



US007198198B2

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

(10) **Patent No.:** **US 7,198,198 B2**
(45) **Date of Patent:** **Apr. 3, 2007**

(54) **ANTENNA DEVICE AND COMMUNICATION DEVICE USING ANTENNA DEVICE**

(75) Inventors: **Hiraku Akiho**, Miyagi (JP); **Yutaka Okazaki**, Tokyo (JP); **Akihiro Kikuchi**, Chiba (JP); **Kazuo Goto**, Kanagawa (JP); **Kazuhiko Urayama**, Tokyo (JP)

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

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

(21) Appl. No.: **10/496,636**

(22) PCT Filed: **Aug. 28, 2003**

(86) PCT No.: **PCT/JP03/10985**

§ 371 (c)(1),
(2), (4) Date: **May 24, 2004**

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(65) **Prior Publication Data**
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(30) **Foreign Application Priority Data**
Sep. 25, 2002 (JP) 2002-279626

(51) **Int. Cl.**
G06K 19/06 (2006.01)
H01Q 11/12 (2006.01)

(52) **U.S. Cl.** **235/492; 343/746**

(58) **Field of Classification Search** 343/702, 343/700 MS, 742, 867, 895; 231/491, 436, 231/438, 492; 235/491, 436, 438, 492
See application file for complete search history.

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Primary Examiner—Shih-Chao Chen

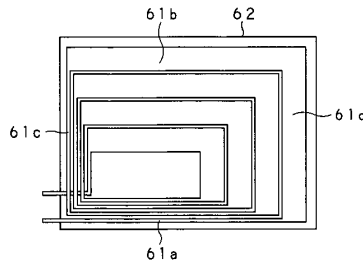
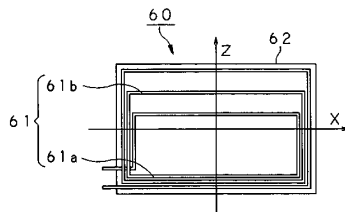
Assistant Examiner—Minh Dieu A

(74) *Attorney, Agent, or Firm*—Wolf, Greenfield & Sacks, P.C.

(57) **ABSTRACT**

An antenna device (60) is provided that is used in a recorder and/or writer destined for writing and reading data to and from a contactless IC card (1). The antenna device (60) includes a loop coil (61) that radiates a magnetic field, magnetically couples with a loop coil (4) provided in the IC card (1), and sends and receives data to and from the IC card (1). The loop coil (61) is formed asymmetric for the winding sections thereof opposite to each other across the center of the loop coil (61) to be different in interval from each other.

9 Claims, 9 Drawing Sheets





US007199755B2

(12) **United States Patent**
Belhora

(10) **Patent No.:** **US 7,199,755 B2**
(45) **Date of Patent:** **Apr. 3, 2007**

(54) **COMPACT ANTENNA BLOCK FOR A WIRELESS DEVICE**

(75) Inventor: **Abdelkrim Belhora**, Crosnes (FR)

(73) Assignee: **FCI**, Versailles (FR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 396 days.

(21) Appl. No.: **10/475,598**

(22) PCT Filed: **Apr. 16, 2002**

(86) PCT No.: **PCT/FR02/01311**

§ 371 (c)(1),
(2), (4) Date: **Mar. 19, 2004**

(87) PCT Pub. No.: **WO02/087015**

PCT Pub. Date: **Oct. 31, 2002**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

Apr. 23, 2001 (FR) 01 05466
Apr. 23, 2001 (FR) 01 05467

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

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

(58) **Field of Classification Search** **343/700 MS, 343/702, 846, 767, 795**

See application file for complete search history.

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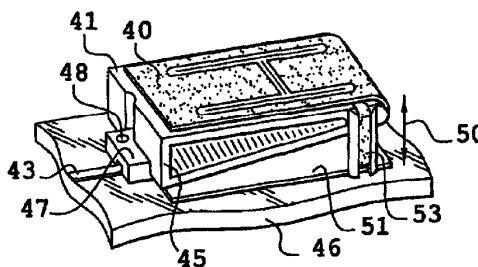
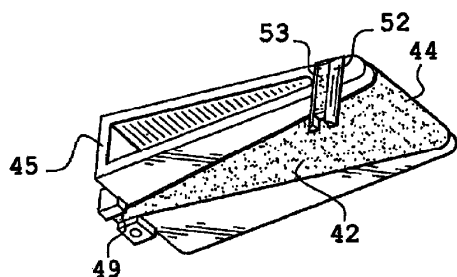
Primary Examiner—Michael C. Wimer

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

(57) **ABSTRACT**

In order to create a compact antenna block a corner-shaped support is provided with a radiating area on an upper surface thereof and a transition area is provided on an underlying surface. The transition area is characterized in that it is triangular. The angle of the triangle forms a connection point for the antenna. The tapered part of the corner-shaped support is fitted with a pole enabling it to be lifted above the plane of the circuit to which the antenna block is connected, whereby the transition area extends gradually above said plane, the upper radiating area being substantially parallel to said plane. As a result the impedance of the antenna can be regulated more easily in such a way that it is continuously constant and the reflection coefficient is improved.

18 Claims, 2 Drawing Sheets





US007199756B2

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

(10) **Patent No.:** **US 7,199,756 B2**
(45) **Date of Patent:** **Apr. 3, 2007**

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

(75) Inventors: **Kwang-hwan Cha**, Suwon (KR);
Young-ki Kim, Hwaseong-gun (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 439 days.

(21) Appl. No.: **10/701,597**

(22) Filed: **Nov. 6, 2003**

(65) **Prior Publication Data**
US 2004/0097270 A1 May 20, 2004

(30) **Foreign Application Priority Data**
Nov. 19, 2002 (KR) 10-2002-0071904

(51) **Int. Cl.**
H04M 1/00 (2006.01)
H04B 7/00 (2006.01)

(52) **U.S. Cl.** **343/700 R**; 455/82; 455/575.7;
343/702; 343/824

(58) **Field of Classification Search** 455/90.1-90.3,
455/562.1, 566, 575.5, 575.7, 121, 82, 269,
455/272; 343/702, 824
See application file for complete search history.

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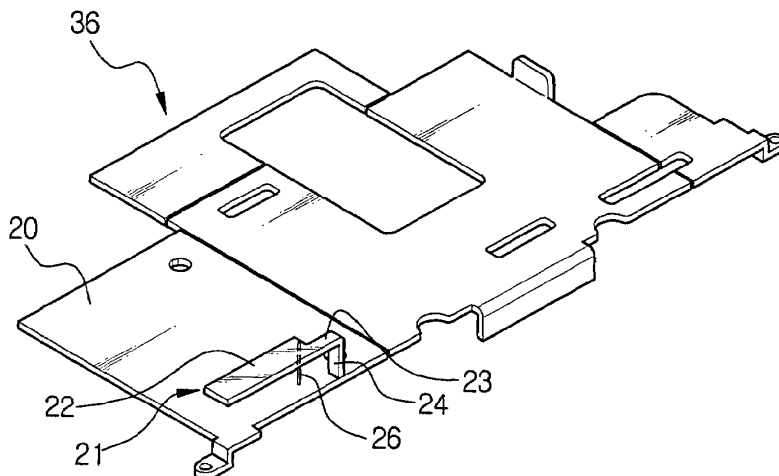
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Primary Examiner—Simon Nguyen
(74) *Attorney, Agent, or Firm*—Staas & Halsey LLP

(57) **ABSTRACT**

A compact-size planar antenna uses, as a ground plane, a LCD-protective bracket of a portable wireless device with an LCD. The antenna includes a top plate spaced apart from the bracket by a predetermined distance, and a short circuit plate connected to the top plate and the bracket with both ends. A power feed line is connected to the top plate and the bracket with both ends, and a dielectric body having a high dielectric constant is arranged between the bracket and the top plate. The compact-size planar antenna is spaced apart from conductor parts of the portable wireless device by a predetermined distance, and formed at a left lower corner of the portable wireless device when viewed from back of the portable wireless device.

16 Claims, 7 Drawing Sheets





US007199757B2

(12) **United States Patent
Tung**

(10) **Patent No.: US 7,199,757 B2**
(45) **Date of Patent: Apr. 3, 2007**

(54) **ANTENNA ASSEMBLY AND A WIRELESS
TELECOMMUNICATION APPARATUS
USING THE SAME**

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(75) Inventor: **Hao-Chun Tung**, Chinmen Hsien (TW)

(73) Assignee: **Benq Corporation**, Taoyuan (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.

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(21) Appl. No.: **11/128,921**

Primary Examiner—Trinh Vo Dinh
(74) *Attorney, Agent, or Firm*—Ladas and Parry LLP

(22) Filed: **May 13, 2005**

(65) **Prior Publication Data**

US 2005/0253761 A1 Nov. 17, 2005

(57) **ABSTRACT**

(30) **Foreign Application Priority Data**

May 14, 2004 (TW) 93113601 A

An antenna assembly includes a base board defining a grounding and dielectric domains, a ground metal layer fabricated on the grounding domain, a dielectric medium mounted on the dielectric domain, and having an upper surface and one lateral surface, a first metal strip including a wave-like strip section mounted on the upper surface of the dielectric medium, and a lateral strip section mounted on the lateral surface of the dielectric medium, and a second metal strip fabricated on the lateral surface of the dielectric medium and having a coupling end coupled electrically to the ground metal layer. After assembly, the first and second metal strips and the ground metal layer cooperatively form an oscillator by virtue of electromagnetic induction to possess a specific frequency range.

(51) **Int. Cl.**

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H01Q 1/24 (2006.01)
H01Q 1/36 (2006.01)

(52) **U.S. Cl.** **343/700 MS; 343/702; 343/895**

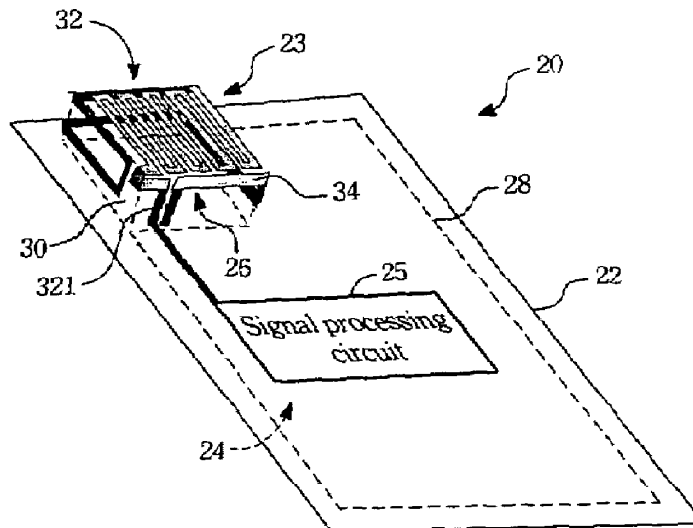
(58) **Field of Classification Search** 343/700 MS, 343/702, 895
See application file for complete search history.

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20 Claims, 4 Drawing Sheets





US007199758B2

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

(10) **Patent No.:** **US 7,199,758 B2**
(45) **Date of Patent:** **Apr. 3, 2007**

(54) **ANTENNA DEVICE**

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2006/0109178 A1* 5/2006 Takeuchi et al. 343/700 MS

(75) Inventors: **Tomoki Ikeda**, Ota-ku (JP); **Norio Tanaka**, Ota-ku (JP); **Naofumi Shiraishi**, Ota-ku (JP); **Hideaki Oshima**, Minato-ku (JP); **Seiji Katakura**, Minato-ku (JP); **Hiroshi Iijima**, Minato-ku (JP)

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(73) Assignees: **ALPS Electric Co., Ltd.**, Tokyo (JP); **Nippon Sheet Glass Company, Limited**, Tokyo (JP)

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

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Primary Examiner—Shih-Chao Chen

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

(21) Appl. No.: **11/157,616**

(22) Filed: **Jun. 21, 2005**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

Jun. 25, 2004 (JP) 2004-188093

(51) **Int. Cl.**

H01Q 1/38 (2006.01)
H01Q 9/38 (2006.01)
H01Q 1/48 (2006.01)

(52) **U.S. Cl.** **343/700 MS; 343/830; 343/846**

(58) **Field of Classification Search** **343/711, 343/713, 700 MS, 830, 846**
See application file for complete search history.

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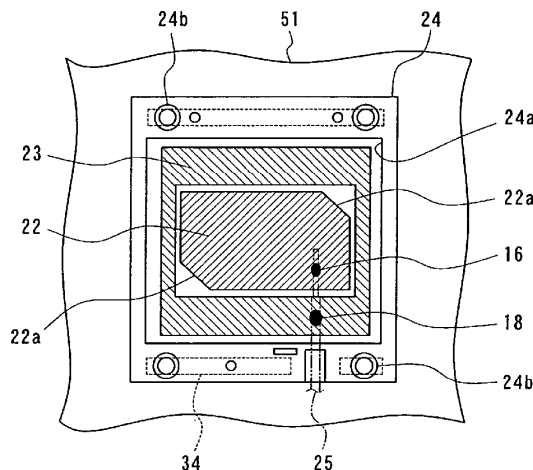
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(57) **ABSTRACT**

An antenna device is provided in which a common mode current does not flow in a coaxial cable. The coaxial cable is uprighted at the end of the base plate and bent toward the notched portion of the cover so that the connector reaches to the notched portion. A short-circuit stub structure is provided in such a manner that a part of the outer sheath of the coaxial cable is removed to expose the outer conductor and a ring-shaped metal terminal is crimped to the exposed outer conductor. The ring-shaped metal terminal is fixed by using a screw to an acceptance member made of a stainless steel provided on the base plate. The terminal is provided at the position within 0.25λ from the feeding point of the ground antenna element.

7 Claims, 8 Drawing Sheets





US007199761B2

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

(10) **Patent No.:** **US 7,199,761 B2**
(45) **Date of Patent:** **Apr. 3, 2007**

(54) **WIRELESS COMMUNICATION DEVICE WITH IMPROVED ANTENNA SYSTEM**

(75) Inventors: **Juan M. Martinez**, Antioch, IL (US); **David Fisk**, Vista, CA (US); **Siu Man Wong**, Singapore (SG)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 7 days.

(21) Appl. No.: **11/200,665**

(22) Filed: **Aug. 10, 2005**

(65) **Prior Publication Data**
US 2007/0035453 A1 Feb. 15, 2007

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
(52) **U.S. Cl.** **343/702**
(58) **Field of Classification Search** **343/702,**
343/700 MS, 846
See application file for complete search history.

(56) **References Cited**
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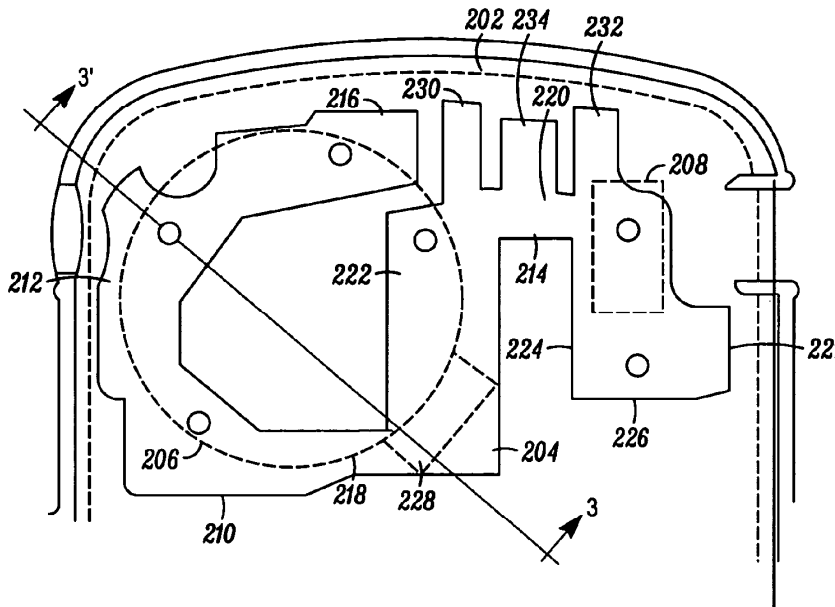
Primary Examiner—Hoang V. Nguyen

(74) *Attorney, Agent, or Firm*—Randi L. Karpinia; Sylvia Chen; Douglas S. Rupert

(57) **ABSTRACT**

A wireless communication device (100) comprises an antenna (204) comprising a major radiating element (210) that includes a letter C shaped part (212) connected to a letter U shaped part (214). The major radiating element (210) is spaced from a ground plane (302) and one or more components (206, 208) having conductive parts are located between the major radiating element (210) and the ground plane (302). Openings (314, 316) in the ground plane (302) are located under the components (206, 208) or terminals (310) of the components (206, 208). Passive radiators (126, 700) having multiple sections (602, 604, 702, 704, 706) of different transverse dimension are located on a flip (110) of the wireless communication device (100) proximate the antenna (204).

11 Claims, 5 Drawing Sheets





US007199763B2

(12) **United States Patent**
Bryan, Jr. et al.

(10) **Patent No.:** **US 7,199,763 B2**
(45) **Date of Patent:** **Apr. 3, 2007**

- (54) **GROUND PROXIMITY ANTENNA SYSTEM**
- (75) Inventors: **John W. Bryan, Jr.**, Bellingham, MA (US); **Lawrence Paul Drury, III**, Mattapoisett, MA (US)
- (73) Assignee: **Lockheed Martin Corporation**, Bethesda, MD (US)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 26 days.
- (21) Appl. No.: **11/120,158**
- (22) Filed: **May 2, 2005**

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- (65) **Prior Publication Data**
US 2005/0243014 A1 Nov. 3, 2005
- Related U.S. Application Data**
- (60) Provisional application No. 60/567,695, filed on May 3, 2004.
- (51) **Int. Cl.**
H01Q 1/34 (2006.01)
- (52) **U.S. Cl.** **343/709**; 343/895
- (58) **Field of Classification Search** 343/895, 343/797, 742, 867, 866, 741, 872, 709
See application file for complete search history.
- (56) **References Cited**
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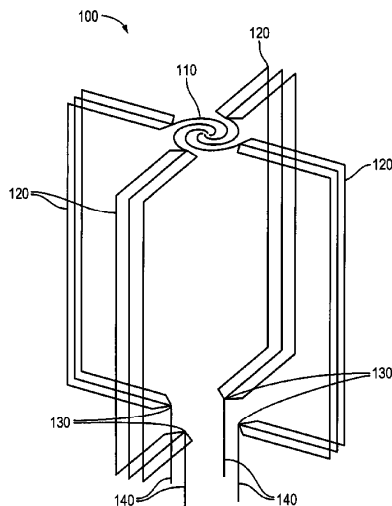
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Primary Examiner—Hoanganh Le
(74) *Attorney, Agent, or Firm*—Goodwin Procter LLP

(57) **ABSTRACT**

The invention provides an antenna system for operation near a ground plane, for example, at or near the surface of a body of water. The antenna system includes, for example, an array of filar elements attached to one or more spiral elements. The system also includes, for example, a buoyant support and/or housing for transporting the antenna to and/or maintaining the antenna at or near the surface of a body of water.

38 Claims, 9 Drawing Sheets





US007199765B2

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

(10) **Patent No.:** **US 7,199,765 B2**
(45) **Date of Patent:** **Apr. 3, 2007**

(54) **MOBILE COMMUNICATION APPARATUS AND GLOBAL POSITIONING SYSTEM (GPS) ANTENNA THEREOF**

(58) **Field of Classification Search** 343/702, 343/700 MS, 846, 767, 770
See application file for complete search history.

(75) Inventors: **Chien-Pang Chou**, Shindian (TW);
Yun-Ta Chen, Shindian (TW)

(56) **References Cited**

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(73) Assignee: **High Tech Computer Corp.**, Taoyuan (TW)

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2004/0070537	A1 *	4/2004	Kadambi et al.	343/700 MS

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

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(21) Appl. No.: **11/182,800**

Primary Examiner—Hoang V. Nguyen

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

(74) *Attorney, Agent, or Firm*—Rabin & Berdo, PC

(65) **Prior Publication Data**

US 2006/0132365 A1 Jun. 22, 2006

(57) **ABSTRACT**

(30) **Foreign Application Priority Data**

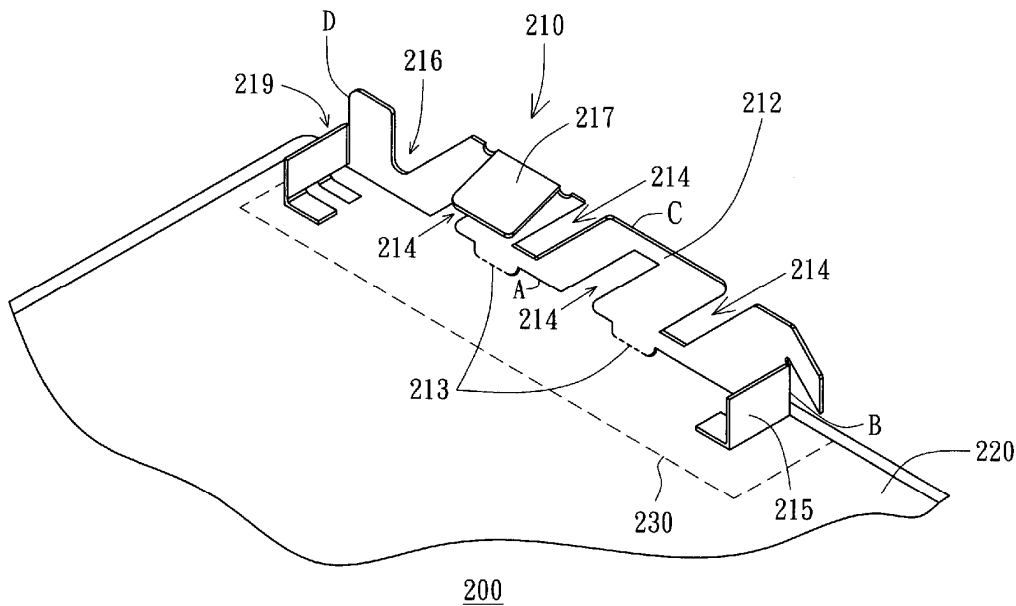
Dec. 16, 2004 (TW) 93139231 A

A mobile communication apparatus includes a printed circuit board (PCB) and a global positioning system (GPS) antenna. The GPS antenna is made of a metal sheet, and vertically inserted into the PCB.

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

(52) **U.S. Cl.** **343/770; 343/702**

36 Claims, 4 Drawing Sheets





US007202818B2

(12) **United States Patent**
Anguera Pros et al.

(10) **Patent No.:** **US 7,202,818 B2**
(45) **Date of Patent:** **Apr. 10, 2007**

(54) **MULTIFREQUENCY MICROSTRIP PATCH ANTENNA WITH PARASITIC COUPLED ELEMENTS**

(75) Inventors: **Jaume Anguera Pros**, Castellion (ES);
Carles Puente Ballardà, Barcelona (ES)

(73) Assignee: **Fractus, S.A.**, Santcugat Del Valles (ES)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 463 days.

(21) Appl. No.: **10/823,206**

(22) Filed: **Apr. 13, 2004**

(65) **Prior Publication Data**

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Related U.S. Application Data

(63) Continuation of application No. PCT/EP01/11913, filed on Oct. 16, 2001.

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

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

(58) **Field of Classification Search** **343/700 MS, 343/846, 833, 834**

See application file for complete search history.

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4,623,894 A	11/1986	Lee et al.
4,673,948 A	6/1987	Kuo
4,730,195 A	3/1988	Phillips et al.
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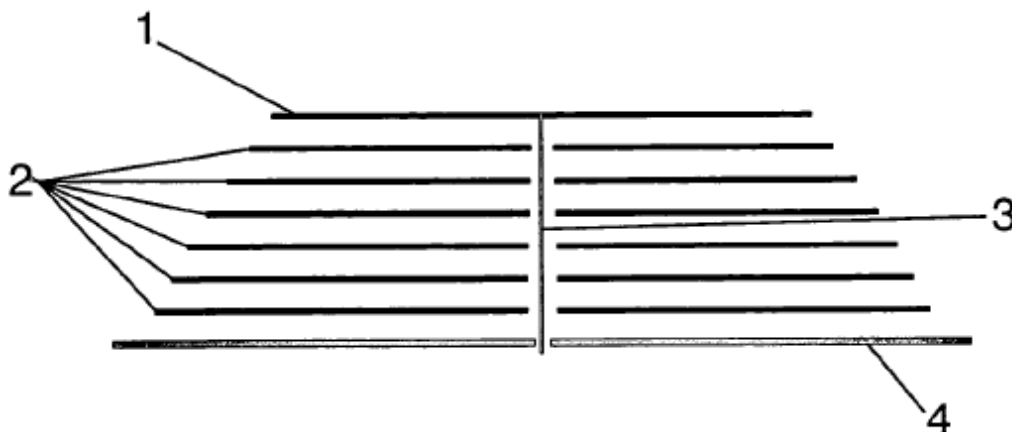
(Continued)

Primary Examiner—Hoang V. Nguyen
(74) *Attorney, Agent, or Firm*—Jenkins & Gilchrist, P.C.

(57) **ABSTRACT**

A multifrequency microstrip patch antenna comprising an active patch and a plurality of parasitic elements placed underneath said active patch, featuring a similar behavior (impedance, directivity, gain, polarization and pattern) at multiple radiofrequency bands.

21 Claims, 4 Drawing Sheets





US007202819B2

(12) **United States Patent Hatch**

(10) **Patent No.: US 7,202,819 B2**
(45) **Date of Patent: Apr. 10, 2007**

(54) **TAPERED MULTIBAND ANTENNA**
(75) Inventor: **Robert J. Hatch**, San Diego, CA (US)

2004/0100406 A1* 5/2004 Okado 343/700 MS

(73) Assignee: **Qualcomm Incorporated**, San Diego, 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 292 days.

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Primary Examiner—Hoanganh Le
(74) *Attorney, Agent, or Firm*—Thomas R. Rouse; Thien T. Nguyen; Sandra L. Godsey

(21) Appl. No.: **10/824,953**

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

(57) **ABSTRACT**

(65) **Prior Publication Data**

US 2005/0233786 A1 Oct. 20, 2005

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

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

(58) **Field of Classification Search** 343/700 MS, 343/702, 846, 848, 795, 807, 893
See application file for complete search history.

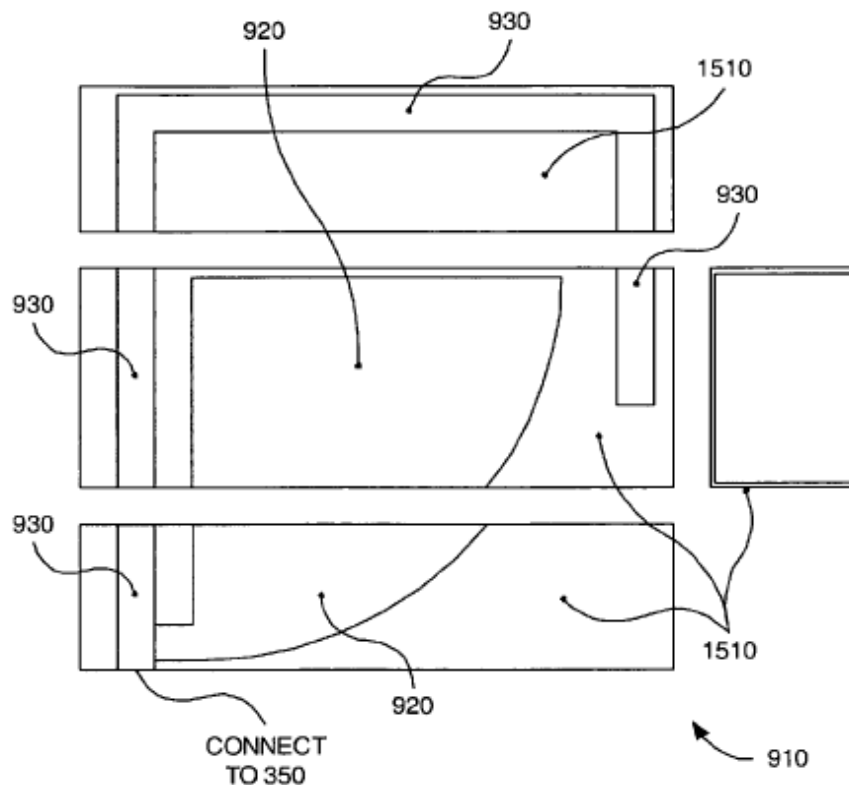
Embodiments disclosed herein address the need in the art for a relatively small multi-band antenna. In one aspect, an antenna poise comprises an element, one edge of which is tapered from the connection point of a counterpoise to a second edge of the element. In another aspect, multiple elements are included in the poise, which may include tapered or rectangular poise elements. In yet another aspect, a quarter-ellipse poise is deployed. In yet another aspect, a poise element with an edge formed according to $y=1/(m*x)$ is formed, where m is any number. A poise may be folded, or deposited on a folded substrate. Various other aspects are also presented. These aspects have the benefit of providing desirable frequency response characteristics over a wide frequency range, selectable by design, along with suitability for deployment in a relatively confined space.

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26 Claims, 12 Drawing Sheets





US007202820B2

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

(10) **Patent No.:** **US 7,202,820 B2**
 (45) **Date of Patent:** ***Apr. 10, 2007**

(54) **WIDE BAND ANTENNA**

(75) Inventors: **Shinichi Kuroda**, Tokyo (JP); **Tomoya Yamaura**, Tokyo (JP)

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

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

This patent is subject to a terminal disclaimer.

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 2005/0184911 A1 8/2005 Kuroda et al.

(21) Appl. No.: **11/107,801**

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

(65) **Prior Publication Data**
 US 2005/0184911 A1 Aug. 25, 2005

Related U.S. Application Data

(63) Continuation of application No. 10/395,078, filed on Mar. 25, 2003, now Pat. No. 6,914,561.

(30) **Foreign Application Priority Data**
 Apr. 9, 2002 (JP) 2002-106417

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

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

(58) **Field of Classification Search** 343/700 MS,
 343/845, 846, 847, 911 R, 907
 See application file for complete search history.

(56) **References Cited**
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U.S. Appl. No. 11/475,218, filed Jun. 27, 2006, Kuroda et al.

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Primary Examiner—Shih-Chao Chen

Assistant Examiner—Minh Dieu A

(74) *Attorney, Agent, or Firm*—Oblon, Spivak, McClelland, Maier & Neustadt, P.C.

(57) **ABSTRACT**

Disclosed is a wideband antenna with a lowered standing wave ratio. The wideband antenna interposes a substance whose conductivity is about 0.1 through 10.0 as an interposition between a reference conductor and a radiation conductor; and thereby, the antenna reduces reflections of signals, and achieves a wider bandwidth as well as a sufficient gain with a lowered standing wave ratio. Also, the invention realizes a thin-type wideband antenna with a wider bandwidth and a sufficient gain, by interposing a magnetic substance whose relative permeability is more than 1 through about 8 as the interposition between the reference conductor and the radiation conductor.

4 Claims, 18 Drawing Sheets

	CHARACTERISTIC OF MAGNETIC SUBSTANCE				DIMENSION OF ANTENNA		MATCHING CAPACITANCE [pF]
	ϵ_r	μ_r	σ [$/\Omega\text{m}$]	$\tan \sigma$ [at 4GHz]	l_e [mm]	g_f [mm]	
FIG. 12: MAGNETIC SUBSTANCE	1.0	4.0	0.1	8.0e-7	15.0	5.0	Cs:0.4
FIG. 13: MAGNETIC SUBSTANCE	1.0	4.0	1.0	8.0e-6	15.0	7.5	Cs:0.5
FIG. 14: MAGNETIC SUBSTANCE	1.0	4.0	10.0	8.0e-5	15.0	7.5	Cs:1.5+ Cp:0.5



US007202821B2

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

(10) **Patent No.:** **US 7,202,821 B2**
(45) **Date of Patent:** **Apr. 10, 2007**

(54) **ANTENNA** 6,894,646 B2 * 5/2005 Washiro et al. 343/700 MS
7,055,754 B2 * 6/2006 Forster 235/492
(75) **Inventors:** **Kazuhiko Fujikawa**, Kyotanabe (JP); 2004/0119593 A1 * 6/2004 Kuhns 340/572.7
Susumu Inatsugu, Hirakata (JP) 2004/0263407 A1 12/2004 Inatsugu et al.
(73) **Assignee:** **Matsushita Electric Industrial Co.,** 2006/0082505 A1 * 4/2006 Baliarda et al. 343/700 MS
Ltd., Osaka (JP)

(*) **Notice:** Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 9 days.

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(21) **Appl. No.:** **11/152,616**

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

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(65) **Prior Publication Data**

US 2005/0280588 A1 Dec. 22, 2005

Primary Examiner—Tan Ho
Assistant Examiner—Dieu Hien Duong
(74) *Attorney, Agent, or Firm*—RatnerPrestia

(30) **Foreign Application Priority Data**

Jun. 18, 2004 (JP) 2004-181026

(57) **ABSTRACT**

(51) **Int. Cl.**
H01Q 1/38 (2006.01)
(52) **U.S. Cl.** **343/700 MS; 343/702**
(58) **Field of Classification Search** **343/700 MS,**
343/702
See application file for complete search history.

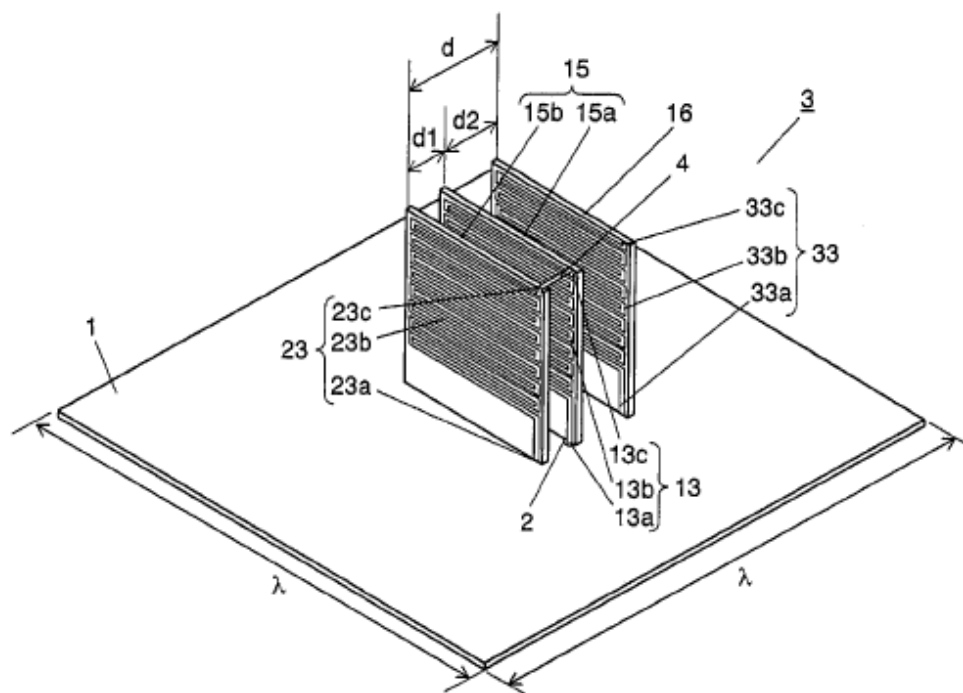
On the top surface of conductive ground plate, first holder having first antenna element, second holder having second antenna element, and support having parasitic antenna element are provided such that holders and support confront each other. Respective intermediate sections of antenna elements are folded to shape like "square C" in plural times, so that antenna is formed. The foregoing construction allows low-profiling and downsizing antennas to be used in mobile radio devices.

(56) **References Cited**

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8 Claims, 5 Drawing Sheets





US007202822B2

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

(10) **Patent No.:** **US 7,202,822 B2**
(45) **Date of Patent:** **Apr. 10, 2007**

- (54) **SPACE-FILLING MINIATURE ANTENNAS**
- (75) **Inventors:** **Carles Puente Baliarda**, Barcelona (ES); **Edouard Jean Louis Rozan**, Barcelona (ES); **Jaume Anguera Pros**, Barcelona (ES)
- (73) **Assignee:** **Fractus, S.A.**, Barcelona (ES)
- (*) **Notice:** Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 81 days.

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4,021,810 A	5/1977	Urpo et al.
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(21) **Appl. No.:** **11/179,250**

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

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(65) **Prior Publication Data**

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Dr. Carles Puente Baliarda; Fractal Antennas; Ph.D. Dissertation; May 1997; Cover page—p. 270; Electromagnetics and Photonics Engineering group, Dept. of Signal Theory and Communications, Universitat Politècnica de Catalunya; Barcelona, SPAIN.

- (63) Continuation of application No. 11/110,052, filed on Apr. 20, 2005, now Pat. No. 7,148,850, which is a continuation of application No. 10/182,635, filed as application No. PCT/EP00/00411 on Jan. 19, 2000, now abandoned.

(Continued)

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

Primary Examiner—Hoang V. Nguyen
(74) *Attorney, Agent, or Firm*—Howison & Arnott, L.L.P.

(52) **U.S. Cl.** **343/700 MS; 343/702; 343/767; 343/866**

(57) **ABSTRACT**

(58) **Field of Classification Search** **343/700 MS, 343/702, 767, 866**
See application file for complete search history.

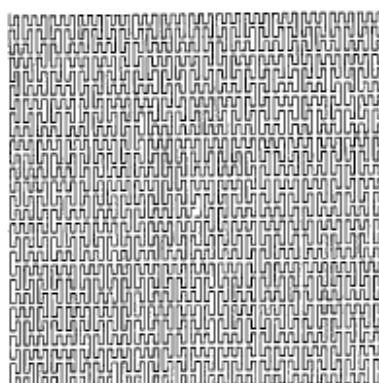
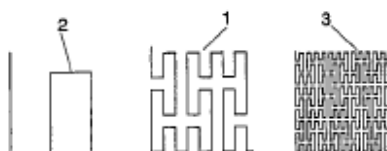
A novel geometry, the geometry of Space-Filling Curves (SFC) is defined in the present invention and it is used to shape a part of an antenna. By means of this novel technique, the size of the antenna can be reduced with respect to prior art, or alternatively, given a fixed size the antenna can operate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

(56) **References Cited**

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53 Claims, 25 Drawing Sheets



4



US007202824B1

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

(10) **Patent No.:** **US 7,202,824 B1**
(45) **Date of Patent:** **Apr. 10, 2007**

(54) **DUAL HEMISPHERE ANTENNA**

(75) Inventors: **John Sanelli**, Seven Hills, OH (US);
Stephen V. Saliga, Akron, OH (US);
David M. Theobald, Akron, OH (US)

(73) Assignee: **Cisco Technology, Inc.**, San Jose, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 163 days.

(21) Appl. No.: **10/686,233**

(22) Filed: **Oct. 15, 2003**

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

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

(58) **Field of Classification Search** 343/702,
343/893, 841, 907, 912, 832, 833, 834, 835,
343/836

See application file for complete search history.

(56) **References Cited**

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Primary Examiner—Trinh Dinh

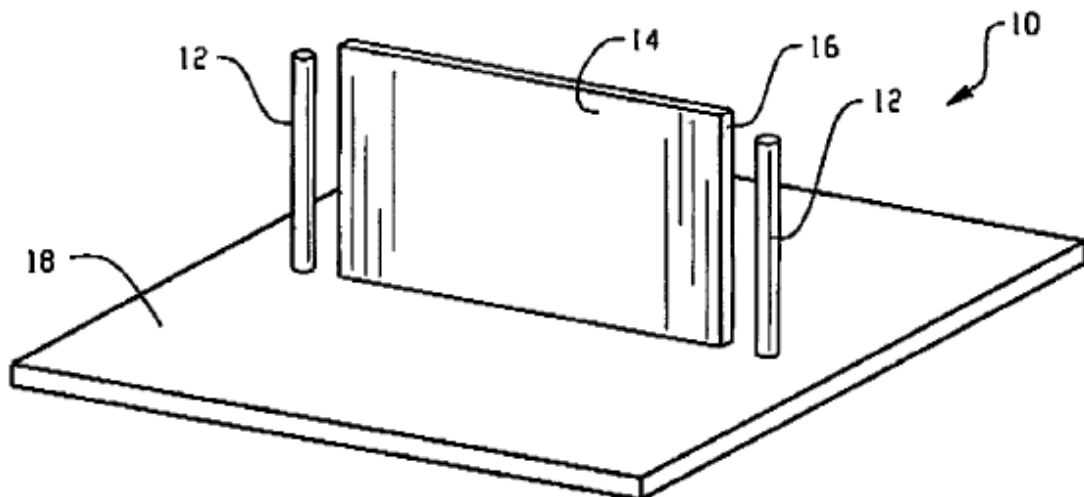
Assistant Examiner—Huedung Mancuso

(74) *Attorney, Agent, or Firm*—Tucker Ellis & West LLP

(57) **ABSTRACT**

A wireless device is disclosed, including an antenna system comprising one or more antenna elements for sending and receiving a wireless signal. One or more conductive members are included, having an edge displaced from and substantially directed toward the at least one antenna element, and cooperating therewith to establish a multiplicity of hemispherical beam patterns for a wireless signal. Embodiments with a multiplicity of antenna elements exhibit a high degree of isolation between said antenna elements.

22 Claims, 8 Drawing Sheets





US007202826B2

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

(10) **Patent No.:** **US 7,202,826 B2**
(45) **Date of Patent:** **Apr. 10, 2007**

(54) **COMPACT VEHICLE-MOUNTED ANTENNA**

(75) Inventors: **Gary W. Grant**, Oregon City, OR (US); **Douglas W. Sherman**, Auburn, IN (US)

(73) Assignee: **Radiall Antenna Technologies, Inc.**, Vancouver, WA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 89 days.

(21) Appl. No.: **10/529,024**

(22) PCT Filed: **Sep. 26, 2003**

(86) PCT No.: **PCT/US03/30453**

§ 371 (c)(1),
(2), (4) Date: **Mar. 22, 2005**

(87) PCT Pub. No.: **WO2004/030143**

PCT Pub. Date: **Apr. 8, 2004**

(65) **Prior Publication Data**
US 2006/0044196 A1 Mar. 2, 2006

Related U.S. Application Data
(60) Provisional application No. 60/414,606, filed on Sep. 27, 2002.

(51) **Int. Cl.**
H01Q 1/32 (2006.01)
H01Q 1/38 (2006.01)

(52) **U.S. Cl.** **343/713; 343/711; 343/713; 343/700 MS; 343/846; 343/702; 343/841; 343/767**

(58) **Field of Classification Search** **343/713, 343/711, 700 MS, 702, 841, 846, 750**
See application file for complete search history.

(56) **References Cited**

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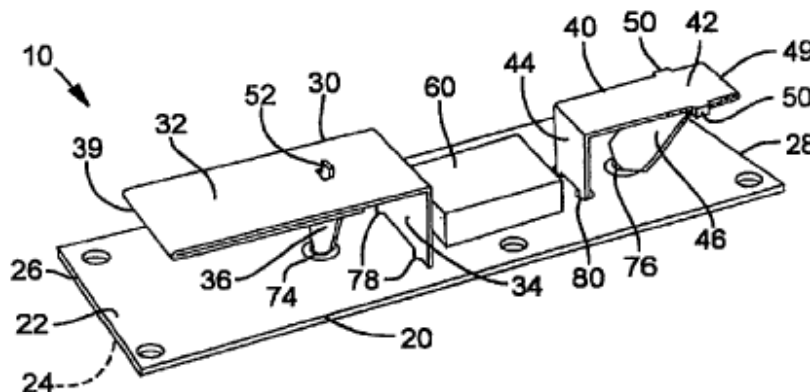
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Primary Examiner—Tho Phan
Assistant Examiner—Chuc Tran
(74) *Attorney, Agent, or Firm*—Klarquist Sparkman, LLP

(57) **ABSTRACT**

A compact, vehicle-mounted antenna is disclosed. In one embodiment, a first and second antenna element are positioned on a conductive ground plane. The antenna elements can comprise platforms supported by a ground and a feed. The antenna elements can be tuned to various bands (e.g., cellular or PCS). At least one additional antenna element (e.g., a GPS receive antenna) can be positioned between the two antenna elements. One of the feeds of the antenna elements can be angled so that the antenna element has a desired height (e.g., a height matching the other antenna element). The antenna elements can be electrically connected to a transmission line via a single feed line.

41 Claims, 6 Drawing Sheets





US007202831B2

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

(10) **Patent No.:** **US 7,202,831 B2**
(45) **Date of Patent:** **Apr. 10, 2007**

(54) **MULTI-BAND FREQUENCY LOOP-SLOT ANTENNA**

(75) Inventors: **Hong-Ren Chen**, Chung Ho (TW); **Kai Shih**, Chung Ho (TW); **Huang-Tse Peng**, Chung Ho (TW); **Yu-Yuan Wu**, Chung Ho (TW)

(73) Assignee: **Darts Technologies Corp.**, Taipei County (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 92 days.

(21) Appl. No.: **11/200,430**

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

(65) **Prior Publication Data**

US 2007/0040745 A1 Feb. 22, 2007

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

(52) **U.S. Cl.** **343/770; 343/767; 343/768; 343/700 MS**

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

(56) **References Cited**

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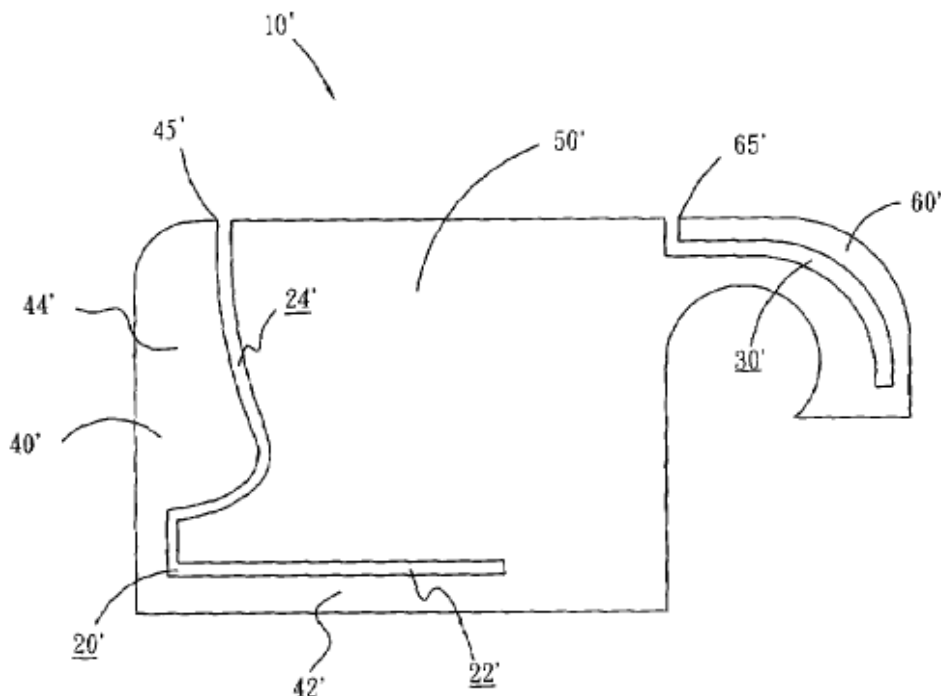
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Primary Examiner—Trinh Vo Dinh

(57) **ABSTRACT**

A loop-slot antenna defined by a conductive plate includes a first slot and a second slot. The first slot and the second slot divide the conductive plate into a first strip, a second strip and a patch element. The first slot is an L-shaped slot and includes a transverse slot section extending along the lower edge of the conductive plate and a longitudinal slot section extending along the left edge of the conductive plate and opening to the upper edge of the conductive plate. The first slot is operated at a first frequency. The first strip includes a transverse branch and a longitudinal branch that has a feed point. The second slot opens upward. The second strip has a free end on which a grounding point is disposed. The patch element is formed between the first and the second slots and operable at a second frequency.

10 Claims, 3 Drawing Sheets





US007202836B2

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

(10) **Patent No.:** **US 7,202,836 B2**
(45) **Date of Patent:** **Apr. 10, 2007**

(54) **ANTENNA APPARATUS AND METHOD OF FORMING SAME**

(75) Inventors: **Sooliam L. Ooi**, Plantation, FL (US);
Nereydo T. Contreras, Plantation, FL (US);
Boon Ping Koh, Petaling Java (MY);
Christos Kontogeorgakis, Plantation, FL (US)

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

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

(21) Appl. No.: **11/123,307**

(22) Filed: **May 6, 2005**

(65) **Prior Publication Data**
US 2006/0250319 A1 Nov. 9, 2006

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

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

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

See application file for complete search history.

(56) **References Cited**

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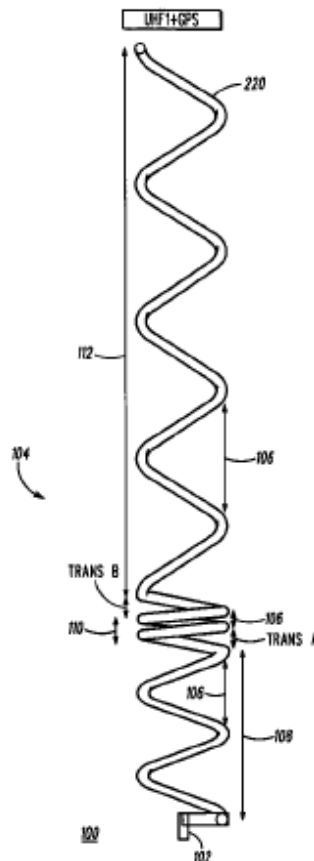
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Primary Examiner—Tan Ho

(57) **ABSTRACT**

An antenna provides dual band capability by providing a single feed (102) leading into a helix (104), the helix characterized by a pitch (106) and number of turns (120) varied to provide dual band operation to a portable communication device.

2 Claims, 9 Drawing Sheets





US007205942B2

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

(10) **Patent No.:** **US 7,205,942 B2**
(45) **Date of Patent:** **Apr. 17, 2007**

(54) **MULTI-BAND ANTENNA ARRANGEMENT**

(75) Inventors: **Hanyang Wang**, Oxfordshire (GB);
Ming Zheng, Hampshire (GB); **Sean Brett**, Surrey (GB)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 2 days.

(21) Appl. No.: **11/176,628**

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

(65) **Prior Publication Data**
US 2007/0008222 A1 Jan. 11, 2007

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

(52) **U.S. Cl.** **343/700 MS**; 343/702;
343/725; 343/846

(58) **Field of Classification Search** 343/702,
343/700 MS, 846, 725
See application file for complete search history.

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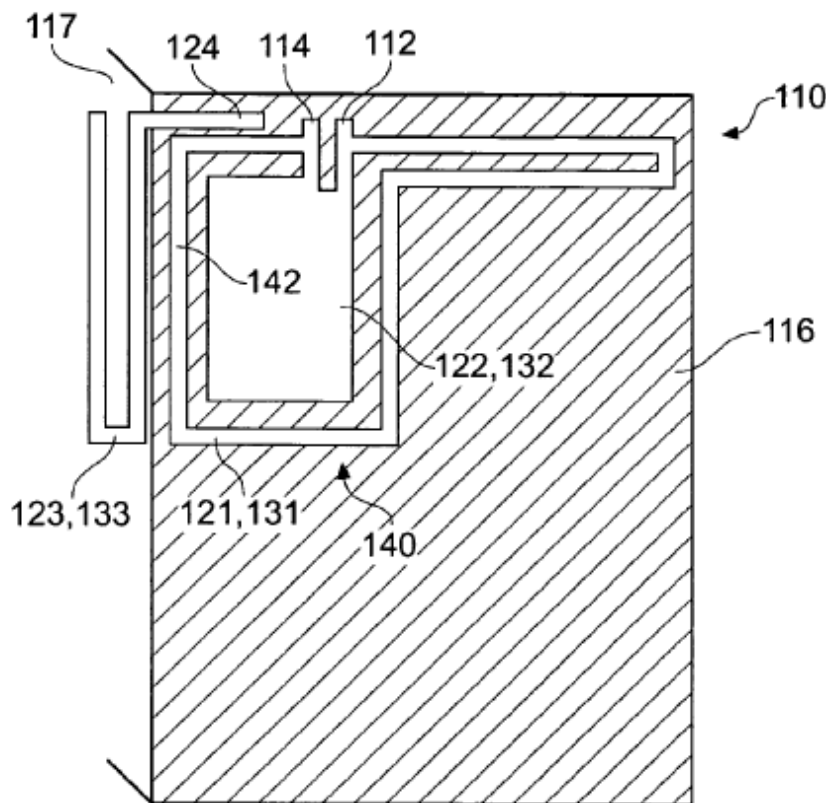
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Primary Examiner—Hoang V. Nguyen
(74) *Attorney, Agent, or Firm*—Harrington & Smith, PC

(57) **ABSTRACT**

An antenna arrangement comprising: a ground plane; a ground point connected to the ground plane; a feed point; a $\lambda/2$ antenna element connected to the ground point and to the feed point and extending between the ground point and the feed point as a loop that defines an area; and a $\lambda/4$ antenna element located within the area.

32 Claims, 3 Drawing Sheets





US007205943B2

(12) **United States Patent**
Mei

(10) **Patent No.:** **US 7,205,943 B2**
(45) **Date of Patent:** **Apr. 17, 2007**

(54) **PRINTED ANTENNA**
(75) **Inventor:** **Chia-Hao Mei, Tu-Cheng (TW)**
(73) **Assignee:** **Hon Hai Precision Industry Co., Ltd.,
Tu-Cheng, 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.

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Primary Examiner—Tan Ho
(74) *Attorney, Agent, or Firm*—Morris Manning & Martin
LLP; Tim Tingkang Xia, Esq.

(21) **Appl. No.:** **11/198,515**
(22) **Filed:** **Aug. 5, 2005**
(65) **Prior Publication Data**
US 2006/0049989 A1 Mar. 9, 2006

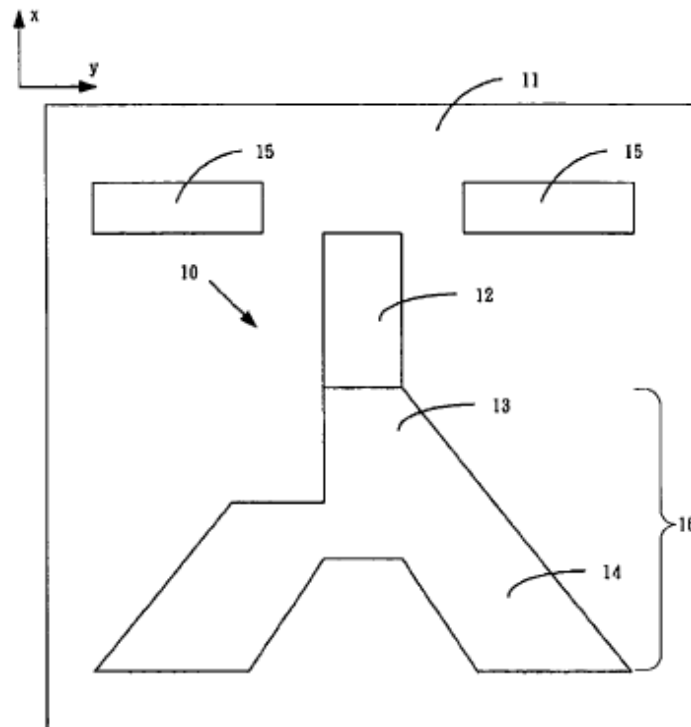
(57) **ABSTRACT**

(30) **Foreign Application Priority Data**
Sep. 3, 2004 (TW) 93214033 U
(51) **Int. Cl.**
H01Q 1/38 (2006.01)
(52) **U.S. Cl.** **343/700 MS; 343/846**
(58) **Field of Classification Search** **343/700 MS,
343/702, 846, 848**
See application file for complete search history.

A printed antenna on a substrate for radiating and capturing radio frequency signals includes a ground portion, a feeding element and a radiating portion. The radiating portion is a main body of the printed antenna, and includes a connecting patch and a radiating patch. One end of the connecting patch is electronically connected to the feeding element. The connecting patch is tapered, with a width thereof gradually decreasing in a direction toward the feeding element. The radiating patch is electronically connected to the connecting patch, and has an inverted V-shape.

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18 Claims, 4 Drawing Sheets





US007205945B2

(12) **United States Patent**
Fukushima

(10) **Patent No.:** **US 7,205,945 B2**
(45) **Date of Patent:** **Apr. 17, 2007**

(54) **ANTENNA AND ELECTRONIC DEVICE USING THE SAME** 3,543,273 A * 11/1970 Perkins 343/702
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5,990,838 A * 11/1999 Burns et al. 343/702
(75) Inventor: **Susumu Fukushima**, Katano (JP) 2002/0057227 A1* 5/2002 Fang 343/895

(73) Assignee: **Matsushita Electric Industrial Co., Ltd.**, Osaka (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 128 days.

(21) Appl. No.: **10/524,895**

(22) PCT Filed: **Jun. 8, 2004**

(86) PCT No.: **PCT/JP2004/008273**

§ 371 (c)(1),
(2), (4) Date: **Feb. 17, 2005**

(87) PCT Pub. No.: **WO2004/109858**

PCT Pub. Date: **Dec. 16, 2004**

(65) **Prior Publication Data**

US 2006/0044193 A1 Mar. 2, 2006

(30) **Foreign Application Priority Data**

Jun. 9, 2003 (JP) 2003-163612

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

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

(58) **Field of Classification Search** **343/702, 343/895, 715, 846**

See application file for complete search history.

(56) **References Cited**

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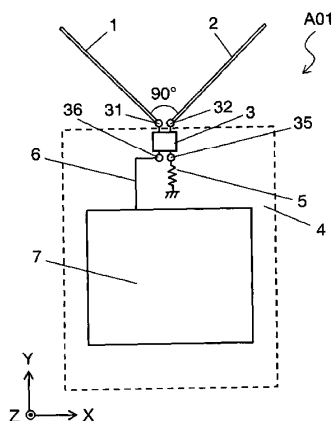
Primary Examiner—Tan Ho

(74) Attorney, Agent, or Firm—RatnerPrestia

(57) **ABSTRACT**

A circularly polarized wave antenna is an antenna having two or more electrically conductive elements and a high frequency circuit, wherein at least two of the plurality of electrically conductive elements are constructed in V-shape with an angle of 90 degrees; therefore, it is possible to realize a circularly polarized wave antenna of simple construction having directivity gains in multi-direction.

11 Claims, 22 Drawing Sheets





US007205947B2

(12) **United States Patent**
Parsche

(10) **Patent No.:** **US 7,205,947 B2**
(45) **Date of Patent:** **Apr. 17, 2007**

(54) **LITZENDRAHT LOOP ANTENNA AND ASSOCIATED METHODS**

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

(73) Assignee: **Harris Corporation**, Melbourne, FL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 223 days.

(21) Appl. No.: **10/921,644**

(22) Filed: **Aug. 19, 2004**

(65) **Prior Publication Data**

US 2006/0038730 A1 Feb. 23, 2006

(51) **Int. Cl.**

H01Q 11/12 (2006.01)

H01Q 21/00 (2006.01)

(52) **U.S. Cl.** **343/742**; 343/788; 343/867

(58) **Field of Classification Search** 343/741-744, 343/866, 788, 842, 867
See application file for complete search history.

(56) **References Cited**

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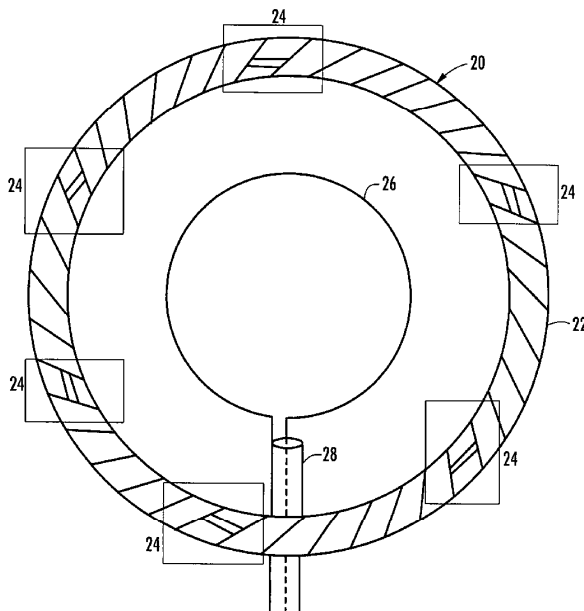
Primary Examiner—Tan Ho

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

(57) **ABSTRACT**

The antenna includes a Litz wire loop having a plurality of individually insulated wires braided together and a plurality of splices therein to define distributed capacitors. A magnetically coupled feed loop is provided within the electrically conductive loop, and a feed structure, such as a coaxial feed line, feeds the magnetically coupled feed loop.

34 Claims, 5 Drawing Sheets





US007205954B2

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

(10) **Patent No.:** **US 7,205,954 B2**
(45) **Date of Patent:** **Apr. 17, 2007**

- (54) **MEANDER LINE ANTENNA**
- (75) Inventors: **Takashi Yamagajo**, Kawasaki (JP); **Toru Maniwa**, Kawasaki (JP); **Manabu Kai**, 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 0 days.

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Primary Examiner—Michael C. Wimer

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

- (21) Appl. No.: **11/156,532**
- (22) Filed: **Jun. 21, 2005**

- (65) **Prior Publication Data**
US 2006/0170606 A1 Aug. 3, 2006

- (30) **Foreign Application Priority Data**
Feb. 1, 2005 (JP) 2005-024727

- (51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 9/26 (2006.01)
- (52) **U.S. Cl.** **343/803**; 343/795; 343/806
- (58) **Field of Classification Search** 343/713,
343/795, 803, 806
See application file for complete search history.

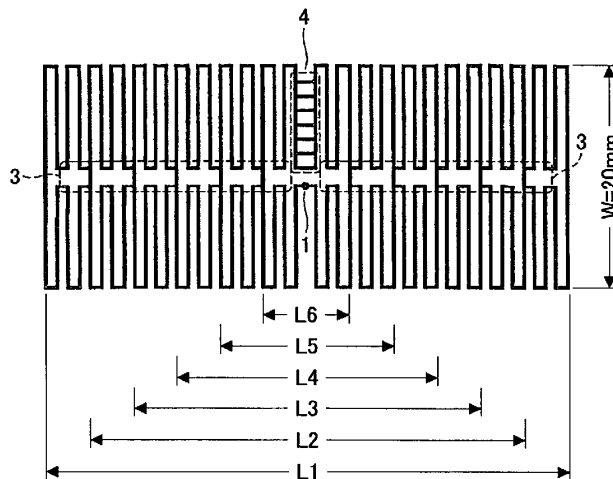
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JP 2002-330018 11/2002

(57) **ABSTRACT**

A meander line antenna formed in the shape of meander is disclosed. The meander line antenna includes a bottom half section that is constituted by a folded conductive pattern of a folded dipole antenna, and includes a feeding point for mounting an IC chip at the central part; a top half section that is constituted by a folded conductive pattern of a folded dipole antenna shaped like the bottom half section; and a frequency adjusting section consisting of connecting conductive patterns arranged at an interval corresponding to a desired frequency centering on the feeding point, the connecting conductive patterns connecting the bottom half section and the top half section. The connecting conductive patterns can be cut off, and the folded conductive pattern outside of the cut-off connecting conductive patterns can be removed.

5 Claims, 3 Drawing Sheets





US007205955B2

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

(10) **Patent No.:** **US 7,205,955 B2**
(45) **Date of Patent:** **Apr. 17, 2007**

(54) **ANTENNA**
(75) Inventors: **Toshiaki Shirosaka**, Kobe (JP); **Shingo Fujisawa**, Kobe (JP)
(73) Assignee: **DX Antenna Company, Limited**, Kobe-shi, Hyogo-ken (JP)

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 8 days.

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(21) Appl. No.: **11/239,257**

(22) Filed: **Sep. 30, 2005**

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(65) **Prior Publication Data**
US 2006/0139230 A1 Jun. 29, 2006

Primary Examiner—Hoang V. Nguyen
(74) *Attorney, Agent, or Firm*—Birch, Stewart, Kolasch and Birch, LLP

(30) **Foreign Application Priority Data**
Dec. 28, 2004 (JP) 2004-379963
Aug. 26, 2005 (JP) 2005-246049

(57) **ABSTRACT**

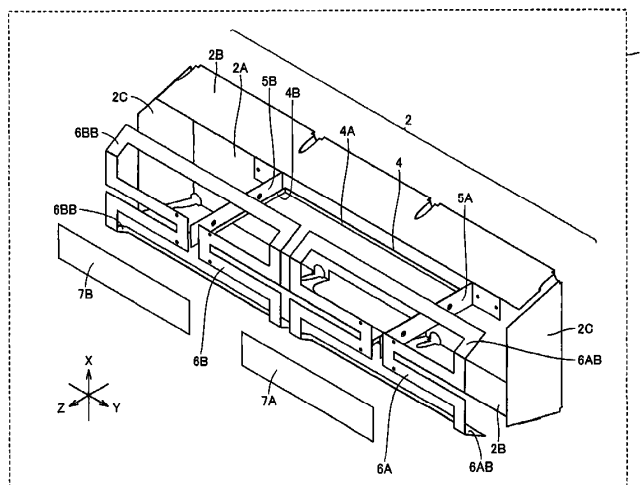
(51) **Int. Cl.**
H01Q 1/50 (2006.01)
(52) **U.S. Cl.** **343/850**; 343/824
(58) **Field of Classification Search** 343/850,
343/853, 824, 833, 834
See application file for complete search history.

A transmission line includes transmission lines parallel and perpendicular, respectively, to a flat portion of a reflector, and the parallel transmission line and the flat portion form a first strip line and the perpendicular transmission line and a conductive plate similarly form a second strip line. Radiators and the transmission line have a radiation impedance and a characteristic impedance, respectively, both set at 150Ω when the antenna's output terminal has a reference impedance of 75Ω. If the parallel transmission line has a midpoint serving as the output terminal of the antenna this portion's receiving current is divided in two so that an impedance of half that of the strip line can be provided and a coaxial cable can directly be connected to the transmission line. A matcher or a mixer is not included in the antenna, and matching and mixing losses can be prevented.

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EP 1 098 391 A2 5/2001

20 Claims, 19 Drawing Sheets





US007209080B2

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

(10) **Patent No.:** **US 7,209,080 B2**
(45) **Date of Patent:** **Apr. 24, 2007**

(54) **MULTIPLE-PORT PATCH ANTENNA**

(75) Inventors: **David D. Crouch**, Corona, CA (US);
Michael Sotelo, Chino, CA (US);
William E. Dolash, Montclair, CA (US)

(73) Assignee: **Raytheon Co.**, Waltham, MA (US)

(*) 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.: **10/883,093**

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

(65) **Prior Publication Data**
US 2006/0007044 A1 Jan. 12, 2006

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

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

(58) **Field of Classification Search** 343/770,
343/722, 746, 750, 751, 767, 844, 893, 908,
343/700 MS
See application file for complete search history.

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Primary Examiner—Don Wong

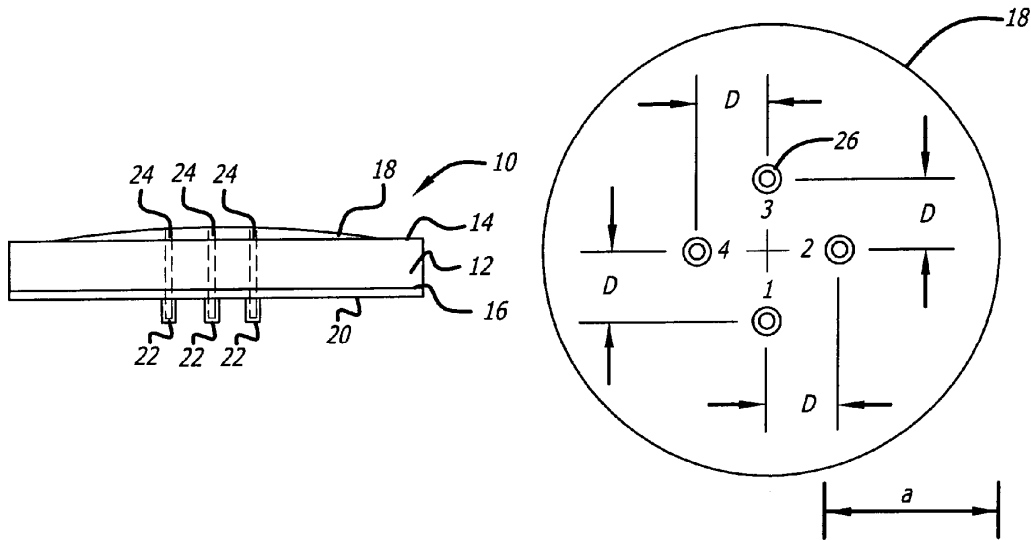
Assistant Examiner—Marie Antoinette Cabucos

(74) *Attorney, Agent, or Firm*—Thomas J. Finn; Leonard A. Alkov; Karl A. Vick

(57) **ABSTRACT**

A system and method for combining and radiating electromagnetic energy. The invention includes a novel antenna comprising a first dielectric substrate having opposite first and second surfaces, a patch of conducting material disposed on the first surface, a ground plane of conducting material disposed on the second surface, and at least three input ports, each input coupled to the patch at a feed point. The feed points are positioned to minimize the total power reflected from each input port. In an illustrative embodiment, the feed points are equally distributed around a circle having the same center as the patch and having a radius chosen to minimize the reflections at each input. In accordance with the novel method of the present invention, the outputs of multiple sources are combined in the antenna itself, by coupling the sources directly to the antenna.

48 Claims, 9 Drawing Sheets





US007209081B2

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

(10) **Patent No.:** **US 7,209,081 B2**
(45) **Date of Patent:** **Apr. 24, 2007**

(54) **MULTI-BAND ANTENNA AND DESIGN METHOD THEREOF**

(58) **Field of Classification Search** 343/700 MS, 343/895, 795, 702, 846
See application file for complete search history.

(75) Inventors: **Hung-Yue Chang**, Taipei Hsien (TW);
Chen-Hsing Fang, Taipei Hsien (TW);
Wei-Li Cheng, Taipei Hsien (TW);
Chih-Lung Chen, Taipei Hsien (TW)

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2006/0170604	A1 *	8/2006	Almog et al.	343/795

(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 43 days.

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Primary Examiner—Hoanganh Le

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

(21) Appl. No.: **11/161,999**

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

(57) **ABSTRACT**

(65) **Prior Publication Data**

US 2006/0164306 A1 Jul. 27, 2006

The present invention provides a multi-band antenna to which the arrangement of Koch fractal antenna is applied. The multi-band antenna is designed in triangular shape whose area is smaller than the general antenna structure. By using the arrangement of Koch fractal antenna, the area of the inverted-F dual-band antenna can be reduced efficiently, so as to enhance more usability.

(30) **Foreign Application Priority Data**

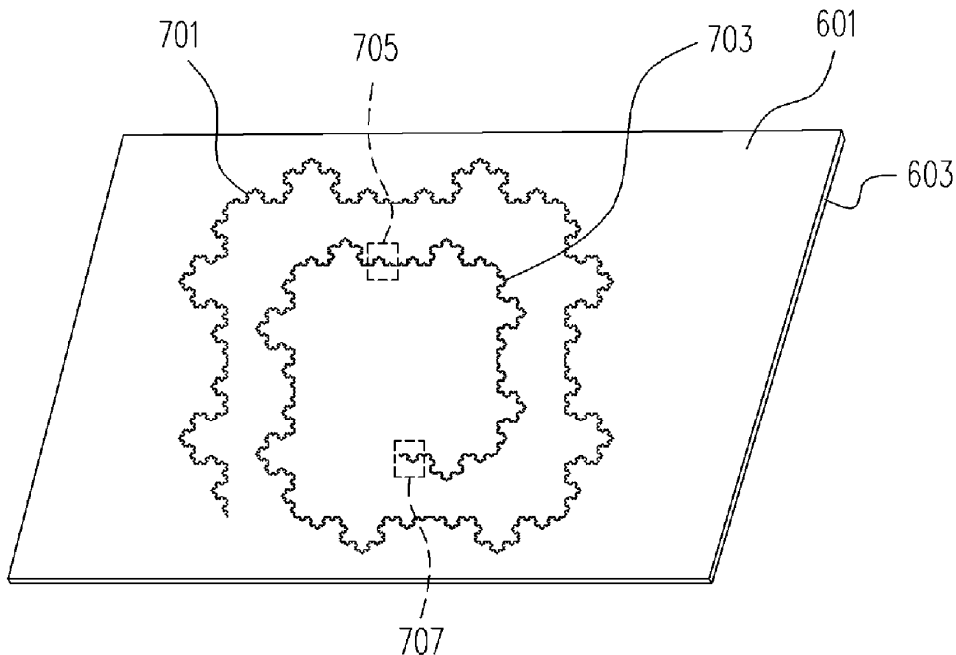
Jan. 21, 2005 (TW) 94101770 A

(51) **Int. Cl.**

H01Q 1/38 (2006.01)

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

10 Claims, 8 Drawing Sheets





US007209084B2

(12) **United States Patent**
Lindell

(10) **Patent No.:** **US 7,209,084 B2**
(45) **Date of Patent:** **Apr. 24, 2007**

(54) **ANTENNA FOR PORTABLE COMMUNICATION DEVICE EQUIPPED WITH A HINGE**

(58) **Field of Classification Search** 343/702, 343/895, 846; 455/90, 550, 575
See application file for complete search history.

(75) Inventor: **Bo Lindell**, Lidingö (SE)

(56) **References Cited**

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

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

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(21) Appl. No.: **10/536,598**

(Continued)

(22) PCT Filed: **Nov. 20, 2003**

FOREIGN PATENT DOCUMENTS

(86) PCT No.: **PCT/EP03/13001**

WO WO 00/28617 5/2000

§ 371 (c)(1),
(2), (4) Date: **May 26, 2005**

(Continued)

(87) PCT Pub. No.: **WO2004/049502**

Primary Examiner—Tho Phan
Assistant Examiner—Chuc Tran
(74) *Attorney, Agent, or Firm*—Myers Bigel Sibley Sajovec, PA

PCT Pub. Date: **Jun. 10, 2004**

(65) **Prior Publication Data**

US 2006/0071863 A1 Apr. 6, 2006

Related U.S. Application Data

(60) Provisional application No. 60/431,505, filed on Dec. 4, 2002.

(30) **Foreign Application Priority Data**

Nov. 26, 2002 (EP) 02026232

(51) **Int. Cl.**

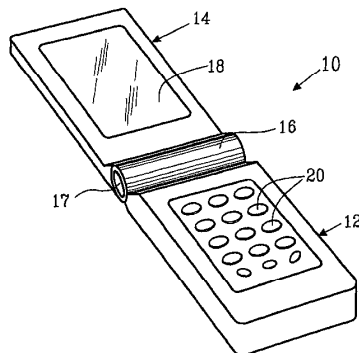
H01Q 1/24 (2006.01)
H04B 1/38 (2006.01)

(57) **ABSTRACT**

A portable communication device includes a first part including a first antenna element located within and extending through a portion of the first part and radio circuit feeding antenna elements, a second part hingedly joined to an end of the first part for providing at least one open and one closed position of the phone, and a hinge element connected to the first and second parts. The hinge element stretches along the end of the first part for providing rotation of one part in relation to the other part around a first axis having a first and second end. The hinge element includes a second antenna element. The radio circuit is connected between the first and second antenna elements.

(52) **U.S. Cl.** **343/702**; 343/895; 455/90; 455/550; 455/575

19 Claims, 5 Drawing Sheets





US007209085B2

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

(10) **Patent No.:** **US 7,209,085 B2**
(45) **Date of Patent:** **Apr. 24, 2007**

(54) **MECHANO-ELECTRONIC ANTENNA**

(56) **References Cited**

(75) Inventors: **Corbett Ray Rowell**, Mongkok (HK);
William H. Darden, Naperville, IL
(US)

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7,046,202 B2 * 5/2006 Chiang et al. 343/700 MS

(73) Assignee: **Molex Incorporated**, Lisle, IL (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 7 days.

Primary Examiner—Tan Ho

(74) *Attorney, Agent, or Firm*—Robert J. Zeitler

(21) Appl. No.: **11/190,103**

(57) **ABSTRACT**

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

A mechano-electronic antenna includes an insulating base board having a first face and a second face which are opposite to each other, and a first radiating surface formed on the first face; and a rotating shaft, which is rotationally provided on and gets through the insulating base board, and is near the first radiating surface, and at least one metal branch arm extends outwards from the rotating shaft on the first face of the insulating base board so that the metal branch arm can be electrically connected with the first radiating surface when the rotating shaft is rotated relative to the insulating base board from the first position to the second position. By these means, the geometrical shapes of the antenna are changed to improve the radiating efficiency of the antenna.

(65) **Prior Publication Data**

US 2006/0066489 A1 Mar. 30, 2006

(30) **Foreign Application Priority Data**

Jul. 23, 2004 (CN) 2004 1 0070842

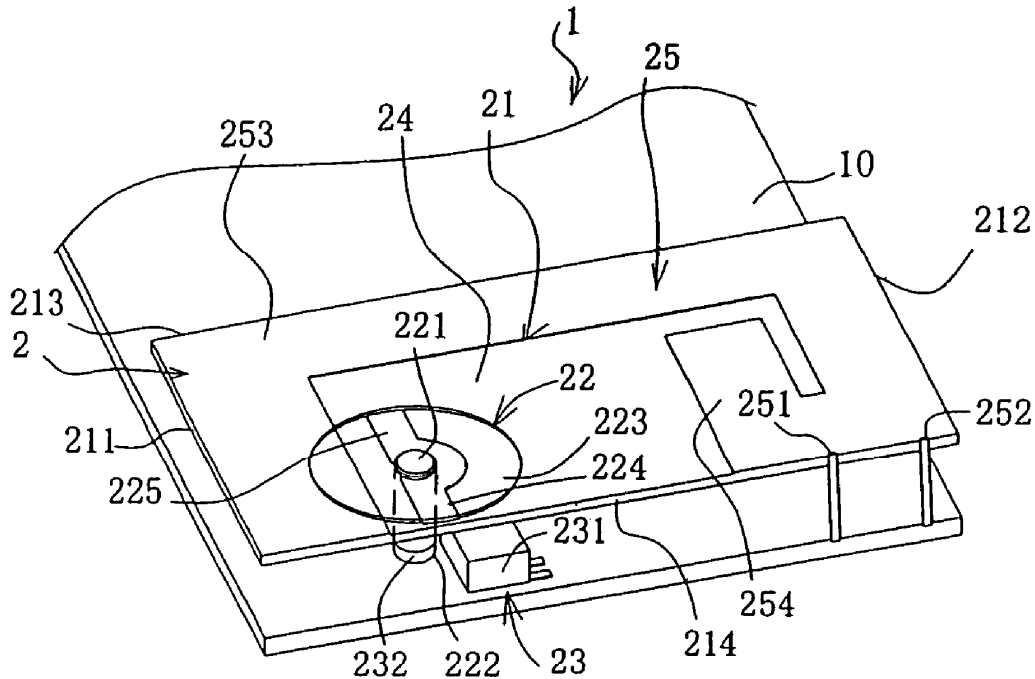
(51) **Int. Cl.**
H01Q 1/24 (2006.01)

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

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

See application file for complete search history.

9 Claims, 4 Drawing Sheets





US007209086B2

(12) **United States Patent**
Chung

(10) **Patent No.:** **US 7,209,086 B2**
(45) **Date of Patent:** **Apr. 24, 2007**

(54) **ANTENNA DEVICE FOR PORTABLE TERMINAL**

(75) Inventor: **Hyung-Jin Chung**, Suwon-si (KR)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 2 days.

(21) Appl. No.: **11/239,871**

(22) Filed: **Sep. 30, 2005**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

Nov. 10, 2004 (KR) 10-2004-0091403

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

(52) **U.S. Cl.** **343/702; 455/575.4**

(58) **Field of Classification Search** **343/702;**
455/575.4

See application file for complete search history.

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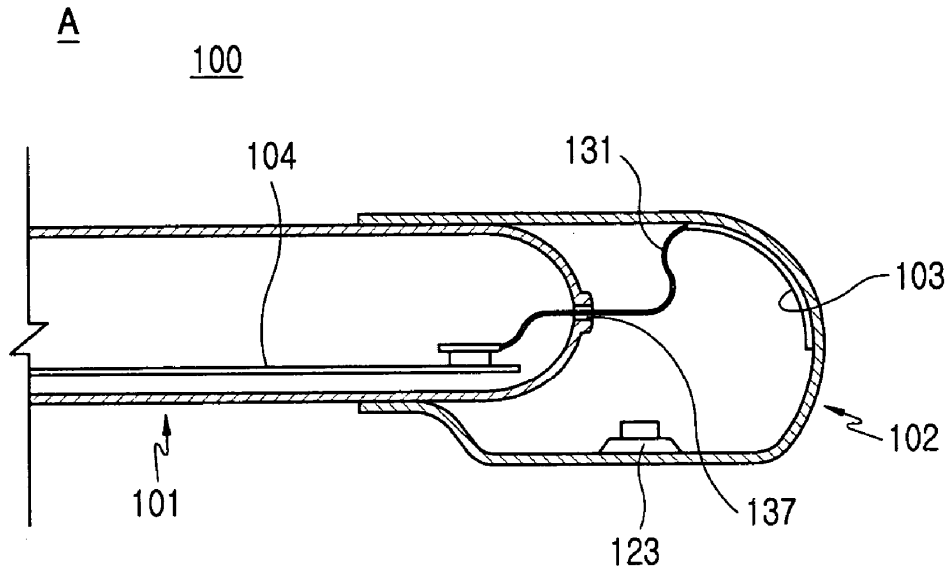
Primary Examiner—Hoang V. Nguyen

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

(57) **ABSTRACT**

Disclosed is an antenna device for a portable terminal including a first housing and a second housing which is slidably assembled with the first housing so as to open and close a part of the first housing. The antenna device includes an antenna pattern which is disposed on an inner surface of the second housing, the second housing enclosing the first housing when the first housing and the second housing have been assembled with each other; and a flexible printed circuit which extends from the antenna pattern into the first housing. In the antenna device, since the antenna pattern is connected to a main board of the portable terminal by means of the flexible printed circuit, the stable connection of the antenna pattern and the main board can be kept.

9 Claims, 7 Drawing Sheets





US007209087B2

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

(10) **Patent No.:** **US 7,209,087 B2**
(45) **Date of Patent:** **Apr. 24, 2007**

(54) **MOBILE PHONE ANTENNA**

(75) Inventors: **Chia-Lun Tang**, Miao-Li Hsien (TW);
Kin-Lu Wong, Kao-Hsiung (TW);
Saou-Wen Su, Taipei (TW)

(73) Assignees: **Industrial Technology Research**
Institute, Hsinchu (TW); **National Sun**
Yat-Sen University, Kaohsiung (TW)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 59 days.

(21) Appl. No.: **11/258,762**

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

(65) **Prior Publication Data**
US 2007/0063901 A1 Mar. 22, 2007

(30) **Foreign Application Priority Data**
Sep. 22, 2005 (TW) 94132804 A

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

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

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

See application file for complete search history.

(56) **References Cited**

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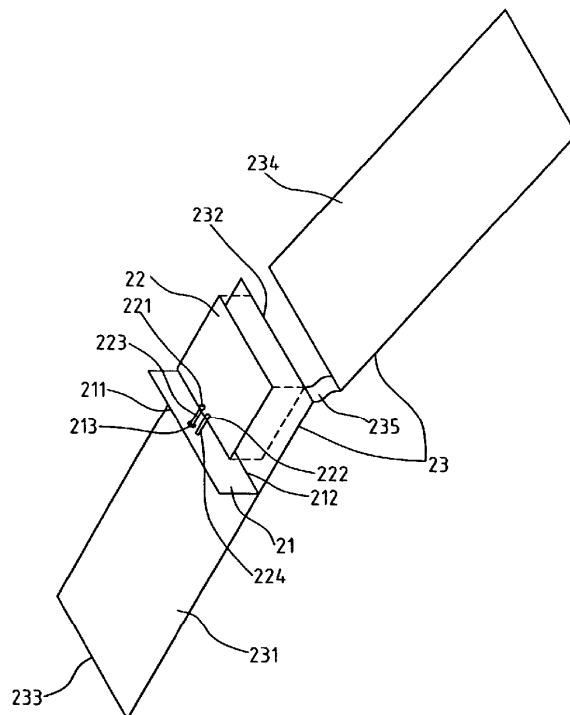
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Primary Examiner—Hoanganh Le

(57) **ABSTRACT**

The present invention provides a mobile phone antenna, which comprises an antenna ground plane, a radiating conducting plate, a feeding conducting strip, a shorting conducting strip, and a system ground plane. Using the antenna ground plane as a shielding metal wall, the present invention advantages itself of making the antenna and a shielding metal box easier to be integrated without a need for an isolation distance. The present invention thus makes the best use of the internal spacing of a mobile phone. This antenna is suitable for application as an embedded antenna for both folded-type and bar-type mobile phones. The operating bandwidth of this antenna can cover the required bandwidth for a Universal Mobile Telecommunication System operation.

13 Claims, 12 Drawing Sheets





US007209088B2

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

(10) **Patent No.:** **US 7,209,088 B2**
(45) **Date of Patent:** **Apr. 24, 2007**

(54) **FEED ANTENNA INCLUDING DIELECTRIC WAVEGUIDE**

(75) Inventors: **Masakatsu Maruyama**, Kobe (JP); **Chitaka Manabe**, Kobe (JP); **Yoshito Fukumoto**, Kobe (JP); **Nobuyuki Kawakami**, Kobe (JP); **Takayuki Hirano**, Kobe (JP)

(73) Assignee: **Kabushiki Kaisha Kobe Seiko Sho**, Hyogo (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.

(21) Appl. No.: **11/000,975**

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

(65) **Prior Publication Data**
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(30) **Foreign Application Priority Data**
Dec. 2, 2003 (JP) 2003-402761

(51) **Int. Cl.**
H01Q 13/00 (2006.01)
(52) **U.S. Cl.** **343/772; 343/700 MS**
(58) **Field of Classification Search** **343/772, 343/786, 700 MS**
See application file for complete search history.

(56) **References Cited**

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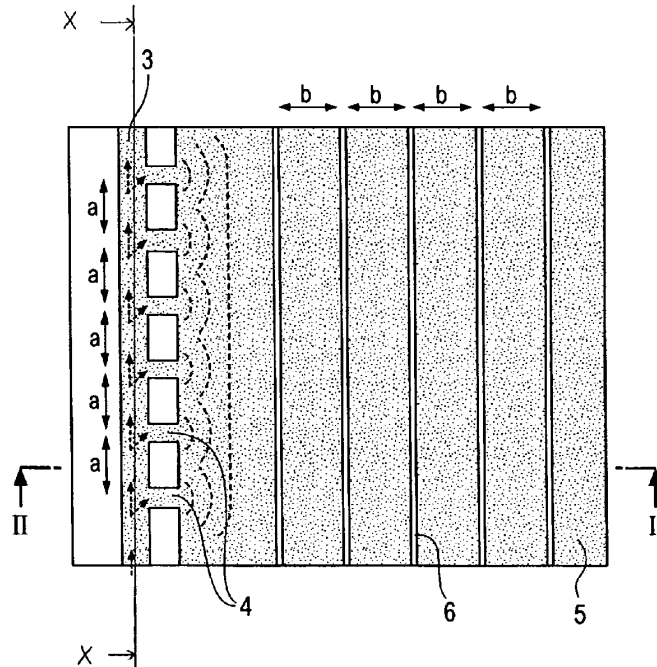
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Primary Examiner—Hoang V. Nguyen
Assistant Examiner—Dieu Hien Duong
(74) *Attorney, Agent, or Firm*—Reed Smith LLP; Stanley P. Fisher, Esq.; Juan Carlos A. Marquez, Esq.

(57) **ABSTRACT**

A feed antenna includes a pair of conductive members, a dielectric waveguide placed therebetween, a dielectric member that is placed between the conductive members and located close to the dielectric waveguide, and a plurality of dielectric binding sections for binding the dielectric waveguide to the dielectric member. One of the conductive members has a plurality of openings.

23 Claims, 12 Drawing Sheets





US007209089B2

(12) **United States Patent**
Schantz

(10) **Patent No.:** **US 7,209,089 B2**
(45) **Date of Patent:** **Apr. 24, 2007**

(54) **BROADBAND ELECTRIC-MAGNETIC ANTENNA APPARATUS AND METHOD**

(76) Inventor: **Hans Gregory Schantz**, 515 Sparkman Dr., Huntsville, AL (US) 35816

(*) 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.: **11/040,077**

(22) Filed: **Jan. 21, 2005**

(65) **Prior Publication Data**

US 2005/0162332 A1 Jul. 28, 2005

Related U.S. Application Data

(60) Provisional application No. 60/538,187, filed on Jan. 22, 2004.

(51) **Int. Cl.**

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H01Q 9/28 (2006.01)
H01Q 21/26 (2006.01)
H01Q 21/00 (2006.01)

(52) **U.S. Cl.** **343/787**; 343/795; 343/797; 343/867

(58) **Field of Classification Search** 343/793, 343/795, 797, 866, 867, 787
See application file for complete search history.

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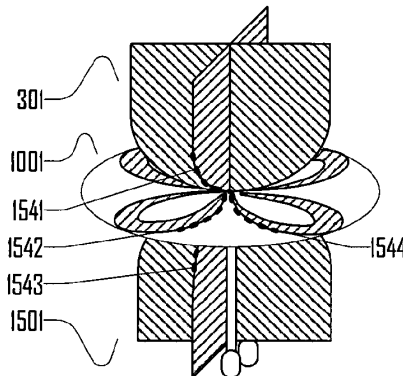
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Primary Examiner—Shih-Chao Chen

(57) **ABSTRACT**

The present invention is directed to a broadband electric-magnetic antenna apparatus and method. The present invention teaches a variety of electric antennas suitable for use in the present invention as well as a variety of magnetic antennas suitable for use in the present invention. Combination of a broadband electric antenna element and a broadband magnetic element to create a broadband electric-magnetic antenna system is discussed. This invention further teaches systems for using a broadband electric magnetic antenna system to radiate or receive quadrature signals.

16 Claims, 4 Drawing Sheets





US007209090B2

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

(10) **Patent No.:** **US 7,209,090 B2**
(45) **Date of Patent:** **Apr. 24, 2007**

(54) **HIGH EFFICIENCY CORE ANTENNA AND CONSTRUCTION METHOD**

(75) Inventors: **Stewart E. Hall**, Wellington, FL (US); **Brent F. Balch**, Fort Lauderdale, FL (US); **Richard L. Copeland**, Lake Worth, FL (US); **William Farrell**, West Palm Beach, FL (US)

(73) Assignee: **Sensormatic Electronics Corporation**, Boca Raton, FL (US)

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

(21) Appl. No.: **10/855,203**

(22) Filed: **May 27, 2004**

(65) **Prior Publication Data**
US 2004/0252068 A1 Dec. 16, 2004

Related U.S. Application Data
(60) Provisional application No. 60/478,943, filed on Jun. 16, 2003.

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

(52) **U.S. Cl.** **343/788**; 343/787

(58) **Field of Classification Search** 343/788, 343/787, 867, 895

See application file for complete search history.

(56) **References Cited**

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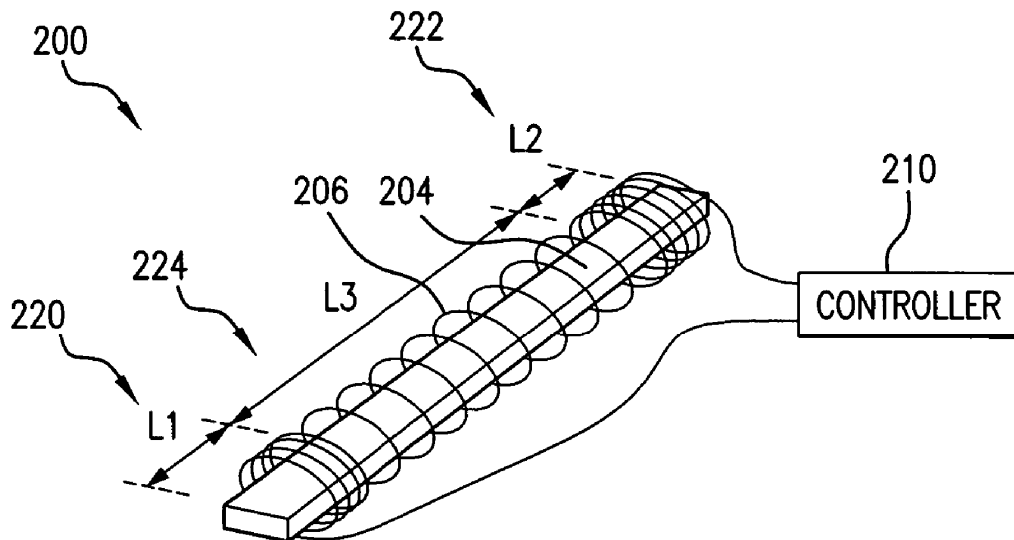
Primary Examiner—Tho Phan

(74) *Attorney, Agent, or Firm*—Christopher & Weisberg, P.A.

(57) **ABSTRACT**

A magnetic core antenna system including a magnetic core and a winding network. The winding network may be configured with a non-uniform ampere-turn distribution to achieve a desired flux density in the core. The network may include a plurality of windings configured to provide a winding impedance facilitating optimal transmitter power delivery to the windings. A magnetic core may be constructed from multiple components having longitudinal contact surfaces and joined by a transverse clamping force. An air gap may be provided between the components to allow relative movement therebetween.

11 Claims, 9 Drawing Sheets





US007209091B2

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

(10) **Patent No.:** **US 7,209,091 B2**
(45) **Date of Patent:** **Apr. 24, 2007**

(54) **VERTICALLY POLARIZED PANEL ANTENNA SYSTEM AND METHOD**

(75) Inventors: **John L. Schadler**, Raymond, ME (US);
Andre J. Skalina, Portland, ME (US)

(73) Assignee: **SPX Corporation**, Charlotte, NC (US)

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

(21) Appl. No.: **11/098,412**

(22) Filed: **Apr. 5, 2005**

(65) **Prior Publication Data**

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

(52) **U.S. Cl.** **343/812**; 343/810; 343/797

(58) **Field of Classification Search** 343/810-820,
343/795, 797, 853, 846
See application file for complete search history.

(56) **References Cited**

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Primary Examiner—Hoang V. Nguyen

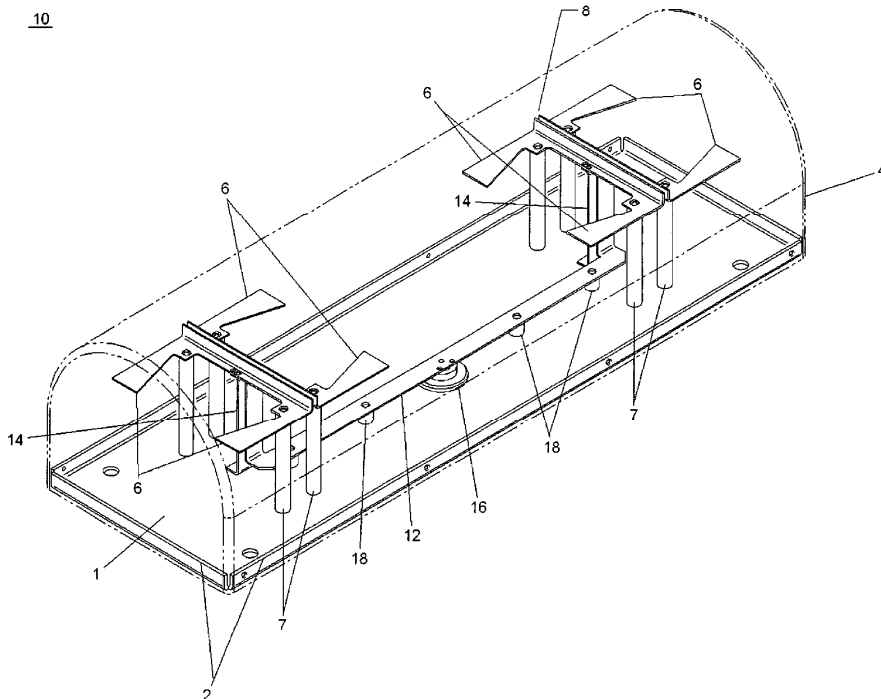
Assistant Examiner—Ephrem Alemu

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

(57) **ABSTRACT**

A very inexpensive and on-site tunable design for a vertically polarized panel antenna system, suitable for the FCC digital broadcast 700 MHz range is provided. Bowtie-like shaped antennas having machine-stampable planar elements with an adjustable separation are configured with a stripline feed. The stripline feed enables easy feeding of doublet systems to allow the configuration of an array of vertically polarized antennas. The various components of the antenna system can be easily tuned, enabling rapid deployment and quick operation.

21 Claims, 5 Drawing Sheets





US007209096B2

(12) **United States Patent**
Chau

(10) **Patent No.:** **US 7,209,096 B2**
(45) **Date of Patent:** **Apr. 24, 2007**

- (54) **LOW VISIBILITY DUAL BAND ANTENNA WITH DUAL POLARIZATION**
- (75) Inventor: **Tam Hung Chau**, Berkeley, IL (US)
- (73) Assignee: **Antenex, 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 27 days.

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- (21) Appl. No.: **11/040,860**
- (22) Filed: **Jan. 21, 2005**

(65) **Prior Publication Data**
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Related U.S. Application Data
(60) Provisional application No. 60/538,685, filed on Jan. 22, 2004.

- (51) **Int. Cl.**
H01Q 1/36 (2006.01)
H01Q 1/24 (2006.01)
- (52) **U.S. Cl.** **343/895; 343/702**
- (58) **Field of Classification Search** 343/702,
343/895, 872
See application file for complete search history.

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Primary Examiner—Shih-Chao Chen
(74) Attorney, Agent, or Firm—Cislo & Thomas LLP

(57) **ABSTRACT**

A low visibility, field-diverse, dual band antenna provides cross-polarized fields enhancing signal communications. A generally flat, but helical, antenna is achieved in conjunction with a core substrate about which the antenna is wrapped, wound, or fixed. The core substrate, pitch or angle of the helix, and length of the transmitting antenna are chosen for a specific two (2) selected resonant frequency. A two-pole low-pass filter may be used to achieve dual band transmission. The passive components are specifically selected to achieve two (2) resonant frequencies PCS/Cellular 821–896 MHz and 1850–1990 MHz. The length and width of the helix are chosen in order to dimension the helical antenna between its linear and circular polarization modes to thereby deliver field-diverse and cross-polarized transmission modes.

32 Claims, 4 Drawing Sheets

