



US007825859B2

(12) **United States Patent**
Teshima

(10) **Patent No.:** **US 7,825,859 B2**

(45) **Date of Patent:** **Nov. 2, 2010**

(54) **ANTENNA DEVICE OPERABLE IN
MULTIPLE FREQUENCY BANDS**

(75) Inventor: **Masao Teshima**, Tokyo (JP)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 583 days.

(21) Appl. No.: **11/973,806**

(22) Filed: **Oct. 10, 2007**

(65) **Prior Publication Data**

US 2008/0266182 A1 Oct. 30, 2008

(30) **Foreign Application Priority Data**

Apr. 25, 2007 (JP) 2007-115235

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

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

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

See application file for complete search history.

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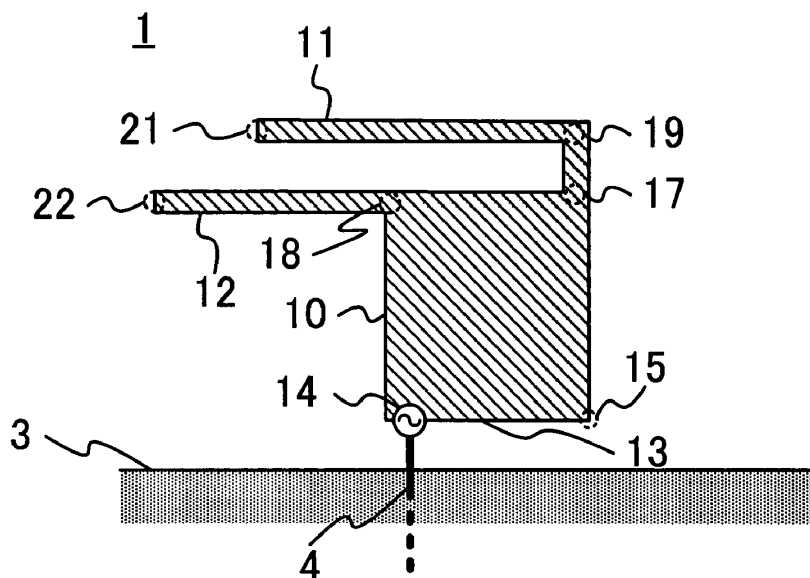
Primary Examiner—Huedung Mancuso

(74) *Attorney, Agent, or Firm*—Holtz, Holtz, Goodman & Chick, PC

(57) **ABSTRACT**

An antenna device usable in a radio apparatus having a printed board includes a ground conductor provided in the printed board, a fed partial element, a first branch element and a second branch element. The fed partial element is shaped as an area including a feed portion near an end of a first side of the area facing a side of the ground conductor, and a first branch portion and a second branch portion each near a portion of a fringe of the area other than the first side. The fed partial element may be fed at the feed portion. The first branch element branches off from the first branch portion and is folded back in a direction approaching the feed portion. The second branch element branches off from the second branch portion and is shaped in a direction close to the direction of the first branch element.

20 Claims, 7 Drawing Sheets



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US007825860B2

(12) **United States Patent**
Ying

(10) **Patent No.:** **US 7,825,860 B2**

(45) **Date of Patent:** **Nov. 2, 2010**

(54) **ANTENNA ASSEMBLY**

2008/0062045 A1 3/2008 Dinallo et al.

(75) Inventor: **Zhinong Ying**, Lund (SE)

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

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 212 days.

(21) Appl. No.: **12/104,013**

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(22) Filed: **Apr. 16, 2008**

Co-pending U.S. Appl. No. 12/104,208, filed Apr. 16, 2008, entitled "Antenna Assembly, Printed Wiring Board and Device," Zhinong Ying et al.

(65) **Prior Publication Data**

US 2009/0262022 A1 Oct. 22, 2009

International Search Report and Written Opinion issued in corresponding international application No. PCT/EP2008/063335, mailed Dec. 4, 2008, 13 pages.

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

Primary Examiner—Hoang V Nguyen

(74) Attorney, Agent, or Firm—Harrity & Harrity, LLP

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

(58) **Field of Classification Search** **343/700 MS, 343/702, 895**

See application file for complete search history.

(57) **ABSTRACT**

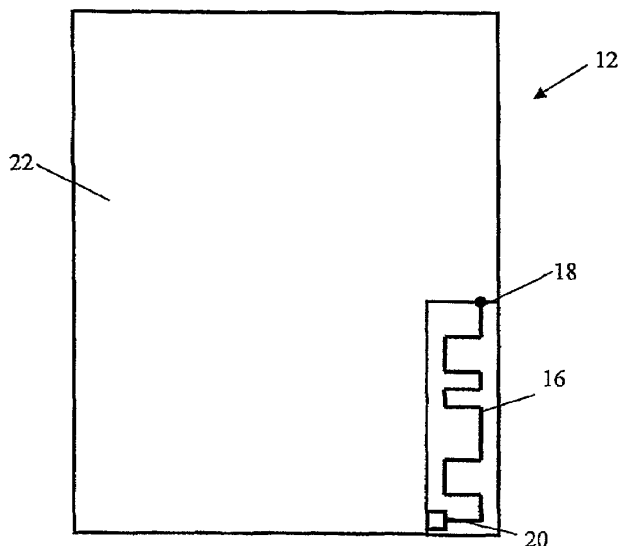
An antenna assembly may include a printed wiring board (PWB) and a dielectric substrate including a first antenna pattern, the dielectric substrate being configured to be mounted on the PWB. The antenna assembly may include a second antenna pattern that may be configured to be used as a radiating element of an FM Tx antenna or a Near Field Communication (NFC) antenna. The second antenna pattern may be provided a) on/in the dielectric substrate, or b) on the PWB at the interface between the dielectric substrate and the PWB, or c) partly on a surface of the dielectric substrate and partly on a surface of said PWB.

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19 Claims, 2 Drawing Sheets



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US007825861B2

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

(10) **Patent No.:** **US 7,825,861 B2**

(45) **Date of Patent:** **Nov. 2, 2010**

(54) **RADIO MODULE**

(75) Inventors: **Koichi Sato**, Tachikawa (JP); **Yusuke Miura**, Hachioji (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 780 days.

(21) Appl. No.: **11/825,066**

(22) Filed: **Jul. 3, 2007**

(65) **Prior Publication Data**

US 2008/0007468 A1 Jan. 10, 2008

(30) **Foreign Application Priority Data**

Jul. 7, 2006 (JP) 2006-188578

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

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

(58) **Field of Classification Search** 343/702,
343/700 MS, 845-846, 829, 833-834; 455/550.1
See application file for complete search history.

(56) **References Cited**

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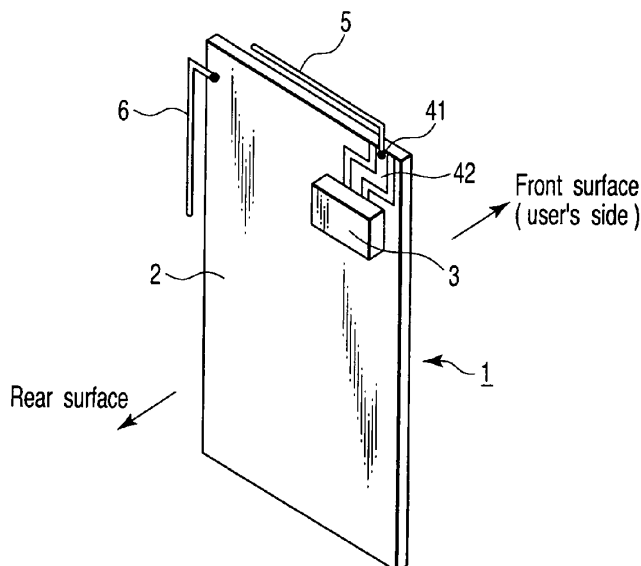
Primary Examiner—Huedung Mancuso

(74) *Attorney, Agent, or Firm*—Holtz, Holtz, Goodman & Chick, PC

(57) **ABSTRACT**

A conductor is mounted on a circuit board parallel to its side along which a radiation of a radio frequency signal is generated. The proximal end of the L-shaped conductor is electrically connected to a ground pattern formed on the rear surface of a circuit board 1, and the distal end of the L-shaped conductor is open. The position at which the conductor is connected to the ground pattern is set to be a position spaced apart by a quarter-wavelength of a radio-frequency signal from a feed point of an antenna. The total length of the conductor is set to be a half-wavelength of the radio-frequency signal.

17 Claims, 24 Drawing Sheets



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US007825863B2

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

(10) **Patent No.:** **US 7,825,863 B2**

(45) **Date of Patent:** **Nov. 2, 2010**

(54) **COMPACT ANTENNA**

(75) Inventors: **Matti Martiskainen**, Tiberias (IL);
Daniel Cho, Kyung Ki-Do (KR); **Steve Krupa**, Cambridge (GB); **Snir Azulay**,
Tiberias (IL); **Yona Haim**, Tiberias (IL)

(73) Assignee: **Galtronics Ltd.**, Tiberias (IL)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 516 days.

(21) Appl. No.: **11/940,959**

(22) Filed: **Nov. 15, 2007**

(65) **Prior Publication Data**

US 2008/0180333 A1 Jul. 31, 2008

Related U.S. Application Data

(60) Provisional application No. 60/859,629, filed on Nov. 16, 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, 833, 846, 848, 895

See application file for complete search history.

(56) **References Cited**

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H. Soutome, et al., "A wide bandwidth monopole antenna using a human-body as a ground plane", The Institute of Electronics, Information and Communication Engineers, IEICE Technical Report SR2005-44 (Jul. 2005)—an English abstract.

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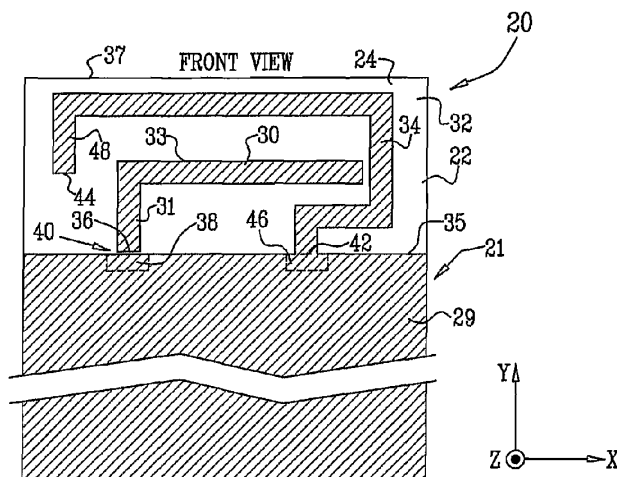
Primary Examiner—Tan Ho

(74) *Attorney, Agent, or Firm*—Fish & Richardson P.C.

(57) **ABSTRACT**

An antenna, including a planar dielectric substrate and a conductive ground plane formed on the substrate. A conductive monopole is formed on the substrate and has an end point located in proximity to a feed region of the ground plane. A conductive coupling element is formed on the substrate and is coupled to the ground plane at a coupling region of the ground plane. The coupling element is folded around the monopole.

66 Claims, 19 Drawing Sheets



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US007825864B2

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

(10) **Patent No.:** **US 7,825,864 B2**
(45) **Date of Patent:** ***Nov. 2, 2010**

(54) **DUAL BAND WLAN ANTENNA**

(75) Inventors: **James Li**, Santa Clara, CA (US); **Jing Jiang**, San Jose, CA (US)

(73) Assignee: **Marvell World Trade Ltd.**, St. Michael (BB)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 292 days.

This patent is subject to a terminal disclaimer.

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(21) Appl. No.: **12/215,819**

EP 0 795 926 A2 9/1997

(22) Filed: **Jun. 30, 2008**

(65) **Prior Publication Data**

US 2009/0002241 A1 Jan. 1, 2009

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Related U.S. Application Data

(63) Continuation of application No. 11/581,717, filed on Oct. 16, 2006, now Pat. No. 7,403,162, which is a continuation of application No. 11/519,979, filed on Sep. 12, 2006, now Pat. No. 7,423,597.

802.11n; IEEE P802.11-04/0889r6; Wireless LANs, TGN Sync Proposal Technical Specification; 131 pages, May 2005.

(60) Provisional application No. 60/771,634, filed on Feb. 9, 2006.

(Continued)

Primary Examiner—Hoang Anh T Le

(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, 725, 729**

See application file for complete search history.

(57)

ABSTRACT

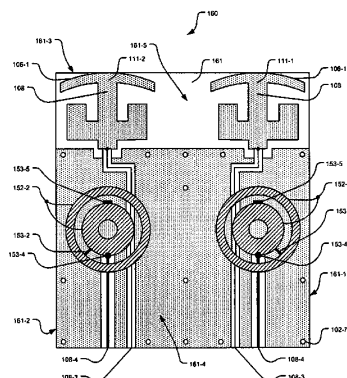
An antenna system includes first and second antennas that are arranged on a substrate and that include an arc-shaped element having a concave side and a convex side, a conducting element that extends substantially radially from a center of said concave side, and a U-shaped element having a base portion with a center that communicates with said conducting element and two side portions that extend from ends of said base portion towards said concave side. Third and fourth antennas are arranged on said substrate and include an inner ring and an outer ring that is concentric to said inner ring.

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20 Claims, 38 Drawing Sheets



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US007830315B2

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

(10) **Patent No.:** **US 7,830,315 B2**
(45) **Date of Patent:** **Nov. 9, 2010**

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

(75) Inventors: **Yuuichi Sugiyama**, Kawasaki (JP);
Kouji Soekawa, Kawasaki (JP)

(73) Assignee: **Fujitsu Limited**, Kawasaki (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 104 days.

(21) Appl. No.: **11/864,462**

(22) Filed: **Sep. 28, 2007**

(65) **Prior Publication Data**

US 2008/0150810 A1 Jun. 26, 2008

(30) **Foreign Application Priority Data**

Dec. 21, 2006 (JP) 2006-344795

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/36 (2006.01)

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

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

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Primary Examiner—Rexford N Barnie

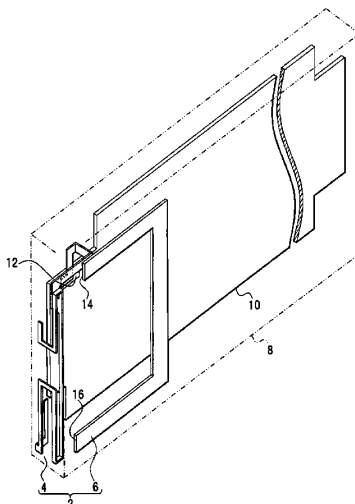
Assistant Examiner—Matthew C Tabler

(74) *Attorney, Agent, or Firm*—Westerman, Hattori, Daniels & Adrian, LLP

(57) **ABSTRACT**

The present invention relates to an antenna apparatus capable of multifrequency resonance and realizes downsizing and multifrequency resonance. The present invention relates to an antenna apparatus capable of multifrequency resonance or a radio communicating apparatus (e.g., portable phone) including the antenna apparatus; toward a feed element connected to and supplied with electricity from a feeding unit of a circuit substrate (printed circuit substrate), a non-feed element is disposed with over the circuit substrate or outside the circuit substrate; and the feed side or the open side of the feed element is electromagnetically coupled to the non-feed element to enable resonance in the frequency band of the non-feed element in addition to resonance in the frequency band of the feed element.

27 Claims, 40 Drawing Sheets



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US007830316B2

(12) **United States Patent**
Wang

(10) **Patent No.:** **US 7,830,316 B2**
(45) **Date of Patent:** **Nov. 9, 2010**

(54) **FOLDABLE ELECTRONIC DEVICE WITH ANTENNA**

(75) Inventor: **Chen-Sheng Wang**, Taipei (TW)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 191 days.

(21) Appl. No.: **12/183,051**

(22) Filed: **Jul. 30, 2008**

(65) **Prior Publication Data**

US 2009/0033571 A1 Feb. 5, 2009

(30) **Foreign Application Priority Data**

Aug. 2, 2007 (TW) 96128410 A

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/10 (2006.01)

(52) **U.S. Cl.** **343/702; 343/901**

(58) **Field of Classification Search** **343/702, 343/872, 900, 901**

See application file for complete search history.

(56) **References Cited**

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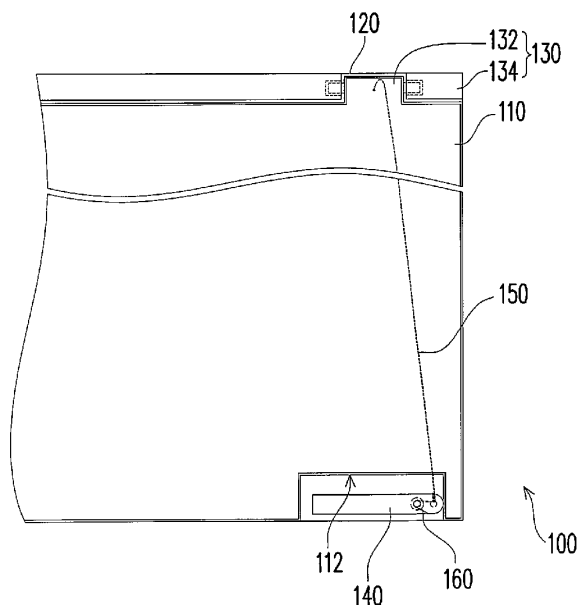
Primary Examiner—Shih-Chao Chen

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

(57) **ABSTRACT**

A foldable electronic device with an antenna including a first body, a second body, a pivotal mechanism, an antenna and a driving element is provided. The first body has a holding recess on one side thereof. The second body is located on the other side of the first body. The pivotal mechanism is used to pivotally connect the first body to the second body. Two sides of the driving element are connected to the pivotal mechanism and the antenna, respectively. When the first body is opened relatively to the second body, the pivotal mechanism drives the driving element to generate a first linear displacement. The first linear displacement drives the antenna to have a second rotation displacement to allow the antenna to extend out of the receiving groove.

7 Claims, 6 Drawing Sheets



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US007830317B2

(12) **United States Patent**
Yamazaki

(10) **Patent No.:** **US 7,830,317 B2**

(45) **Date of Patent:** **Nov. 9, 2010**

(54) **ELECTRONIC APPARATUS**

FOREIGN PATENT DOCUMENTS

- (75) Inventor: **Fuminori Yamazaki**, Fussa (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 146 days.

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JP	2007-049644	2/2007
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WO	2007/058230 A1	5/2007

(21) Appl. No.: **12/338,777**

(22) Filed: **Dec. 18, 2008**

(65) **Prior Publication Data**

US 2009/0322625 A1 Dec. 31, 2009

(30) **Foreign Application Priority Data**

Jun. 30, 2008 (JP) 2008-170171

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

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

(58) **Field of Classification Search** **343/702,**
343/700 MS, 725, 767, 850-855

See application file for complete search history.

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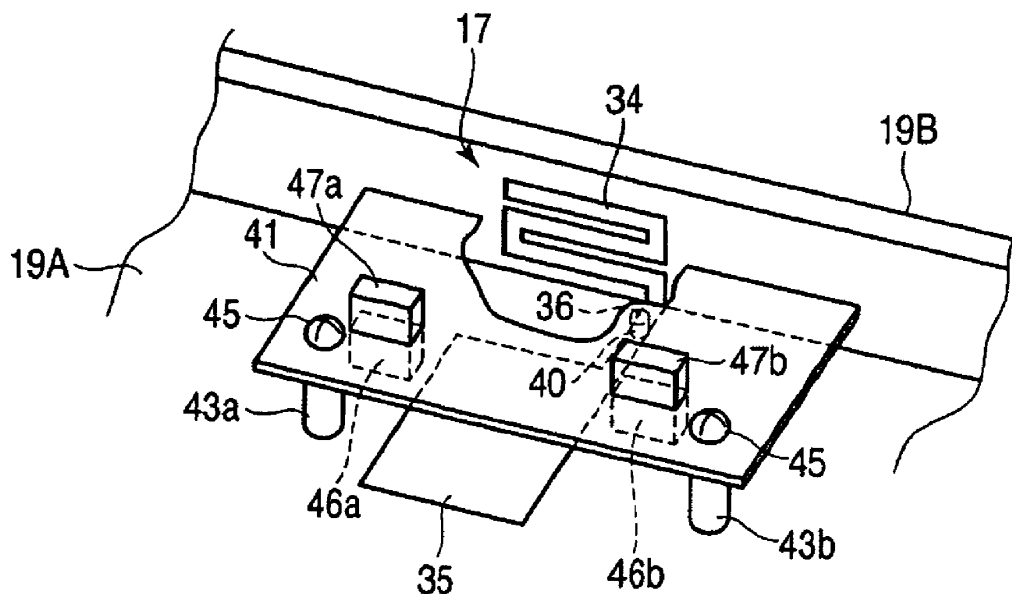
Primary Examiner—Huedung Mancuso

(74) *Attorney, Agent, or Firm*—Blakely, Sokoloff, Taylor & Zafman LLP

(57) **ABSTRACT**

According to one embodiment, an antenna incorporated in an electronic apparatus includes an antenna element formed of a metal thin film and provided on the inner surface of a side wall of a housing, an antenna ground formed of a metal thin film and provided on the inner surface of the bottom wall of the housing, and a conductor portion formed of a metal thin film, provided at least on the inner surface of the bottom wall and connecting the antenna element to the antenna ground. The feed pin of a feed terminal mounted on a printed circuit board is kept in contact with the conductor portion on the bottom wall to feed power from a wireless module to the antenna.

6 Claims, 8 Drawing Sheets



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US007830320B2

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

(10) **Patent No.:** **US 7,830,320 B2**

(45) **Date of Patent:** **Nov. 9, 2010**

(54) **ANTENNA WITH ACTIVE ELEMENTS**

(75) Inventors: **Jeff Shamblin**, San Marcos, CA (US);
ChulMin Han, San Diego, CA (US);
Rowland Jones, Carlsbad, CA (US);
Sebastian Rowson, San Diego, CA
(US); **Laurent Desclos**, 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 0 days.

(21) Appl. No.: **11/841,207**

(22) Filed: **Aug. 20, 2007**

(65) **Prior Publication Data**

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(51) **Int. Cl.**
H01Q 9/16 (2006.01)
H01Q 1/24 (2006.01)

(52) **U.S. Cl.** **343/747; 343/702; 343/895**

(58) **Field of Classification Search** **343/702, 343/729, 861, 747, 745, 895, 700 MS, 748**
See application file for complete search history.

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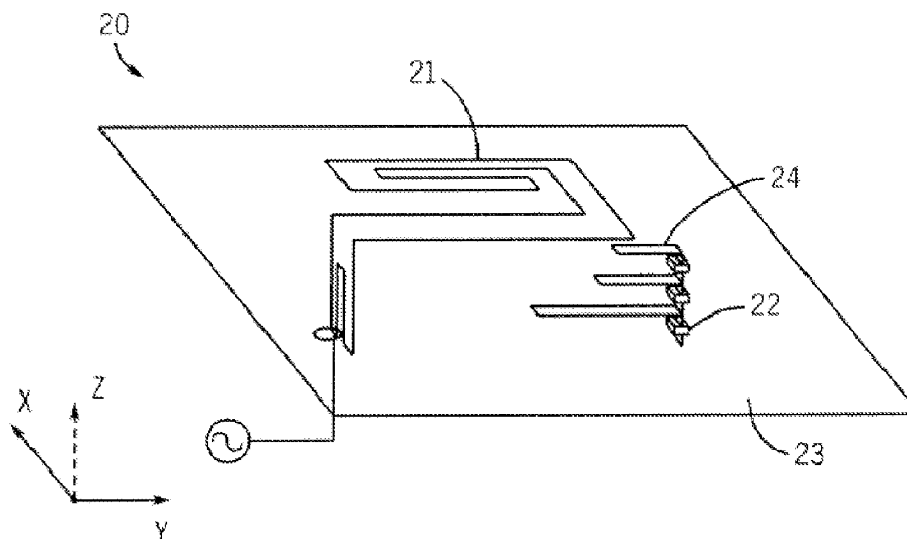
Primary Examiner—HoangAnh T Le

(74) Attorney, Agent, or Firm—Coastal Patent Agency;
Joshua S. Schoonover

(57) **ABSTRACT**

A multi-frequency antenna comprising an IMD element, active tuning elements and parasitic elements. The IMD element is used in combination with the active tuning and parasitic elements for enabling a variable frequency at which the antenna operates, wherein, when excited, the parasitic elements may couple with the IMD element to change an operating characteristic of the IMD element.

6 Claims, 9 Drawing Sheets



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US007830321B2

(12) **United States Patent**
Fukuchi

(10) **Patent No.:** **US 7,830,321 B2**

(45) **Date of Patent:** **Nov. 9, 2010**

(54) **ANTENNA FOR ULTRA WIDE BAND
TELECOMMUNICATIONS**

(75) Inventor: **Keisuke Fukuchi**, 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 311 days.

(21) Appl. No.: **11/688,597**

(22) Filed: **Mar. 20, 2007**

(65) **Prior Publication Data**

US 2007/0222694 A1 Sep. 27, 2007

(30) **Foreign Application Priority Data**

Mar. 23, 2006 (JP) 2006-080711

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

(52) **U.S. Cl.** **343/767**

(58) **Field of Classification Search** **343/767,**
343/770, 702, 817, 818, 795, 846
See application file for complete search history.

(56) **References Cited**

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Primary Examiner—Hoang V Nguyen

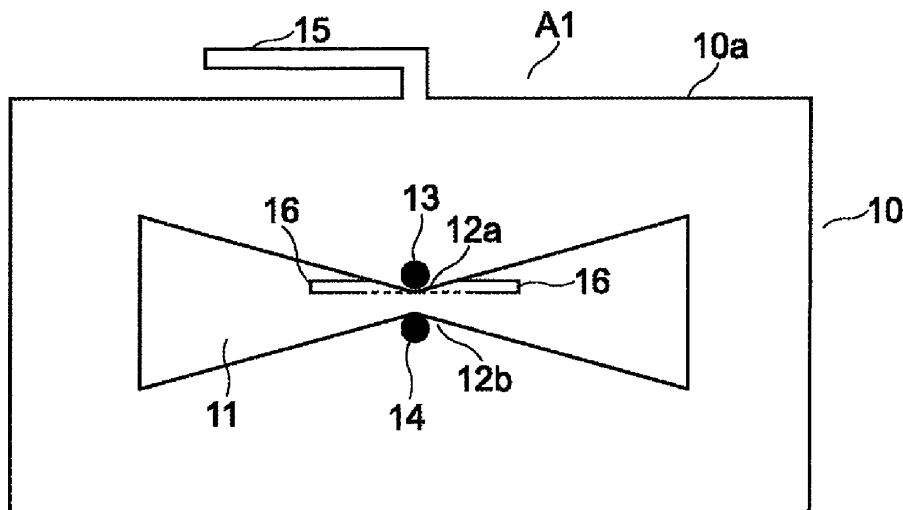
Assistant Examiner—Robert Karacsony

(74) *Attorney, Agent, or Firm*—Antonelli, Terry, Stout & Kraus, LLP.

(57) **ABSTRACT**

An antenna for an ultra wide band telecommunications, provided with a rectangular conductive plate where a bow tie slot is formed, an auxiliary element extended from said rectangular conductive plate above one of two vertical angle parts opposed at a center part of the bow tie slot, a feeding part formed at one of the vertical angle parts, and a grounding part formed at the other vertical angle part.

15 Claims, 4 Drawing Sheets



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US007830326B2

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

(10) **Patent No.:** **US 7,830,326 B2**
(45) **Date of Patent:** **Nov. 9, 2010**

(54) **MULTI-BAND ANTENNA**

(75) Inventors: **Chen-Ta Hung**, Tu-cheng (TW);
Shu-Yean Wang, Tu-cheng (TW);
Yao-Shien Huang, 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.: **12/151,438**

(22) Filed: **May 7, 2008**

(65) **Prior Publication Data**

US 2008/0278382 A1 Nov. 13, 2008

(30) **Foreign Application Priority Data**

May 7, 2007 (TW) 96116050 A

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

(52) **U.S. Cl.** **343/826; 343/830**

(58) **Field of Classification Search** 343/700 MS,
343/702, 795, 826, 828-830, 846
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

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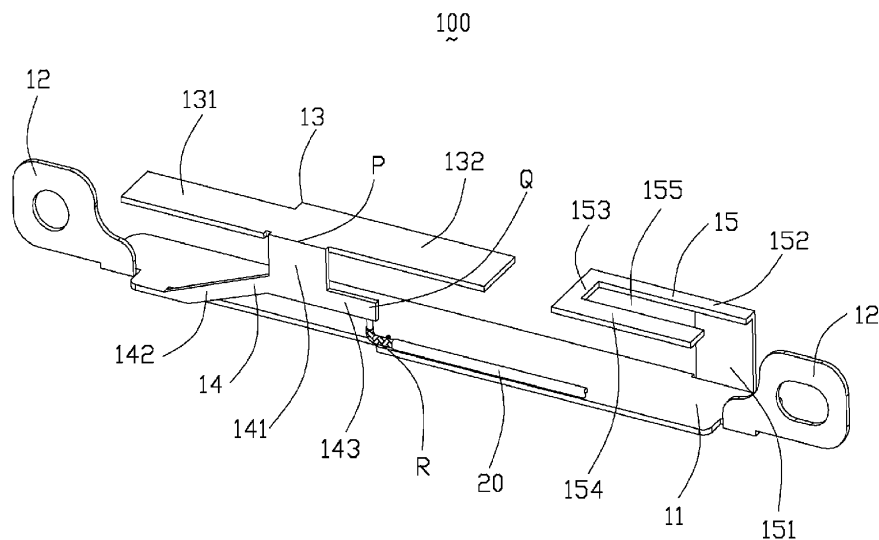
Primary Examiner—Michael C Wimer

(74) *Attorney, Agent, or Firm*—Wei Te Chung; Andrew C.
Cheng; Ming Chieh Chang

(57) **ABSTRACT**

Provided herewith a multi-band antenna comprising a
grounding element lying in a first plane and comprising two
longitudinal sides, a radiating element spaced apart from the
grounding element and comprising a first radiating arm hav-
ing a first length and a second radiating arm having a second
length being about equal to the first length, a connecting
element lying in a second plane and electrically connecting
the grounding element and the radiating element; a feeding
line comprising an inner conductor for feeding signal and an
outer conductor electrically connecting to the grounding ele-
ment; and a coupling radiating element extending vertically
from the grounding element and comprising a first radiating
portion lying in a third plane and a second radiating portion
being perpendicular to the third plane.

20 Claims, 3 Drawing Sheets



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US007830327B2

(12) **United States Patent**
He

(10) **Patent No.:** **US 7,830,327 B2**

(45) **Date of Patent:** **Nov. 9, 2010**

(54) **LOW COST ANTENNA DESIGN FOR WIRELESS COMMUNICATIONS**

(75) Inventor: **Ziming He**, Irvine, CA (US)

(73) Assignee: **Powerwave Technologies, Inc.**, Santa Ana, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 138 days.

(21) Appl. No.: **12/152,726**

(22) Filed: **May 16, 2008**

(65) **Prior Publication Data**

US 2008/0284661 A1 Nov. 20, 2008

Related U.S. Application Data

(60) Provisional application No. 60/930,738, filed on May 18, 2007.

(51) **Int. Cl.**
H01Q 1/36 (2006.01)
H01Q 9/30 (2006.01)

(52) **U.S. Cl.** **343/828; 343/829; 343/846**

(58) **Field of Classification Search** 343/700 MS, 343/702, 846, 795, 806, 808, 809, 828, 829
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

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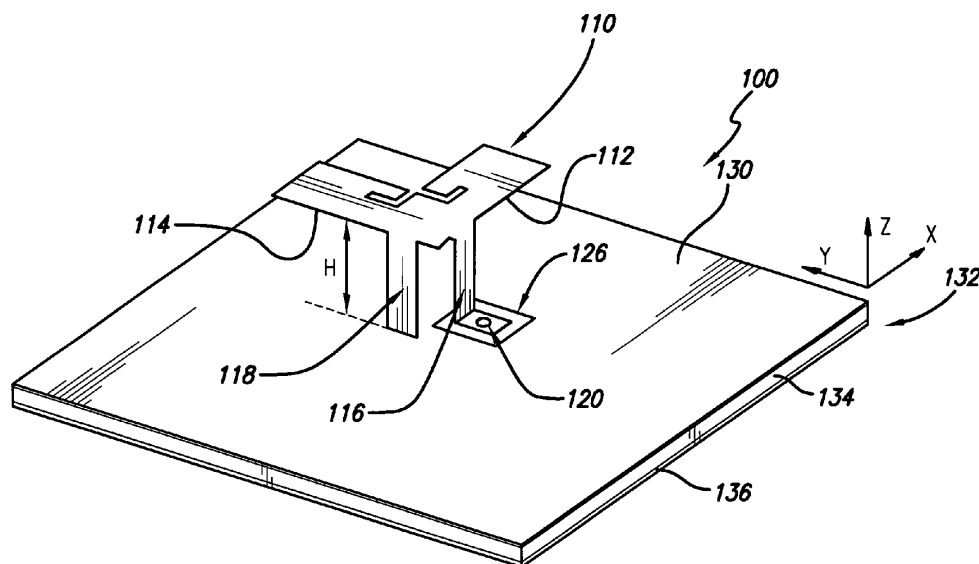
Primary Examiner—Michael C Wimer

(74) *Attorney, Agent, or Firm*—OC Patent Law Group

(57) **ABSTRACT**

A low cost and multi-featured antenna is disclosed. The antenna employs a radiating element mounted to a ground plane and having first and second branches spaced above the ground plane forming a generally L shaped planar radiating structure. The antenna can be either linear or circular polarization, and can be either single band or dual band, and only one feeding port is needed to obtain circular polarization. The antenna can be easily applied to various frequency bands.

11 Claims, 10 Drawing Sheets



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US007830330B2

(12) **United States Patent**
Pelzer

(10) **Patent No.:** **US 7,830,330 B2**
(45) **Date of Patent:** **Nov. 9, 2010**

(54) **ANTENNA CONFIGURATION**

(75) Inventor: **Heiko Pelzer**, Erkelenz (DE)

(73) Assignee: **NXP B.V.**, Eindhoven (NL)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 142 days.

(21) Appl. No.: **10/594,021**

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

(86) PCT No.: **PCT/IB2005/050788**

§ 371 (c)(1),

(2), (4) Date: **Apr. 24, 2007**

(87) PCT Pub. No.: **WO2005/093899**

PCT Pub. Date: **Oct. 6, 2005**

(65) **Prior Publication Data**

US 2007/0229387 A1 Oct. 4, 2007

(30) **Foreign Application Priority Data**

Mar. 25, 2004 (EP) 04101236

(51) **Int. Cl.**
H01Q 3/24 (2006.01)

(52) **U.S. Cl.** **343/876**; 343/700 MS;
343/702; 343/850; 343/860

(58) **Field of Classification Search** 343/700 MS,
343/745

See application file for complete search history.

(56) **References Cited**

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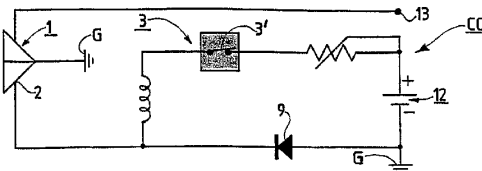
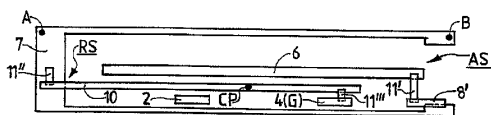
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Primary Examiner—Trinh Vo Dinh

(57) **ABSTRACT**

Regarding an antenna configuration (1) preferably provided for a telecommunication device and comprising a first resonator structure (6) and second resonator structure (RS) being capacitive coupled with the first resonator structure (6) it is suggested to provide the antenna configuration (1) with a control electrode (2) and a switching stage (3), said control electrode (2) by means of the switching stage (3) being switchably connected to ground (G) and said switching stage (3) enabling to change capacitive coupling of the two resonator structures (6, RS) and thus to change the resonance frequency of the antenna configuration (1) and making possible to switch between a first frequency range and a second frequency range for enhancing the bandwidth and achieving improved matching of the antenna configuration (1).

8 Claims, 3 Drawing Sheets



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US007839335B2

(12) **United States Patent**
Chen

(10) **Patent No.:** **US 7,839,335 B2**

(45) **Date of Patent:** **Nov. 23, 2010**

(54) **ANTENNA AND WIRELESS NETWORK
DEVICE HAVING THE SAME**

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7,705,786 B2 * 4/2010 Iellici et al. 343/702

(75) Inventor: **Yu Ren Chen**, Luodong Township, Yilan
County (TW)

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(73) Assignee: **Cameo Communications Inc.** (TW)

Primary Examiner—Tho G Phan

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 313 days.

(57) **ABSTRACT**

(21) Appl. No.: **11/790,467**

(22) Filed: **Apr. 25, 2007**

(65) **Prior Publication Data**

US 2008/0268908 A1 Oct. 30, 2008

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

(52) **U.S. Cl.** **343/700 MS; 343/702;**
343/873

(58) **Field of Classification Search** 343/700 MS.
343/702, 829, 846, 873
See application file for complete search history.

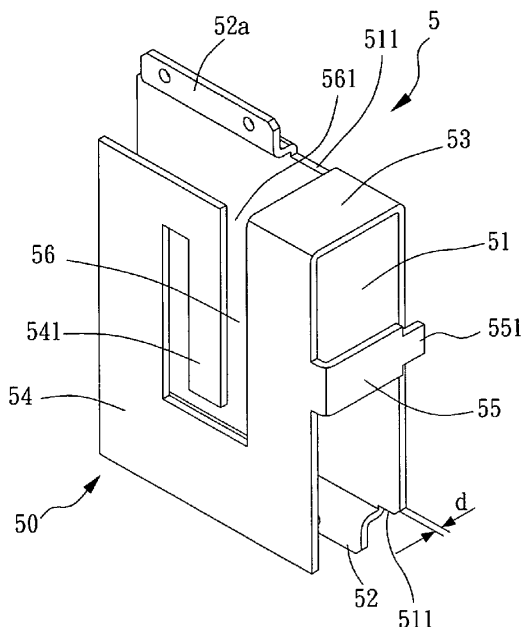
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6,670,923 B1 * 12/2003 Kadambi et al. 343/700 MS
6,724,348 B2 * 4/2004 Fang 343/702
6,831,607 B2 * 12/2004 Hebron et al. 343/700 MS

An antenna applied to a wireless network device comprises a base, a pair of embedded portions, and an antenna portion. The base has two sides opposite to each other. Each of the embedded portions has a side wall portion and a locking wing portion. The side wall portion is substantially vertical to the base and connected to the sides of the base, while the locking wing portion is connected to the side wall portion, substantially parallel to the base, and spaced apart from the base with a first height. The antenna portion is provided with a ground member, a radiation member, and a signal member. The ground member is substantially vertical to the base, connected to one of the two sides of the base, and spaced apart from the embedded portion with an interval. The radiation member is connected to the ground member, substantially parallel to the base, and spaced apart from the base with a second height. The signal member is connected to the radiation member, substantially vertical to the base, and formed with a free end separated from the base. When the antenna is positioned in at least one slot formed on a substrate of the wireless network device, the radiation member is spaced apart from the substrate with a height difference between the second height and the first height.

7 Claims, 9 Drawing Sheets



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US007839341B2

(12) **United States Patent**
Seo

(10) **Patent No.:** **US 7,839,341 B2**
(45) **Date of Patent:** **Nov. 23, 2010**

(54) **ANTENNA AND MOBILE TERMINAL USING THE SAME**

(75) Inventor: **Dong Kyu Seo**, Ulsan-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 713 days.

(21) Appl. No.: **11/774,161**

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

(65) **Prior Publication Data**

US 2008/0007467 A1 Jan. 10, 2008

(30) **Foreign Application Priority Data**

Jul. 7, 2006 (KR) 10-2006-0063805

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

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

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

See application file for complete search history.

(56) **References Cited**

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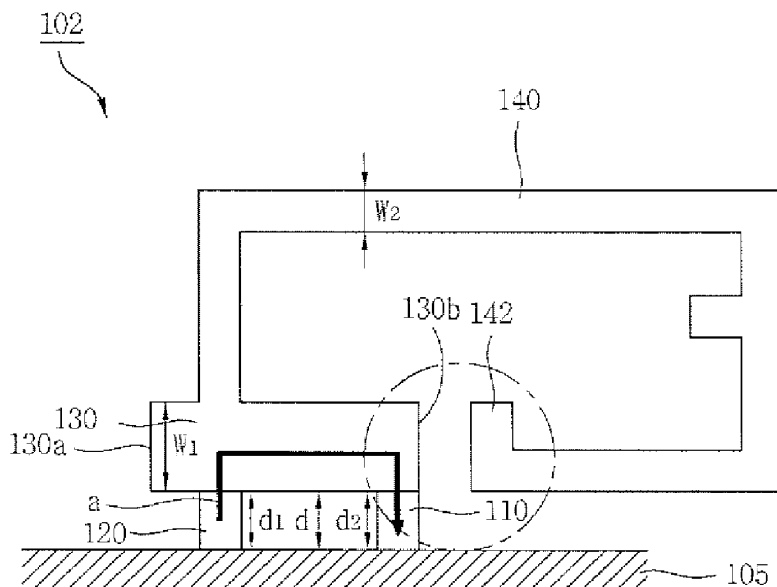
Primary Examiner—Huedung Mancuso

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

(57) **ABSTRACT**

An antenna and a mobile terminal using the same is provided. The mobile terminal according to an aspect of the present invention includes a shielding unit and an antenna comprising a feed unit and a ground unit formed over the shielding unit, a first pattern connected to a top surface of the feed unit and the ground unit and isolated from the shielding unit, and a second pattern connected to a first end of the first pattern and having an open end formed close to a portion of the first pattern second end connected to the ground unit. The first pattern has a high frequency band characteristic, and the second pattern has a low frequency band characteristic.

20 Claims, 4 Drawing Sheets



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US007839343B2

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

(10) **Patent No.:** **US 7,839,343 B2**
(45) **Date of Patent:** **Nov. 23, 2010**

(54) **MOBILE WIRELESS COMMUNICATIONS
DEVICE COMPRISING A TOP-MOUNTED
AUXILIARY INPUT/OUTPUT DEVICE AND A
BOTTOM-MOUNTED ANTENNA**

(75) Inventors: **Yihong Qi**, Waterloo (CA); **Ying Tong
Man**, Kitchener (CA); **Perry
Jarmuszewski**, Waterloo (CA)

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

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

(21) Appl. No.: **12/571,662**

(22) Filed: **Oct. 1, 2009**

(65) **Prior Publication Data**

US 2010/0022268 A1 Jan. 28, 2010

Related U.S. Application Data

(63) Continuation of application No. 12/167,170, filed on
Jul. 2, 2008, now Pat. No. 7,612,726, which is a con-
tinuation of application No. 11/422,165, filed on Jun.
5, 2006, now Pat. No. 7,405,703, which is a continua-
tion of application No. 11/042,269, filed on Jan. 25,
2005, now Pat. No. 7,088,294.

(60) Provisional application No. 60/576,159, filed on Jun.
2, 2004, provisional application No. 60/576,637, filed
on Jun. 3, 2004.

(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,
343/700 MS, 741, 866, 895; 455/575.1,
455/90

See application file for complete search history.

(56) **References Cited**

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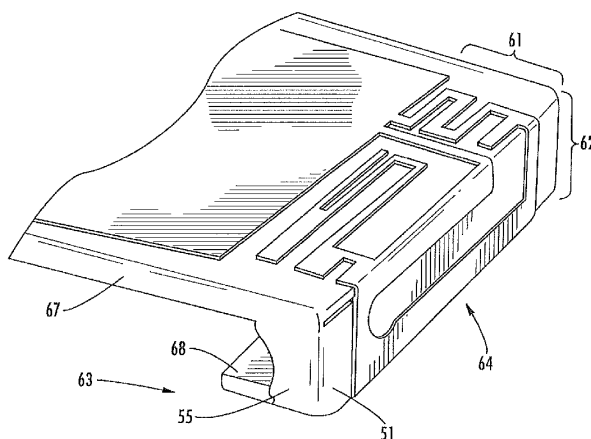
Primary Examiner—Hoang V Nguyen

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

(57) **ABSTRACT**

A mobile wireless communications device may include a housing having an upper portion and a lower portion, a dielectric substrate carried by the housing, circuitry carried by the dielectric substrate, and an audio output transducer carried by the upper portion of the housing and connected to the circuitry. The device may further include a user input interface carried by the housing and connected to the circuitry, and at least one auxiliary input/output device carried by the upper portion of the housing and connected to the circuitry. An antenna may also be carried within the lower portion of the housing comprising a pattern of conductive traces on the dielectric substrate.

22 Claims, 11 Drawing Sheets



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US007839344B2

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

(10) **Patent No.:** **US 7,839,344 B2**

(45) **Date of Patent:** **Nov. 23, 2010**

(54) **WIDEBAND MULTIFUNCTION ANTENNA
OPERATING IN THE HF RANGE,
PARTICULARLY FOR NAVAL
INSTALLATIONS**

(75) Inventors: **Gaetano Marrocco**, Montecompatri
(IT); **Fernando Bardati**, Rome (IT);
Manlio Proia, Rome (IT); **Piero
Tognolatti**, Rome (IT); **Lorenzo
Mattioni**, Rome (IT); **Raffaele Perelli**,
Ardea (IT); **Giampiero Colasanti**, Rome
(IT); **Giovanni Falcione**, Rome (IT)

(73) Assignee: **Selex Communications S.p.A.**, Genoa
(IT)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 192 days.

(21) Appl. No.: **11/914,634**

(22) PCT Filed: **May 18, 2006**

(86) PCT No.: **PCT/IB2006/051583**

§ 371 (c)(1),

(2), (4) Date: **Nov. 16, 2007**

(87) PCT Pub. No.: **WO2006/123311**

PCT Pub. Date: **Nov. 23, 2006**

(65) **Prior Publication Data**

US 2008/0278407 A1 Nov. 13, 2008

(30) **Foreign Application Priority Data**

May 19, 2005 (IT) TO2005A0344

(51) **Int. Cl.**
H01Q 1/34 (2006.01)

(52) **U.S. Cl.** **343/709; 343/749**

(58) **Field of Classification Search** **343/900,**
343/866, 867, 868, 804, 709, 742, 745, 749

See application file for complete search history.

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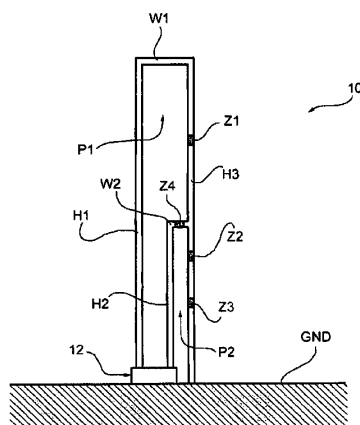
Primary Examiner—HoangAnh T Le

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

(57) **ABSTRACT**

A linear antenna for operation in the HF frequency range, particularly for naval communications is disclosed, comprising a radiating arrangement (H1, H2, H3, W1, W2), adapted to be operatively associated with a ground conductor (20) and at least one electrical impedance device (Z1-Z4), characterized in that it includes: a plurality of wire radiating elements with a predominantly vertical extension, forming a first and a second conducting branch (H1, H2) adapted to be operatively coupled to a feed circuit, and a return conducting branch (H3) adapted to be operatively coupled to a ground conductor (20); and a plurality of wire radiating elements with a predominantly transverse extension, forming connecting conducting branches (W1, W2) for connecting the conducting branches (H1, H2) adapted to be coupled to the feed circuit (12), to the conducting branch (H3) adapted to be coupled to the ground conductor (20), the radiating elements being positioned in such a way as to form, in a plane in which the antenna lies, two nested closed paths (P1, P2) between the feed circuit (12) and the ground conductor (20), having at least one radiating element in common, and—a plurality of electrical impedance devices (Z1-Z4) interposed along the conducting branches (H1, H2, H3, W1, W2) and adapted to impede the flow of current within corresponding predetermined frequency ranges in such a way as to establish selectively, according to the operating frequency, a plurality of different current paths along the conducting branches (H1, H2, H3, W1, W2), corresponding to a plurality of different electrical and/or geometrical configurations of the antenna (10).

32 Claims, 2 Drawing Sheets



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US007839347B2

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

(10) **Patent No.:** **US 7,839,347 B2**
(45) **Date of Patent:** **Nov. 23, 2010**

(54) **ANTENNA ASSEMBLIES WITH TAPERED LOOP ANTENNA ELEMENTS AND REFLECTORS**

(75) Inventors: **Richard E. Schneider**, Wildwood, MO (US); **John Edwin Ross, III**, Moab, UT (US); **Corey Feit**, St. Louis, MO (US); **Dale Picolet**, House Springs, MO (US); **Chad Stuemke**, St. Louis, MO (US)

(73) Assignee: **Antennas Direct, Inc.**, Ellisville, MO (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 316 days.

(21) Appl. No.: **12/040,464**

(22) Filed: **Feb. 29, 2008**

(65) **Prior Publication Data**

US 2009/0146899 A1 Jun. 11, 2009

Related U.S. Application Data

(60) Provisional application No. 60/992,331, filed on Dec. 5, 2007.

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

(52) **U.S. Cl.** **343/741**; 343/834; 343/866

(58) **Field of Classification Search** 343/741, 343/742, 834, 866, 867
See application file for complete search history.

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Primary Examiner—Tho G Phan
(74) *Attorney, Agent, or Firm*—Harness, Dickey & Pierce, P.L.C.

(57) **ABSTRACT**

According to various aspects, exemplary embodiments are provided of antenna assemblies. In one exemplary embodiment, an antenna assembly generally includes at least one antenna element having a generally annular shape with an opening. At least one reflector element is spaced-apart from the antenna element for reflecting electromagnetic waves generally towards the antenna element.

46 Claims, 17 Drawing Sheets

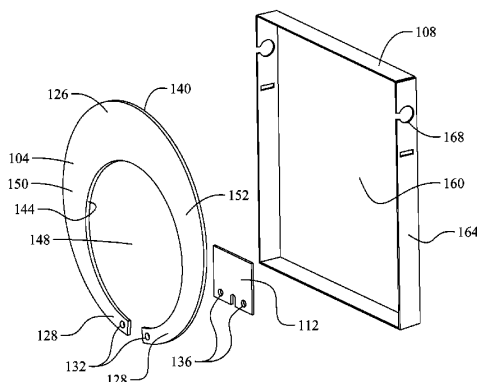


Fig. 3



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US007839350B2

(12) **United States Patent**
Nagai

(10) **Patent No.:** **US 7,839,350 B2**
(45) **Date of Patent:** **Nov. 23, 2010**

(54) **ANTENNA DEVICE**

(75) Inventor: **Shuichi Nagai**, Kyoto (JP)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 261 days.

(21) Appl. No.: **12/092,739**

(22) PCT Filed: **Aug. 4, 2006**

(86) PCT No.: **PCT/JP2006/315469**

§ 371 (c)(1),
(2), (4) Date: **May 6, 2008**

(87) PCT Pub. No.: **WO2007/069366**

PCT Pub. Date: **Jun. 21, 2007**

(65) **Prior Publication Data**

US 2009/0046029 A1 Feb. 19, 2009

(30) **Foreign Application Priority Data**

Dec. 12, 2005 (JP) 2005-358221

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

(52) **U.S. Cl.** **343/850; 343/700 MS; 343/851; 343/852**

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

(56) **References Cited**

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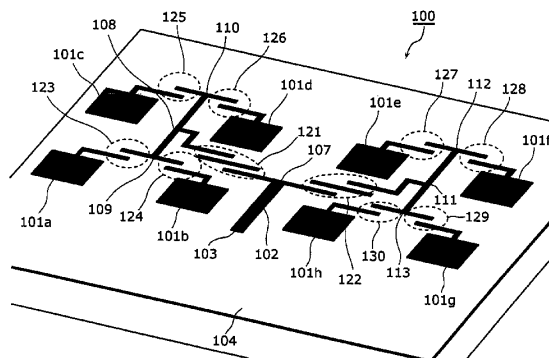
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Primary Examiner—Trinh V Dinh
(74) *Attorney, Agent, or Firm*—Greenblum & Bernstein, P.L.C.

(57) **ABSTRACT**

An antenna device according to the present invention includes; a plurality of antenna elements; a line which is electro-magnetically connected to each of the antenna elements and is branched from at least one branch point in the line; and filters formed in the line between a first branch point and each of said plurality of antenna elements. Here, the first branch point is the electrically farthest branch point from each of the antenna elements among all branch points.

7 Claims, 11 Drawing Sheets



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US007840242B2

(12) **United States Patent**
Yoshino

(10) **Patent No.:** **US 7,840,242 B2**
(45) **Date of Patent:** **Nov. 23, 2010**

(54) **EARPHONE ANTENNA**

(75) Inventor: **Yoshitaka Yoshino**, 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 459 days.

(21) Appl. No.: **11/538,736**

(22) Filed: **Oct. 4, 2006**

(65) **Prior Publication Data**

US 2007/0105438 A1 May 10, 2007

(30) **Foreign Application Priority Data**

Oct. 7, 2005 (JP) 2005-295434

(51) **Int. Cl.**
H04B 1/00 (2006.01)

(52) **U.S. Cl.** **455/575.2**; 381/74; 381/370

(58) **Field of Classification Search** 455/572,
455/569.1, 569.2, 575.2, 296-307, 270-278.1;
381/370-383, 55, 74, 111, 123, 77, 79; 343/718,
343/722; 349/577, 669

See application file for complete search history.

(56) **References Cited**

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Primary Examiner—Rafael Pérez-Gutiérrez

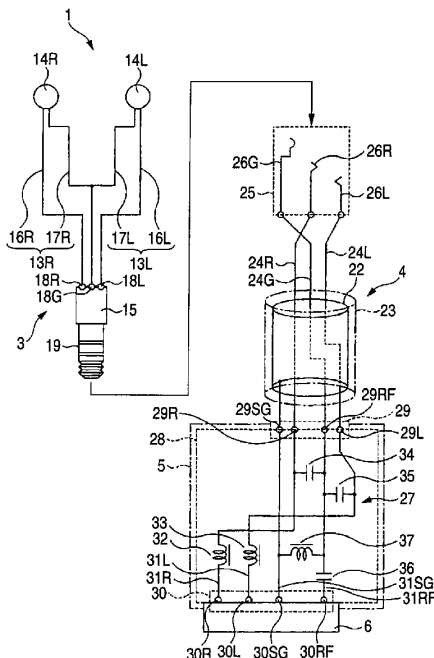
Assistant Examiner—Marcos Batista

(74) *Attorney, Agent, or Firm*—K&L Gates LLP

(57) **ABSTRACT**

An earphone antenna includes: earphone cords; an earphone portion; a coaxial cable; and a pin plug connector portion; wherein the earphone cords cooperate with a shielded line of the coaxial cable using a connection point with the coaxial cable as a feeding point to constitute an antenna for receiving RF signals; wherein conductor lines constituting a core wire of the coaxial cable form signal lines for transmitting audio signals and a ground line; and wherein the coaxial cable is connected with a separation-superimposition circuit portion which is mounted at a side of the pin plug connector portion or at a side of a wireless electronic device and acts to separate the RF signals and the audio signals and to superimpose the audio signals.

5 Claims, 6 Drawing Sheets



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US007840243B2

(12) **United States Patent**
Hirai

(10) **Patent No.:** **US 7,840,243 B2**
(45) **Date of Patent:** **Nov. 23, 2010**

(54) **ANTENNA ARRANGEMENT IN A MOBILE
TERMINAL APPARATUS**

(75) Inventor: **Masayoshi Hirai**, Yokohama (JP)

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

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 541 days.

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(21) Appl. No.: **11/814,482**

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(22) PCT Filed: **Jan. 26, 2006**

JP 05-259656 A 10/1993

(86) PCT No.: **PCT/JP2006/300877**

§ 371 (c)(1),
(2), (4) Date: **Jul. 20, 2007**

(Continued)

(87) PCT Pub. No.: **WO2006/077983**

Primary Examiner—Andrew Wendell

PCT Pub. Date: **Jul. 27, 2006**

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

(57) **ABSTRACT**

(65) **Prior Publication Data**

US 2009/0131125 A1 May 21, 2009

(30) **Foreign Application Priority Data**

Jan. 21, 2005 (JP) P.2005-014113

(51) **Int. Cl.**

H04M 1/00 (2006.01)

H04M 9/00 (2006.01)

(52) **U.S. Cl.** **455/575.7**; 455/575.1; 455/575.3;
379/428.01

(58) **Field of Classification Search** 455/550.1,
455/575.1, 575.3, 575.5, 575.7; 379/428.01
See application file for complete search history.

(56) **References Cited**

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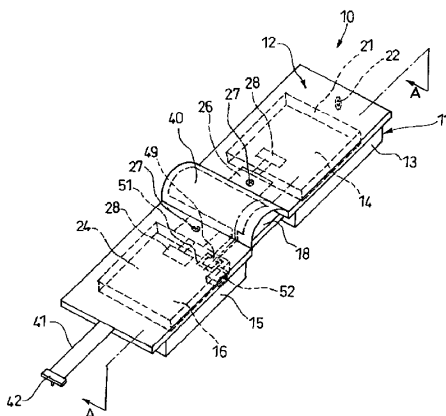
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There is provided a mobile terminal apparatus in which
downsizing of the mobile terminal apparatus can be achieved
and an antenna characteristic can be suitably supplied.

In a mobile terminal apparatus **10**, upper and lower housing
13 and **15** are coupled with each other by a coupling part **18** so
as to be openable and closable, upper and lower circuit boards
21 and **24** are provided in the upper and lower housing **13** and
15, upper and lower protective cover parts **31** and **32** cover the
upper and lower housing; and a flexible part **33** couples the
upper and lower protective cover parts so as to be openable
and closable and covers the coupling part. In the mobile
terminal apparatus **10**, an antenna power feeding land **51** is
provided in one of the upper and lower circuit boards, a power
feeding terminal of the antenna part **40** is electrically con-
nected to this one circuit board via the antenna power feeding
land, and the antenna part is housed in the flexible part.

6 Claims, 7 Drawing Sheets



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US007843390B2

(12) **United States Patent**
Liu

(10) **Patent No.:** **US 7,843,390 B2**
(45) **Date of Patent:** **Nov. 30, 2010**

(54) **ANTENNA**

(75) Inventor: **Chih-Kai Liu**, Taipei Hsien (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 1104 days.

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(21) Appl. No.: **11/524,913**

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

(65) **Prior Publication Data**

US 2007/0268186 A1 Nov. 22, 2007

(30) **Foreign Application Priority Data**

May 18, 2006 (TW) 95117726 A

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

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

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

See application file for complete search history.

(56) **References Cited**

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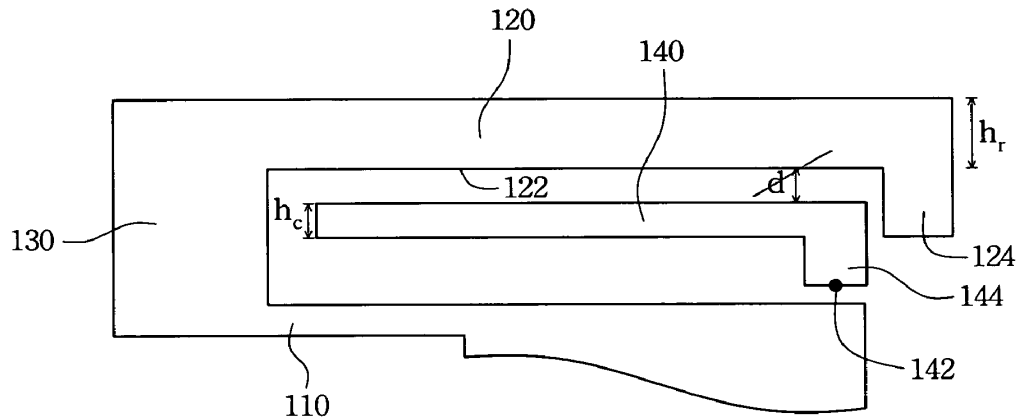
Primary Examiner—Tan Ho

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

(57) **ABSTRACT**

An antenna includes a grounding element, a radiating element, an interconnecting element and a conductive element. The interconnecting element connects the radiating element and the grounding element. The conductive element is disposed between the grounding element and the radiating element and apart from the grounding element and the radiating element. Moreover, the conductive element has a feed position thereon.

7 Claims, 3 Drawing Sheets



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US007843395B2

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

(10) **Patent No.:** **US 7,843,395 B2**
(45) **Date of Patent:** **Nov. 30, 2010**

(54) **TOUCH PEN HAVING AN ANTENNA AND ELECTRONIC DEVICE HAVING THE TOUCH PEN**

(75) Inventors: **Li-Ying Chen**, Taipei Hsien (TW);
Ju-Wen Teng, Taipei Hsien (TW)

(73) Assignees: **Giga-Byte Communications Inc.**,
Tainan (TW); **Giga-Byte Technology Co., Ltd.**, Taipei (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 861 days.

(21) Appl. No.: **11/751,714**

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

(65) **Prior Publication Data**

US 2008/0291178 A1 Nov. 27, 2008

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

(52) **U.S. Cl.** **343/702; 343/901**

(58) **Field of Classification Search** **343/702, 343/900, 901; 455/575.7**

See application file for complete search history.

(56) **References Cited**

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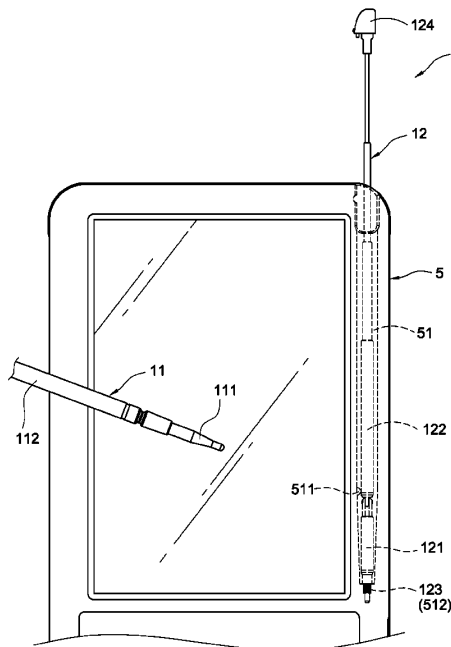
Primary Examiner—HoangAnh T Le

(74) Attorney, Agent, or Firm—Chun-Ming Shih; HDLS IPR Services

(57) **ABSTRACT**

An electronic apparatus has a touch pen. The touch pen includes a pen tube and an antenna. The pen tube has a hollow tube body and a touch end. The tube body is used to accommodate the antenna. Further, the antenna has a fixed tube body and a telescopic tube body. The interior of the fixed tube body is provided with electronic circuit and is electrically connected with the telescopic tube body. Therefore, when the touch pen is accommodated in the electronic device and is electrically connected with the electronic device, the electronic device can receive the wireless signals via the antenna within the touch pen. Alternatively, the antenna is provided within the electronic device directly and is electrically connected thereto, so that the electronic device can be kept to have a function of receiving the wireless signals during the use of the touch pen.

23 Claims, 6 Drawing Sheets



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US007843396B2

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

(10) **Patent No.:** **US 7,843,396 B2**
(45) **Date of Patent:** **Nov. 30, 2010**

(54) **ANTENNAS FOR HANDHELD ELECTRONIC DEVICES WITH CONDUCTIVE BEZELS**

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

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

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

EP 1 286 413 2/2003

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(21) Appl. No.: **12/564,803**

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(22) Filed: **Sep. 22, 2009**

Hobson et al. U.S. Appl. No. 60/833,587, filed Jan. 5, 2007.

(65) **Prior Publication Data**

US 2010/0007564 A1 Jan. 14, 2010

(Continued)

Related U.S. Application Data

Primary Examiner—Tho G Phan

(74) *Attorney, Agent, or Firm*—Treyz Law Group; G. Victor Treyz; Nancy Y. Ru

(63) Continuation of application No. 11/821,192, filed on Jun. 21, 2007, now Pat. No. 7,612,725.

(57) **ABSTRACT**

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

(52) **U.S. Cl.** **343/702**; 343/700 MS;
343/767; 343/846

(58) **Field of Classification Search** 343/702,
343/700, 767, 829, 846
See application file for complete search history.

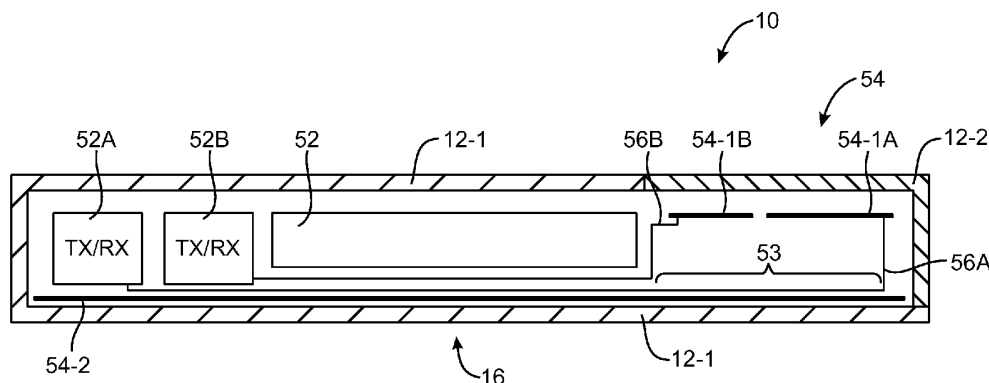
A handheld electronic device may be provided that contains wireless communications circuitry. The handheld electronic device may have a housing and a display. The display may be attached to the housing a conductive bezel. The handheld electronic device may have one or more antennas for supporting wireless communications. A ground plane in the handheld electronic device may serve as ground for one or more of the antennas. The ground plane and bezel may define an opening. A rectangular slot antenna or other suitable slot antenna may be formed from or within the opening. One or more antenna resonating elements may be formed above the slot. An electrical switch that bridges the slot may be used to modify the perimeter of the slot so as to tune the communications bands of the handheld electronic device.

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16 Claims, 20 Drawing Sheets



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US007843397B2

(12) **United States Patent**
Boyle

(10) **Patent No.:** **US 7,843,397 B2**
(45) **Date of Patent:** **Nov. 30, 2010**

(54) **TUNING IMPROVEMENTS IN**
"INVERTED-L" PLANAR ANTENNAS

(75) Inventor: **Kevin R. Boyle**, Horsham (GB)

(73) Assignee: **EPCOS AG**, Munich (DE)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 388 days.

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(21) Appl. No.: **10/565,928**

(22) PCT Filed: **Jul. 16, 2004**

(Continued)

(86) PCT No.: **PCT/IB2004/002369**

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§ 371 (c)(1),
(2), (4) Date: **Jan. 20, 2006**

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(87) PCT Pub. No.: **WO2005/011055**

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PCT Pub. Date: **Feb. 3, 2005**

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(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

Jul. 24, 2003 (GB) 0317305.1

(Continued)

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

Primary Examiner—Douglas W Owens

Assistant Examiner—Dieu Hien T Duong

(74) *Attorney, Agent, or Firm*—Slater & Matsil, L.L.P.

(52) **U.S. Cl.** **343/745**; 343/700 MS

(58) **Field of Classification Search** 343/700 MS,
343/702, 745

See application file for complete search history.

(57) **ABSTRACT**

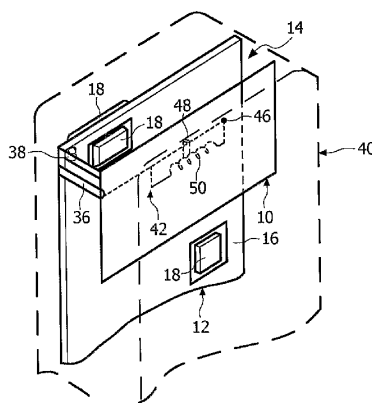
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A communications apparatus, includes a housing (40) containing a printed circuit board (PCB) (12) having a ground plane (16) and electronic components in rf shields (18) thereon. A planar antenna (10) is mounted spaced from the ground plane and a dielectric (14) is present in a space between the PCB and the planar antenna. A feed (36) couples the planar antenna (10) to the rf components.

20 Claims, 5 Drawing Sheets



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