



US008319688B2

(12) **United States Patent**
Parsche

(10) **Patent No.:** **US 8,319,688 B2**

(45) **Date of Patent:** ***Nov. 27, 2012**

(54) **PLANAR SLOT ANTENNA HAVING
MULTI-POLARIZATION CAPABILITY 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 454 days.

This patent is subject to a terminal dis-
claimer.

(21) Appl. No.: **12/388,004**

(22) Filed: **Feb. 18, 2009**

(65) **Prior Publication Data**

US 2010/0207829 A1 Aug. 19, 2010

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

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

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

See application file for complete search history.

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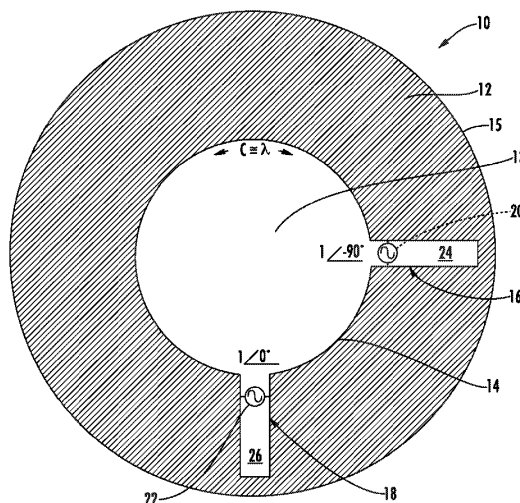
Primary Examiner — Hoanganh Le

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

(57) **ABSTRACT**

The antenna apparatus may include a planar, electrically con-
ductive, slot antenna element having a geometrically shaped
opening therein defining an inner perimeter, and a pair of
spaced apart signal feedpoints along the inner perimeter sepa-
rated by a distance of one quarter of the inner perimeter to
impart a traveling wave current distribution. The inner peri-
meter of the planar, electrically conductive, slot antenna ele-
ment may be equal to about one operating wavelength
thereof. The antenna apparatus may provide at least one of
linear, circular, dual linear and dual circular polarizations,
and it may provide an in situ or conformal antenna for
vehicles or aircraft.

25 Claims, 7 Drawing Sheets



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US008319690B2

(12) **United States Patent**
Oh

(10) **Patent No.:** **US 8,319,690 B2**

(45) **Date of Patent:** **Nov. 27, 2012**

(54) **MOBILE TERMINAL HAVING ADDITIONAL
ANTENNA PATTERN IN MAIN BODY**

(75) Inventor: **Kyung Jin Oh**, Hwaseong-si (KR)

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

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 777 days.

(21) Appl. No.: **12/284,812**

(22) Filed: **Sep. 25, 2008**

(65) **Prior Publication Data**

US 2009/0102727 A1 Apr. 23, 2009

(30) **Foreign Application Priority Data**

Sep. 27, 2007 (KR) 10-2007-0097436

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

H01Q 9/30 (2006.01)

(52) **U.S. Cl.** **343/702; 343/900; 343/909**

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

(56) **References Cited**

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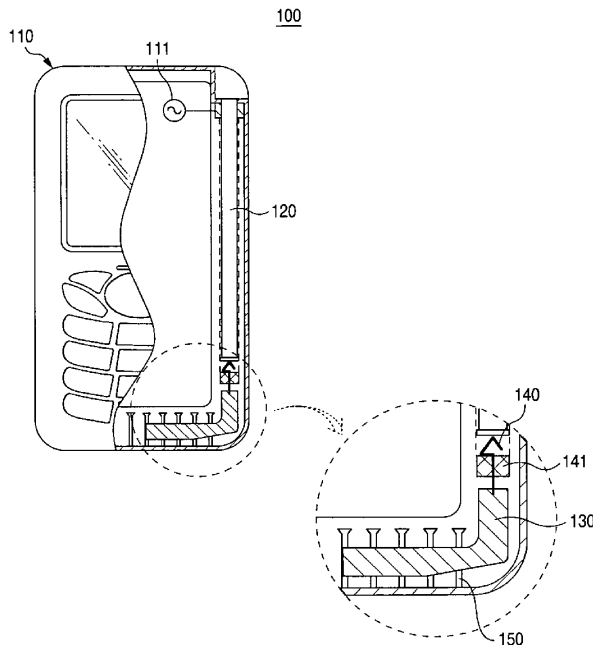
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Primary Examiner — Trinh Dinh

(57) **ABSTRACT**

The present invention relates to a mobile terminal having an antenna pattern in a main body of the mobile terminal. The mobile terminal includes: a main body having a feed point; a first antenna disposed in the main body, and a second antenna; wherein the second antenna is connected to the first antenna when the first antenna is retracted into the main body. According to the present invention, a digital broadcast signal can be received efficiently without extending an antenna to the outside of a main body of a mobile terminal. Further, damage to an antenna and wear of an antenna connection part are decreased.

20 Claims, 5 Drawing Sheets



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US008319691B2

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

(10) **Patent No.:** **US 8,319,691 B2**
(45) **Date of Patent:** **Nov. 27, 2012**

(54) **MULTI-BAND ANTENNA**

(56) **References Cited**

(75) Inventors: **Tiao-Hsing Tsai**, Yunghe (TW);
Cheng-Hsiung Wu, Kaohsiung (TW);
Chao-Hsu Wu, Lujhu Township,
Taoyuan County (TW)

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

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 371 days.

(21) Appl. No.: **12/789,647**

(22) Filed: **May 28, 2010**

(65) **Prior Publication Data**

US 2011/0128185 A1 Jun. 2, 2011

(30) **Foreign Application Priority Data**

Nov. 27, 2009 (TW) 98140596 A

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

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

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

See application file for complete search history.

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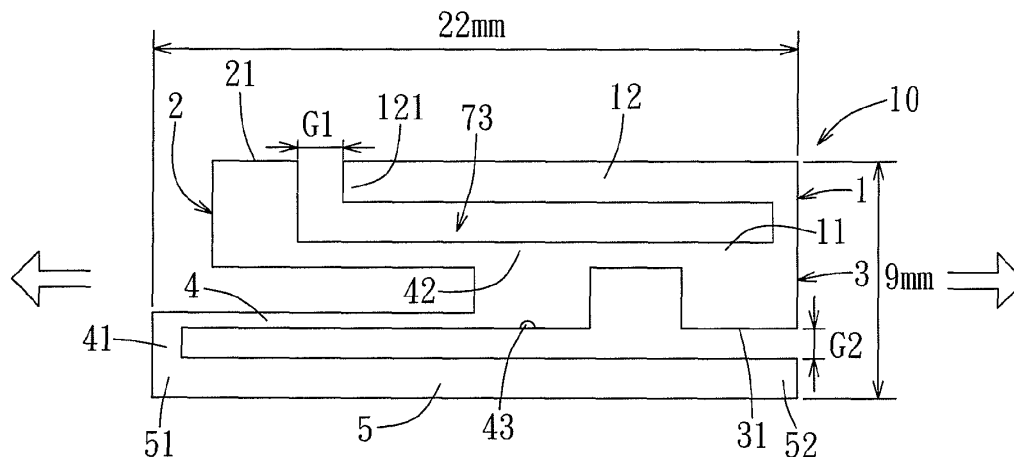
Primary Examiner — Tho G Phan

(74) *Attorney, Agent, or Firm* — Berenato & White, LLC

(57) **ABSTRACT**

A multi-band antenna includes a ground section, a feed-in section, a first conductor arm, and a second conductor arm. The feed-in section has a first end, a second end opposite to the first end, and a feed-in point for feeding in radio frequency signals. The first end of the feed-in section is connected electrically to the ground section. The first conductor arm has a connecting section that extends from the second end of the feed-in section, and an extending section that extends from the connecting section, that is distal from the ground section, and that has a first end portion. The second conductor arm extends from the second end of the feed-in section, and has a second end portion that is adjacent to the first end portion of the extending section.

12 Claims, 10 Drawing Sheets



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US008319692B2

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

(10) **Patent No.:** **US 8,319,692 B2**

(45) **Date of Patent:** ***Nov. 27, 2012**

(54) **CAVITY ANTENNA FOR AN ELECTRONIC DEVICE**

(75) Inventors: **Bing Chiang**, Cupertino, CA (US);
Gregory A. Springer, Sunnyvale, CA (US)

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

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **13/344,442**

(22) Filed: **Jan. 5, 2012**

(65) **Prior Publication Data**

US 2012/0105294 A1 May 3, 2012

Related U.S. Application Data

(63) Continuation of application No. 12/401,599, filed on Mar. 10, 2009, now Pat. No. 8,102,321.

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

(52) **U.S. Cl.** **343/702; 343/898**

(58) **Field of Classification Search** **343/702, 343/767, 898, 700 MS**

See application file for complete search history.

(56) **References Cited**

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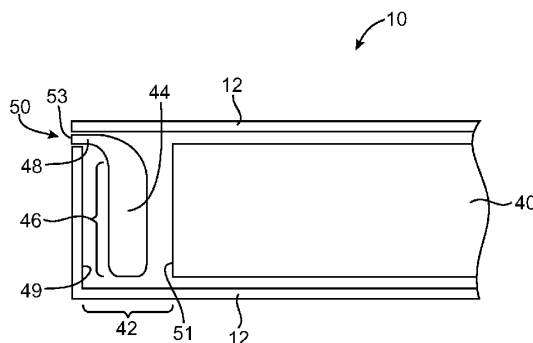
Primary Examiner — Hoanganh Le

(74) *Attorney, Agent, or Firm* — Treyz Law Group; G. Victor Treyz; David C. Kellogg

(57) **ABSTRACT**

A cavity antenna for an electronic device such as a portable computer is provided. The antenna may be formed from a conductive cavity and an antenna probe that serves as an antenna feed. The conductive cavity may have the shape of a folded rectangular cavity. A dielectric support structure may be used in forming the antenna cavity. A fin may protrude from one end of the dielectric support structure. The antenna probe may be formed from conductive structures mounted on the fin. An inverted-F antenna configuration or other antenna configuration may be used in forming the antenna probe. The electronic device may have a housing with conductive walls. When the cavity antenna mounted within an electronic device, a planar rectangular end face of the fin may protrude through a thin rectangular opening in the conductive walls to allow the antenna to operate without being blocked by the housing.

16 Claims, 12 Drawing Sheets



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US008319695B2

(12) **United States Patent**
Rofougaran

(10) **Patent No.:** **US 8,319,695 B2**

(45) **Date of Patent:** **Nov. 27, 2012**

(54) **ADJUSTABLE INTEGRATED CIRCUIT
ANTENNA STRUCTURE**

(75) Inventor: **Ahmadreza (Reza) Rofougaran**,
Newport Coast, CA (US)

(73) Assignee: **Broadcom Corporation**, Irvine, 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.: **13/114,443**

(22) Filed: **May 24, 2011**

(65) **Prior Publication Data**

US 2011/0221643 A1 Sep. 15, 2011

Related U.S. Application Data

(62) Division of application No. 11/648,825, filed on Dec.
29, 2006, now Pat. No. 7,973,730.

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

(52) **U.S. Cl.** **343/750; 343/700 MS; 343/745;**
343/751

(58) **Field of Classification Search** 343/700,
343/702, 745, 750, 751

See application file for complete search history.

(56) **References Cited**

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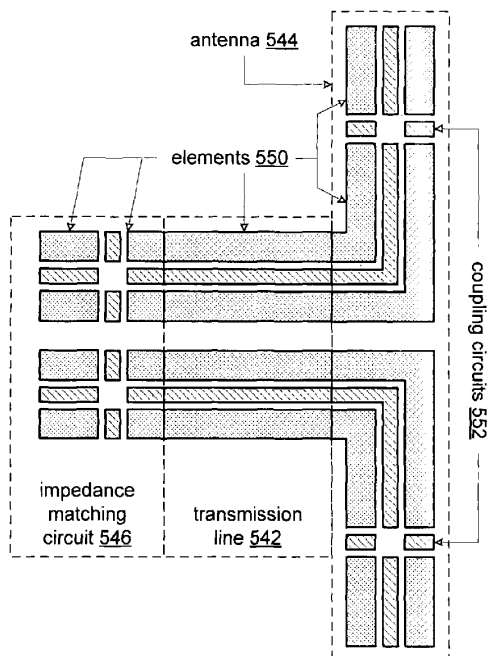
Primary Examiner — Tho G Phan

(74) *Attorney, Agent, or Firm* — Garlick & Markison; Holly
L. Rudnick

(57) **ABSTRACT**

An adjustable integrated circuit antenna structure includes an antenna, a ground plane, a plurality of transmission line circuit elements and a coupling circuit. The coupling circuit is operable to couple at least one of the plurality of transmission line circuit elements into a transmission line circuit based on a transmission line characteristic signal. The transmission line circuit has at least one of a bandwidth, an impedance, a quality factor, and a frequency band in accordance with the transmission line circuit characteristic signal.

20 Claims, 38 Drawing Sheets



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US008320850B1

(12) **United States Patent**
Khlat

(10) **Patent No.:** **US 8,320,850 B1**
(45) **Date of Patent:** **Nov. 27, 2012**

(54) **POWER CONTROL LOOP USING A TUNABLE ANTENNA MATCHING CIRCUIT**

(75) Inventor: **Nadim Khlat**, Cugnaux (FR)

(73) Assignee: **RF Micro Devices, Inc.**, Greensboro, NC (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.: **12/726,817**

(22) Filed: **Mar. 18, 2010**

Related U.S. Application Data

(60) Provisional application No. 61/161,333, filed on Mar. 18, 2009.

(51) **Int. Cl.**
H03C 1/52 (2006.01)
H01Q 11/12 (2006.01)
H04B 1/04 (2006.01)
(52) **U.S. Cl.** **455/107; 455/123**
(58) **Field of Classification Search** **455/522, 455/77, 107, 120, 121, 123, 125, 127.1, 127.2**
See application file for complete search history.

(56) References Cited

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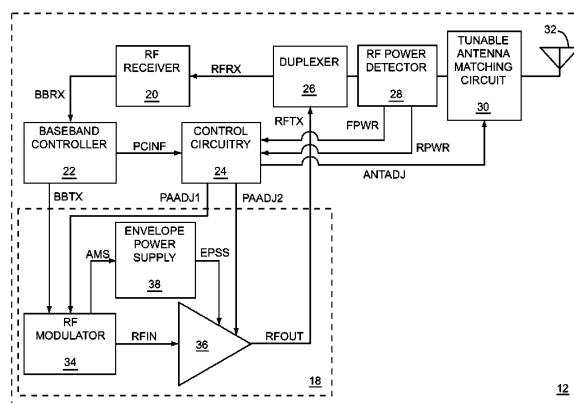
Primary Examiner — Nguyen Vo

(74) Attorney, Agent, or Firm — Withrow & Terranova, P.L.L.C.

(57) **ABSTRACT**

The present disclosure relates to combining tunable antenna matching circuit adjustments and RF power amplifier output power adjustments of a first RF terminal in response to output power adjustment commands received from a second RF terminal. The output power adjustment commands may be part of an output power control loop between the first RF terminal and the second RF terminal to control the output power from the first RF terminal. The first RF terminal may include an RF receiver, an RF power amplifier, and a tunable antenna matching circuit coupled between an output of the RF power amplifier and an antenna. The tunable antenna matching circuit adjustments may be impedance adjustments of the tunable antenna matching circuit and the RF power amplifier output power adjustments may result from adjustments to one or more input signals to the RF power amplifier.

22 Claims, 11 Drawing Sheets



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US008320980B2

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

(10) **Patent No.:** **US 8,320,980 B2**

(45) **Date of Patent:** **Nov. 27, 2012**

(54) **ANTENNA ASSEMBLY OF MOBILE TERMINAL**

(75) Inventors: **Jong Deok Lee**, Suwon-si (KR); **Sang Up Lee**, Yongin-si (KR)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 321 days.

(21) Appl. No.: **12/455,535**

(22) Filed: **Jun. 3, 2009**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

Jun. 5, 2008 (KR) 10-2008-0052931

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

(52) **U.S. Cl.** **455/575.7**; 455/550.1; 455/575.1;
455/575.3; 455/575.4; 343/702

(58) **Field of Classification Search** 455/575.7,
455/550.1, 575.1, 575.3, 575.4; 343/702
See application file for complete search history.

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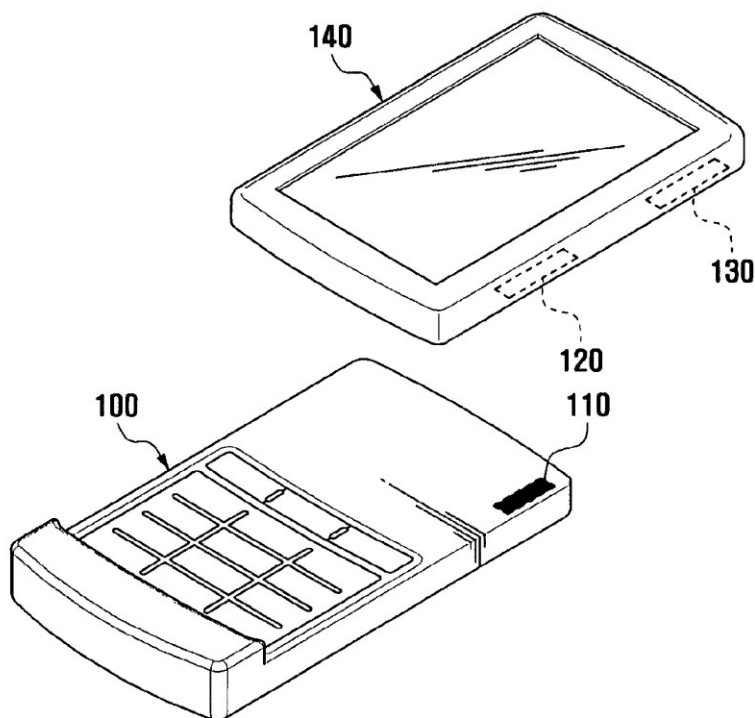
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Primary Examiner — Temica M Beamer

(57) **ABSTRACT**

An antenna assembly of a mobile terminal is provided. The antenna assembly of a mobile terminal includes: a main antenna disposed at a side of the mobile terminal; a first coupling antenna coupled to the main antenna in a first mechanical state of the mobile terminal; and a second coupling antenna coupled to the main antenna in a second mechanical state according to a mechanical operation of the mobile terminal.

20 Claims, 11 Drawing Sheets



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US008325091B2

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

(10) **Patent No.:** **US 8,325,091 B2**

(45) **Date of Patent:** **Dec. 4, 2012**

(54) **DUAL-BAND ANTENNA**

(75) Inventors: **Ping Li**, Shanghai (CN); **Chong Zhang**, Shanghai (CN); **Cho-Ju Chung**, Taipei Hsien (TW)

(73) Assignees: **Ambit Microsystems (Shanghai) Ltd.**, Shanghai (CN); **Hon Hai Precision Industry Co., Ltd.**, Tu-Cheng, New Taipei (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 393 days.

(21) Appl. No.: **12/758,032**

(22) Filed: **Apr. 12, 2010**

(65) **Prior Publication Data**
US 2011/0187618 A1 Aug. 4, 2011

(30) **Foreign Application Priority Data**
Feb. 2, 2010 (CN) 2010 2 0302141 U

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

(52) **U.S. CL.** **343/700 MS; 343/767**

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

(56) **References Cited**

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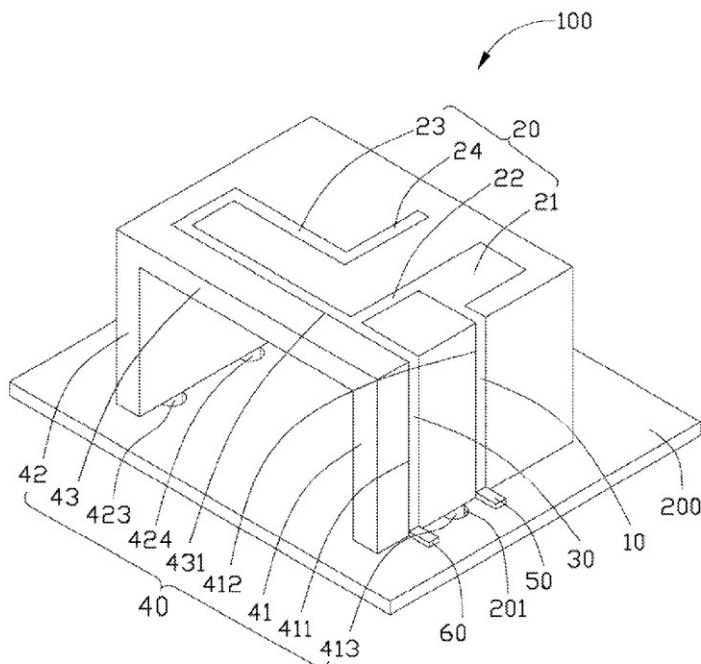
Primary Examiner — Tho G Phan

(74) *Attorney, Agent, or Firm* — Altis Law Group, Inc.

(57) **ABSTRACT**

A dual-band antenna includes a feeding portion, a radiating portion, a grounding portion, and an insulating support portion. The insulating support portion includes a first support wall, a second support wall, and a third support wall. The third support wall is parallel to the substrate, and perpendicularly connected to the first support wall and the second support wall, to position the radiating portion.

7 Claims, 2 Drawing Sheets



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US008325093B2

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

(10) **Patent No.:** **US 8,325,093 B2**

(45) **Date of Patent:** **Dec. 4, 2012**

(54) **PLANAR ULTRA WIDEBAND MODULAR ANTENNA ARRAY**

(75) Inventors: **Steven S. Holland**, Amherst, MA (US);
Marinos N. Vouvakis, Amherst, MA (US)

(73) Assignee: **University of Massachusetts**, Boston, MA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 121 days.

(21) Appl. No.: **12/848,301**

(22) Filed: **Aug. 2, 2010**

(65) **Prior Publication Data**

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Related U.S. Application Data

(60) Provisional application No. 61/230,271, filed on Jul. 31, 2009.

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

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

(58) **Field of Classification Search** 343/700 MS, 343/702, 846, 829-830, 848, 853
See application file for complete search history.

(56) **References Cited**

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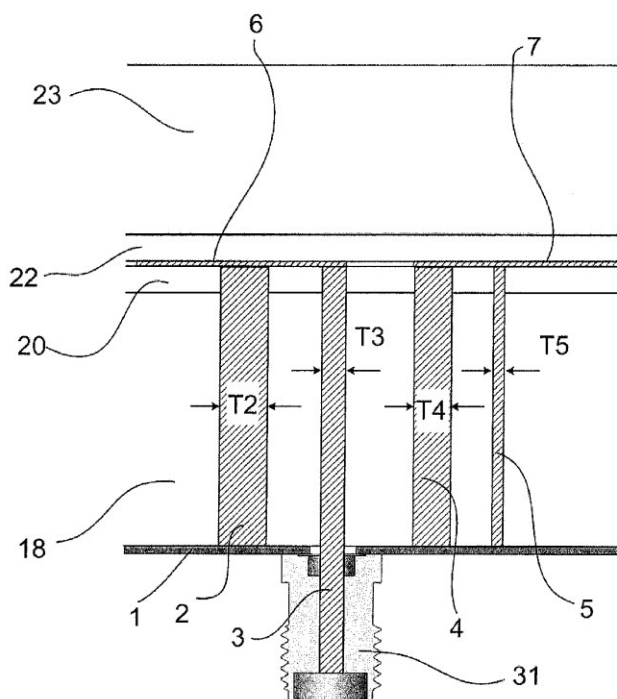
Primary Examiner — Huedung Mancuso

(74) *Attorney, Agent, or Firm* — Brian M. Dingman; Mirick, O'Connell, DeMallie & Lougee, LLP

(57) **ABSTRACT**

A planar ultrawideband modular antenna for connection to a feed network. The antenna has a ground plane, and an array of antenna elements spaced from the ground plane, each antenna element comprising a pair of arms. A first fed arm is electrically coupled to the feed network. The grounded arm is directly electrically coupled to the ground plane. There are one or more conductors such as conductive vias electrically connecting the fed arm to the ground plane, and optionally there are one or more additional conductors electrically connecting the grounded arm to the ground plane.

29 Claims, 28 Drawing Sheets



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US008325094B2

(12) **United States Patent**
Ayala Vazquez et al.

(10) **Patent No.:** **US 8,325,094 B2**

(45) **Date of Patent:** **Dec. 4, 2012**

(54) **DIELECTRIC WINDOW ANTENNAS FOR ELECTRONIC DEVICES**

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 688 days.

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(22) Filed: **Jun. 17, 2009**

(65) **Prior Publication Data**

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(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, 767, 770**
See application file for complete search history.

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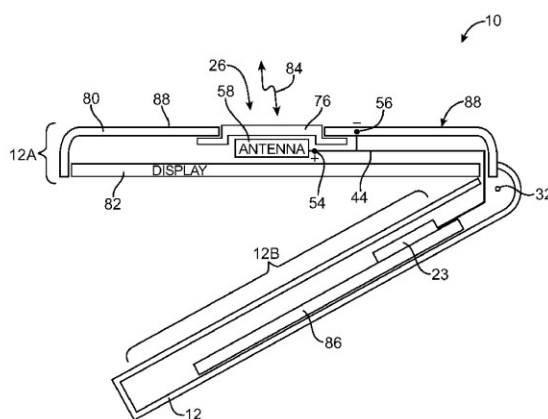
Primary Examiner — Hoanganh Le

(74) *Attorney, Agent, or Firm* — Treyz Law Group; G. Victor Treyz; David C. Kellogg

(57) **ABSTRACT**

Logo antennas are provided for electronic devices such as portable computers. An electronic device may have a housing with conductive housing walls. A logo antenna may be formed from an antenna resonating element such as a patch antenna resonating element, a monopole antenna resonating element, or other antenna resonating element structure. A conductive cavity may be placed behind the antenna resonating element. A dielectric antenna window that serves as a logo may be used to cover the antenna resonating element. The dielectric antenna window may be mounted in an opening in the conductive housing walls. A positive antenna feed terminal may be coupled to the antenna resonating element. A ground antenna feed terminal may be coupled to the cavity and portions of the conductive housing walls. The dielectric antenna window may be shaped in the form of a logo.

11 Claims, 10 Drawing Sheets



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US008325095B2

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

(10) **Patent No.:** **US 8,325,095 B2**

(45) **Date of Patent:** **Dec. 4, 2012**

(54) **ANTENNA ELEMENT AND PORTABLE RADIO**

(75) Inventors: **Tomoaki Nishikido**, Sendai (JP);
Hironori Kikuchi, Sendai (JP); **Yoshio Koyanagi**, Yokohama (JP); **Kenichi Sato**, Sendai (JP); **Hiroaki Ohmori**, Sendai (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 364 days.

(21) Appl. No.: **12/672,391**

(22) PCT Filed: **Aug. 10, 2007**

(86) PCT No.: **PCT/JP2007/065751**

§ 371 (c)(1),
(2), (4) Date: **Feb. 5, 2010**

(87) PCT Pub. No.: **WO2009/022389**

PCT Pub. Date: **Feb. 19, 2009**

(65) **Prior Publication Data**

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

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

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

See application file for complete search history.

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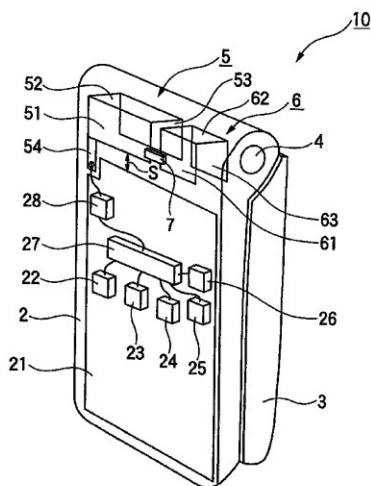
Primary Examiner — Hoang V Nguyen

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

(57) **ABSTRACT**

There is provided an antenna element capable of implementing miniaturization, acquisition of a high gain, and broadening of a band and coping with multiple bands. The antenna element includes a first antenna element 5 having shape of a box (a rectangular-parallelepiped shape) in which a first conductor plate 51, a second conductor plate 52, and a third conductor plate 53 are arranged so as to define at least three surfaces of a substantial rectangular parallelepiped and in which electric power is fed from a substantial corner of a lower circuit board (a ground plate) 21 to the first conductor plate 51; and a second antenna element 6 having shape of a box (a rectangular-parallelepiped shape) in which a fourth conductor plate 61, a fifth conductor plate 62, and a sixth conductor plate 63 are arranged so as to define at least three surfaces of a substantial rectangular parallelepiped, the fourth conductor plate 61 being connected by way of a resonance circuit 7 to the first antenna element 5 at a portion thereof apart from a feeding point of the first antenna element 5.

5 Claims, 6 Drawing Sheets



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US008325096B2

(12) **United States Patent**
Ayala Vazquez et al.

(10) **Patent No.:** **US 8,325,096 B2**
(45) **Date of Patent:** ***Dec. 4, 2012**

(54) **CLUTCH BARREL ANTENNA FOR
WIRELESS ELECTRONIC DEVICES**

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Kough, San Jose, CA (US)

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

This patent is subject to a terminal dis-
claimer.

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(21) Appl. No.: **13/269,150**

(22) Filed: **Oct. 7, 2011**

(65) **Prior Publication Data**

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Related U.S. Application Data

(63) Continuation of application No. 12/238,385, filed on
Sep. 25, 2008, now Pat. No. 8,059,039.

(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, 767, 770

See application file for complete search history.

(56) **References Cited**

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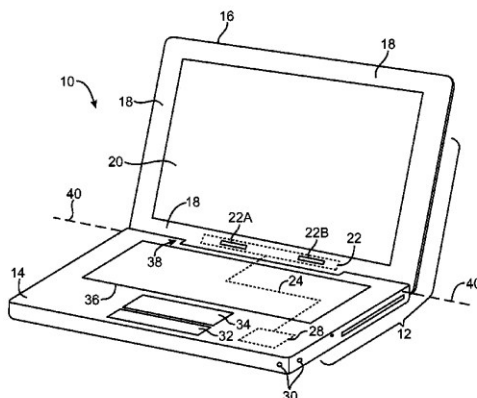
Primary Examiner — Hoanganh Le

(74) *Attorney, Agent, or Firm* — Treyz Law Group; G. Victor
Treyz; David C. Kellogg

(57) **ABSTRACT**

Wireless portable electronic devices such as laptop comput-
ers are provided with antennas. An antenna may be provided
within a clutch barrel in a laptop computer. The clutch barrel
may have a dielectric cover. Antenna elements may be
mounted within the clutch barrel cover on an antenna support
structure. There may be two or more antenna elements
mounted to the antenna support structure. These antenna ele-
ments may be of different types. A first antenna element for
the clutch barrel antenna may be formed from a dual band
antenna element having a closed slot and an open slot. A
second antenna element for the clutch barrel antenna may be
formed from a dual band antenna element of a hybrid type
having a planar resonating element arm and a slot resonating
element. Flex circuit structures may be used in implanting the
first and second antenna elements for the clutch barrel
antenna.

21 Claims, 13 Drawing Sheets



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US008325101B2

(12) **United States Patent**
Payne

(10) **Patent No.:** **US 8,325,101 B2**

(45) **Date of Patent:** **Dec. 4, 2012**

(54) **CROSS-DIPOLE ANTENNA
CONFIGURATIONS**

(75) Inventor: **William Ernest Payne**, Dallas, GA (US)

(73) Assignee: **Venti Group, LLC**, Laguna Hills, CA
(US)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
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(21) Appl. No.: **12/841,048**

(22) Filed: **Jul. 21, 2010**

(65) **Prior Publication Data**

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Related U.S. Application Data

(63) Continuation-in-part of application No. 12/784,992,
filed on May 21, 2010, which is a continuation-in-part
of application No. 12/534,703, filed on Aug. 3, 2009.

(51) **Int. Cl.**
H01Q 21/28 (2006.01)

(52) **U.S. Cl.** **343/797; 343/792**

(58) **Field of Classification Search** **343/797,**
343/793, 792

See application file for complete search history.

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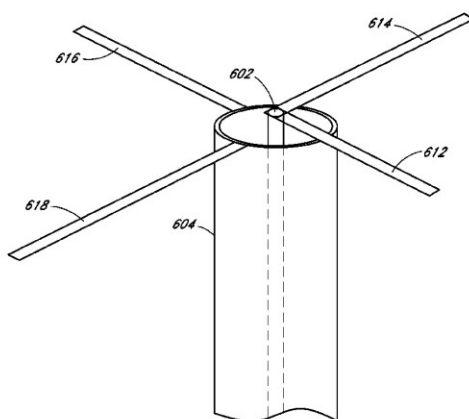
Primary Examiner — Hoang V Nguyen

(74) *Attorney, Agent, or Firm* — Knobbe Martens Olson &
Bear LLP

(57) **ABSTRACT**

An apparatus has an improved antenna pattern for a cross
dipole antenna. Such antennas desirably have an omnidirec-
tional antenna pattern. Conventional cross dipole antennas
exhibit nulls in their antenna patterns, which can cause anten-
nas to deviate from a standard or specification. Applicant
recognized and confirmed that the connection of a coaxial
cable to the antenna arms is a cause of the nulls in the antenna
pattern, and has devised techniques disclosed herein to com-
pensate or cancel the effects of the connection. In one em-
bodiment, the arms of the cross dipole antenna that are
coupled to a center conductor of the coaxial cable remain of
conventional length, but the arms of the cross dipole antenna
that are coupled to a shield of the coaxial cable are lengthened
by a fraction of the radius of the outer diameter of the coaxial
cable.

62 Claims, 15 Drawing Sheets



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US008325103B2

(12) **United States Patent**
Autti

(10) **Patent No.:** **US 8,325,103 B2**

(45) **Date of Patent:** **Dec. 4, 2012**

(54) **ANTENNA ARRANGEMENT**

(75) Inventor: **Marko Tapio Autti**, Oulu (FI)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 266 days.

(21) Appl. No.: **12/775,653**

(22) Filed: **May 7, 2010**

(65) **Prior Publication Data**

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H01Q 1/00 (2006.01)

H01Q 1/24 (2006.01)

(52) **U.S. Cl.** **343/904; 343/702**

(58) **Field of Classification Search** 343/904,
343/702, 700 MS, 846, 848
See application file for complete search history.

(56) **References Cited**

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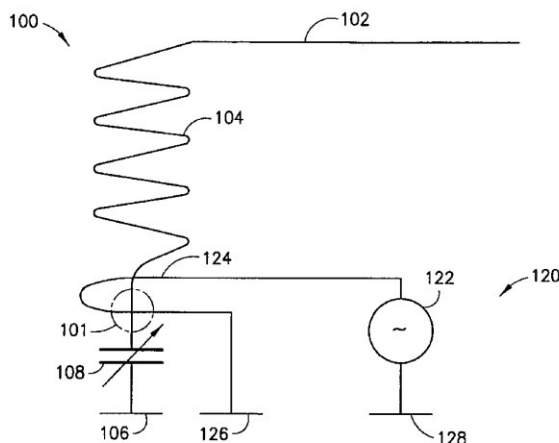
Primary Examiner — Hoanganh Le

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

(57) **ABSTRACT**

An apparatus such as for example an antenna sub-assembly includes a multiband antenna circuitry and feed circuitry. The multiband antenna circuitry includes a resonator; a first ground port configured to couple the resonator to a common voltage potential; and at least one reactive component disposed between the resonator and the first ground port. The feed circuitry includes: a signal feed port configured to couple to a radio; a second ground port configured to couple the feed circuitry to the common voltage potential; and a feeding element disposed between the signal feed port and the second ground port, the feeding element configured to inductively couple the feed circuitry to the antenna circuitry between the resonator and the first ground port. In some example embodiments there is a variable reactance to enable the resonator to be tunable. In those and/or other embodiments there is a second and even a third resonator for multi-band operation.

18 Claims, 6 Drawing Sheets



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US008325955B2

(12) **United States Patent**
Tang

(10) **Patent No.:** **US 8,325,955 B2**

(45) **Date of Patent:** **Dec. 4, 2012**

(54) **METHOD FOR IMPROVING
COMPATIBILITY OF HEARING AID WITH
ANTENNA**

(75) Inventor: **Chia-Lun Tang**, Pa-Te (TW)

(73) Assignee: **Auden Techno Corp.**, Tao-Yuan Hsien
(TW)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
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(65) **Prior Publication Data**

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H04R 25/00 (2006.01)

(52) **U.S. Cl.** **381/315**; 381/312; 381/313; 381/314;
381/316; 381/331

(58) **Field of Classification Search** 381/23.1,
381/315

See application file for complete search history.

(56) **References Cited**

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Primary Examiner — Fernando L Toledo

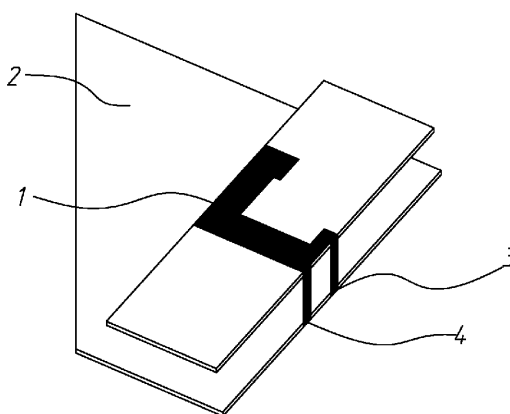
Assistant Examiner — Mohammed Shamsuzzaman

(74) *Attorney, Agent, or Firm* — Guice Patents PLLC

(57) **ABSTRACT**

A method for improving compatibility of a hearing aid with an antenna, in which at least a metal frame is provided near by a grounding surface of the antenna to change the direction of radiation of the antenna, thereby to enhance the directivity of the antenna on the side away from a hearing aid, and to reduce the quantity of radiation proceeding toward the hearing aid and to improve the near-field quantity (for about 3 dB) of an electric field of an HAC tested plane. This method can further increase the heights of the metal frames to reduce the near-field quantity of the electric field of HAC (hearing aid compatibility) tested plane.

5 Claims, 12 Drawing Sheets



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(12) **United States Patent**
Sato

(10) **Patent No.:** **US 8,326,235 B2**
(45) **Date of Patent:** **Dec. 4, 2012**

(54) **COMMUNICATION DEVICE**

(75) Inventor: **Masaru Sato**, Kawasaki (JP)

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

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(30) **Foreign Application Priority Data**

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(52) **U.S. Cl.** **455/78**; 455/82; 455/83; 327/308;
327/404; 333/103

(58) **Field of Classification Search** 455/39,
455/78, 82, 83; 327/308, 404; 333/81 R,
333/103

See application file for complete search history.

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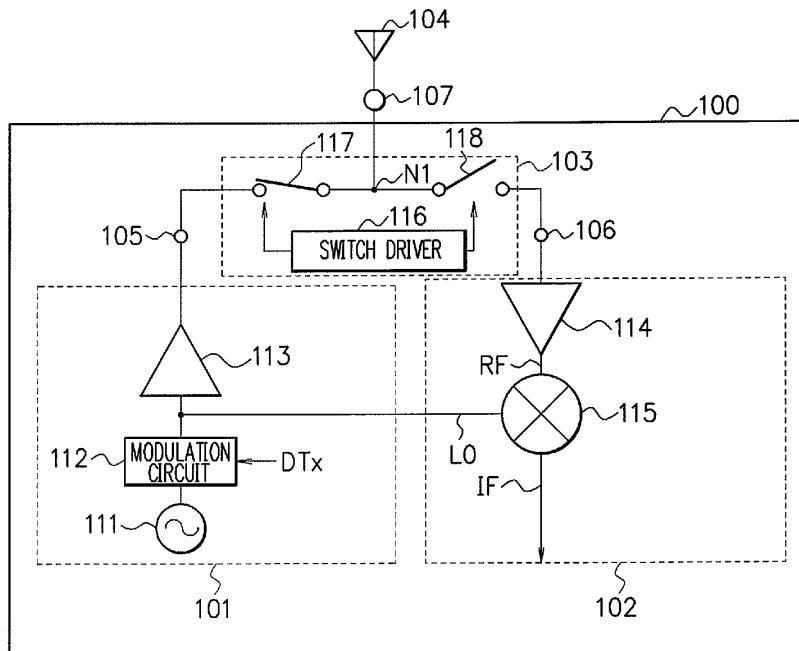
Primary Examiner — Tuan H Nguyen

(74) *Attorney, Agent, or Firm* — Kratz, Quintos & Hanson, LLP

(57) **ABSTRACT**

There is provided a communication device including: a first node connected to an antenna; a transmission unit outputting a signal to the antenna via the first node; a reception unit having a signal input thereto from the antenna via the first node; a first switch provided between the first node and the transmission unit; and a second switch provided between the first node and the reception unit, and in which the second switch is alternately turned on and off repeatedly, and the reception unit includes an amplifier amplifying a signal that the transmission unit outputs via the first and second switches and a mixer mixing a signal amplified in the amplifier and a local signal.

5 Claims, 7 Drawing Sheets



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US008326249B2

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

(10) **Patent No.:** **US 8,326,249 B2**
(45) **Date of Patent:** **Dec. 4, 2012**

(54) **METHODS AND APPARATUS FOR SUPPORTING COMMUNICATIONS USING A FIRST POLARIZATION DIRECTION ELECTRICAL ANTENNA AND A SECOND POLARIZATION DIRECTION MAGNETIC ANTENNA**

(75) Inventors: **Juergen Cezanne**, Ocean Township, NJ (US); **Saurabha R. Tavildar**, Jersey City, NJ (US); **Bikram Reddy Anreddy**, Bridgewater, NJ (US); **Xinzhou Wu**, Monmouth Junction, NJ (US); **Rajiv Laroia**, Far Hills, NJ (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 987 days.

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H04B 7/00 (2006.01)

(52) **U.S. Cl.** **455/272; 455/269**

(58) **Field of Classification Search** 455/269,
455/272, 274, 279.1, 63.4, 78, 83, 562.1,
455/575.7, 13.3, 25; 343/787, 701, 725,
343/726, 728, 732

See application file for complete search history.

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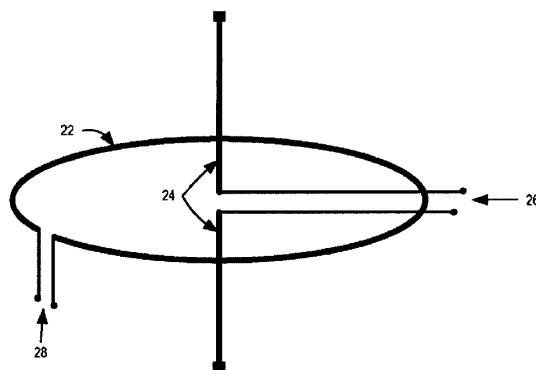
Primary Examiner — Eugene Yun

(74) *Attorney, Agent, or Firm* — Michelle Gallardo;
Nicholas J. Pauley; Jonathan T. Velasco

(57) **ABSTRACT**

A communications device, e.g., a mobile wireless terminal, includes a plurality of antennas having different associated polarization directions. The plurality of antennas includes an electrical antenna, e.g., a dipole antenna and a magnetic antenna, e.g., a loop antenna or a slot antenna. In one embodiment the electrical antenna is used for receiving and/or transmitting signals associated with a vertical polarization direction, while the magnetic antenna is used for receiving and/or transmitting signals associated with a horizontal polarization direction. In some embodiments different data streams are communicated concurrently via the electrical and magnetic antennas. Methods for operating the communications device to switch between the electrical and magnetic antennas and/or to control reception and/or transmission are described. The novel antenna configuration facilitates the use of the horizontal polarization direction communications between the communications device and a base station without the need for directionally azimuth positioning the magnetic antenna.

22 Claims, 19 Drawing Sheets



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US008326347B2

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

(10) **Patent No.:** **US 8,326,347 B2**
(45) **Date of Patent:** ***Dec. 4, 2012**

(54) **WIRELESS COMMUNICATION SYSTEM
INTEGRATED INTO A COMPUTER DISPLAY**

(75) Inventors: **Matthew J. Wagner**, Houston, TX (US);
Robin T. Castell, Spring, TX (US);
Timothy Neill, Houston, TX (US)

(73) Assignee: **Hewlett-Packard Development
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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.

This patent is subject to a terminal dis-
claimer.

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(21) Appl. No.: **13/448,114**

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(22) Filed: **Apr. 16, 2012**

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10/034,224, filed Dec. 28, 2001.

(65) **Prior Publication Data**

US 2012/0202564 A1 Aug. 9, 2012

(Continued)

Related U.S. Application Data

(63) Continuation of application No. 10/034,224, filed on
Dec. 28, 2001, now Pat. No. 8,185,147.

Primary Examiner — Marceau Milord

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

(52) **U.S. Cl.** **455/550.1**; 455/556.1; 455/557;
455/556.2; 455/575.7; 455/101; 455/423;
455/73; 343/702; 343/873; 343/346; 343/700 MS

(58) **Field of Classification Search** 455/556.1,
455/557, 73, 575.7, 423, 556.2, 550.1; 343/702,
343/700 MS, 846

See application file for complete search history.

(56) **References Cited**

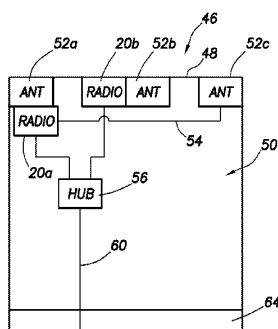
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(57) **ABSTRACT**

An electronic device has a display in which the casing of the display includes a plurality of recessed cavities into which radio and antenna modules can be inserted to provide the electronic device with a wireless communication capability. The display can have cavities for one or more radios and one or more antenna modules. A radio electrically connects to one or more antenna modules via conductor(s) contained within the display and connects to the host electronic device via a serial bus (e.g., USB). Accordingly, the display can have a plurality of radio/antenna combinations thereby concurrently providing the electronic device with multiple wireless communication capabilities.

13 Claims, 2 Drawing Sheets



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US008326376B2

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

(10) **Patent No.:** **US 8,326,376 B2**
(45) **Date of Patent:** **Dec. 4, 2012**

(54) **PORTABLE APPARATUS**

(75) Inventors: **Masahiro Kaneko**, Shinagawa (JP);
Masahiro Yanagi, Shinagawa (JP);
Hideki Iwata, Shinagawa (JP); **Takashi**
Yuba, Shinagawa (JP); **Shigemi**
Kurashima, Shinagawa (JP); **Yuriko**
Segawa, 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 752 days.

(21) Appl. No.: **11/528,313**

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

(65) **Prior Publication Data**
US 2007/0238492 A1 Oct. 11, 2007

(30) **Foreign Application Priority Data**
Apr. 11, 2006 (JP) 2006-108872

(51) **Int. Cl.**
H04W 74/00 (2009.01)
(52) **U.S. Cl.** **455/575.1**; 455/343.1; 455/343.2;
455/343.3; 455/343.5; 455/343.6; 343/849
(58) **Field of Classification Search** 455/573,
455/343.1, 575.1, 575.2, 575.3, 575.4, 575.5,
455/575.6; 343/700, 745, 829, 845, 846,
343/847, 848, 849
See application file for complete search history.

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classroom) discloses a background art of the present invention.

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Primary Examiner — Kamran Afshar

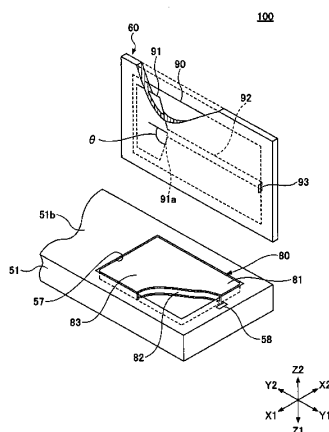
Assistant Examiner — Khalid Shaheed

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

(57) **ABSTRACT**

A portable apparatus including a flat antenna apparatus is
disclosed. The portable apparatus operates with a battery. The
flat antenna apparatus includes an antenna element and a
ground element, where the ground element is a surface of the
battery.

7 Claims, 8 Drawing Sheets



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US008326380B2

(12) **United States Patent**
Kaneoya

(10) **Patent No.:** **US 8,326,380 B2**

(45) **Date of Patent:** **Dec. 4, 2012**

(54) **FOLDABLE PORTABLE WIRELESS
COMMUNICATION APPARATUS**

(75) Inventor: **Masanori Kaneoya**, Musashimurayama
(JP)

(73) Assignee: **Casio Hitachi Mobile Communications
Co., Ltd.**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 1160 days.

(21) Appl. No.: **11/489,988**

(22) Filed: **Jul. 20, 2006**

(65) **Prior Publication Data**

US 2007/0021159 A1 Jan. 25, 2007

(30) **Foreign Application Priority Data**

Jul. 21, 2005 (JP) 2005-211695
Mar. 28, 2006 (JP) 2006-088117

(51) **Int. Cl.**

H04M 1/00 (2006.01)

H04Q 1/24 (2006.01)

(52) **U.S. Cl.** **455/575.3**; 455/90.3; 343/702

(58) **Field of Classification Search** 455/90.2,
455/90.3, 347, 575.1, 575.3; 343/702, 718,
343/700 MS, 906

See application file for complete search history.

(56) **References Cited**

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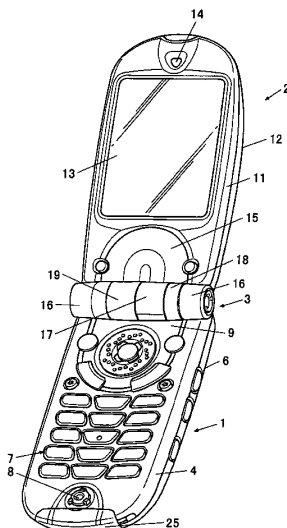
Primary Examiner — Quochien B Vuong

(74) *Attorney, Agent, or Firm* — Cozen O'Connor

(57) **ABSTRACT**

A foldable portable wireless communication apparatus which ensures miniaturization of housing and good antenna characteristic has first casing including transmitter and/or operation section, and second housing including receiver and/or display section and rotatably linked with the first casing through hinge section provided on one end portion of the first housing on the front face side thereof. An antenna board is provided in area at back of the hinge section inside the first housing, and a circuit board having a radio-frequency circuit section mounted thereon is provided in area not overlapping the hinge section inside the first housing. A connection conductor connecting the antenna board and the high frequency wave input/output point of the radio-frequency circuit section is configured into a monopole antenna by setting the direction of extension of the connection conductor in the lengthwise direction of the first housing in the vicinity of the high frequency wave input/output point.

11 Claims, 7 Drawing Sheets



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US008330655B2

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

(10) **Patent No.:** **US 8,330,655 B2**
(45) **Date of Patent:** **Dec. 11, 2012**

(54) **CONNECTORS WITH EMBEDDED ANTENNAS**

(75) Inventors: **Stephen P. Zadesky**, Portola Valley, CA (US); **Christopher D. Prest**, Mountain View, CA (US)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 586 days.

(21) Appl. No.: **12/543,457**

(22) Filed: **Aug. 18, 2009**

(65) **Prior Publication Data**

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

(52) **U.S. Cl.** **343/702; 343/906**

(58) **Field of Classification Search** **343/702, 343/767, 906**
See application file for complete search history.

(56) **References Cited**

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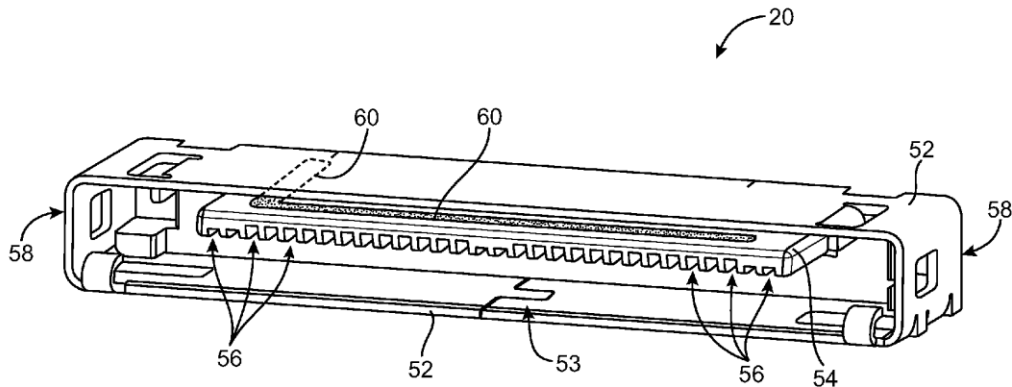
Primary Examiner — Tho G Phan

(74) *Attorney, Agent, or Firm* — Treyz Law Group; David C. Kellogg; G. Victor Treyz

(57) **ABSTRACT**

Connectors for electronic devices are provided with embedded antennas. The connectors may be 30-pin connectors. A 30-pin connector may have a conductive shell structure that defines a cavity and a planar dielectric member that extends into the cavity and that has contact pins. An antenna may be formed from an antenna resonating element on the planar dielectric member and an antenna ground formed from the conductive shell structure. An antenna may be formed from a slot in the conductive shell. The antenna and the pins may be electrically coupled to an electronic device using a cable.

20 Claims, 6 Drawing Sheets



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US008330656B2

(12) **United States Patent**
Chiu

(10) **Patent No.:** **US 8,330,656 B2**
(45) **Date of Patent:** **Dec. 11, 2012**

(54) **ELECTRONIC DEVICE AND FIXING
STRUCTURE THEREOF**

(75) Inventor: **Yi-Tsung Chiu**, Tao Yuan Shien (TW)

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

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 635 days.

(21) Appl. No.: **12/545,985**

(22) Filed: **Aug. 24, 2009**

(65) **Prior Publication Data**

US 2010/0277375 A1 Nov. 4, 2010

(30) **Foreign Application Priority Data**

Apr. 29, 2009 (TW) 98207231 U

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H01Q 1/24 (2006.01)

(52) **U.S. Cl.** **343/702; 343/878**

(58) **Field of Classification Search** **343/702,**
343/878

See application file for complete search history.

(56) **References Cited**

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Primary Examiner — Hoang V Nguyen

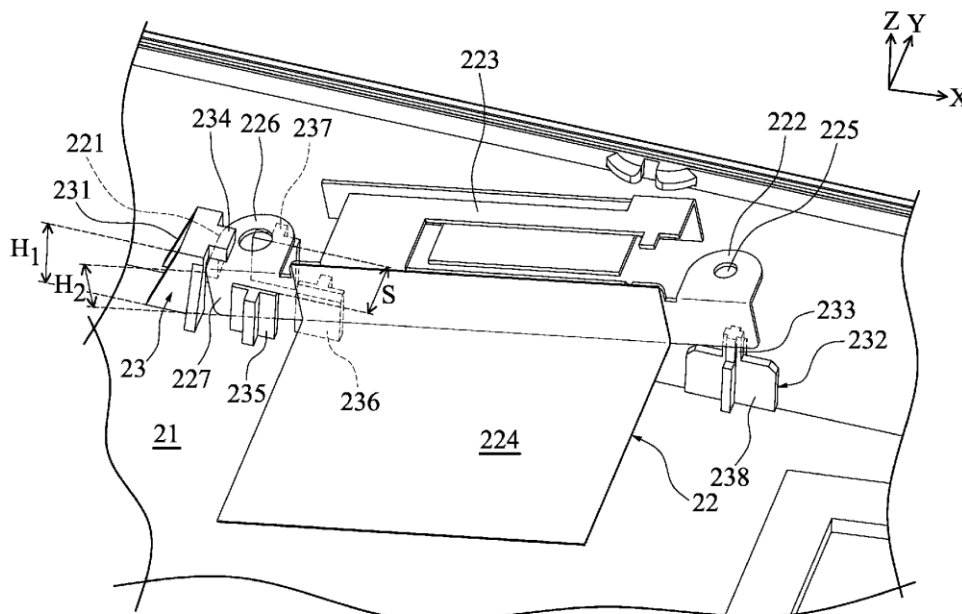
Assistant Examiner — Kyana R McCain

(74) *Attorney, Agent, or Firm* — McClure, Qualey &
Rodack, LLP

(57) **ABSTRACT**

An electronic device and a fixing module are provided. The electronic device further includes a housing and an antenna module. The antenna module includes an antenna, a first engaging portion and a second engaging portion. The first engaging portion and the second engaging portion are installed on two ends of the antenna. The first engaging portion includes an upper surface. The fixing module installed on the housing includes a first limiting element and a second limiting element. When the antenna module is fixed with the fixing module, the first limiting element is engaged with the first engaging portion, and the second limiting element is engaged with the second limiting element. The first limiting element includes a protrusion. When the antenna module is fixed with the fixing module, the protrusion covers the upper surface of the first engaging portion.

16 Claims, 5 Drawing Sheets



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US008330657B2

(12) **United States Patent**
Liu

(10) **Patent No.:** **US 8,330,657 B2**

(45) **Date of Patent:** **Dec. 11, 2012**

(54) **ANTENNA AND PORTABLE WIRELESS COMMUNICATION DEVICE USING THE SAME**

(75) Inventor: **Chien-Chang Liu**, Tu-Cheng (TW)

(73) Assignee: **Chi Mei Communications Systems, Inc.**, Tu-Cheng, New Taipei (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 391 days.

(21) Appl. No.: **12/627,056**

(22) Filed: **Nov. 30, 2009**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

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

(52) **U.S. Cl.** **343/702; 34/702; 34/700 MS**

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

See application file for complete search history.

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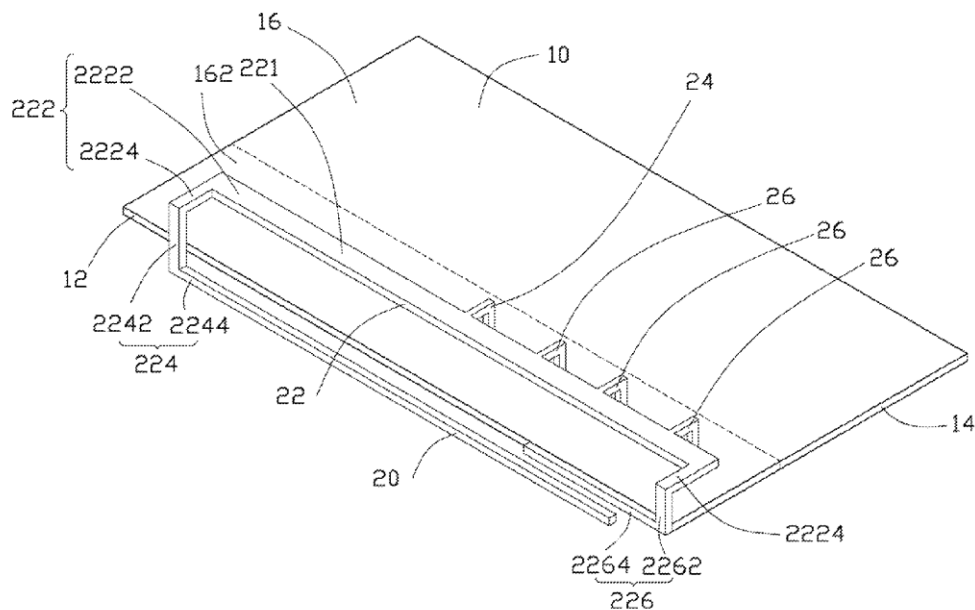
Primary Examiner — Dieu H Duong

(74) *Attorney, Agent, or Firm* — Altis Law Group, Inc.

(57) **ABSTRACT**

A portable wireless communication device includes a base circuit board, an antenna, and a switch. The base circuit board is a printed circuit board including a feed point and a ground point. The antenna is disposed on the base circuit board including a radiating portion, a feed portion, and a plurality of ground portions. The feed portion electrically connected to the feed point. The switch is electrically connected between the ground point and the plurality of ground portions to choose one ground portion to electrically connect to the ground point and obtain wide working frequency bands.

16 Claims, 6 Drawing Sheets



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US008330658B2

(12) **United States Patent**
Ishii

(10) **Patent No.:** **US 8,330,658 B2**
(45) **Date of Patent:** **Dec. 11, 2012**

(54) **PORTABLE COMMUNICATION DEVICE**

(75) Inventor: **Junichi Ishii**, Tokyo (JP)

(73) Assignee: **NEC 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 311 days.

(21) Appl. No.: **12/672,626**

(22) PCT Filed: **Oct. 17, 2008**

(86) PCT No.: **PCT/JP2008/068823**

§ 371 (c)(1),

(2), (4) Date: **Feb. 8, 2010**

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(30) **Foreign Application Priority Data**

Oct. 18, 2007 (JP) 2007-270853

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

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

(58) **Field of Classification Search** **343/702, 343/876; 455/575.1, 575.4, 575.7**

See application file for complete search history.

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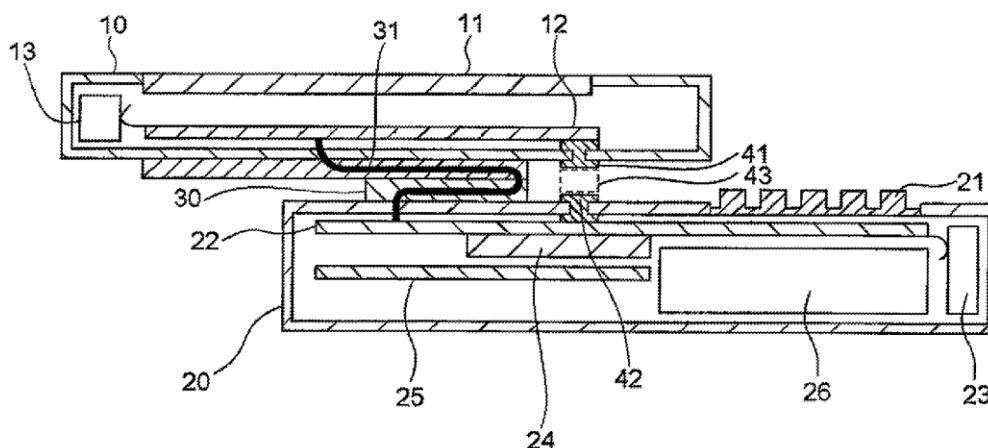
Primary Examiner — Hoang V Nguyen

(57)

ABSTRACT

A portable communication device includes a first housing and a second housing that are slidably placed one on another and can shift between an open state and a closed state, a wireless circuit installed in the first housing, a first antenna installed in the second housing, and a noncontact switching member that connects together the first antenna and the wireless circuit in a noncontact manner in the open state and disconnects the noncontact between the first antenna and the wireless circuit in the closed state.

7 Claims, 14 Drawing Sheets



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US008330665B2

(12) United States Patent
Kaikkonen et al.**(10) Patent No.: US 8,330,665 B2****(45) Date of Patent: Dec. 11, 2012****(54) ANTENNA DEVICE AND PORTABLE RADIO COMMUNICATION DEVICE COMPRISING SUCH ANTENNA DEVICE**2008/0224943 A1 * 9/2008 Konaka 343/876
2009/0251383 A1 10/2009 Tani et al.**FOREIGN PATENT DOCUMENTS****(76) Inventors:** **Andrei Kaikkonen**, Järfälla (SE); **Peter Lindberg**, Uppsala (SE); **Axel von Arbin**, Täby (SE)EP 1120855 8/2001
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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 322 days.**OTHER PUBLICATIONS****(21) Appl. No.: 12/745,230**

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(22) PCT Filed: Nov. 25, 2008

(Continued)

(86) PCT No.: PCT/SE2008/051342§ 371 (c)(1),
(2), (4) Date: **Jun. 9, 2010***Primary Examiner* — Douglas W Owens*Assistant Examiner* — Collin Dawkins**(87) PCT Pub. No.: WO2009/070100****(74) Attorney, Agent, or Firm** — Harness, Dickey & Pierce, P.L.C.PCT Pub. Date: **Jun. 4, 2009****(65) Prior Publication Data**

US 2010/0302114 A1 Dec. 2, 2010

(30) Foreign Application Priority Data

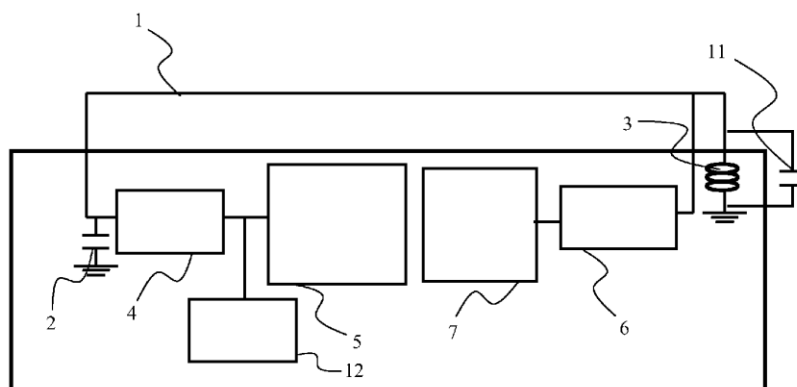
Nov. 30, 2007 (EP) 07445044

(51) Int. Cl.
H01Q 1/00 (2006.01)**(52) U.S. Cl.** 343/722; 343/752; 343/741**(58) Field of Classification Search** 343/722,
343/752, 741, 702

See application file for complete search history.

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2002/0118075 A1 * 8/2002 Ohwada et al. 333/32**(57) ABSTRACT**

The present invention relates to an antenna device for a portable radio communication device adapted for receiving and/or transmitting radio signals in at least a first and a second operating frequency band, said antenna device comprising a half-loop radiating element, comprising a feeding portion and a grounding portion, and arranged to operate at FM frequencies. The antenna device comprises a capacitor at said feeding portion and an inductor at said grounding portion, and said half-loop radiating element is arranged to simultaneously with FM frequencies operate at frequencies at least ten times higher than FM frequencies, wherein said capacitor is arranged to short circuit said half-loop radiating element to ground for frequencies at least ten times higher than FM frequencies and said inductor is arranged to short circuit said half-loop radiating element to ground for FM frequencies.

17 Claims, 2 Drawing Sheets

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US008330666B2

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

(10) **Patent No.:** **US 8,330,666 B2**
(45) **Date of Patent:** **Dec. 11, 2012**

(54) **MULTIBAND ANTENNA**

(75) Inventors: **Tun-Yuan Tsou**, Tu-Cheng (TW);
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(73) Assignee: **Chi Mei Communications Systems, Inc.**, Tu-Cheng, New Taipei (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 464 days.

(21) Appl. No.: **12/693,641**

(22) Filed: **Jan. 26, 2010**

(65) **Prior Publication Data**
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(30) **Foreign Application Priority Data**
Jun. 8, 2009 (CN) 2009 1 0303052

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

(52) **U.S. Cl.** **343/726; 343/730**

(58) **Field of Classification Search** 343/726,
343/727, 728, 729, 730, 700 MS
See application file for complete search history.

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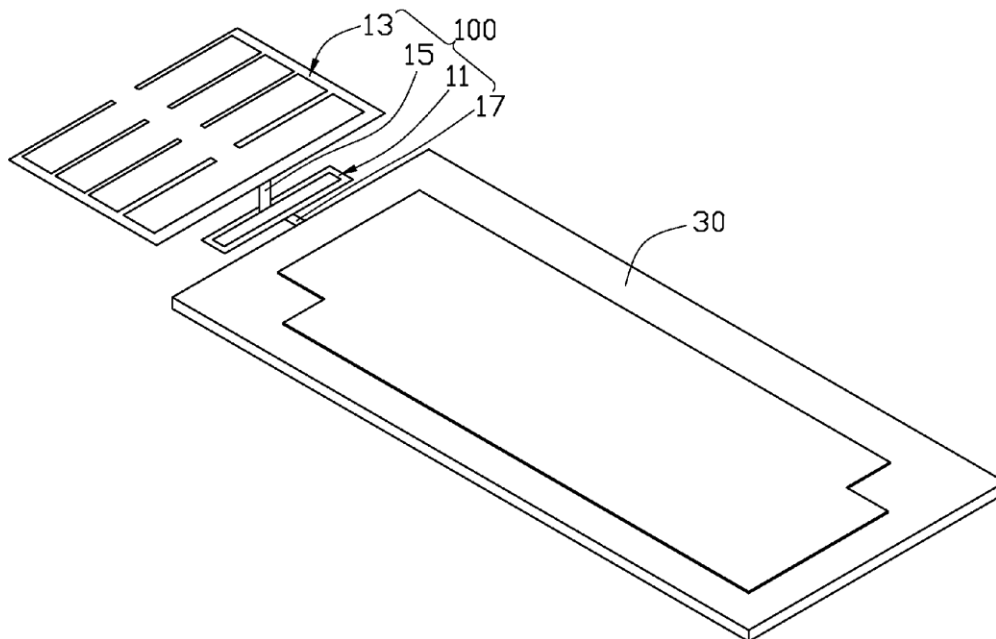
Primary Examiner — Hoanganh Le

(74) *Attorney, Agent, or Firm* — Altis Law Group, Inc.

(57) **ABSTRACT**

A multiband antenna includes a first radio unit closed loop and a second radio unit connected to the first radio unit and symmetrical structure. When the multiband antenna functions, the first radio unit functions as a balanced loop antenna, and the second radio unit functions as a dipole antenna.

18 Claims, 4 Drawing Sheets



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US008330668B2

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

(10) **Patent No.:** **US 8,330,668 B2**
(45) **Date of Patent:** ***Dec. 11, 2012**

(54) **DUAL STAGGER OFF SETTABLE AZIMUTH
BEAM WIDTH CONTROLLED ANTENNA
FOR WIRELESS NETWORK**

(75) Inventors: **Gang Yi Deng**, Irvine, CA (US); **Bill Vassilakis**, Orange, CA (US); **Matthew J. Hunton**, Liberty Lake, WA (US); **Alexander Rabinovich**, Cypress, CA (US); **Nando Hunt**, Newport Beach, 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 323 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **12/080,483**

(22) Filed: **Apr. 3, 2008**

(65) **Prior Publication Data**

US 2008/0246681 A1 Oct. 9, 2008

Related U.S. Application Data

(60) Provisional application No. 60/922,130, filed on Apr. 6, 2007.

(51) **Int. Cl.**
H01Q 19/06 (2006.01)
H01Q 3/12 (2006.01)
H01Q 21/00 (2006.01)

(52) **U.S. Cl.** **343/754; 343/761; 343/835; 343/839; 343/853; 343/893; 343/796; 343/797**

(58) **Field of Classification Search** **343/754, 343/761, 835, 839, 853**

See application file for complete search history.

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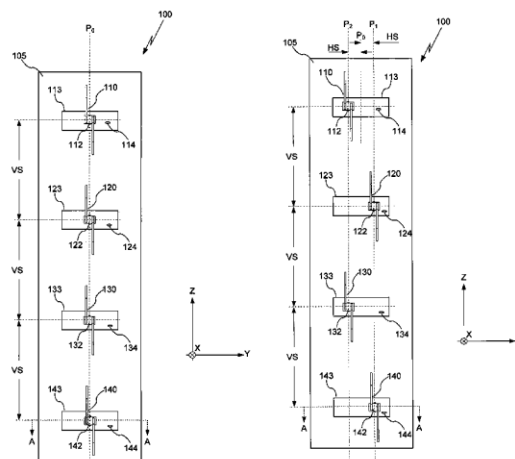
Primary Examiner — Trinh Dinh

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

(57) **ABSTRACT**

An antenna adapted for wireless networks and having a variably controlled stagger antenna array architecture is disclosed. The antenna array contains a plurality of driven radiating elements that are spatially arranged having each radiating element or element groups orthogonally movable relative to a main vertical axis so as to provide a controlled variation of the antenna array's azimuth radiation pattern.

14 Claims, 8 Drawing Sheets



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US008334810B2

(12) **United States Patent**
Foo

(10) **Patent No.:** **US 8,334,810 B2**
(45) **Date of Patent:** **Dec. 18, 2012**

(54) **RESONANT CAP LOADED HIGH GAIN
PATCH ANTENNA**

(75) Inventor: **Senglee Foo**, 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 625 days.

(21) Appl. No.: **12/490,212**

(22) Filed: **Jun. 23, 2009**

(65) **Prior Publication Data**

US 2009/0322642 A1 Dec. 31, 2009

Related U.S. Application Data

(60) Provisional application No. 61/133,147, filed on Jun.
25, 2008.

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

(52) **U.S. Cl.** **343/700 MS; 343/893**

(58) **Field of Classification Search** **343/700 MS,**
343/702, 816, 893
See application file for complete search history.

(56) **References Cited**

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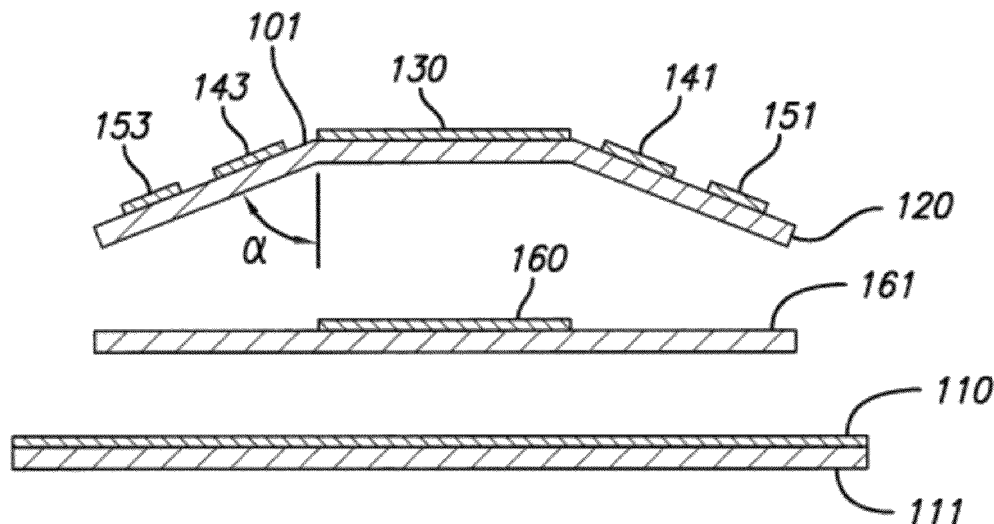
Primary Examiner — Hoanganh Le

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

(57) **ABSTRACT**

An antenna architecture containing a broadband resonant cap
positioned over a radiating patch is disclosed. The resonant
cap consists of a rectangular resonant patch at the center with
parasitic patches in close proximity of the four edges of the
resonant patch. The parasitic patches may be coplanar with
the resonant patch or may be mounted at an angle with respect
to the vertical axis of the resonant patch. The resonant cap
reduces the HPBW of the emitted radiation and improves
emission directivity.

16 Claims, 3 Drawing Sheets



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US008334812B2

(12) **United States Patent**
Brannan

(10) **Patent No.:** **US 8,334,812 B2**

(45) **Date of Patent:** **Dec. 18, 2012**

(54) **MICROWAVE ABLATION ANTENNA
RADIATION DETECTOR**

(75) Inventor: **Joseph D. Brannan**, Erie, CO (US)

(73) Assignee: **Vivant Medical, Inc.**, Boulder, CO (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 686 days.

(21) Appl. No.: **12/542,785**

(22) Filed: **Aug. 18, 2009**

(65) **Prior Publication Data**

US 2010/0321257 A1 Dec. 23, 2010

Related U.S. Application Data

(63) Continuation-in-part of application No. 12/487,917, filed on Jun. 19, 2009.

(51) **Int. Cl.**
G01R 29/10 (2006.01)

(52) **U.S. Cl.** **343/703; 340/600; 600/430; 606/33**

(58) **Field of Classification Search** **343/703, 343/841; 340/573.1, 600; 600/430; 606/33**
See application file for complete search history.

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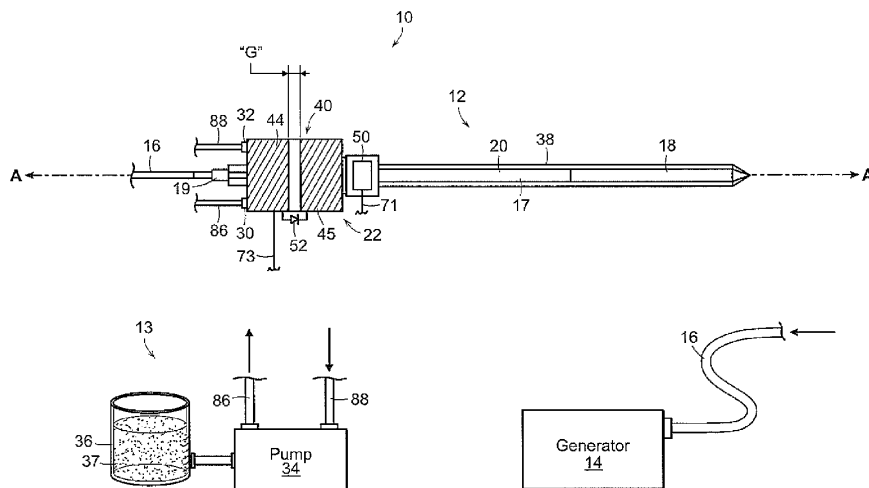
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Primary Examiner — Tho G Phan

(57) **ABSTRACT**

A radiation detector is disclosed. The radiation detector is disposed on a microwave antenna assembly. The radiation detector includes a receiving antenna adapted to receive microwave energy. The receiving antenna includes a first tubular antenna member and a second tubular antenna member disposed concentrically about a longitudinal axis defined by the microwave antenna assembly. The detector also includes at least one rectifier coupled to the receiving antenna adapted to rectify at least a portion of the microwave energy and a filter coupled to the at least one rectifier and adapted to convert the rectified microwave energy into a detection signal.

21 Claims, 4 Drawing Sheets



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US008334814B2

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

(10) **Patent No.:** **US 8,334,814 B2**
(45) **Date of Patent:** **Dec. 18, 2012**

(54) **ANTENNA FOR CIRCULAR POLARIZATION,
HAVING A CONDUCTIVE BASE SURFACE**

(75) Inventors: **Stefan Lindenmeier**, Gauting (DE);
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Jochen Hopf, Haar (DE); **Leopold
Reiter**, Gilching (DE)

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(73) Assignee: **Delphi Delco Electronics Europe
GmbH**, Troy, MI (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 401 days.

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(21) Appl. No.: **12/786,236**

(22) Filed: **May 24, 2010**

Primary Examiner — Anh Tran

(74) Attorney, Agent, or Firm — J. Gordon Lewis

(65) **Prior Publication Data**

US 2010/0302112 A1 Dec. 2, 2010

(30) **Foreign Application Priority Data**

May 30, 2009 (DE) 10 2009 023 514

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

(52) **U.S. Cl.** **343/727**; 343/713; 343/725; 343/767

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

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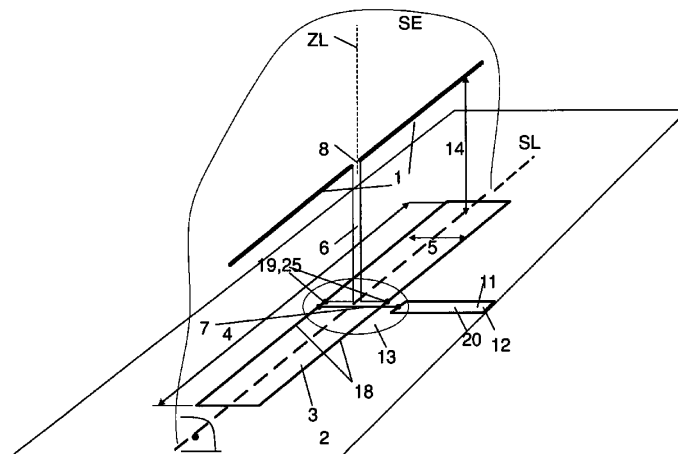
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(57) **ABSTRACT**

An antenna for circular polarization having an electrical dipole radiator which is oriented essentially parallel to an electrically conductive base surface in a plane of symmetry SE oriented perpendicular to the electrically conductive base surface. The dipole is in connection with a slot radiator which is configured in an electrically conductive base surface, with its longitudinal expanse along the intersection line between the plane of symmetry SE and the electrically conductive base surface. The slot radiator connection location is formed by means of connection points situated at the longitudinal edges and lying opposite one another. The electrical dipole radiator and the slot radiator are tuned to one another in their resonance frequencies. The slot radiator and the electrical dipole radiator with dipole feed line are connected with the antenna connection location by way of a combining network, in terms of magnitude and phase, in such a manner that circular polarization exists in the remote field at the frequency at which the radiators are tuned to one another.

20 Claims, 5 Drawing Sheets



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