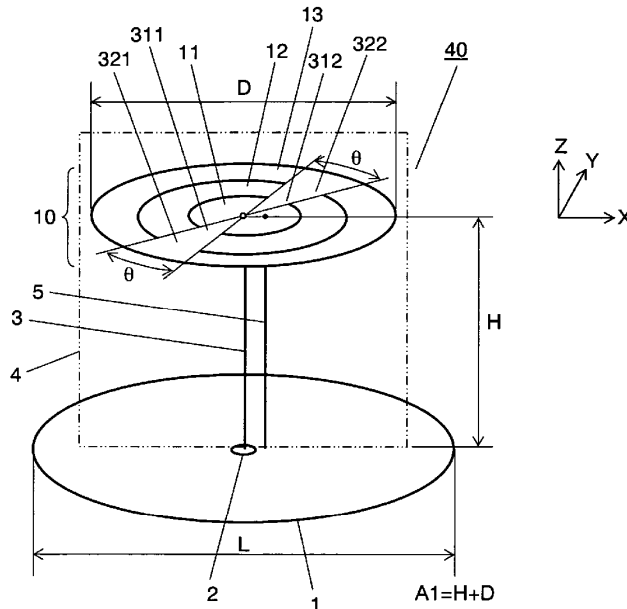
A monopole antenna is formed of a ground plane, a flat conductor faced to the ground plane and separated from it by a clearance "H", and a linear conductor that is connected to the flat conductor, extended on the ground plane side in an insulated state from the ground plane, and connected to a signal source. The flat conductor is formed of an inner conductor, and outer conductors disposed on the outer periphery of the inner conductor at a predetermined interval. Set regions of the outer edge of the inner conductor and the inner edges of the outer conductors are interconnected through one or more coupling conductors.

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6 Claims, 7 Drawing Sheets





US007158087B2

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

(10) **Patent No.:** **US 7,158,087 B2**
(45) **Date of Patent:** **Jan. 2, 2007**

(54) **DUAL-BAND DIPOLE ANTENNA**

(75) Inventors: **Hsin Kuo Dai**, Tu-Chen (TW); **Yun Long Ke**, Tu-chen (TW); **Lung-Sheng Tai**, Tu-Chen (TW); **Mu Hsiung Lin**, Tu-chen (TW); **Chin Pao Kuo**, Santa Clara, CA (US)

(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 70 days.

(21) Appl. No.: **11/025,814**

(22) Filed: **Dec. 28, 2004**

(65) **Prior Publication Data**
US 2005/0212713 A1 Sep. 29, 2005

(30) **Foreign Application Priority Data**
Mar. 26, 2004 (TW) 93108258 A

(51) **Int. Cl.**
H01Q 9/16 (2006.01)

(52) **U.S. Cl.** **343/792; 343/791**

(58) **Field of Classification Search** 343/791, 343/792, 790
See application file for complete search history.

(56) **References Cited**

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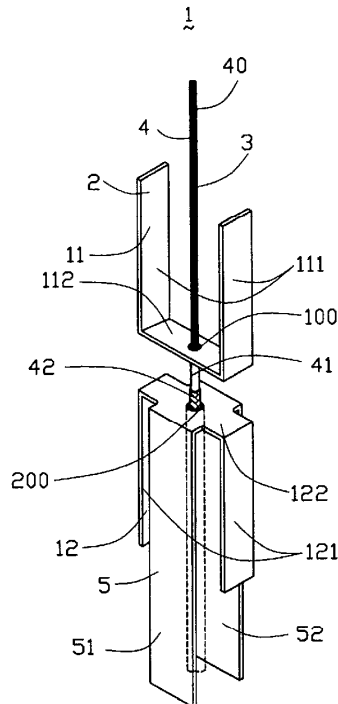
Primary Examiner—Tho Phan

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

(57) **ABSTRACT**

A dual-band antenna (1) includes a first antenna (2) and a second antenna (3). The first antenna includes a first dipole half (11) and a second dipole half (12). The first dipole half is disposed above the second dipole half with a space therebetween and the two dipole halves are corresponding to each other in a lengthwise direction. The second antenna includes a coaxial cable (4) including an inner conductor feeding the first antenna and comprising an exposed extending section (40) acting as a radiating portion of the second antenna, and a ground patch (5) electrically connected with the second dipole half.

17 Claims, 6 Drawing Sheets





US007158089B2

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

(10) **Patent No.:** **US 7,158,089 B2**
(45) **Date of Patent:** **Jan. 2, 2007**

(54) **COMPACT ANTENNAS FOR ULTRA WIDE BAND APPLICATIONS**

(75) Inventors: **Alireza Hormoz Mohammadian**, San Diego, CA (US); **Joseph Patrick Burke**, Carlsbad, CA (US); **Samir S. Soliman**, San Diego, CA (US)

(73) Assignee: **Qualcomm Incorporated**, 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 24 days.

(21) Appl. No.: **10/999,745**

(22) Filed: **Nov. 29, 2004**

(65) **Prior Publication Data**

US 2006/0114166 A1 Jun. 1, 2006

(51) **Int. Cl.**
H01Q 9/28 (2006.01)
H01Q 1/38 (2006.01)

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

(58) **Field of Classification Search** 343/795, 343/793, 812, 700 MS
See application file for complete search history.

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Primary Examiner—Don Wong

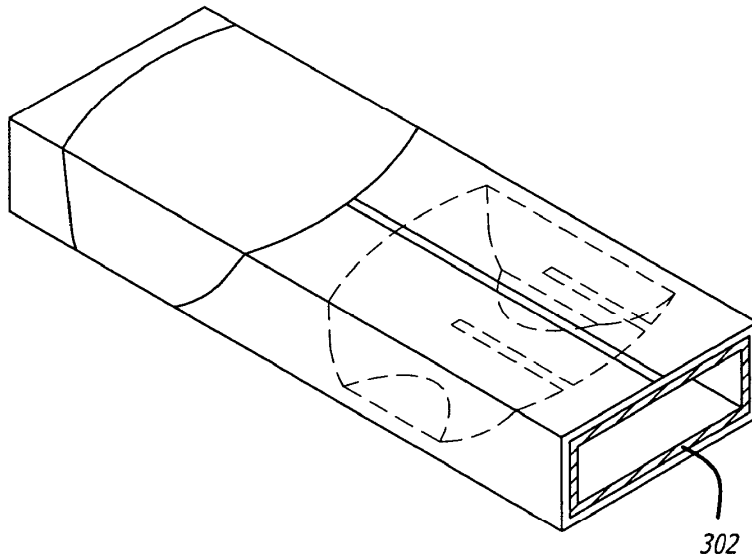
Assistant Examiner—Marie Antoinette Cabucos

(74) *Attorney, Agent, or Firm*—Philip R. Wadsworth; Sandip S. Minhas; David J. Huffaker

(57) **ABSTRACT**

Compact antennas for ultra wide band applications are disclosed. The compact antenna may be an elliptic dipole antenna with a poise and counterpoise both having an elliptical shape. A substrate may be used to support the poise and counterpoise with the substrate having a closed three-dimensional shape.

38 Claims, 6 Drawing Sheets





US007158090B2

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

(10) **Patent No.:** **US 7,158,090 B2**
(45) **Date of Patent:** **Jan. 2, 2007**

(54) **ANTENNA FOR A WIRELESS NETWORK**

(75) Inventors: **Chia-Lun Tang**, Miaoli (TW);
Shih-Huang Yeh, Yunlin (TW);
Yung-Tao Liu, Kaohsiung (TW);
Che-Wei Su, Changhua (TW); **Kin-Lu Wong**, Kaohsiung (TW)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 198 days.

(21) Appl. No.: **10/871,573**

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

(65) **Prior Publication Data**
US 2005/0280596 A1 Dec. 22, 2005

(51) **Int. Cl.**
H01Q 1/48 (2006.01)
H01Q 9/38 (2006.01)
(52) **U.S. Cl.** **343/846**; 343/829; 343/848
(58) **Field of Classification Search** 343/829,
343/845-849

See application file for complete search history.

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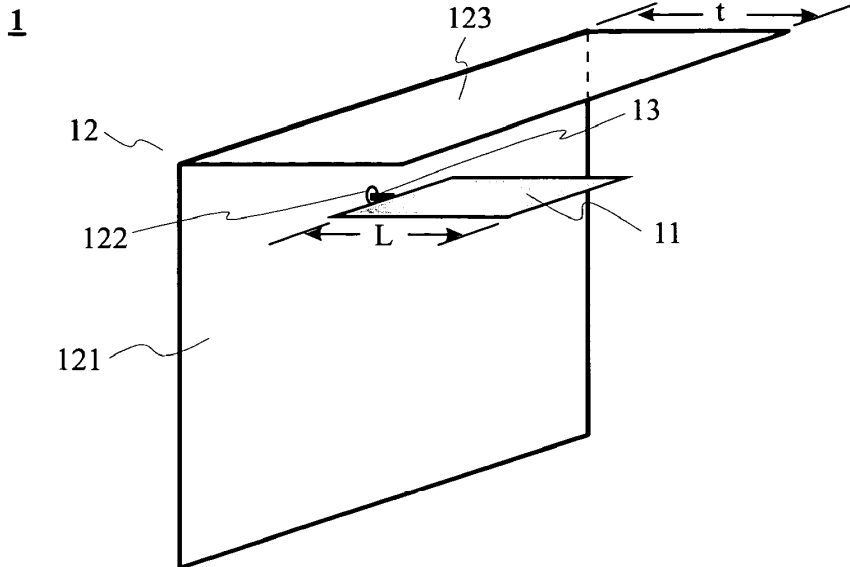
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Primary Examiner—Tan Ho
Assistant Examiner—Leith Al-Nazer
(74) *Attorney, Agent, or Firm*—Finnegan, Henderson, Farabow, Garrett & Dunner, L.L.P.

(57) **ABSTRACT**

A data access system includes a plurality of access points and an antenna corresponding to one of the access points. The antenna includes a planar monopole, a vertical ground plane and a top horizontal ground plane. In one aspect, the top horizontal ground plane outwardly extends over the planar monopole for a distance that is generally between three-quarters to three-halves of the length of the planar monopole.

16 Claims, 6 Drawing Sheets





US007158093B2

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

(10) **Patent No.:** **US 7,158,093 B2**
(45) **Date of Patent:** **Jan. 2, 2007**

(54) **QUADRI-FILAR HELIX ANTENNA STRUCTURE**

(75) Inventors: **Pei-Lin Yang**, Hsinchu (TW);
Chia-Chun Hung, Hsinchu (TW);
Chun-Hao Chen, Hsinchu (TW);
Ting-Chun Lee, Hsinchu (TW)

(73) Assignee: **Jabil Circuit Taiwan Limited**, 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.: **11/079,284**

(22) Filed: **Mar. 15, 2005**

(65) **Prior Publication Data**
US 2006/0103586 A1 May 18, 2006

(30) **Foreign Application Priority Data**
Nov. 12, 2004 (TW) 93134657 A

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

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

(58) **Field of Classification Search** 343/895,
343/821, 859, 700 MS, 702, 795
See application file for complete search history.

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Primary Examiner—Trinh Dinh

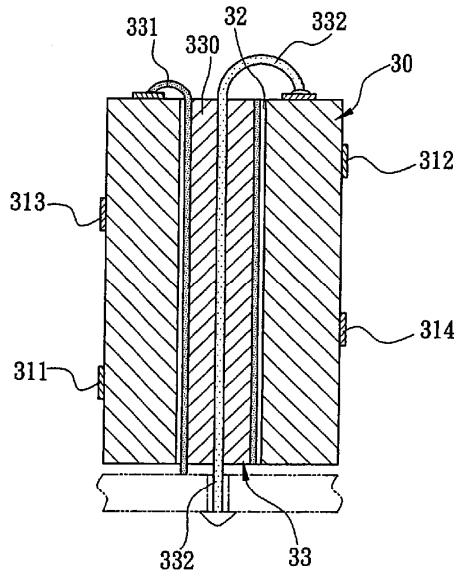
Assistant Examiner—Huedung Mancuso

(74) *Attorney, Agent, or Firm*—Bacon & Thomas, PLLC

(57) **ABSTRACT**

The present invention discloses a quadri-filar helix antenna structure, which comprises a cylindrical body made of a dielectric material with a relative dielectric constant ϵ_r , greater than 4, and four radiating metal plates disposed on a distal end surface of the cylindrical body and extended along the radial direction of the center of the cylindrical body to its periphery and then along the radial direction in a spiral course on the circumferential surface thereof to its periphery on the other end respectively, wherein the ends of every two adjacent radiating metal plates are coupled with each other to constitute two sets of antenna structures, a penetrating hole is disposed at the central position of the cylindrical body and is precisely embedded into a coaxial cable, and a shield cable disposed at the periphery on one end of the coaxial cable is coupled to an end of another set of antenna structure. Therefore, the antenna not only reduces the overall volume, but also greatly lowers its production costs.

7 Claims, 6 Drawing Sheets





US007158819B1

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

(10) **Patent No.:** **US 7,158,819 B1**
(45) **Date of Patent:** **Jan. 2, 2007**

(54) **ANTENNA APPARATUS WITH INNER ANTENNA AND GROUNDED OUTER HELIX ANTENNA**

(75) Inventors: **Narendra Pulimi**, Schaumburg, IL (US); **Li Chen**, Buffalo Grove, IL (US); **Vimal Natarajan**, Waukegan, IL (US)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 904 days.

(21) Appl. No.: **09/606,445**

(22) Filed: **Jun. 29, 2000**

(51) **Int. Cl.**
H04Q 7/20 (2006.01)

(52) **U.S. Cl.** **455/575.5**; 455/274; 343/702

(58) **Field of Classification Search** 455/550, 455/90, 575.5, 83, 97, 107, 121, 193.1, 269, 455/274; 343/702, 895, 792, 901, 725
See application file for complete search history.

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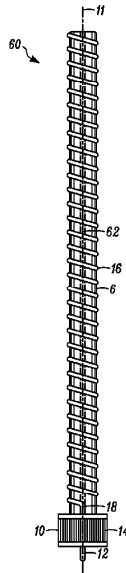
Primary Examiner—Jean Gelin

(74) *Attorney, Agent, or Firm*—Paul J. Bartusiak; Randall S. Vaas; Lawrence J. Chapa

(57) **ABSTRACT**

A dual-band cellular telephone antenna. A monopole antenna is tuned to a first resonant frequency of operation. A first helical antenna is coupled to the monopole antenna and has turns surrounding the monopole antenna, where the first helical antenna is tuned to a second resonant frequency of operation. A grounded second helical antenna surrounds the first helical antenna and is formed to have an upper capacitive loading segment to tune the grounded second helical antenna at substantially the second resonant frequency of operation. The cellular telephone has a housing formed of a conductive material. A printed circuit board (PCB) has a metalized ground plane, wherein the metalized ground plane and the grounded second helical antenna are coupled to the cellular telephone housing.

15 Claims, 2 Drawing Sheets





US007161538B2

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

(10) **Patent No.:** **US 7,161,538 B2**
(45) **Date of Patent:** **Jan. 9, 2007**

(54) **MULTIPLE BAND ANTENNA AND ANTENNA ASSEMBLY**

(75) Inventors: **Zhijun Zhang**, San Diego, CA (US); **Jean-Christophe Langer**, San Diego, CA (US); **Rob Sutter**, DeKalb, IL (US); **Tony Kfoury**, Lisle, IL (US)

(73) Assignee: **Amphenol-T&M Antennas**, Vernon Hills, 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.: **11/136,094**

(22) Filed: **May 24, 2005**

(65) **Prior Publication Data**
US 2005/0275594 A1 Dec. 15, 2005

Related U.S. Application Data
(60) Provisional application No. 60/573,875, filed on May 24, 2004.

(51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 9/16 (2006.01)

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

(58) **Field of Classification Search** **343/700 MS, 343/702, 793, 795, 895**
See application file for complete search history.

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Chia-Ching Lin, Gwo-Yun Lee and Kin-Lu Wong, "Surface-Mount Dual-Loop Antenna for 2.4/5 GHz WLAN Operation", Electronics Letters, Sep. 4, 2003, vol. 39, No. 18, pp. 1302-1304.

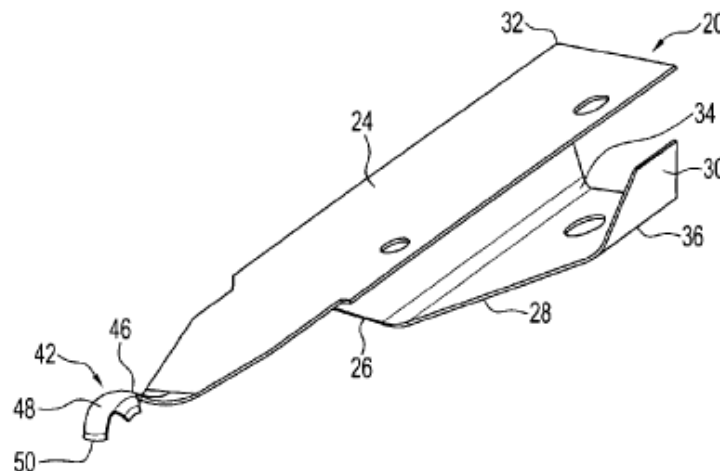
(Continued)

Primary Examiner—Trinh Vo Dinh
(74) *Attorney, Agent, or Firm*—Greer, Burns & Crain, Ltd.

(57) **ABSTRACT**

Multiple band antenna for mounting to a portable device. The antenna comprises a piece of conductive metal including a half-bowtie portion shaped to define a monopole and folded to provide a plurality of planar surfaces together generally enclosing a volume. A flexible spring contact extends from the half-bowtie portion. The spring contact is configured for engaging a contact of the portable device.

21 Claims, 14 Drawing Sheets





US007161540B1

(12) **United States Patent**
Liu

(10) **Patent No.:** **US 7,161,540 B1**

(45) **Date of Patent:** **Jan. 9, 2007**

(54) **DUAL-BAND PATCH ANTENNA**

6,133,882 A * 10/2000 LaFleur et al. 343/700 MS
7,071,889 B1 * 7/2006 McKinzie et al. 343/756

(75) Inventor: **I-Ru Liu**, Taipei (TW)

(73) Assignee: **Accton Technology Corporation**,
Hsinchu (TW)

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Primary Examiner—Hoanganh Le

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

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

(57) **ABSTRACT**

(21) Appl. No.: **11/209,831**

(22) Filed: **Aug. 24, 2005**

(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, 846, 848**

See application file for complete search history.

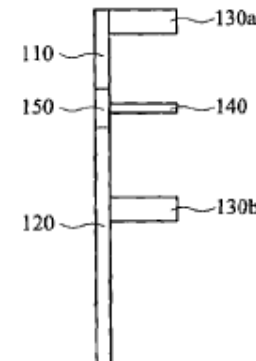
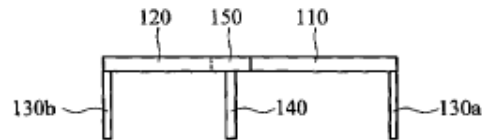
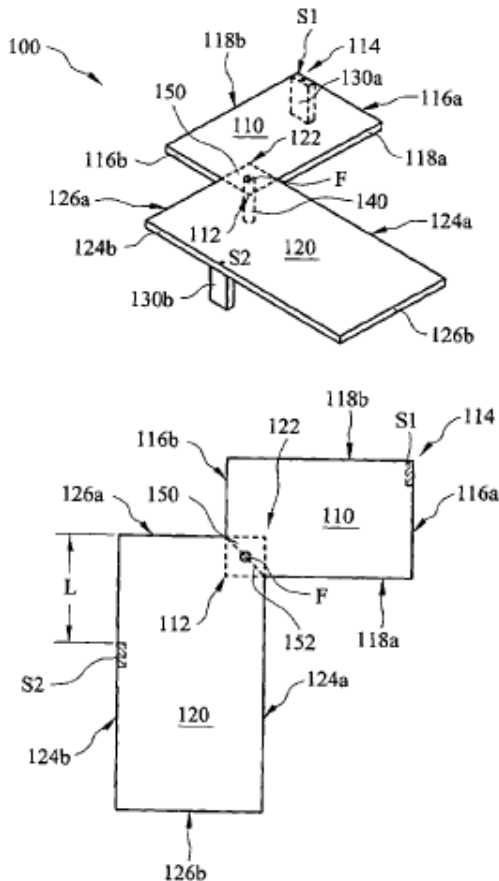
A dual-band patch antenna is disclosed. The dual-band patch antenna includes a polygon patch constructed from two rectangular radiators (radiating metal patches) combined as the shape similar to Siamese Twins, each of the rectangular radiators having a shorting strip for size reducing. The dual-band patch antenna employs one single common probe feed connected to the overlap portion of two rectangular radiators. When the dual-band patch antenna is operated at about 2.45 GHz and about 5.4 GHz, good radiation pattern and antenna gain are obtained for being applicable to IEEE802.11b/g/a/j or Bluetooth specifications.

(56) **References Cited**

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6,091,365 A * 7/2000 Demeryd et al. 343/700 MS

15 Claims, 13 Drawing Sheets





US007161541B2

(12) **United States Patent**
Chen

(10) **Patent No.:** **US 7,161,541 B2**

(45) **Date of Patent:** **Jan. 9, 2007**

(54) **MOBILE TELECOMMUNICATION DEVICE AND PLANAR ANTENNA THEREOF**

2006/0152411 A1* 7/2006 Iguchi et al. 343/700 MS

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(75) Inventor: **Ming-Feng Chen**, Taipei (TW)

EP 1 263 079 A1 12/2002

(73) Assignee: **Asustek Computer Inc.**, Taipei (TW)

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

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(21) Appl. No.: **11/211,819**

"Dual-Frequency Planar Inverted-F Antenna" Liu et al., Oct. 1997, pp. 1451-1458.

(22) Filed: **Aug. 25, 2005**

"Low-Profile Enhanced-Bandwidth PIFA Antennas for Wireless Communications Packaging" Virga et al., Oct. 1997, pp. 1879-1888.

(65) **Prior Publication Data**

US 2006/0061509 A1 Mar. 23, 2006

"A Dual-Band Planar Inverted-F Patch Antenna with a Branch-Line Slit" Hsiao et al., Feb. 2002, pp. 310-312.

(30) **Foreign Application Priority Data**

Sep. 17, 2004 (TW) 93128170 A

(Continued)

Primary Examiner—Tan Ho

(74) *Attorney, Agent, or Firm*—Thomas, Kayden, Horstemeyer & Risley

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

H01Q 1/38 (2006.01)

(57) **ABSTRACT**

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

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

See application file for complete search history.

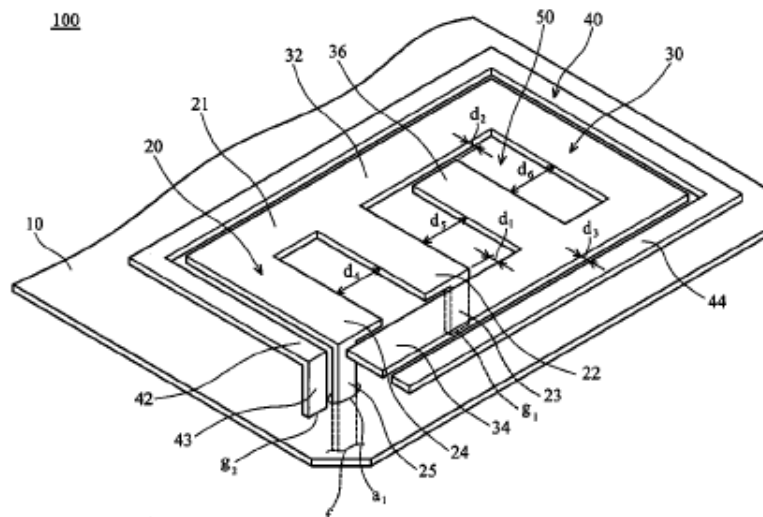
A planar antenna. A first plane radiation member, a second plane radiation member, and a third plane radiation member oppose a ground area and provide a first resonant frequency, a second resonant frequency, and a third second resonant frequency, respectively. The first plane radiation member includes a first ground end, a feeding end, and an intermediate portion therebetween. The feeding end inputs signals. The second plane radiation member includes a connecting portion and a first free end extending to one side of the first plane radiation member and separated from the first ground end and feeding end by a first gap. The connecting portion is connected to the intermediate portion. The third plane radiation member includes a second ground end and a third free end surrounding the first and second plane radiation members and separated therefrom by a third gap. The second ground end is connected to the ground area.

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- 7,119,743 B1* 10/2006 Iguchi et al. 343/700 MS
- 2005/0007283 A1* 1/2005 Jo et al. 343/702

28 Claims, 2 Drawing Sheets





US007161542B2

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

(10) **Patent No.:** **US 7,161,542 B2**
(45) **Date of Patent:** **Jan. 9, 2007**

- (54) **ANTENNA FOR RFID**
- (75) Inventors: **Takanori Endo**, Saitama (JP); **Tadashi Yonezawa**, Saitama (JP); **Seirou Yahata**, Funabashi (JP)
- (73) Assignee: **Mitsubishi Materials 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.

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6,371,380	B1	4/2002	Tanimura	235/492
6,421,013	B1 *	7/2002	Chung	343/700 MS

- (21) Appl. No.: **10/433,606**
- (22) PCT Filed: **Dec. 18, 2001**
- (86) PCT No.: **PCT/JP01/11078**
§ 371 (c)(1),
(2), (4) Date: **Nov. 10, 2003**

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JP	60-233904		11/1985
JP	6-59046		3/1994

- (87) PCT Pub. No.: **WO02/50951**
PCT Pub. Date: **Jun. 27, 2002**
- (65) **Prior Publication Data**
US 2004/0075616 A1 Apr. 22, 2004

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- (30) **Foreign Application Priority Data**
Dec. 18, 2000 (JP) 2000-383102
Dec. 3, 2001 (JP) 2001-368241
- (51) **Int. Cl.**
H01Q 1/24 (2006.01)
- (52) **U.S. Cl.** **343/702; 343/895**
- (58) **Field of Classification Search** **343/702, 343/700 MS, 895, 866, 867, 873**
See application file for complete search history.

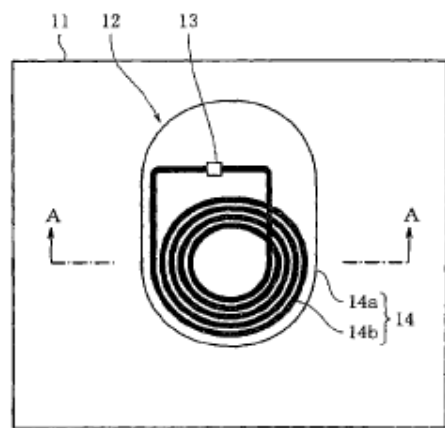
Primary Examiner—Hoang V. Nguyen
Assistant Examiner—Huechung Mancuso
(74) *Attorney, Agent, or Firm*—Oblon, Spivak, McClelland, Maier & Neustadt, P.C.

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(57) **ABSTRACT**

An antenna for RFID (Radio Frequency Identification) configured to be electrically connected to an IC (Integrated Circuit) chip or capacitor and configured to be affixed to an article. The antenna includes: a planar conductive member having a first side configured to be mounted on the article; and a coil body configured with coil turns and mounted on or at a second side which is opposite to the first side of the conductive member. The number of the coil turns and diameter of the coil body are adjusted such that a characteristic of said coil body has a predetermined value. The conductive member shields the coil body from the article.

18 Claims, 4 Drawing Sheets





US007161543B2

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

(10) **Patent No.:** **US 7,161,543 B2**
(45) **Date of Patent:** **Jan. 9, 2007**

(54) **ANTENNA SET FOR MOBILE DEVICES**

(75) Inventors: **Ping-Xi Cheng**, Taipei (TW); **He-Jun Chang**, Taipei (TW)

(73) Assignee: **Winston NeWeb Corp.**, 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 45 days.

(21) Appl. No.: **10/973,379**

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

(65) **Prior Publication Data**

US 2005/0093752 A1 May 5, 2005

(30) **Foreign Application Priority Data**

Oct. 31, 2003 (TW) 92130452 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, 846, 848**

See application file for complete search history.

(56) **References Cited**

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Primary Examiner—Trinh Dinh

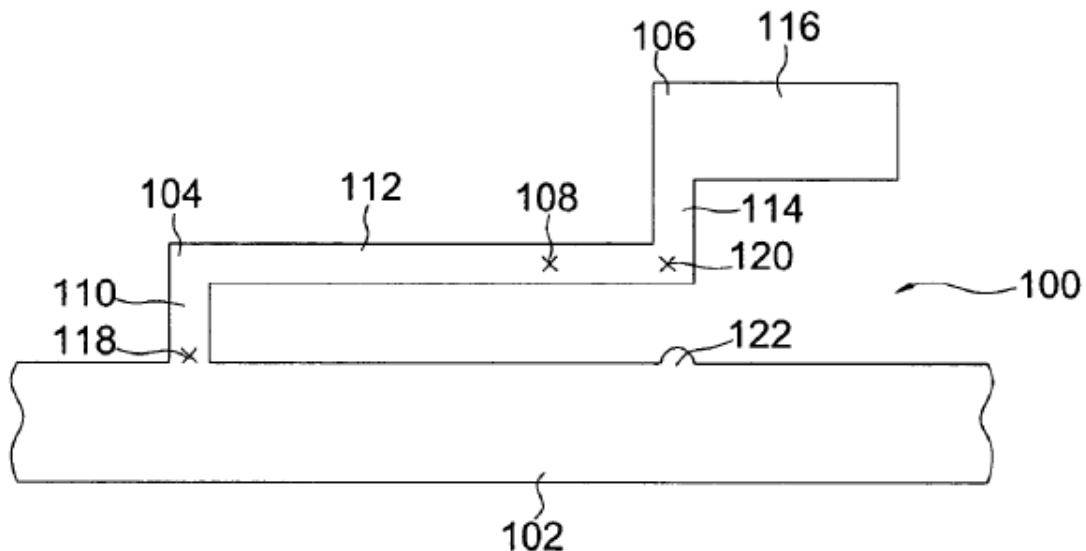
Assistant Examiner—Hueding Mancuso

(74) *Attorney, Agent, or Firm*—Ingrassia, Fisher & Lorenz, P.C.

(57) **ABSTRACT**

An antenna for the mobile electronic device. The antenna includes a first L-shaped element connecting to a second L-shaped element. Both elements are used for sending and receiving signals in a frequency band. Besides, an antenna set includes a first antenna unit and a second antenna unit, which are configured to optimize the superposition of both radiations as isotropic.

16 Claims, 5 Drawing Sheets





US007161547B2

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

(10) **Patent No.:** **US 7,161,547 B2**
(45) **Date of Patent:** **Jan. 9, 2007**

(54) **ANTENNA DEVICE**

(75) Inventors: **Masahiro Yanagi**, Shinagawa (JP);
Shigemi Kurashima, Shinagawa (JP);
Hiroto Inoue, Shinagawa (JP); **Takuya**
Uchiyama, Shinagawa (JP); **Junichi**
Akama, Shinagawa (JP); **Noboru Fujii**,
Shinagawa (JP); **Takashi Arita**,
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 0 days.

(21) Appl. No.: **10/954,204**

(22) Filed: **Oct. 1, 2004**

(65) **Prior Publication Data**
US 2005/0264462 A1 Dec. 1, 2005

(30) **Foreign Application Priority Data**
Mar. 9, 2004 (JP) 2004-066117

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

(52) **U.S. Cl.** **343/752; 343/700 MS**

(58) **Field of Classification Search** 343/700 MS,
343/752, 828, 829, 848
See application file for complete search history.

(56) **References Cited**

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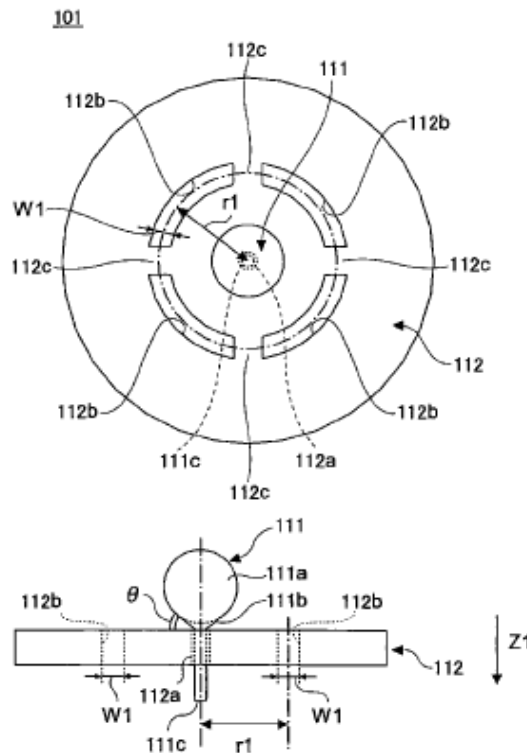
Primary Examiner—Shih-Chao Chen

(74) *Attorney, Agent, or Firm*—Staas & Halsey LLP

(57) **ABSTRACT**

A disclosed antenna device includes a ground plate, a
feeding unit that extends from the ground plate at a prede-
termined angle for a predetermined length, the feeding unit
being prepared perpendicular to the ground plate, and a
non-conductive section formed in the ground plate. The
shape of the non-conductive section is adjusted according to
a desired frequency characteristic.

7 Claims, 16 Drawing Sheets





US007161550B2

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

(10) **Patent No.:** **US 7,161,550 B2**

(45) **Date of Patent:** **Jan. 9, 2007**

(54) **DUAL- AND QUAD-RIDGED HORN
ANTENNA WITH IMPROVED ANTENNA
PATTERN CHARACTERISTICS**

(75) Inventors: **James S. McLean**, Austin, TX (US);
Robert A. Sutton, Austin, TX (US)

(73) Assignee: **TDK Corporation**, Chiba (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 22 days.

(21) Appl. No.: **11/108,394**

(22) Filed: **Apr. 18, 2005**

(65) **Prior Publication Data**

US 2005/0231436 A1 Oct. 20, 2005

Related U.S. Application Data

(60) Provisional application No. 60/563,965, filed on Apr. 20, 2004.

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

(52) **U.S. Cl.** **343/786; 343/787**

(58) **Field of Classification Search** **343/786, 343/772, 787**

See application file for complete search history.

(56) **References Cited**

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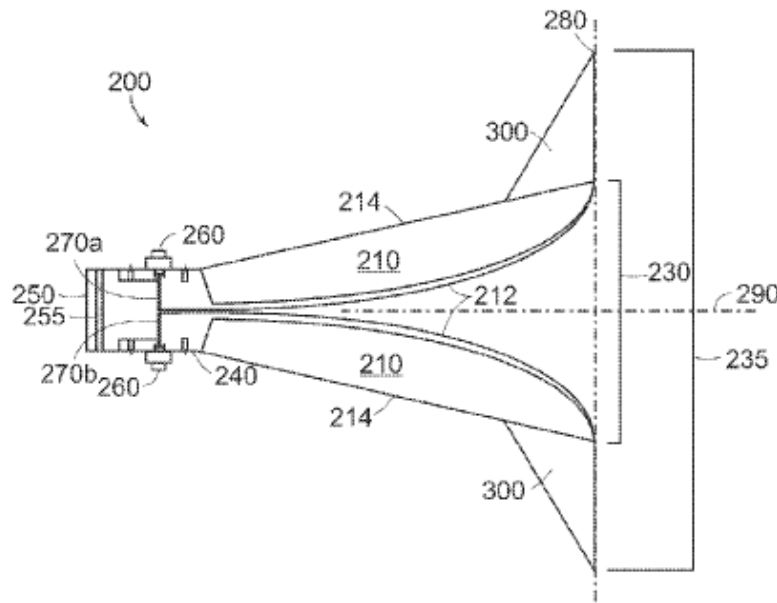
Primary Examiner—Trinh Vo Dinh

(74) *Attorney, Agent, or Firm*—Kevin L. Daffer, Daffer McDaniel, LLP

(57) **ABSTRACT**

As provided herein, a dual- or quad-ridged broadband horn antenna may include a pair of conductive antenna elements arranged opposite one another for guiding an electromagnetic wave in a longitudinal direction through the horn antenna. In some cases, the pair of conductive antenna elements may include substantially convex inner surfaces and appropriately shaped outer surfaces. The convex inner surfaces may generally function to direct or guide the radiated energy without disturbing the intended radiation pattern. To maintain the intended radiation pattern, the broadband horn antenna may also include a pair of tapered extension elements, each coupled to an outer surface of a different one of the antenna elements at one end thereof. In some cases, a magnetic material may be arranged upon at least a portion of the antenna elements to restrict surface currents to flowing along the inner surfaces only. In some cases, longitudinal grooves may be formed within the inner surfaces to restrict surface currents from flowing in a direction transverse to the longitudinal direction.

24 Claims, 5 Drawing Sheets





US007164385B2

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

(10) **Patent No.:** **US 7,164,385 B2**
(45) **Date of Patent:** **Jan. 16, 2007**

(54) **SINGLE-FEED MULTI-FREQUENCY MULTI-POLARIZATION ANTENNA**

(75) Inventors: **Ayman Duzdar**, Holly, MI (US);
Andreas D. Fuchs, Lake Orion, MI (US)

(73) Assignee: **Receptec Holdings, LLC**, Holly, MI (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.: **11/145,878**

(22) Filed: **Jun. 6, 2005**

(65) **Prior Publication Data**
US 2006/0273961 A1 Dec. 7, 2006

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

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

(58) **Field of Classification Search** **343/700 MS, 343/702, 853**

See application file for complete search history.

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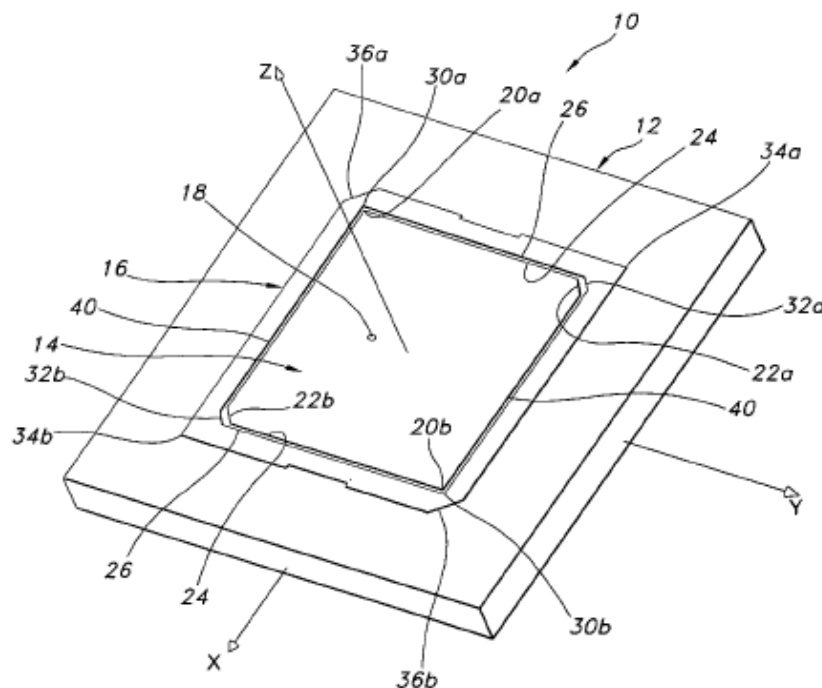
Primary Examiner—Hoang V. Nguyen

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

(57) **ABSTRACT**

An antenna capable of receiving both left-hand circularly polarized (LHCP) signals and right-hand circularly polarized (RHCP) signals, and outputting both signals on a single feed. The antenna includes two coplanar concentric patches. The inner patch is substantially square. The outer patch has inner and outer edges both of which are square. The two patches do not physically contact one another. A single feed is connected to the inner patch. The inner patch receives the LHCP signal, and the two patches together receive the RHCP signal.

3 Claims, 14 Drawing Sheets





US007164386B2

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

(10) **Patent No.:** **US 7,164,386 B2**
(45) **Date of Patent:** ***Jan. 16, 2007**

- (54) **SPACE-FILLING MINIATURE ANTENNAS** 3,622,890 A 11/1971 Fujimoto et al.
- 3,683,376 A 8/1972 Pronovost
- (75) Inventors: **Carles Puente Baliarda**, Barcelona 3,818,490 A 6/1974 Leahy
(ES); **Edouard Jean Louis Rozan**,
Barcelona (ES); **Jaime Anguera Pros**,
Barcelona (ES) 3,967,276 A 6/1976 Goubau
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- (73) Assignee: **Fractus, S.A.**, Barcelona (ES) 4,131,893 A 12/1978 Munson et al.
- (*) Notice: Subject to any disclaimer, the term of this 4,141,016 A 2/1979 Nelson
patent is extended or adjusted under 35 4,381,566 A 4/1983 Kane
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Primary Examiner—Hoang V. Nguyen
(74) *Attorney, Agent, or Firm*—Howison & Amott, L.L.P.

(57) **ABSTRACT**

A novel geometry, the geometry of Space-Filling Curves (SFC) is defined in the present invention and it is used to shape a part of an antenna. By means of this novel technique, the size of the antenna can be reduced with respect to prior art, or alternatively, given a fixed size the antenna can operate at a lower frequency with respect to a conventional antenna of the same size.

23 Claims, 26 Drawing Sheets

(21) Appl. No.: **11/154,843**

(22) Filed: **Jun. 16, 2005**

(65) **Prior Publication Data**
US 2005/0231427 A1 Oct. 20, 2005

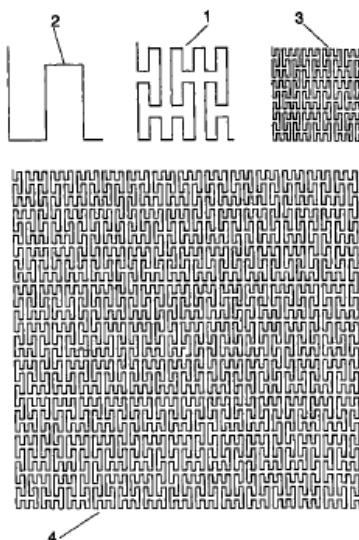
Related U.S. Application Data

(63) Continuation of application No. 10/182,635, filed as application No. PCT/EP00/00411 on Jan. 19, 2000.

- (51) **Int. Cl.**
H01Q 1/38 (2006.01)
- (52) **U.S. Cl.** **343/700 MS; 343/850**
- (58) **Field of Classification Search** **343/700 MS,**
343/895, 795, 767, 850, 853, 866
See application file for complete search history.

(56) **References Cited**
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US007164387B2

(12) **United States Patent**
Sievenpiper

(10) **Patent No.:** **US 7,164,387 B2**
(45) **Date of Patent:** **Jan. 16, 2007**

(54) **COMPACT TUNABLE ANTENNA**

(75) Inventor: **Daniel F. Sievenpiper**, Santa Monica, CA (US)

(73) Assignee: **HRL Laboratories, LLC**, Malibu, CA (US)

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

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(Continued)

(21) Appl. No.: **10/836,966**

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(22) Filed: **Apr. 30, 2004**

DE 196 00 609 A1 4/1997

(65) **Prior Publication Data**

US 2004/0227678 A1 Nov. 18, 2004

(Continued)

Related U.S. Application Data

OTHER PUBLICATIONS

(60) Provisional application No. 60/470,025, filed on May 12, 2003.

U.S. Appl. No. 10/944,032, filed Sep. 17, 2004, Sievenpiper.

(Continued)

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

Primary Examiner—Don Wong

(52) **U.S. Cl.** **343/702; 343/700 MS; 343/876; 343/866**

Assistant Examiner—Binh Van Ho

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

(58) **Field of Classification Search** **343/702, 343/703, 700 MS; 333/103**

See application file for complete search history.

(57) **ABSTRACT**

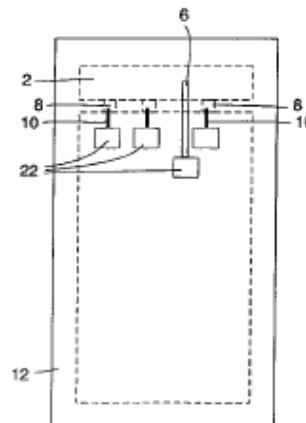
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The present disclosure relates to a method and an antenna for transmitting/receiving a RF signal at a plurality of different frequencies. Transmitting/receiving a RF signal at a plurality of different frequencies is achieved by providing a F antenna comprising a plurality of switches which can be used to adjust the resonant frequency of the antenna. By providing a F antenna, the antenna will be much smaller than the wavelength at which the antenna is operating. This allows the antenna to be used in compact devices such as PDA's and cellular phones.

45 Claims, 6 Drawing Sheets





US007164389B1

(12) **United States Patent**
Platt

(10) **Patent No.:** **US 7,164,389 B1**

(45) **Date of Patent:** **Jan. 16, 2007**

(54) **HIGH FREQUENCY BROADBAND ANTENNA**

(75) Inventor: **John Jeremy Churchill Platt**, Grand Haven, MI (US)

(73) Assignee: **R. A. Miller Industries, Inc.**, Grand Haven, MI (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 117 days.

(21) Appl. No.: **10/711,905**

(22) Filed: **Oct. 12, 2004**

Related U.S. Application Data

(60) Provisional application No. 60/481,534, filed on Oct. 21, 2003.

(51) **Int. Cl.**
H01Q 9/04 (2006.01)

(52) **U.S. Cl.** **343/790; 343/792; 343/793**

(58) **Field of Classification Search** 343/790-793
See application file for complete search history.

(56) **References Cited**

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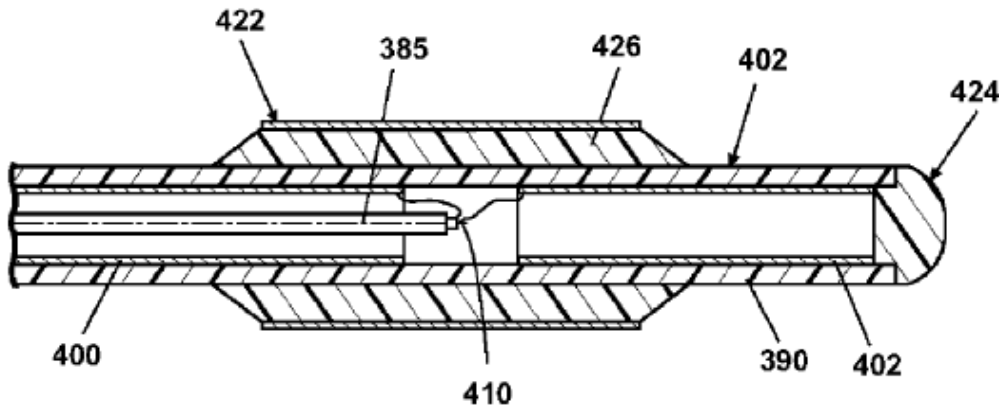
Primary Examiner—Tho Phan

(74) *Attorney, Agent, or Firm*—McGarry Bair PC

(57) **ABSTRACT**

A broadband antenna comprises an upper section with an open sleeve dipole radiator to receive and/or transmit signals in a high frequency band.

7 Claims, 21 Drawing Sheets





US007164933B1

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

(10) **Patent No.:** **US 7,164,933 B1**

(45) **Date of Patent:** **Jan. 16, 2007**

(54) **APPARATUS AND METHOD FOR REDUCING THE ELECTROMAGNETIC INTERFERENCE BETWEEN TWO OR MORE ANTENNAS COUPLED TO A WIRELESS COMMUNICATION DEVICE**

6,624,536 B1* 9/2003 Sawada et al. 307/91
6,894,648 B1* 5/2005 Kozakai 343/702
2002/0000937 A1* 1/2002 Kozakai 343/700 MS
2005/0041624 A1* 2/2005 Hui et al. 370/335

(75) Inventors: **Todd W. Steigerwald**, Austin, TX (US); **Jerry Mayfield**, Georgetown, TX (US)

* cited by examiner

(73) Assignee: **Motion Computing, Inc.**, Austin, TX (US)

Primary Examiner—Joseph Feild

Assistant Examiner—Huy D Nguyen

(74) *Attorney, Agent, or Firm*—Kevin L. Daffer; Daffer McDaniel, LLP

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 185 days.

(57) **ABSTRACT**

(21) Appl. No.: **10/791,082**

(22) Filed: **Mar. 2, 2004**

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

(52) **U.S. Cl.** **455/562.1; 455/575.7; 455/575.5; 455/97; 455/129**

(58) **Field of Classification Search** **455/562.1, 455/575.7, 575.5, 97, 129, 13.2, 19, 82; 343/851**
See application file for complete search history.

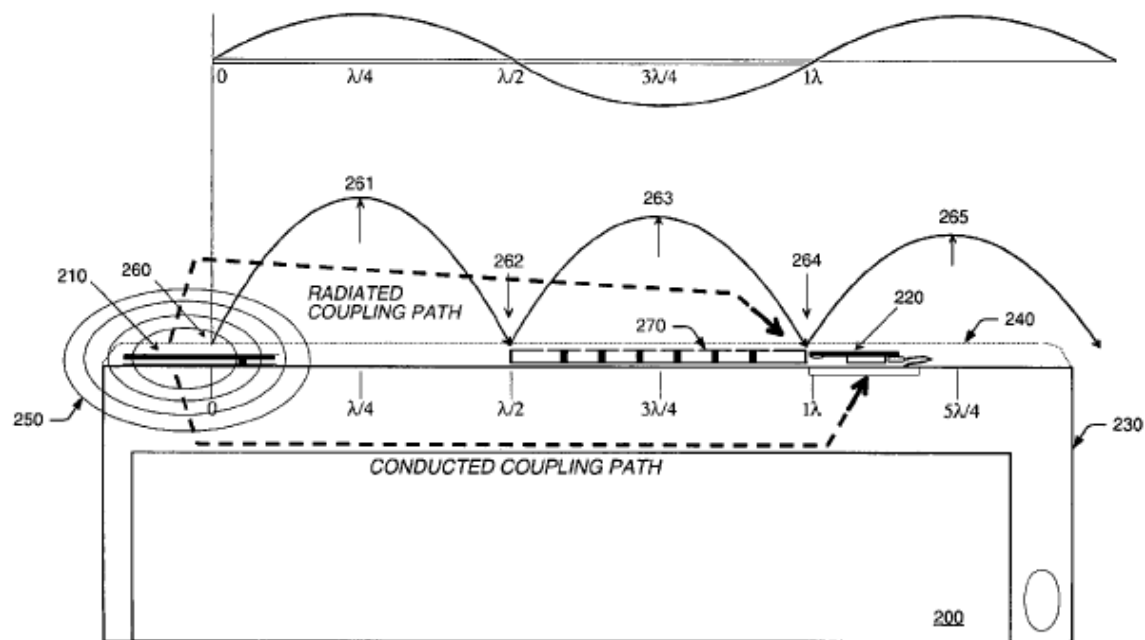
An apparatus for reducing the electromagnetic interference between two or more co-located antennas is described herein. In one embodiment, the apparatus is positioned proximate to a second antenna for intercepting electromagnetic energy radiated from a first antenna during transmission of a signal. To reduce interference at the second antenna, the apparatus includes a plurality of resonant circuit elements, each being configured to resonate at or near a carrier frequency of the transmitted signal for redirecting at least a portion of the electromagnetic energy away from the second antenna. A method for reducing the electromagnetic interference between two or more antennas coupled to a wireless communication device is also disclosed herein.

(56) **References Cited**

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13 Claims, 10 Drawing Sheets





US007167132B2

(12) **United States Patent**
Tamaoka

(10) **Patent No.:** **US 7,167,132 B2**
(45) **Date of Patent:** **Jan. 23, 2007**

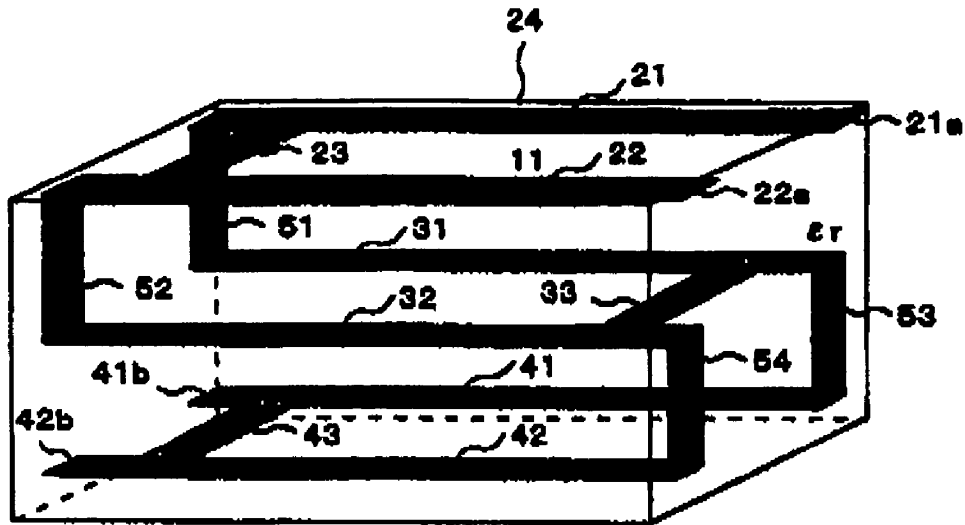
- (54) **SMALL ANTENNA AND A MULTIBAND ANTENNA**
 - (75) Inventor: **Hiroyuki Tamaoka**, Tokyo (JP)
 - (73) Assignee: **The Furukawa Electric Co., Ltd.** (JP)
 - (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.
 - (21) Appl. No.: **10/961,496**
 - (22) Filed: **Oct. 8, 2004**
 - (65) **Prior Publication Data**
US 2005/0093751 A1 May 5, 2005
 - (30) **Foreign Application Priority Data**
Oct. 9, 2003 (JP) 2003-351064
 - (51) **Int. Cl.**
H01Q 1/24 (2006.01)
 - (52) **U.S. Cl.** **343/702; 343/895**
 - (58) **Field of Classification Search** **343/700 MS, 343/702, 895**
- See application file for complete search history.

- (56) **References Cited**
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2003/0080904 A1 * 5/2003 Chen 343/700 MS
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- Primary Examiner*—Tho Phan
- (74) *Attorney, Agent, or Firm*—Cantor Colburn LLP

(57) **ABSTRACT**

A small antenna comprising: an antenna pattern consisting of: two linear conductor elements; a shorting element that electrically connects the two linear conductor elements and a dielectric in a predetermined shape that contains the antenna pattern therein; where the two linear conductor elements are arranged in parallel with each other, and one of the two linear conductor elements is used as a fed line element, while the other is used as a grounded line element.

15 Claims, 12 Drawing Sheets





US007167137B2

(12) **United States Patent**
Apostolos

(10) **Patent No.:** **US 7,167,137 B2**
(45) **Date of Patent:** **Jan. 23, 2007**

- (54) **COLLAPSIBLE WIDE BAND WIDTH DISCONE ANTENNA**
- (75) Inventor: **John T. Apostolos**, Merrimac, NH (US)
- (73) Assignee: **BAE Systems Information and Electronic Systems Integration Inc.**, Nashua, NH (US)

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

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Primary Examiner—Hoanganh Le
Assistant Examiner—Hung Tran Vy
(74) *Attorney, Agent, or Firm*—Daniel J. Long; Robert K. Tendler

(21) Appl. No.: **11/067,417**

(22) Filed: **Feb. 25, 2005**

(65) **Prior Publication Data**

US 2005/0168393 A1 Aug. 4, 2005

Related U.S. Application Data

(62) Division of application No. 10/658,186, filed on Sep. 9, 2003, now Pat. No. 6,967,626.

(51) **Int. Cl.**
H01Q 11/12 (2006.01)
H01Q 13/00 (2006.01)

(52) **U.S. Cl.** **343/774; 343/773**

(58) **Field of Classification Search** 343/876,
343/786, 773, 772, 792.5, 785, 119, 790,
343/830, 872, 846, 895
See application file for complete search history.

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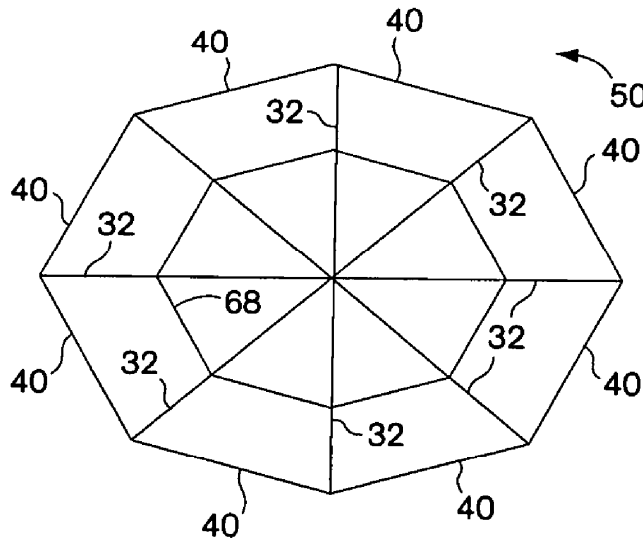
U.S. PATENT DOCUMENTS

3,987,456 A * 10/1976 Gelin 343/830

(57) **ABSTRACT**

A collapsible discone antenna is provided with an ultra wide band width by providing a collapsible conical skeleton cone, with the rods of the skeleton being provided with meander lines so as to effectively reduce the overall dimensions of the antenna by a factor of 2, with the antenna rods being electrically interconnected at their distal ends so as to eliminate performance degradation due to varying ground conductivities. A specialized feed configuration is used in one embodiment to feed multiple antennas stacked above a low band disc through the utilization of one or more coaxial lines which are wrapped around a ferrite toroid so that they may be passed up through the low-band disc without detuning the low band discone antenna. The use of the toroid inductor between the low-band cone and the low-band disc further reduces the low frequency cutoff of the antenna by markedly decreasing the VSWR at frequencies as low as 20 megahertz.

9 Claims, 6 Drawing Sheets





US007167140B2

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

(10) **Patent No.:** **US 7,167,140 B2**
(45) **Date of Patent:** ***Jan. 23, 2007**

(54) **COIL ANTENNA**
(75) Inventors: **Yoshihiko Kato**, Sendai (JP); **Naoharu Yamamoto**, Sendai (JP); **Makoto Teshima**, Sendai (JP)
(73) Assignee: **NEC Tokin Corporation**, Sendai (JP)
(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 40 days.

This patent is subject to a terminal disclaimer.

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(21) Appl. No.: **10/883,083**

(22) Filed: **Jul. 1, 2004**

(65) **Prior Publication Data**

US 2005/0024285 A1 Feb. 3, 2005

(30) **Foreign Application Priority Data**

Jul. 2, 2003 (JP) 2003-270331

(51) **Int. Cl.**
H01Q 7/08 (2006.01)

(52) **U.S. Cl.** **343/788**

(58) **Field of Classification Search** 343/788
See application file for complete search history.

(56) **References Cited**

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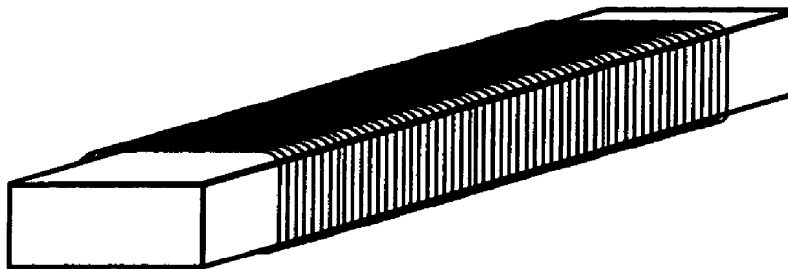
(Continued)

Primary Examiner—Don Wong
Assistant Examiner—Marie Antoinette Cabucos
(74) *Attorney, Agent, or Firm*—Frishauf, Holtz, Goodman & Chick, P.C.

(57) **ABSTRACT**

A coil antenna having a magnetic core and a wire wound around the magnetic core. The magnetic core is flexible and bendable and is made of a mixture including soft magnetic powder and an organic binder agent. The soft magnetic powder comprises a plurality of particles, each of which is coated with an insulator layer which is made of an oxide layer.

25 Claims, 4 Drawing Sheets





US00D535647S

(12) **United States Design Patent** (10) **Patent No.:** **US D535,647 S**
Hall et al. (45) **Date of Patent:** **** Jan. 23, 2007**

(54) **RFID ANTENNA**
(75) Inventors: **David Malcolm Hall**, Lockkeys (AU);
Philippe Martin, Beaune (FR)
(73) Assignee: **Tagsys SA** (FR)
(**) Term: **14 Years**
(21) Appl. No.: **29/243,203**
(22) Filed: **Nov. 21, 2005**
(51) **LOC (8) Cl.** **14-03**
(52) **U.S. Cl.** **D14/230**
(58) **Field of Classification Search** D14/137,
D14/138, 230-238, 299, 358, 343; D12/42,
D12/43; 343/700 R-705, 871-908, 795,
343/840, 711-713, 819, 846; 455/90.2, 90.3,
455/91, 128, 269, 344, 347, 562.1
See application file for complete search history.

(56) **References Cited**
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Primary Examiner—Louis S. Zarfaz
Assistant Examiner—John Windmuller
(74) *Attorney, Agent, or Firm*—Lerner, David, Littenberg,
Krumholz & Mentlik, LLP

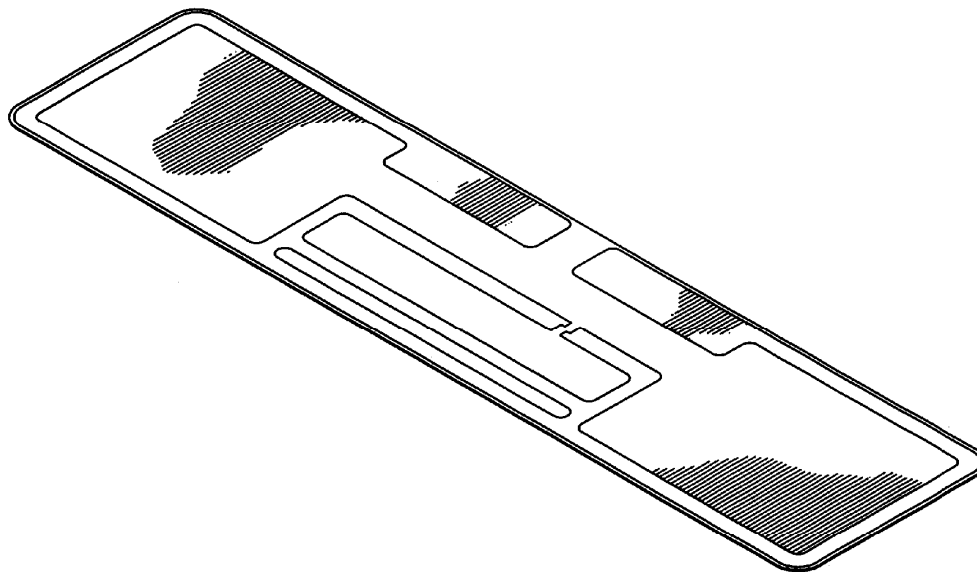
(57) **CLAIM**

The ornamental design for an RFID antenna, as shown and described.

DESCRIPTION

FIG. 1 is a perspective view of an RFID antenna showing our new design;
FIG. 2 is a top plan view thereof;
FIG. 3 is a bottom plan view thereof;
FIG. 4 is a front elevational view thereof, the rear elevational view being identical; and,
FIG. 5 is a right side elevational view thereof, the left side elevational view being identical.

1 Claim, 2 Drawing Sheets





US00D535648S

(12) **United States Design Patent** (10) **Patent No.:** **US D535,648 S**
Miura (45) **Date of Patent:** **** Jan. 23, 2007**

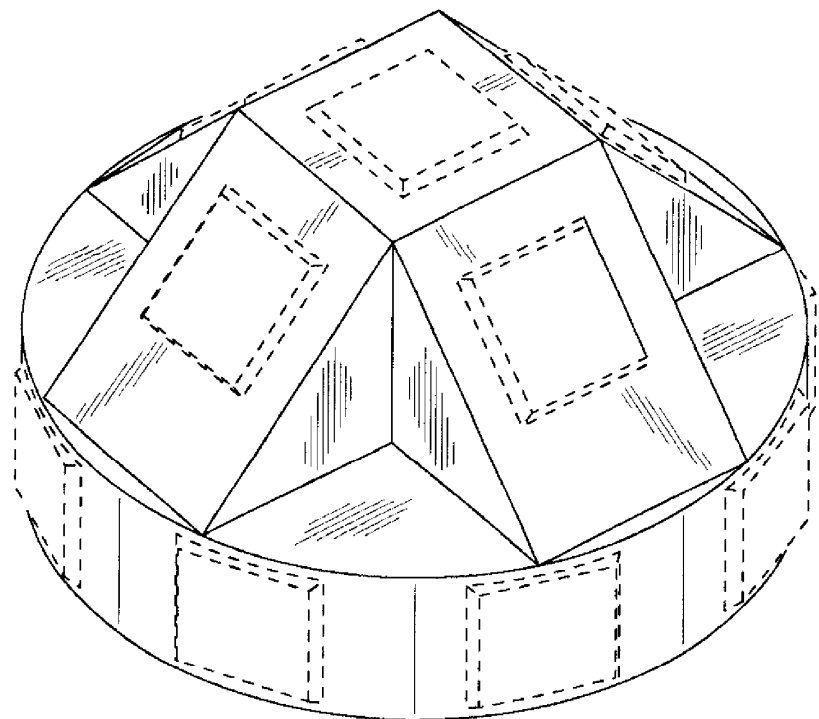
(54) **ANTENNA**
(75) Inventor: **Toshio Miura**, Tokyo (JP)
(73) Assignee: **Shin Nihon Helicopter Kabushiki Kaisha**, Tokyo (JP)
(**) Term: **14 Years**
(21) Appl. No.: **29/230,534**
(22) Filed: **May 24, 2005**
(30) **Foreign Application Priority Data**
Dec. 8, 2004 (JP) D2004-037572
(51) **LOC (8) Cl.** **14-03**
(52) **U.S. Cl.** **D14/233**
(58) **Field of Classification Search** D14/137,
D14/138, 230-238, 299, 358, 343; D12/42,
D12/43; 343/700 R-705, 871-908, 795,
343/840, 711-713, 819, 846; 455/90.2, 90.3,
455/91, 128, 269, 344, 347, 562.1
See application file for complete search history.
(56) **References Cited**
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D493,447 S * 7/2004 Noro et al. D14/230
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Primary Examiner—Louis S. Zarfaz
Assistant Examiner—John Windmuller
(74) *Attorney, Agent, or Firm*—Rader, Fishman & Grauer PLLC

(57) **CLAIM**
The ornamental design for an antenna, as shown and described.

DESCRIPTION
FIG. 1 is a perspective view of an antenna showing my new design;
FIG. 2 is a front elevational view thereof, the rear elevational view thereof being the same image thereof;
FIG. 3 is a right side elevational view thereof, the left side elevational view thereof being the same image thereof;
FIG. 4 is a top plan view thereof; and,
FIG. 5 is a bottom plan view thereof.
Portions of FIGS. 1-5 that are shown as broken lines are for illustrative purpose only and form no part of the claimed design.

1 Claim, 5 Drawing Sheets





US007170446B1

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

(10) **Patent No.:** US 7,170,446 B1
(45) **Date of Patent:** Jan. 30, 2007

(54) **PHASED ARRAY ANTENNA
INTERCONNECT HAVING SUBSTRATE
SLAT STRUCTURES**

Primary Examiner—Benny T. Lee
(74) *Attorney, Agent, or Firm*—Nathan O. Jensen; Kyle
Eppel

(75) Inventors: **James B. West**, Cedar Rapids, IA (US);
John C. Mather, Cedar Rapids, IA
(US)

(57) **ABSTRACT**

(73) Assignee: **Rockwell Collins, Inc.**, Cedar Rapids,
IA (US)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 120 days.

A phased array antenna is provided having a plurality of phase shifter devices for phase shifting and beam steering a radiated beam of the phased array antenna. The plurality of phase shifter devices are interconnected with an interconnect structure comprising a plurality of linear array substrate slats. Each linear array substrate slat includes a plurality of radiating elements formed using first and second metal layers of the substrate slat, a plurality of phase shifter devices and a common RF feed conductor for the plurality of radiating elements. The common RF feed conductor is formed on a third metal layer of the substrate slat that is disposed between the first and second metal layers. The common RF feed conductor is configured to include a single location for electrical connections to receive RF signals for the plurality of radiating elements. The phased array antenna also includes bias/control conductors applied to selected areas of the third metal layer, a fourth metal layer applied over the second metal layer and a shielding metal layer applied on the fourth metal layer. The bias/control conductors are configured to include a single location for electrical connections to receive bias voltages and control signals. The fourth metal layer includes circuit connections from the bias/control circuitry to the plurality of phase shifter devices. Each phase shifter device is attached to a radiating element via a mounting location on the shielding metal layer. Accordingly, a phased array antenna interconnect structure is provided that reduces the number of electrical connections required to provide RF signals and bias/control signals to multiple radiating elements and phase shifters, respectively, of the phased array antenna and provides a cost effective phased array antenna architecture that has a single locus of electrical connection for RF and bias control signals embedded in a multi-layer linear array or slat substrate of the phased array antenna.

(21) Appl. No.: **10/949,842**

(22) Filed: **Sep. 24, 2004**

(51) **Int. Cl.**
H01P 1/18 (2006.01)
H01Q 3/30 (2006.01)

(52) **U.S. Cl.** **342/372; 333/164; 343/767**

(58) **Field of Classification Search** 333/156,
333/161; 342/371, 372, 375; 343/767, 853
See application file for complete search history.

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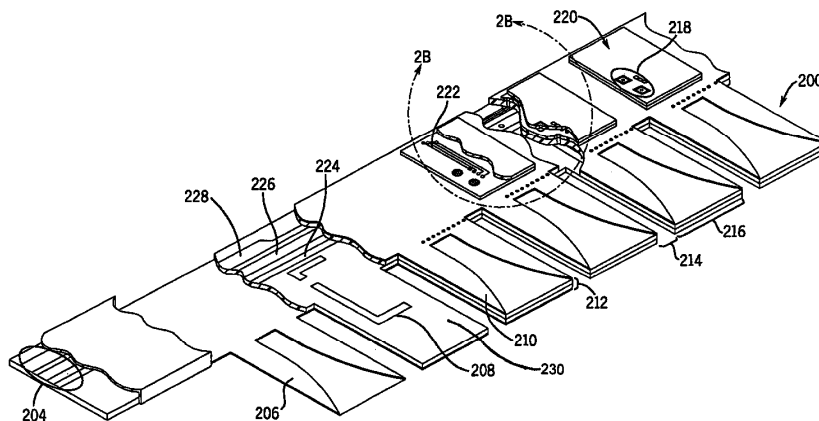
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20 Claims, 6 Drawing Sheets





US007170448B2

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

(10) **Patent No.:** **US 7,170,448 B2**
(45) **Date of Patent:** **Jan. 30, 2007**

(54) **OMNIDIRECTIONAL RESONANT ANTENNA**

(75) Inventors: **Bernard Jecko**, Rilhac Rancon (FR);
Francois Torres, Veyrac (FR);
Guillaume Villemaud, Rillieux la Pape (FR)

(73) Assignee: **Centre National de la Recherche Scientifique (C.N.R.S.)**, Paris (FR)

(*) 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.: **10/479,749**

(22) PCT Filed: **Jun. 6, 2002**

(86) PCT No.: **PCT/FR02/01935**

§ 371 (c)(1),
(2), (4) Date: **May 7, 2004**

(87) PCT Pub. No.: **WO02/101877**

PCT Pub. Date: **Dec. 19, 2002**

(65) **Prior Publication Data**
US 2004/0183730 A1 Sep. 23, 2004

(30) **Foreign Application Priority Data**
Jun. 8, 2001 (FR) 01 07546

(51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 21/26 (2006.01)
H01Q 9/26 (2006.01)

(52) **U.S. Cl.** **343/700 MS; 343/797; 343/803**

(58) **Field of Classification Search** **343/702, 343/722, 797, 803, 700 MS, 725**
See application file for complete search history.

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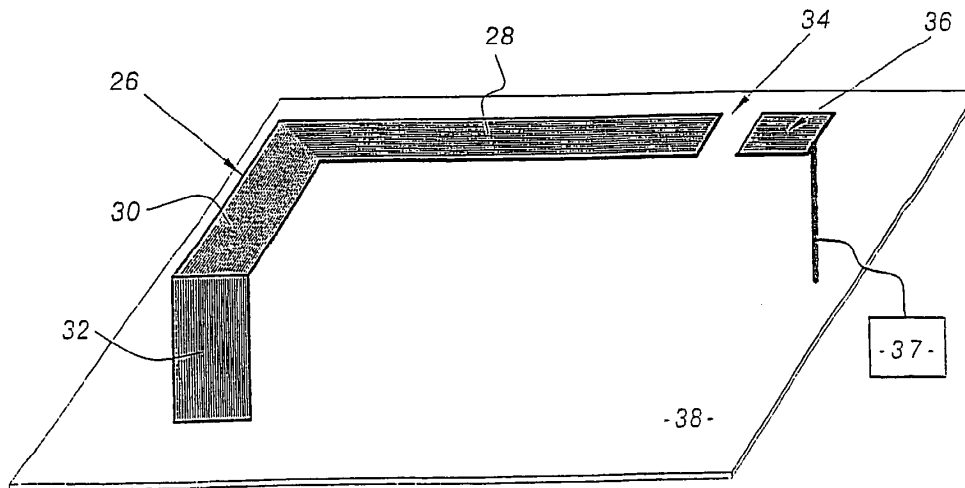
(Continued)

Primary Examiner—Don Wong
Assistant Examiner—Marie Antoinette Cabucos
(74) *Attorney, Agent, or Firm*—Young & Thompson

(57) **ABSTRACT**

An omnidirectional resonant antenna in a half-plane or in the whole plane comprises a single radiating electric conductor (26) having at least three abutted wires (28, 30, 32), the length of each wire and the orientation of the wires relative to one another determining the global orientation of the electric conductor. The wires are oriented along at least three different spatial directions and the lengths of the wires are designed to obtain an omnidirectional global radiation of the electric conductor in a half-plane or in the whole plane.

19 Claims, 3 Drawing Sheets





US007170449B2

(12) **United States Patent**
Eide

(10) **Patent No.:** **US 7,170,449 B2**
(45) **Date of Patent:** **Jan. 30, 2007**

(54) **ANTENNA SYSTEM FOR GEORADAR**

4,978,965 A * 12/1990 Mohuchy 343/727
5,166,697 A * 11/1992 Viladevall et al. 343/727
6,218,989 B1 * 4/2001 Schneider et al. ... 343/700 MS
6,552,691 B2 * 4/2003 Mohuchy et al. 343/770

(75) Inventor: **Egil Eide**, Tiller (NO)

(73) Assignee: **3D-Radar AS**, Tiller (NO)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 95 days.

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JP 63304188 A 12/1988
JP 1009387 A 1/1989

(21) Appl. No.: **10/531,728**

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(22) PCT Filed: **Oct. 6, 2003**

Brown, G.H., et al., "Experimentally Determined Radiation Characteristics of Conical and Triangular Antennas*," *RCA Review*, Dec. 1952, pp. 425-453.

(86) PCT No.: **PCT/NO03/00332**

Eide, E.S., "Radar Imaging of Small Objects Closely Below the Earth Surface," *Department of Telecommunications, Norwegian University of Science and Technology*, Aug. 2000, pp. 1 00-101 and 108-111.

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

Eide, E.S., "Ultra-wideband transmit/receive antenna pair for ground penetrating radar," *IEE Proceedings-Microwaves, Antennas and Propagation*, Jun. 2000, No. 147(3), pp. 231-235.

(87) PCT Pub. No.: **WO2004/042427**

PCT Pub. Date: **May 21, 2004**

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(65) **Prior Publication Data**

US 2006/0012525 A1 Jan. 19, 2006

Primary Examiner—Tho Phan

Assistant Examiner—Chuc Tran

(30) **Foreign Application Priority Data**

Nov. 5, 2002 (NO) 20025295

(74) *Attorney, Agent, or Firm*—Rothwell, Figg, Ernst & Manbeck

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

(57) **ABSTRACT**

(52) **U.S. Cl.** **343/700 MS**; 343/893;
343/846; 343/853; 343/727; 343/730; 343/767

An antenna system for ground penetrating radar, comprising at least two orthogonally mounted transmitter antenna elements (1, 2) and at least two orthogonally mounted receiver antenna elements (3, 4), in which the antenna elements consist of triangular monopoles formed by adding metal surfaces to a plate carrier (6), made of fiberglass substrate, that is mounted on the bottom side of a layer of radar absorbing material (7), wherein the upper side of the absorber is covered by a metallic ground plane (8).

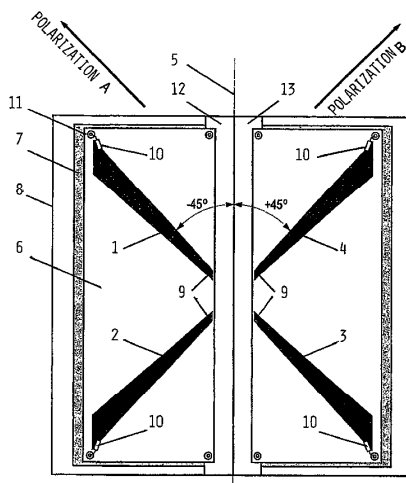
(58) **Field of Classification Search** 343/700 MS,
343/727, 730, 893, 846, 767, 770
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,746,867 A * 5/1988 Gunton 324/329

10 Claims, 2 Drawing Sheets





US007170450B2

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

(10) **Patent No.:** **US 7,170,450 B2**
(45) **Date of Patent:** **Jan. 30, 2007**

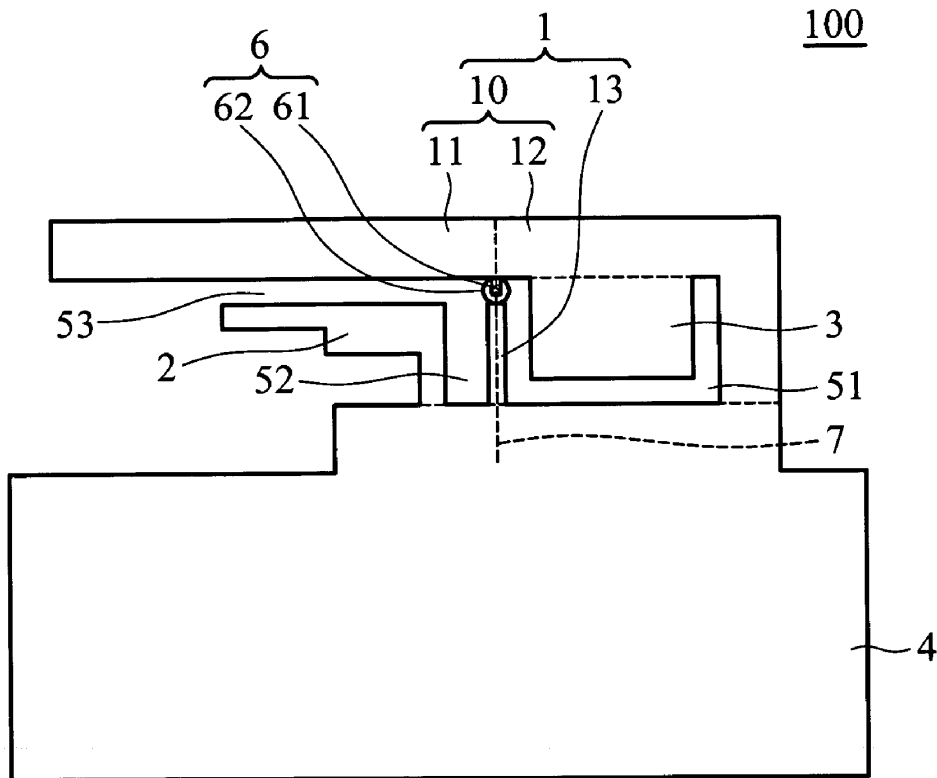
- (54) **ANTENNAS**
 - (75) Inventors: **Yuan-Li Chang**, Taipei (TW);
Chih-Ming Wang, Taipei (TW)
 - (73) Assignee: **Wistron NeWeb Corp.**, Taipei Hsien (TW)
 - (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.
 - (21) Appl. No.: **11/128,817**
 - (22) Filed: **May 12, 2005**
 - (65) **Prior Publication Data**
US 2006/0092083 A1 May 4, 2006
 - (30) **Foreign Application Priority Data**
Oct. 28, 2004 (TW) 93132684 A
 - (51) **Int. Cl.**
H01Q 1/38 (2006.01)
 - (52) **U.S. Cl.** **343/700 MS; 343/702**
 - (58) **Field of Classification Search** **343/700 MS, 343/702**
- See application file for complete search history.

- (56) **References Cited**
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2004/0104853 A1* 6/2004 Chen 343/702
- * cited by examiner
- Primary Examiner*—Trinh Vo Dinh
(74) *Attorney, Agent, or Firm*—Quintero Law Office

(57) **ABSTRACT**

An antenna comprises a first metal element, a second metal element, a third metal element, a ground element and a cable. The first metal element and the second metal element are connected to the ground element. The third metal element is disposed on the first metal element. The cable is coupled to the first metal element. The antenna has three different resonant frequencies (a first resonant frequency, a second resonant frequency and a third resonant frequency) for transmitting three signals in different frequency bands.

13 Claims, 6 Drawing Sheets





US007170451B2

(12) **United States Patent**
Hsu

(10) **Patent No.:** **US 7,170,451 B2**
(45) **Date of Patent:** **Jan. 30, 2007**

(54) **ANTENNA DEVICE HAVING ULTRA WIDE BANDWIDTH CHARACTERISTICS**

6,590,545 B2 7/2003 McCorkle
7,050,013 B2* 5/2006 Kim et al. 343/770
7,109,926 B2* 9/2006 du Toit 343/700 MS

(75) Inventor: **Fideric Hsu**, Taipei (TW)

(73) Assignee: **Universal Scientific Industrial Co., Ltd.** (TW)

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 42 days.

Primary Examiner—Shih-Chao Chen
(74) *Attorney, Agent, or Firm*—Caesar, Rivise, Bernstein, Cohen & Pokotilow, Ltd.

(21) Appl. No.: **11/184,148**

(57) **ABSTRACT**

(22) Filed: **Jul. 19, 2005**

(65) **Prior Publication Data**

US 2006/0232487 A1 Oct. 19, 2006

(51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 13/10 (2006.01)

(52) **U.S. Cl.** **343/700 MS; 343/770**

(58) **Field of Classification Search** 343/700 MS, 343/767, 770, 846

See application file for complete search history.

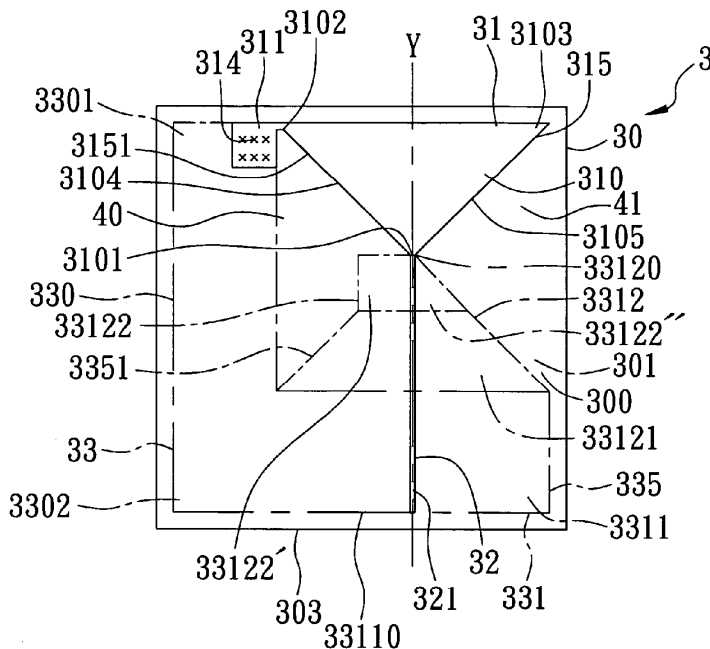
(56) **References Cited**

U.S. PATENT DOCUMENTS

6,429,819 B1* 8/2002 Bishop et al. 343/725

14 Claims, 8 Drawing Sheets

An antenna device having ultra wide bandwidth characteristics includes: a dielectric substrate having first and second surfaces that are opposite to each other in a normal direction; a radiating element formed on the first surface of the dielectric substrate and defining an axis perpendicular to the normal direction; and a grounding element formed on the second surface of the dielectric substrate and cooperating with the radiating element to define first and second imaginary slots in the dielectric substrate. The first and second imaginary slots extend in the normal direction from the first surface to the second surface of the dielectric substrate, and are respectively disposed at two opposite sides of the axis.





US007170456B2

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

(10) **Patent No.:** **US 7,170,456 B2**
(45) **Date of Patent:** **Jan. 30, 2007**

(54) **DIELECTRIC CHIP ANTENNA STRUCTURE**

(56) **References Cited**

(75) Inventors: **Won Il Kwak**, Daejeon (KR); **Seong Ook Park**, Daejeon (KR)

U.S. PATENT DOCUMENTS

(73) Assignee: **Information and Communications University Research and Industrial Cooperation Group**, Daejeon (KR)

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2006/0170611	A1*	8/2006	Ko et al.	343/895	

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

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Primary Examiner—Tan Ho

(21) Appl. No.: **11/194,703**

(74) *Attorney, Agent, or Firm*—Greenblum & Bernstein, P.L.C.

(22) Filed: **Aug. 2, 2005**

(57) **ABSTRACT**

(65) **Prior Publication Data**

US 2006/0192713 A1 Aug. 31, 2006

Disclosed herein is a dielectric chip antenna structure using a metal conductor formed at the lateral side of the antenna along the longitudinal direction of the antenna. The dielectric chip antenna structure forms the metal conductor at the long side of the antenna to induce antenna resonance through coupling effect between the antenna and the ground. Furthermore, the dielectric chip antenna structure minimizes the space occupied by the antenna and modifies the theoretical feeding structures of the reverse F type antenna and monopole antenna to meet user's various demands.

(30) **Foreign Application Priority Data**

Feb. 25, 2005 (KR) 10-2005-0015740

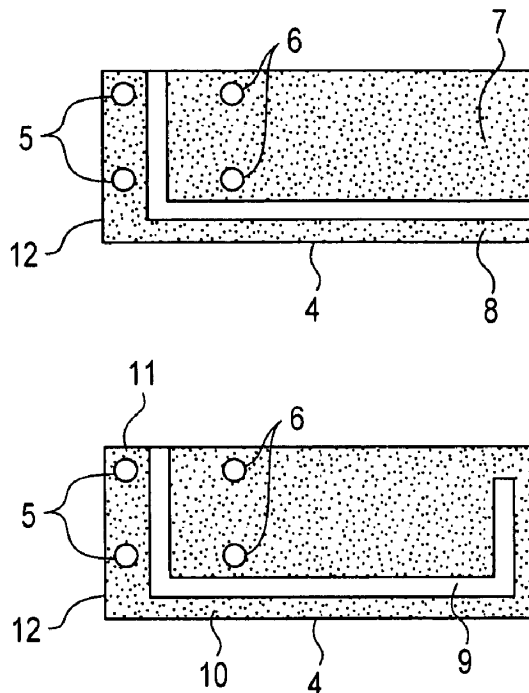
(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/38 (2006.01)

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

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

See application file for complete search history.

15 Claims, 10 Drawing Sheets





US007170461B2

(12) **United States Patent**
Parsche

(10) **Patent No.:** **US 7,170,461 B2**
(45) **Date of Patent:** **Jan. 30, 2007**

(54) **CONICAL DIPOLE ANTENNA AND ASSOCIATED METHODS**

(75) Inventor: **Francis Eugene Parsche**, Palm Bay, FL (US)

(73) Assignee: **Harris Corporation**, Melbourne, FL (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.: **11/121,617**

(22) Filed: **May 4, 2005**

(65) **Prior Publication Data**

US 2006/0250315 A1 Nov. 9, 2006

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

(52) **U.S. Cl.** **343/773; 343/774; 343/807**

(58) **Field of Classification Search** **343/773, 343/774, 800, 807, 808, 786**

See application file for complete search history.

(56) **References Cited**

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Primary Examiner—Hoanganh Le

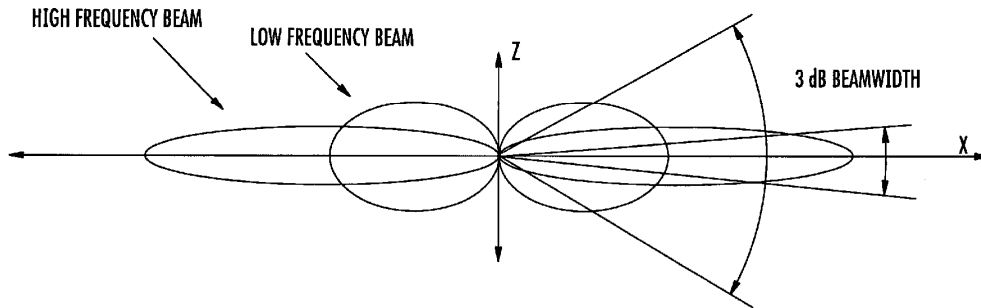
(74) *Attorney, Agent, or Firm*—Allen, Dyer, Doppelt, Milbrath & Gilchrist, P.A.

(57) **ABSTRACT**

The dipole antenna includes a first antenna element assembly and a second antenna element assembly arranged in a dipole antenna configuration. The first antenna element assembly has one or more conical antenna elements, and the second antenna element assembly has a series of conical antenna elements with each successive conical antenna element at least partially within a prior conical antenna element. Each of the first and second antenna dipole assemblies may also include a respective disk antenna element and a filament antenna element. The antenna has a stable beamwidth and broad bandwidth over a range of frequencies.

30 Claims, 6 Drawing Sheets

E PLANE PATTERN CUT





US007170463B1

(12) **United States Patent**
Seavey

(10) **Patent No.:** **US 7,170,463 B1**
(45) **Date of Patent:** ***Jan. 30, 2007**

(54) **BROADBAND OMNIDIRECTIONAL ARRAY ANTENNA SYSTEM**

(75) Inventor: **John M. Seavey**, Cohasset, MA (US)

(73) Assignee: **Antenna Research Associates, Inc.**,
Pembroke, MA (US)

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

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **11/140,704**

(22) Filed: **May 31, 2005**

Related U.S. Application Data

(63) Continuation-in-part of application No. 11/036,449, filed on Jan. 15, 2005.

(51) **Int. Cl.**
H01Q 9/16 (2006.01)

(52) **U.S. Cl.** **343/793; 343/790; 343/798**

(58) **Field of Classification Search** **343/790, 343/792, 793, 798, 800**

See application file for complete search history.

(56) **References Cited**

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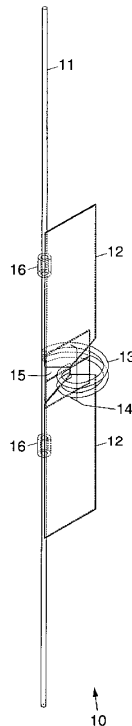
Primary Examiner—Tho Phan

(74) *Attorney, Agent, or Firm*—Kenneth W. Float

(57) **ABSTRACT**

Broadband omnidirectional, vertically polarized communications antenna systems are disclosed. The antenna systems comprises a plurality of center-fed stacked dipole radiating elements disposed along a central axis, a coaxial feed line coupled between each of the stacked radiating elements. In certain embodiments, a two-wire balun is coupled to a feed point of each radiating element and a shunt inductor and capacitor are coupled to each radiating element. Other embodiments do not require the use of the balun. Certain embodiments use a printed-circuit dipole having a flat shape. Other embodiments use a metal dipole having a cylindrical shape. The array antenna systems may be stacked vertically in separate bays each with its independent RF port.

20 Claims, 12 Drawing Sheets





US007170464B2

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

(10) **Patent No.:** **US 7,170,464 B2**
(45) **Date of Patent:** **Jan. 30, 2007**

(54) **INTEGRATED MOBILE COMMUNICATION ANTENNA**
(75) Inventors: **Chia-Lun Tang**, Miaoli Country (TW); **Shih-Huang Yeh**, Yunlin Country (TW); **Kin-Lu Wong**, Kaohsiung (TW); **Shao-Lun Chien**, Taoyuan Country (TW)

4,924,237 A * 5/1990 Honda et al. 343/702
6,308,084 B1 10/2001 Lonka
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2003/0125079 A1 7/2003 Park et al.
2004/0097262 A1 5/2004 Lee

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

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

Primary Examiner—Michael C. Wimer
(74) *Attorney, Agent, or Firm*—Birch, Stewart, Kolasch & Birch, LLP

(21) Appl. No.: **10/989,507**

(57) **ABSTRACT**

(22) Filed: **Nov. 17, 2004**

(65) **Prior Publication Data**
US 2006/0071865 A1 Apr. 6, 2006

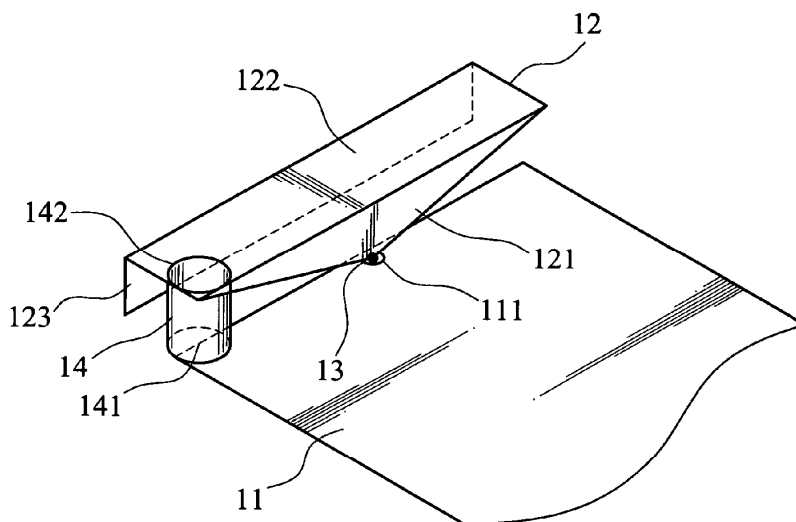
(30) **Foreign Application Priority Data**
Sep. 21, 2004 (TW) 93128636 A

(51) **Int. Cl.**
H01Q 1/22 (2006.01)
(52) **U.S. Cl.** **343/830**; 343/841; 343/846
(58) **Field of Classification Search** 343/700 MS, 343/713, 829, 830, 846, 841
See application file for complete search history.

An integrated antenna for mobile communications. A short-circuiting metal cylinder is provided in the antenna for arranging other functional modules such that the antenna and related circuits may have better integration. The provided antenna includes a ground with a via-hole; a radiating member arranged on the ground and having a feeding portion for receiving signals via electrical connection through the via-hole; and a short-circuiting member having a space, a first end of which is electrically connected to the ground substantially vertically, and the other end of which is electrically connected to the radiating member. The radiating member further includes a first sub-radiating member, a second sub-radiating member and a third sub-radiating member. The first sub-radiating member is substantially triangular, and the second sub-radiating portion is substantially parallel to the ground. The third sub-radiating member is substantially parallel to the first sub-radiating member.

(56) **References Cited**
U.S. PATENT DOCUMENTS
3,656,160 A * 4/1972 Burton 343/702

12 Claims, 9 Drawing Sheets





US007170752B2

(12) **United States Patent**
Nakabuchi

(10) **Patent No.:** **US 7,170,752 B2**
(45) **Date of Patent:** **Jan. 30, 2007**

(54) **NAVIGATION SYSTEM INCORPORATING ANTENNA**

(75) Inventor: **Masayuki Nakabuchi**, Hekinan (JP)

(73) Assignee: **Denso Corporation**, Kariya (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.: **10/941,781**

(22) Filed: **Sep. 15, 2004**

(65) **Prior Publication Data**

US 2005/0057904 A1 Mar. 17, 2005

(30) **Foreign Application Priority Data**

Sep. 16, 2003 (JP) 2003-322939

(51) **Int. Cl.**
H05K 5/00 (2006.01)
H01Q 1/38 (2006.01)

(52) **U.S. Cl.** **361/724; 343/700 MS**

(58) **Field of Classification Search** 361/724,
361/752, 730, 736, 748, 749, 764; 343/702,
343/700 MS, 714

See application file for complete search history.

(56) **References Cited**

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Primary Examiner—Tuyet Vo

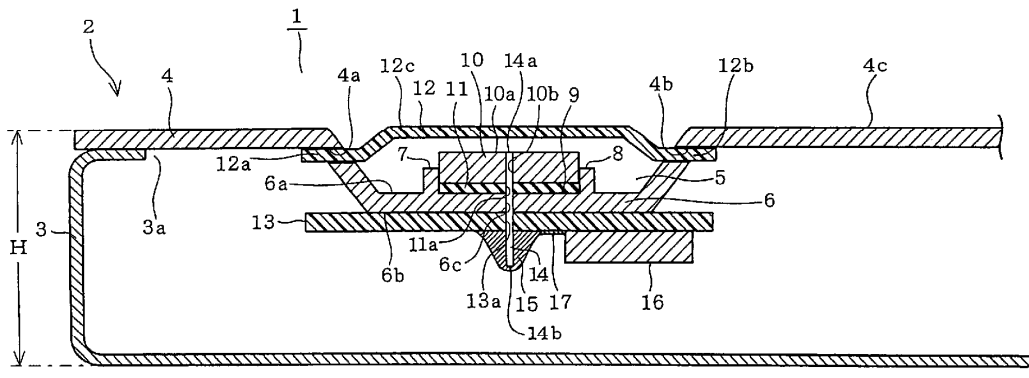
Assistant Examiner—Minh Dieu A

(74) *Attorney, Agent, or Firm*—Harness, Dickey & Pierce, PLC

(57) **ABSTRACT**

A navigation system incorporating an antenna includes a cabinet constructed of electroplated case and cover. An antenna element is integrated to the cabinet and electrically connected with the cover that is a ground of the antenna element. With this configuration, the cabinet and the antenna element can be installed in a vehicle at once and wiring of the antenna element outside the cabinet can be eliminated. Thus, installability of the navigation system is improved in comparison with known devices. Furthermore, the cover is formed such that its surface is larger than that of the antenna element. As a result, directivity of the antenna element is properly secured.

17 Claims, 3 Drawing Sheets





US00D534527S

(12) **United States Design Patent** (10) **Patent No.:** **US D534,527 S**
Hung et al. (45) **Date of Patent:** **** Jan. 2, 2007**

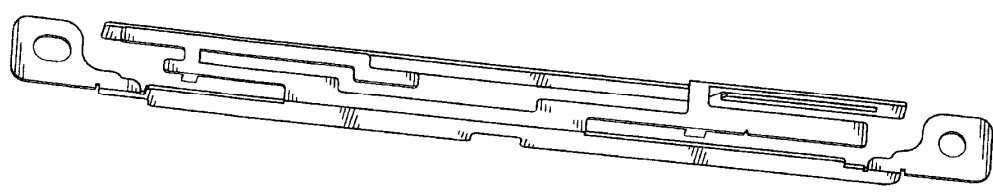
(54) **COMBINE ANTENNA**
(75) Inventors: **Chen-Ta Hung**, Tu-Cheng (TW);
Yao-Shien Huang, Tu-Cheng (TW);
Shu-Yean Wang, Tu-Cheng (TW)
(73) Assignee: **Hon Hai Precision Ind. Co., Ltd.**,
Taipei Hsien (TW)
(**) Term: **14 Years**
(21) Appl. No.: **29/260,632**
(22) Filed: **May 30, 2006**
(30) **Foreign Application Priority Data**
Nov. 28, 2005 (TW) 94307203
(51) **LOC (8) Cl.** **14-03**
(52) **U.S. Cl.** **D14/230**
(58) **Field of Classification Search** D14/137,
D14/138, 230-238, 299, 358, 343; D12/42,
D12/43; 343/700 R-705, 871-908, 795,
343/840, 711-713, 819, 846; 455/90.2, 90.3,
455/91, 128, 269, 344, 347, 562.1
See application file for complete search history.

(56) **References Cited**
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D456,388 S * 4/2002 Hwang D14/230
D492,672 S * 7/2004 Hung et al. D14/230
* cited by examiner
Primary Examiner—Louis S. Zarfaz
Assistant Examiner—John Windmuller
(74) *Attorney, Agent, or Firm*—Wei Te Chung

(57) **CLAIM**
The ornamental design for a combine antenna, as shown.

DESCRIPTION
FIG. 1 is a front top left perspective view of a combine antenna showing our new design;
FIG. 2 is a front elevation view thereof;
FIG. 3 is a rear elevation view thereof;
FIG. 4 is a left side elevation view thereof;
FIG. 5 is a right side elevation view thereof;
FIG. 6 is a top plan view thereof; and,
FIG. 7 is a bottom plan view thereof.

1 Claim, 6 Drawing Sheets





US00D534902S

(12) **United States Design Patent** (10) **Patent No.:** **US D534,902 S**
Su et al. (45) **Date of Patent:** ** **Jan. 9, 2007**

(54) **MULTI-BAND ANTENNA**

(75) Inventors: **Wen-Fong Su**, Tu-Cheng (TW);
Lung-Sheng Tai, Tu-Cheng (TW);
Po-Kang Ku, Tu-Cheng (TW)

(73) Assignee: **Hon Hai Precision Ind. Co., Ltd.**,
Taipei Hsien (TW)

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

(21) Appl. No.: **29/245,452**

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

(30) **Foreign Application Priority Data**

Oct. 17, 2005 (TW) 94306285

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

(52) **U.S. Cl.** **D14/230**

(58) **Field of Classification Search** D14/137,
D14/138, 230-238, 299, 358, 343; D12/42,
D12/43; 343/700 R-705, 871-908, 795,
343/840, 711-713, 819, 846; 455/90.2, 90.3,
455/91, 128, 269, 344, 347, 562.1

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

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D456,388 S * 4/2002 Hwang D14/230

* cited by examiner

Primary Examiner—Louis S. Zarfas

Assistant Examiner—John Windmuller

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

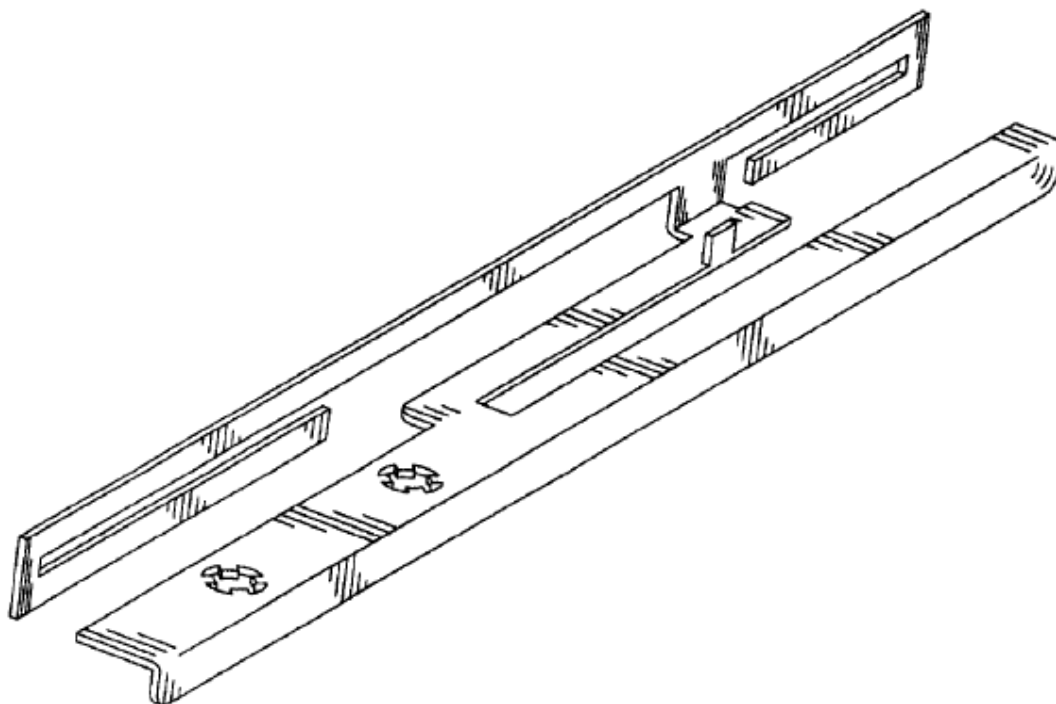
(57) **CLAIM**

The ornamental design for a multi-band antenna, as shown.

DESCRIPTION

FIG. 1 is a front top right perspective view of a multi-band antenna showing our new design;
FIG. 2 is a front elevational view thereof;
FIG. 3 is a rear elevational view thereof;
FIG. 4 is a left side elevational view thereof;
FIG. 5 is a right side elevational view thereof;
FIG. 6 is a top plan view thereof; and,
FIG. 7 is a bottom plan view thereof.

1 Claim, 6 Drawing Sheets





US00D534903S

(12) **United States Design Patent** (10) **Patent No.:** **US D534,903 S**
Hung et al. (45) **Date of Patent:** ** **Jan. 9, 2007**

(54) **MULTI-BAND ANTENNA**

(75) **Inventors:** **Chen-Ta Hung**, Tu-Cheng (TW);
Lung-Sheng Tai, Tu-Cheng (TW);
Shang-Jen Chen, Tu-Cheng (TW)

(73) **Assignee:** **Hon Hai Precision Ind. Co., Ltd.**,
Taipei Hsien (TW)

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

(21) **Appl. No.:** **29/245,551**

(22) **Filed:** **Dec. 23, 2005**

(30) **Foreign Application Priority Data**

Nov. 4, 2005 (TW) 94306681

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

(52) **U.S. Cl.** **D14/230**

(58) **Field of Classification Search** D14/137,
D14/138, 230-238, 299, 358, 343; D12/42,
D12/43; 343/700 R-705, 871-908, 795,
343/840, 711-713, 819, 846; 455/90.2, 90.3,
455/91, 128, 269, 344, 347, 562.1

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

D424,063 S * 5/2000 Kudo D14/230
D456,388 S * 4/2002 Hwang D14/230

* cited by examiner

Primary Examiner—Louis S. Zarfes

Assistant Examiner—John Windmuller

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

(57) **CLAIM**

The ornamental design for a multi-band antenna, as shown.

DESCRIPTION

FIG. 1 is a front top right perspective view of a multi-band antenna showing our new design;

FIG. 2 is a front elevational view thereof;

FIG. 3 is a rear elevational view thereof;

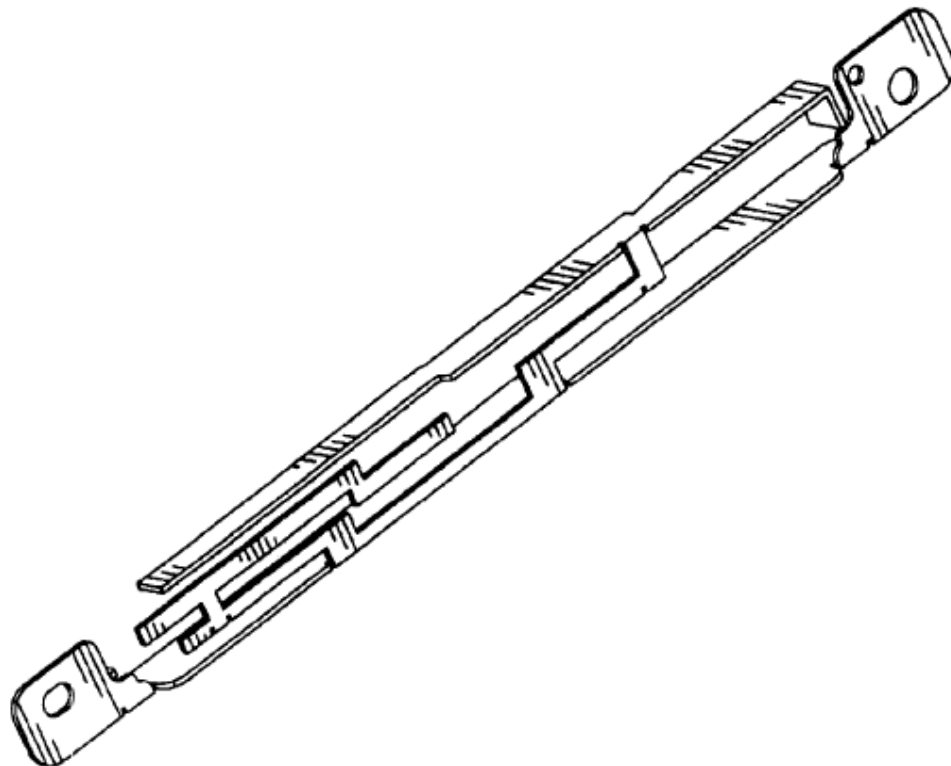
FIG. 4 is a left side elevational view thereof;

FIG. 5 is a right side elevational view thereof;

FIG. 6 is a top plan view thereof; and,

FIG. 7 is a bottom plan view thereof.

1 Claim, 7 Drawing Sheets





US00D535290S

(12) **United States Design Patent** (10) **Patent No.:** **US D535,290 S**
Su et al. (45) **Date of Patent:** **** Jan. 16, 2007**

(54) **MULTI-BAND ANTENNA**

(75) **Inventors:** **Wen-Fong Su**, Tu-Cheng (TW);
Lung-Sheng Tai, Tu-Cheng (TW);
Po-Kang Ku, Tu-Cheng (TW)

(73) **Assignee:** **Hon Hai Precision Ind. Co., Ltd.**,
Taipei Hsien (TW)

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

(21) **Appl. No.:** **29/245,369**

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

(30) **Foreign Application Priority Data**

Oct. 17, 2005 (TW) 94306286

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

(52) **U.S. Cl.** **D14/230**

(58) **Field of Classification Search** D14/137,
D14/138, 230-238, 299, 358, 343; D12/42,
D12/43; 343/700 R-705, 871-908, 795,
343/840, 711-713, 819, 846; 455/90.2, 90.3,
455/91, 128, 269, 344, 347, 562.1

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

D424,063 S * 5/2000 Kudo D14/230
D456,388 S * 4/2002 Hwang D14/230

* cited by examiner

Primary Examiner—Louis S. Zarfes

Assistant Examiner—John Windmuller

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

(57) **CLAIM**

The ornamental design for a multi-band antenna, as shown.

DESCRIPTION

FIG. 1 is a front top right perspective view of a multi-band antenna showing our new design;

FIG. 2 is a front elevational view thereof;

FIG. 3 is a rear elevational view thereof;

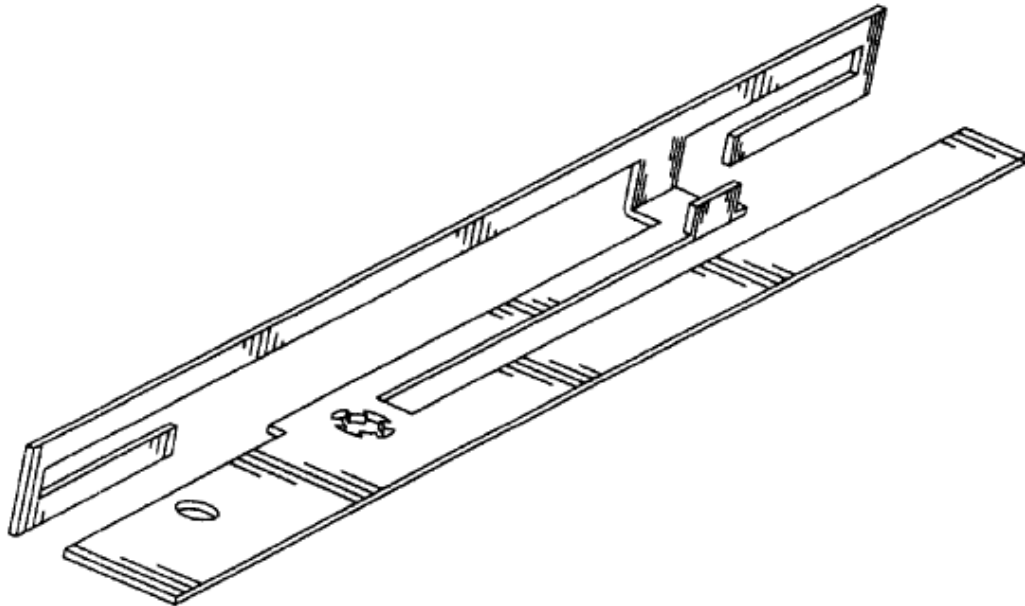
FIG. 4 is a left side elevational view thereof;

FIG. 5 is a right side elevational view thereof;

FIG. 6 is a top plan view thereof; and,

FIG. 7 is a bottom plan view thereof.

1 Claim, 6 Drawing Sheets





US00D535982S

(12) **United States Design Patent** (10) **Patent No.:** **US D535,982 S**
Inoue (45) **Date of Patent:** **** Jan. 30, 2007**

(54) **ANTENNA**
(75) Inventor: **Shigemi Inoue**, Kobe (JP)
(73) Assignee: **DX Antenna Company, Limited**,
Hyogo pref. (JP)
(**) Term: **14 Years**
(21) Appl. No.: **29/239,318**
(22) Filed: **Sep. 29, 2005**
(30) **Foreign Application Priority Data**
May 23, 2005 (JP) 2005-014698
(51) **LOC (8) Cl.** **14-03**
(52) **U.S. Cl.** **D14/230**
(58) **Field of Classification Search** D14/137,
D14/138, 230-238, 299, 358; D12/42, 43;
343/700 R-705, 871-908, 795, 840, 711-713,
343/819, 846; 455/90.2, 90.3, 91, 128, 269,
455/344, 347, 562.1
See application file for complete search history.

(56) **References Cited**
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Primary Examiner—Robert A. Delehanty
Assistant Examiner—John Windmuller
(74) *Attorney, Agent, or Firm*—Wenderoth, Lind & Ponack,
L.L.P.

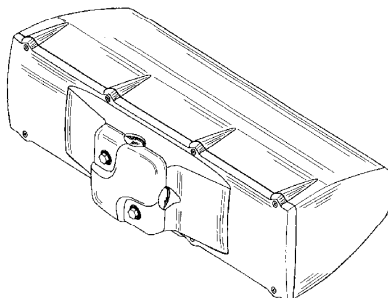
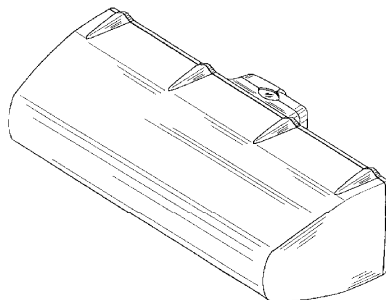
(57) **CLAIM**

The ornamental design for an antenna, as shown and described.

DESCRIPTION

FIG. 1 is a front elevational view of the antenna;
FIG. 2 is a rear elevational view of the antenna;
FIG. 3 is a top plan view of the antenna;
FIG. 4 is a bottom plan view of the antenna;
FIG. 5 is a right-side elevational view of the antenna;
FIG. 6 is a left-side elevational view of the antenna;
FIG. 7 is a perspective view of the antenna; and,
FIG. 8 is another perspective view of the antenna.

1 Claim, 3 Drawing Sheets





US00D535983S

(12) **United States Design Patent** (10) **Patent No.:** **US D535,983 S**
Krieger et al. (45) **Date of Patent:** **** Jan. 30, 2007**

(54) **ANTENNA FOR IMOBILE FM AUDIO TRANSMITTER CHARGING DOCK**

(75) Inventors: **Michael Krieger**, Miami Beach, FL (US); **Kevin Ellsworth**, Hollywood, FL (US)

(73) Assignee: **Vector Products, Inc.**, Fort Lauderdale, FL (US)

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

(21) Appl. No.: **29/241,570**

(22) Filed: **Oct. 31, 2005**

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

(52) **U.S. Cl.** **D14/230**

(58) **Field of Classification Search** D14/137, D14/138, 230-238, 299, 358, 343; D12/42, D12/43; 343/700 R-705, 871-908, 795, 343/840, 711-713, 819, 846; 455/90.2, 90.3, 455/91, 128, 269, 344, 347, 562.1
See application file for complete search history.

(56) **References Cited**

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* cited by examiner

Primary Examiner—Louis S. Zarfes
Assistant Examiner—John Windmuller
(74) *Attorney, Agent, or Firm*—Venable LLP; Robert Kinberg; Manni Li

(57) **CLAIM**

The ornamental design for an antenna for imobile FM audio transmitter charging dock, as shown and described.

DESCRIPTION

FIG. 1 is a front top left perspective view of an antenna for imobile FM audio transmitter charging dock showing our new design;
FIG. 2 is a front elevational view thereof;
FIG. 3 is a rear elevational view thereof;
FIG. 4 is a left side elevational view thereof;
FIG. 5 is a right side elevational view thereof;
FIG. 6 is a top plan view thereof; and,
FIG. 7 is a bottom plan view thereof.

1 Claim, 4 Drawing Sheets

