



US007187328B2

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

(10) **Patent No.:** **US 7,187,328 B2**
(45) **Date of Patent:** **Mar. 6, 2007**

- (54) **ANTENNA DEVICE**
- (75) Inventors: **Masato Tanaka**, Tokyo (JP);
Jae-Hyeuk Jang, Tokyo (JP);
Young-Sik Kim, Seoul (KR); **Byung Sun Park**, Seoul (KR)
- (73) Assignee: **National Institute of Information and Communications Technology, Incorporated Administrative Agency**, Tokyo (JP)

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

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(21) Appl. No.: **10/532,298**

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(22) PCT Filed: **Oct. 25, 2002**

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(86) PCT No.: **PCT/JP02/11131**

§ 371 (c)(1),
(2), (4) Date: **Jan. 3, 2006**

Rexberg et al., "Feed array element for mobile communication service systems," Digest of the Antennas and Propagation Society International Symposium, Seattle, WA, vol. 3, Jun. 20, 1994, pp. 902-905.

(87) PCT Pub. No.: **WO2004/038862**

PCT Pub. Date: **May 6, 2004**

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

(65) **Prior Publication Data**

US 2006/0139209 A1 Jun. 29, 2006

(57) **ABSTRACT**

- (51) **Int. Cl.**
H01Q 1/38 (2006.01)
- (52) **U.S. Cl.** **343/700 MS; 343/789**
- (58) **Field of Classification Search** **343/700 MS, 343/846, 786, 789**
See application file for complete search history.

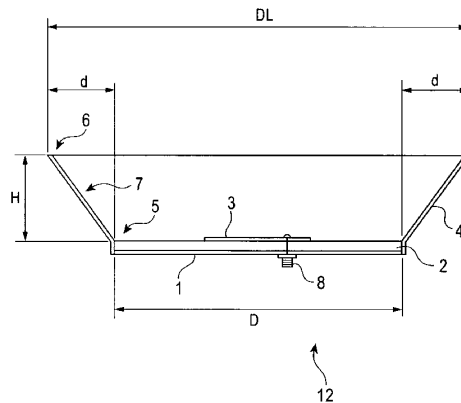
In an antenna device having a substantially conical conductive member, having upper and lower sides made open, erected in a substantially vertical direction around a substantially circular microstrip patch provided on the upper side of a substantially circular substrate, the lower opening portion of the conductive member is grounded to a ground plate provided on the lower side of the substrate, and the diameter of the upper opening portion of the conductive member is larger than the diameter of the lower opening portion of the conductive member.

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6 Claims, 9 Drawing Sheets





US007187329B2

(12) **United States Patent**
Okado

(10) **Patent No.:** **US 7,187,329 B2**
(45) **Date of Patent:** **Mar. 6, 2007**

(54) **ANTENNA, DIELECTRIC SUBSTRATE FOR ANTENNA, AND WIRELESS COMMUNICATION CARD**

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

(75) Inventor: **Hironori Okado**, Tokyo (JP)

(56) **References Cited**

(73) Assignee: **Taiyo Yuden Co., Ltd.**, Tokyo (JP)

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

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(21) Appl. No.: **10/536,456**

EP 831548 A2 3/1998

(22) PCT Filed: **Jul. 14, 2003**

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(86) PCT No.: **PCT/JP03/08919**

U.S. Appl. No. 10/654,432, filed Sep. 4, 2003, Okado.

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

(Continued)

Primary Examiner—Shih-Chao Chen
(74) *Attorney, Agent, or Firm*—Oliff & Berridge, PLC

(87) PCT Pub. No.: **WO2004/049505**

(57) **ABSTRACT**

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

An antenna of this invention has a ground pattern and a planar element having a cut-out portion from an edge portion farthest from a feed position toward the ground pattern side, and the ground pattern and the planar element are juxtaposed with each other. By providing the cut-out portion, the miniaturization can be realized and current paths to obtain radiation in the low frequency range can be secured. In addition, because the planar element and the ground element are juxtaposed with each other, the volume necessary for the implementation is reduced, and it becomes easy to control the antenna characteristic, particularly, the impedance characteristic, thereby the broad bandwidth can be achieved.

(65) **Prior Publication Data**

US 2005/0248487 A1 Nov. 10, 2005

(30) **Foreign Application Priority Data**

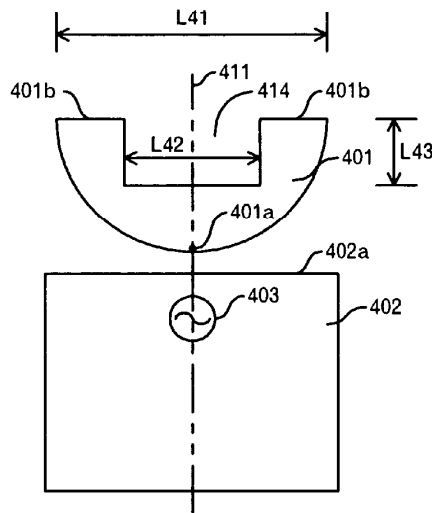
Nov. 27, 2002 (JP) 2002-343290
Mar. 4, 2003 (JP) 2003-056740

(51) **Int. Cl.**

H01Q 1/38 (2006.01)
H01Q 13/10 (2006.01)
H01Q 1/48 (2006.01)

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

1 Claim, 31 Drawing Sheets





US007187330B2

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

(10) **Patent No.:** **US 7,187,330 B2**
(45) **Date of Patent:** **Mar. 6, 2007**

(54) **DIFFERENTIAL AND SINGLE ENDED ELLIPTICAL ANTENNAS**

(75) Inventors: **Johnna Dawn Powell**, Cambridge, MA (US); **Anantha Chandrakasan**, Belmont, MA (US)

(73) Assignee: **Massachusetts Institute of Technology**, Cambridge, MA (US)

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

(21) Appl. No.: **11/158,905**

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

(65) **Prior Publication Data**
US 2005/0280582 A1 Dec. 22, 2005

Related U.S. Application Data

(60) Provisional application No. 60/582,099, filed on Jun. 22, 2004.

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

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

(58) **Field of Classification Search** **343/700 MS, 343/769**

See application file for complete search history.

(56) **References Cited**

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Primary Examiner—Hoang V. Nguyen

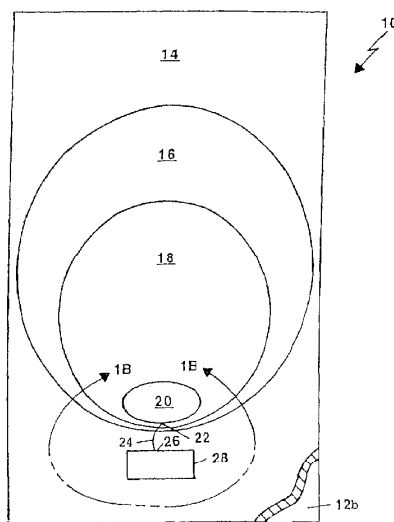
Assistant Examiner—Dieu Hien Duong

(74) *Attorney, Agent, or Firm*—Daly, Crowley, Mofford & Durkee, LLP

(57) **ABSTRACT**

An antenna element includes a radiating antenna element having an elliptical shape disposed on a first surface of a substrate. A dielectric clearance region having an elliptical shape is disposed about the radiating antenna element to space the radiating antenna element from a ground plane. The clearance region is shaped such that a portion of the radiating element in which an antenna feed is disposed is proximate the ground plane. The antenna can also be provided having an elliptically shaped tuning region disposed within the radiating antenna element. The antenna is suitable for use in single-ended or differential ultra wide band (UWB) transmitting and/or receiving systems.

24 Claims, 9 Drawing Sheets





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

(10) **Patent No.:** **US 7,187,331 B2**
(45) **Date of Patent:** **Mar. 6, 2007**

(54) **EMBEDDED MULTIBAND ANTENNAS**

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2004/0056805 A1* 3/2004 Chen 343/700 MS

(75) Inventors: **Zhi Ning Chen**, Singapore (SG); **Brian P. Gaucher**, Brookfield, CT (US); **Duixian Liu**, Yorktown Heights, NY (US)

* cited by examiner

(73) Assignee: **Lenovo(Singapore) Pte, Ltd.**, Singapore (SG)

Primary Examiner—Hoang V. Nguyen
(74) *Attorney, Agent, or Firm*—Ronald V. Davidge; Carlos Munoz-Bustamante

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

(57) **ABSTRACT**

(21) Appl. No.: **10/967,408**

A compact sized embedded, multiband, multi-standard, interoperable antenna for portable devices used in wireless applications is provided. The antenna design includes an asymmetrical structure provided on a double-sided printed circuit board. The asymmetrical structure covers both the ultra-wideband and the wireless local area network band. The asymmetrical structure provided on the front side of the printed circuit board is a primary radiator with a supplement strip radiator, whereby the bottom of the primary radiator is close to the vertical ground plane and fed by a probe extended from a coaxial line. The asymmetrical structure on the front side provides a well-matched bandwidth covering the ultra-wideband band of 3.1 GHz to 10.6 GHz. A second supplement strip is provided on the backside of the printed circuit board which provides the second resonance at the 2.4 GHz wireless local area network band.

(22) Filed: **Oct. 18, 2004**

(65) **Prior Publication Data**

US 2006/0082504 A1 Apr. 20, 2006

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

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

(58) **Field of Classification Search** **343/700 MS; 343/702, 895, 846**

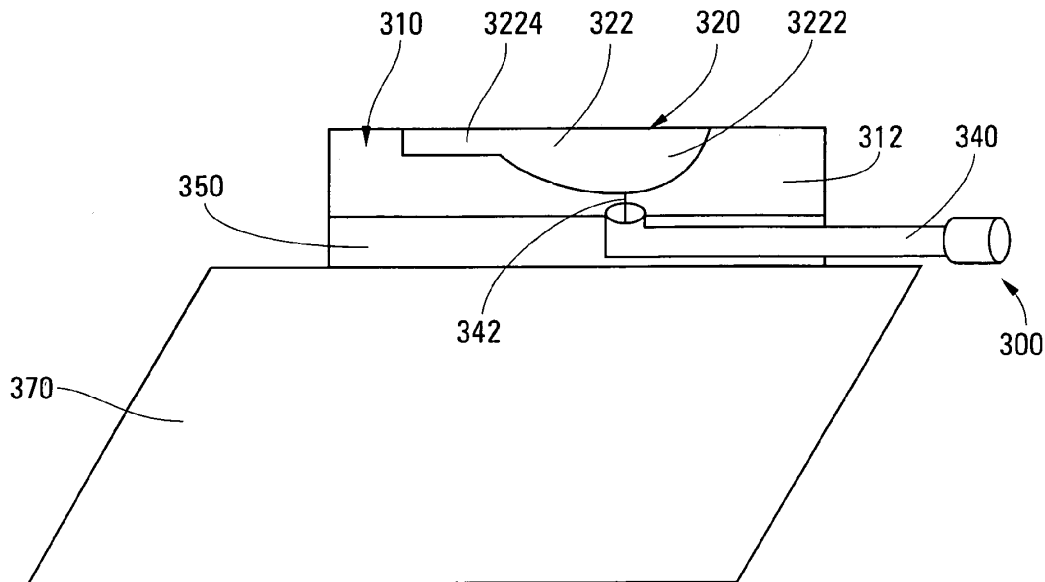
See application file for complete search history.

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15 Claims, 5 Drawing Sheets





US007187332B2

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

(10) **Patent No.:** **US 7,187,332 B2**
(45) **Date of Patent:** **Mar. 6, 2007**

(54) **MOBILE WIRELESS COMMUNICATIONS DEVICE WITH HUMAN INTERFACE DIVERSITY ANTENNA AND RELATED METHODS**

(75) Inventors: **Vytas Kezys**, Ancaster (CA); **Yihong Qi**, Waterloo (CA)

(73) Assignee: **Research in Motion Limited**, Ontario (CA)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 97 days.

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Primary Examiner—Hoang V. Nguyen

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

(21) Appl. No.: **11/067,935**

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

(65) **Prior Publication Data**

US 2006/0192724 A1 Aug. 31, 2006

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

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

(58) **Field of Classification Search** 343/702, 343/700 MS, 876; 455/90, 575

See application file for complete search history.

(56) **References Cited**

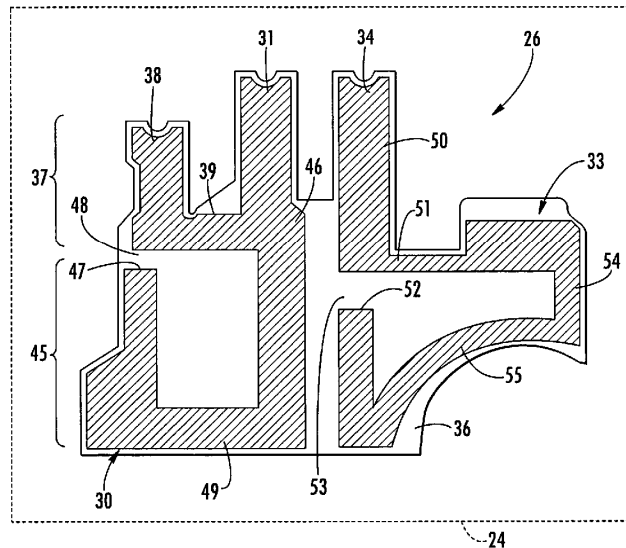
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(57) **ABSTRACT**

A mobile wireless communications device may include a portable handheld housing, and a wireless transceiver carried by the housing. A pair of antennas are positioned in side-by-side relation preferably in the upper portion of the portable handheld housing. A human interface diversity controller is connected to the wireless transceiver to preferentially operate with the plurality of antennas based upon a relative position of the portable handheld housing with respect to a hand of a human user. The device can select or weight the antennas based upon the position of the device when being held by a user.

13 Claims, 4 Drawing Sheets





US007187333B2

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

(10) **Patent No.:** **US 7,187,333 B2**
(45) **Date of Patent:** **Mar. 6, 2007**

(54) **ANTENNA DEVICE** 5,298,894 A * 3/1994 Cerny et al. 340/870.02
5,585,809 A * 12/1996 Yajima et al. 343/713
(75) Inventors: **Akira Yoneya**, Akita (JP); **Yoshiaki Imano**, Akita (JP); **Akemi Kato**, Akita (JP); **Tsutomu Ito**, Akita (JP) 5,885,679 A * 3/1999 Yasue et al. 428/57

FOREIGN PATENT DOCUMENTS

(73) Assignee: **Mitsumi Electric Co., Ltd.**, Tokyo (JP) JP 2001-68912 3/2001

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 24 days.

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Primary Examiner—Michael C. Wimer
(74) *Attorney, Agent, or Firm*—Whitham, Curtis, Christofferson & Cook, P.C.

(21) Appl. No.: **10/879,348**

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

(57) **ABSTRACT**

(65) **Prior Publication Data**
US 2005/0068248 A1 Mar. 31, 2005

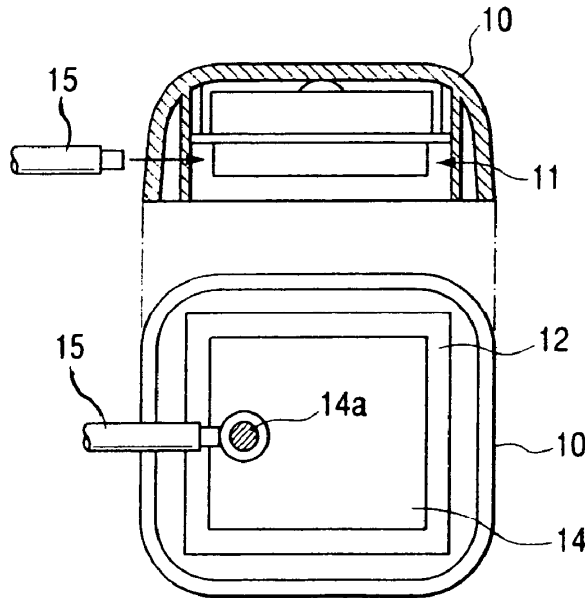
An antenna device that can surely prevent water from coming into the part where the transmission cable is introduced and allows the number of parts to be reduced so that the cost can be reduced. The antenna device includes an antenna module that receives radio waves transmitted from a satellite, a cover member having a sufficient internal space to store the antenna module and its bottom opened, and a bottom plate to close the open bottom of the cover member. The transmission cable is connected to the antenna module. The transmission cable is inserted from the hole provided at the cover member and sealed by a seal material including silicon resin in the hole. The bottom plate is made of a metal plate and a magnet plate and the magnet plate has projections to position the magnet. After the bottom plate is attached, a composite resin material is filled and the cover member has its bottom side sealed.

(30) **Foreign Application Priority Data**
Sep. 30, 2003 (JP) P.2003-342105

(51) **Int. Cl.**
H01Q 1/40 (2006.01)
(52) **U.S. Cl.** 343/713; 343/872; 343/700 MS
(58) **Field of Classification Search** 343/702, 343/711-713, 715, 872, 873, 905, 700 MS, 343/906, 878
See application file for complete search history.

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10 Claims, 4 Drawing Sheets





US007187339B2

(12) **United States Patent**
Mori

(10) **Patent No.:** **US 7,187,339 B2**
(45) **Date of Patent:** **Mar. 6, 2007**

(54) **ANTENNA APPARATUS**
(75) Inventor: **Kohei Mori**, Kanagawa (JP)
(73) Assignee: **Sony Corporation** (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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WO	WO 03/058758 A1	7/2003

(21) Appl. No.: **11/033,382**
(22) Filed: **Jan. 12, 2005**
(65) **Prior Publication Data**
US 2005/0162327 A1 Jul. 28, 2005

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(30) **Foreign Application Priority Data**
Jan. 23, 2004 (JP) P2004-016186

Primary Examiner—Hoang V. Nguyen
Assistant Examiner—Ephrem Alemu
(74) *Attorney, Agent, or Firm*—Rader Fishman & Grauer PLLC; Ronald P. Kananen

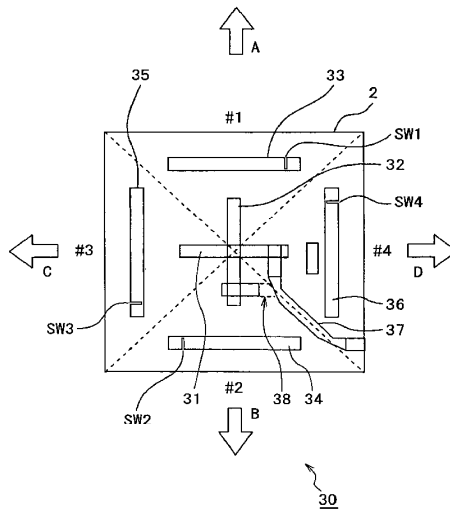
(51) **Int. Cl.**
H01Q 13/10 (2006.01)
(52) **U.S. Cl.** **343/770**; 343/700 MS;
343/768
(58) **Field of Classification Search** 343/700 MS,
343/702, 819, 815, 833, 834, 767, 768, 770
See application file for complete search history.

(57) **ABSTRACT**

In order to have an antenna apparatus small in size and capable of switching its directivity pattern without degrading its antenna efficiency, the present invention provides an antenna apparatus having a driven element formed at an approximately center position of a planar printed circuit board and parasitic elements not performing feeding formed before and behind the first antenna element, respectively, so that the driven element is caused to function as a radiator and either one of the parasitic elements is made to have a length as long as an electrical length of a radiator or slightly shorter than that to function as a director and the other one of the parasitic elements is left to have an electrical length longer than that of the radiator to function as a reflector.

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9 Claims, 16 Drawing Sheets





US007187341B2

(12) **United States Patent**
Lee

(10) **Patent No.:** **US 7,187,341 B2**
(45) **Date of Patent:** **Mar. 6, 2007**

(54) **ANTENNA APPARATUS HAVING A REFLECTOR**

(58) **Field of Classification Search** 343/895,
343/702, 795, 834, 817, 700 MS, 835, 836,
343/839
See application file for complete search history.

(75) Inventor: **Chang-Jung Lee**, Taoyuan (TW)

(56) **References Cited**

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

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

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Primary Examiner—Shih-Chao Chen

Assistant Examiner—Minh Dieu A

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

(21) Appl. No.: **11/080,046**

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

(57) **ABSTRACT**

(65) **Prior Publication Data**

US 2005/0206577 A1 Sep. 22, 2005

The present invention discloses an antenna apparatus comprising a reflector including a V-like structure (from the cross-sectional view) with an angle. A radiation unit (antenna) is set within the V-like structure. The angle is about 120 degree. The V-like structure includes a fixing plate, a first side plate attached on a first edge of the fixing plate and a second side plate attached on a second edge of the fixing plate, thereby constructing the angle.

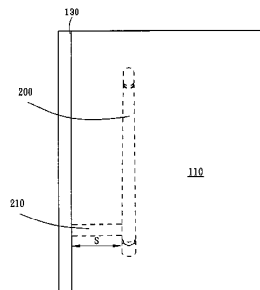
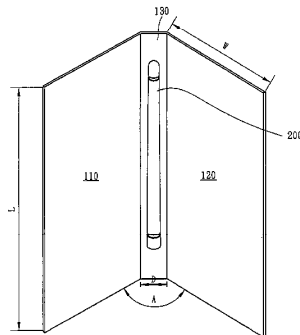
(30) **Foreign Application Priority Data**

Mar. 17, 2004 (TW) 93107032 A

(51) **Int. Cl.**
H01Q 19/10 (2006.01)

(52) **U.S. Cl.** **343/837**

11 Claims, 6 Drawing Sheets





US007190310B2

(12) **United States Patent**
Masutani

(10) **Patent No.:** **US 7,190,310 B2**
(45) **Date of Patent:** **Mar. 13, 2007**

(54) **ANTENNA APPARATUS**
(75) Inventor: **Takeshi Masutani**, Moriguchi (JP)
(73) Assignee: **Matsushita Electric Industrial Co., Ltd.**, Osaka (JP)
(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(56) **References Cited**
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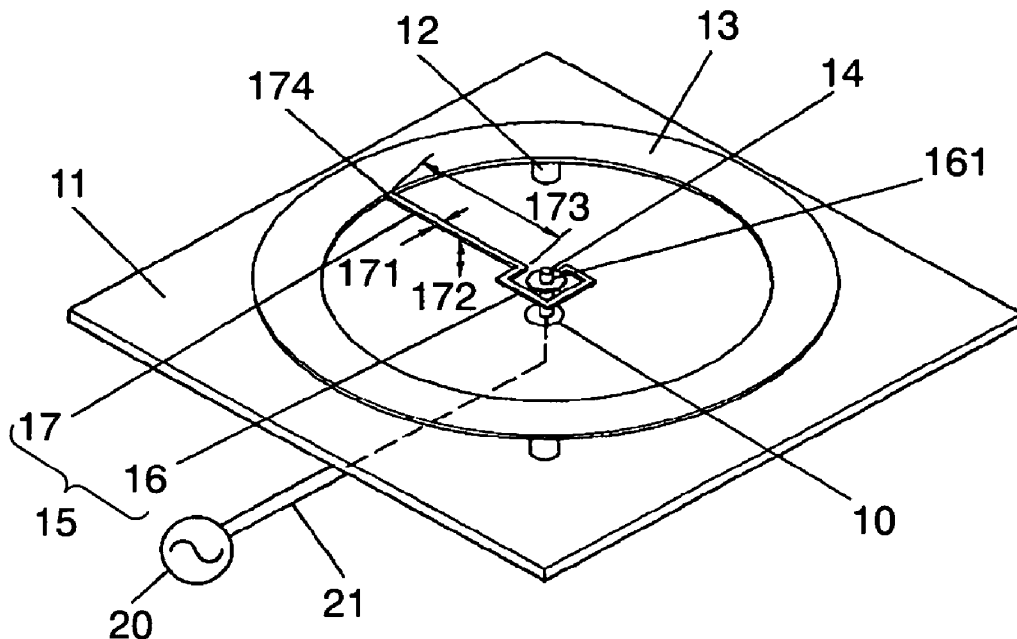
(21) Appl. No.: **10/988,956**
(22) Filed: **Nov. 15, 2004**
(65) **Prior Publication Data**
US 2005/0110689 A1 May 26, 2005

* cited by examiner
Primary Examiner—Michael C. Wimer
(74) *Attorney, Agent, or Firm*—RatnerPrestia

(30) **Foreign Application Priority Data**
Nov. 20, 2003 (JP) 2003-390525
Jun. 1, 2004 (JP) 2004-162860
(51) **Int. Cl.**
H01Q 1/36 (2006.01)
(52) **U.S. Cl.** **343/700 MS; 343/769**
(58) **Field of Classification Search** 343/700 MS,
343/769, 741, 748, 846, 713
See application file for complete search history.

(57) **ABSTRACT**
A ring electrode is disposed in a ring shape opposite to a grounded electrode in a flat shape at a predetermined distance therefrom. A connection member is disposed which is made up of impedance converting portion and transmission line portion, connected in series with impedance converting portion, between the inner side of ring electrode and feeding terminal. Thus, an antenna apparatus easy to achieve impedance matching thereof by use of a connection member can be economically realized.

6 Claims, 4 Drawing Sheets





US007190320B2

(12) **United States Patent**
Okado

(10) **Patent No.:** **US 7,190,320 B2**
(45) **Date of Patent:** **Mar. 13, 2007**

(54) **ANTENNA AND DIELECTRIC SUBSTRATE FOR ANTENNA**

(75) Inventor: **Hironori Okado**, Tokyo (JP)

(73) Assignee: **Taiyo Yuden Co., Ltd.**, Tokyo (JP)

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

(21) Appl. No.: **11/283,678**

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

(65) **Prior Publication Data**

US 2006/0071861 A1 Apr. 6, 2006

Related U.S. Application Data

(62) Division of application No. 10/654,432, filed on Sep. 4, 2003, now Pat. No. 7,098,856.

(30) **Foreign Application Priority Data**

Nov. 27, 2002 (JP) 2002-343290
Mar. 4, 2003 (JP) 2003-056740
May 28, 2003 (JP) 2003-150370

(51) **Int. Cl.**
H01Q 9/28 (2006.01)
H01Q 9/04 (2006.01)

(52) **U.S. Cl.** **343/806**; 343/700 MS

(58) **Field of Classification Search** 343/702,
343/700 MS, 767, 770, 806, 895, 865, 805,
343/807, 808, 809

See application file for complete search history.

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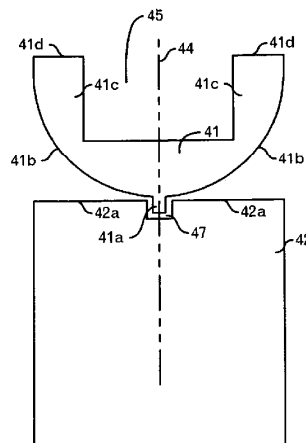
Primary Examiner—Shih-Chao Chen
Assistant Examiner—Minh Dieu A

(74) *Attorney, Agent, or Firm*—Oliff & Berridge, PLC

(57) **ABSTRACT**

An antenna comprises a ground pattern, and a planar element that is fed and equipped with a cut-out portion provided from the farthest edge portion formed from the feed position toward the ground pattern side, and the ground pattern and the planar element are juxtaposed with each other. The cut-out portion enables to further miniaturize the antenna and secure current paths to obtain radiation in a low-frequency range. Since the ground pattern and the planar element are juxtaposed with each other, the mount volume of the antenna can be reduced, and the antenna characteristic, particularly the impedance characteristic, can be easily controlled, and the bandwidth can be widened.

6 Claims, 16 Drawing Sheets





US007190324B2

(12) **United States Patent**
Henderson

(10) **Patent No.:** **US 7,190,324 B2**
(45) **Date of Patent:** **Mar. 13, 2007**

(54) **LOW-PROFILE LENS ANTENNA**

(56) **References Cited**

(75) Inventor: **Robert I Henderson**, Chelmsford (GB)

U.S. PATENT DOCUMENTS

(73) Assignee: **Bae Systems plc**, London (GB)

2,887,684 A *	5/1959	Dexter et al.	343/781 R
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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 3 days.

(Continued)

(21) Appl. No.: **10/494,320**

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(22) PCT Filed: **Mar. 30, 2004**

DE 197 14 578 A 11/1998

(86) PCT No.: **PCT/GB2004/001347**

(Continued)

§ 371 (c)(1),
(2), (4) Date: **Apr. 30, 2004**

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(87) PCT Pub. No.: **WO2004/088793**

Fernandes et al; "Constant Flux Illumination of Square Cells for Millimeter-Wave Wireless Communications"; IEEE Transactions on Microwave Theory and Techniques, IEEE Inc. New York, US, vol. 49, No. 11, Nov. 2001, pp. 2137-2141, XP001110333.

PCT Pub. Date: **Oct. 14, 2004**

(Continued)

(65) **Prior Publication Data**

US 2004/0263419 A1 Dec. 30, 2004

Primary Examiner—Don Wong
Assistant Examiner—Marie Antoinette Cabucos
(74) *Attorney, Agent, or Firm*—Nixon & Vanderhye P.C.

(30) **Foreign Application Priority Data**

Mar. 31, 2003	(EP)	03252032
Mar. 31, 2003	(GB)	0307413.5

(57) **ABSTRACT**

(51) **Int. Cl.**

H01Q 15/02	(2006.01)
H01Q 15/24	(2006.01)
H01Q 13/00	(2006.01)
H01Q 19/06	(2006.01)

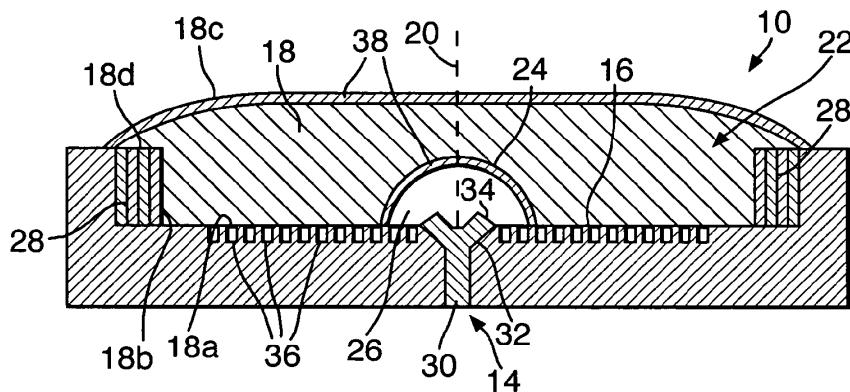
This invention relates to a low-profile lens antenna. In particular, this invention relates to a low-profile lens antenna for use in a depression in a surface, e.g. a concavity in the ground. A low-profile lens antenna is provided that comprises a feed and a lens, wherein the lens is shaped to produce a radiation pattern that shows a general increase in power from 0° to 90° from the central axis of the antenna when illuminated with radiation from the feed.

(52) **U.S. Cl.** **343/909**; 343/783; 343/753

(58) **Field of Classification Search** 343/783, 343/909, 753, 720, 846, 781 CA, 911 R, 343/911 L, 848, 705, 700 MS

See application file for complete search history.

21 Claims, 1 Drawing Sheet





US007193564B2

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

(10) **Patent No.:** **US 7,193,564 B2**
(45) **Date of Patent:** **Mar. 20, 2007**

(54) **ANTENNA DEVICE, AND METHOD OF MANUFACTURING THE SAME ANTENNA DEVICE**

6,724,347 B2 * 4/2004 Tomomatsu et al. . 343/700 MS
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2004/0027298 A1 2/2004 Iguchi et al.
2005/0237260 A1 * 10/2005 Bancroft 343/859

(75) Inventors: **Naoyuki Takagi**, Joyo (JP); **Setsuo Takesako**, Neyagawa (JP); **Yoshinobu Nakagawa**, Osaka (JP)

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

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 3 days.

JP 2003-101335 A 4/2003
WO WO 03/028149 A1 4/2003

(21) Appl. No.: **11/122,571**

* cited by examiner

(22) Filed: **May 5, 2005**

Primary Examiner—Tan Ho
(74) *Attorney, Agent, or Firm*—RatnerPrestia

(65) **Prior Publication Data**
US 2005/0264458 A1 Dec. 1, 2005

(57) **ABSTRACT**

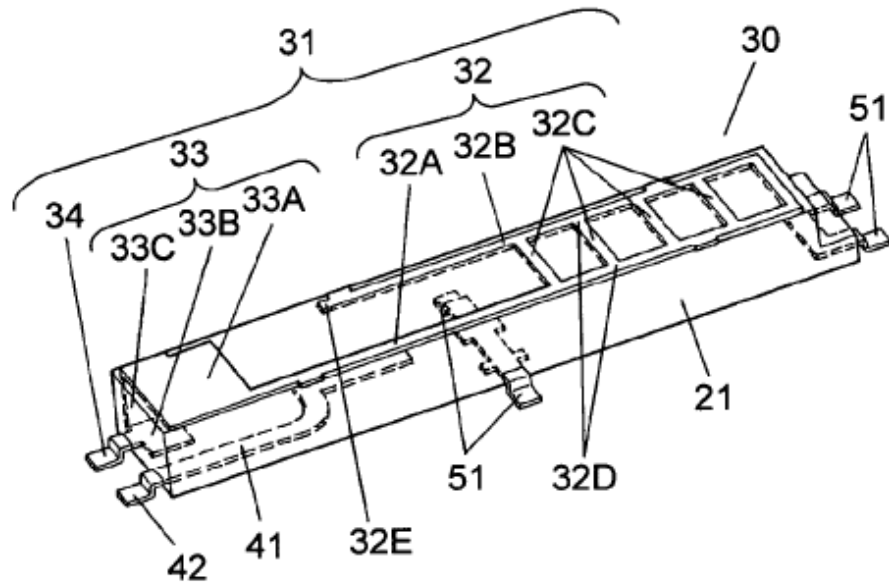
(30) **Foreign Application Priority Data**
May 27, 2004 (JP) 2004-157395

An antenna device includes an electrically insulating base section and a metallic first antenna element fixed to the base section. The first antenna element includes an adjusting section shaped like a ladder or a lattice, which is formed of rails confronting each other and connecting bars which couple a part of the rails. The structure discussed above allows the adjusting section to adjust frequency characteristics corresponding to the antenna element to desirable ones with ease, so that a basic tooling die can be commonly used and standardized antenna device is obtainable with ease.

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

(56) **References Cited**
U.S. PATENT DOCUMENTS
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7 Claims, 11 Drawing Sheets





US007193565B2

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

(10) **Patent No.:** **US 7,193,565 B2**
(45) **Date of Patent:** **Mar. 20, 2007**

(54) **MEANDERLINE COUPLED QUADBAND ANTENNA FOR WIRELESS HANDSETS**

(75) Inventors: **Frank M. Caimi**, Vero Beach, FL (US); **Gregory A. O'Neill, Jr.**, Rockledge, FL (US)

(73) Assignee: **SkyCross, Inc.**, Viera, FL (US)

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

(21) Appl. No.: **11/145,171**

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

(65) **Prior Publication Data**

US 2005/0270243 A1 Dec. 8, 2005

Related U.S. Application Data

(60) Provisional application No. 60/577,328, filed on Jun. 5, 2004.

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

(52) **U.S. Cl.** **343/700 MS; 343/702; 343/895; 343/846**

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

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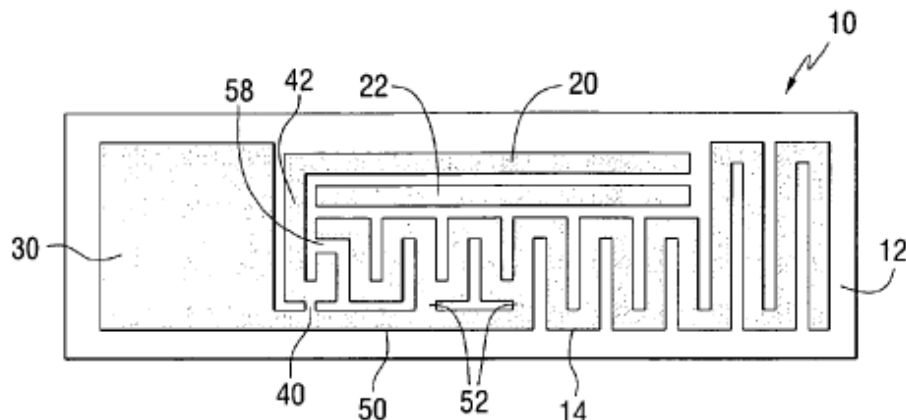
Harvey, A. F.; "Periodic and Guiding Structures at Microwave Frequencies"; IRE Transactions on Microwave Theory Techniques; Jan. 1960; pp. 30-61.

Primary Examiner—Hoang V. Nguyen
(74) *Attorney, Agent, or Firm*—John L. DeAngelis; Beusse Wolter Sanks Mora & Maire, P.A.

(57) **ABSTRACT**

An antenna operative in a plurality of frequency bands. The antenna comprises first and second high band resonators, a resonating meanderline and a counterpoise. A ground return conductively couples one or more regions of the counterpoise to the meanderline. One or more of the first resonating element, the second resonating element and the resonating meanderline are coupled by magnetic and/or capacitive coupling to provide operation in the plurality of frequency bands.

34 Claims, 3 Drawing Sheets





US007193566B2

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

(10) **Patent No.:** **US 7,193,566 B2**
(45) **Date of Patent:** **Mar. 20, 2007**

(54) **PLANAR MONOPOLE ANTENNAS**

FOREIGN PATENT DOCUMENTS

(75) Inventors: **Chih-Lung Chen**, Taipei (TW);
Chih-Kai Liu, Taipei (TW)

EP 1 469 554 A1 10/2004
WO WO 98/38694 9/1998
WO WO 2004/102742 A1 11/2004

(73) Assignee: **Wistron NeWeb Corp.**, Taipei Hsien (TW)

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 41 days.

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(21) Appl. No.: **11/223,391**

M. Rahman et al, "Dual-Band Strip-Sleeve Monopole for Handheld Telephones," *Microwave and Optical Technology Letters*, vol. 21, No. 2, 1999, pp. 79-82, John Wiley & Sons, Inc., USA.

(22) Filed: **Sep. 8, 2005**

Maria A. Stuchly et al, "Modeling Antenna Close to the Human Body," *IEEE*, vol. 5, 2000, pp. 83-89, USA.

(65) **Prior Publication Data**

US 2006/0232478 A1 Oct. 19, 2006

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(30) **Foreign Application Priority Data**

Apr. 18, 2005 (TW) 94112244 A

Primary Examiner—Hoang V. Nguyen

(74) *Attorney, Agent, or Firm*—Quintero Law Office

(51) **Int. Cl.**

H01Q 1/38 (2006.01)

(57) **ABSTRACT**

(52) **U.S. Cl.** **343/700 MS; 343/833; 343/834; 343/846**

Planar monopole antennas. A planar monopole antenna for communicating radio signals within a specific frequency range includes a substrate, a ground, a first sleeve, a second sleeve and a radiator. The radiator and the ground are formed on the substrate. The first and second sleeves project from a side of the ground in a first direction, wherein the first sleeve has a first length, and the second sleeve has a second length in the first direction. The side of the ground defines a third length. The radiator has a fourth length in the first direction, substantially equal to the sum of the first, second, and third lengths.

(58) **Field of Classification Search** **343/700 MS, 343/846, 702, 833, 834**

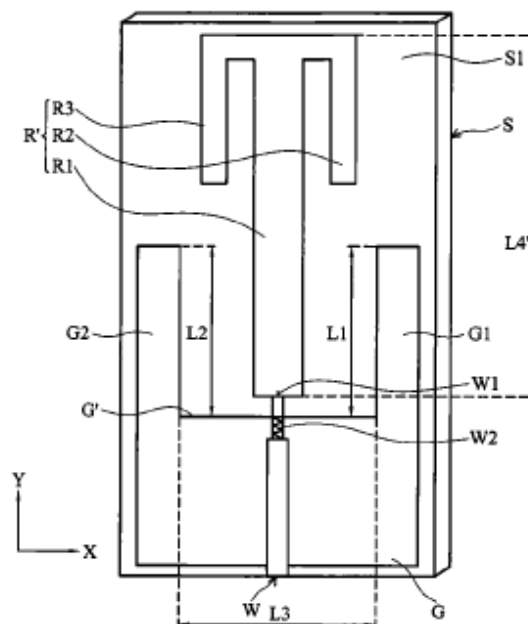
See application file for complete search history.

(56) **References Cited**

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2002/0057227 A1* 5/2002 Fang 343/895

20 Claims, 5 Drawing Sheets





US007193569B2

(12) **United States Patent**
Vesterinen

(10) **Patent No.:** **US 7,193,569 B2**
(45) **Date of Patent:** **Mar. 20, 2007**

(54) **DOUBLE-LAYER ANTENNA STRUCTURE FOR HAND-HELD DEVICES**

6,362,789 B1 *	3/2002	Trumbull et al.	343/700 MS
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6,670,923 B1 *	12/2003	Kadambi et al.	343/700 MS
2003/0214437 A1 *	11/2003	Rawnick et al.	343/700 MS

(75) Inventor: **Jukka Vesterinen**, Jyväskylä (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 58 days.

* cited by examiner

Primary Examiner—Trinh Dinh
Assistant Examiner—Huedung Mancuso

(21) Appl. No.: **10/755,715**

(57) **ABSTRACT**

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

(65) **Prior Publication Data**
US 2005/0151689 A1 Jul. 14, 2005

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

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

(58) **Field of Classification Search** 343/700 MS,
343/702, 703, 711, 829, 830
See application file for complete search history.

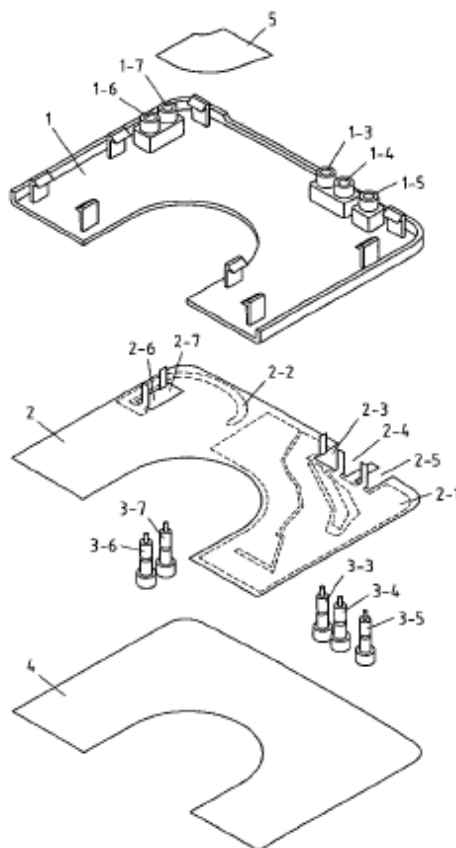
The invention relates to a device, comprising an at least partially plane antenna carrier with a first side and a second side, at least one first Printed Wiring Board (PWB) being attached to said first side of said antenna carrier and having a first radiation structure formed on it, and at least one second PWB being attached to said second side of said antenna carrier. Said second PWB structure preferably represents a parasitic antenna element that improves the radiation pattern of an antenna that at least partially is represented by said first radiation structure. The invention further relates to a GPS-capable mobile phone, a method, a computer program and a radio system.

(56) **References Cited**

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6,249,254 B1 6/2001 Bateman et al. 343/700 MS

24 Claims, 4 Drawing Sheets





US007193571B2

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

(10) **Patent No.:** **US 7,193,571 B2**
(45) **Date of Patent:** **Mar. 20, 2007**

- (54) **COMPOSITE ANTENNA**
- (75) Inventors: **Susumu Inatsugu**, Hirakata (JP);
Kazuhiko Fujikawa, Kyotanabe (JP);
Masami Segawa, Izumi (JP)
- (73) Assignee: **Matsushita Electric Industrial Co., Ltd.**, Osaka (JP)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 52 days.

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Primary Examiner—Hoang V. Nguyen

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

- (21) Appl. No.: **11/046,765**
- (22) Filed: **Feb. 1, 2005**
- (65) **Prior Publication Data**
US 2005/0174291 A1 Aug. 11, 2005
- (30) **Foreign Application Priority Data**
Feb. 9, 2004 (JP) 2004-031767

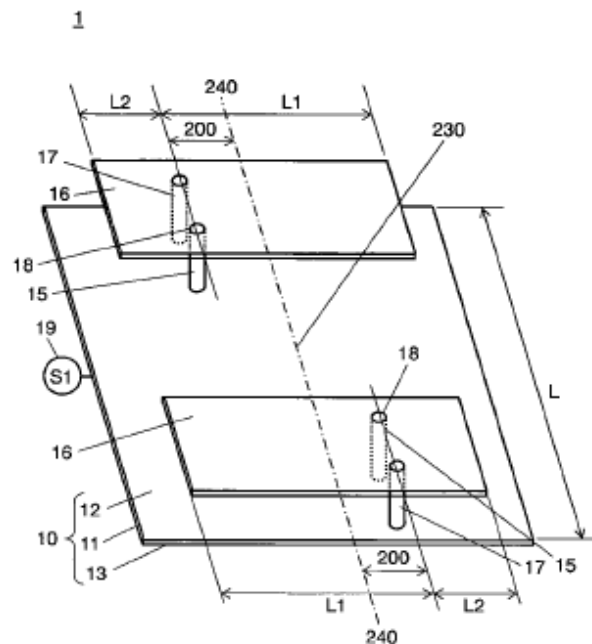
- (51) **Int. Cl.**
H01Q 1/24 (2006.01)
- (52) **U.S. Cl.** **343/702; 343/846**
- (58) **Field of Classification Search** **343/702, 343/700 MS, 846**
See application file for complete search history.

- (56) **References Cited**
U.S. PATENT DOCUMENTS
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6,295,030 B1* 9/2001 Kozakai et al. 343/700 MS
6,326,924 B1* 12/2001 Muramoto et al. 343/702

(57) **ABSTRACT**

A composite antenna has a conductor ground plate having a preset shape, a plurality of antenna elements faced to each other and separated from the conductor ground plate by predetermined element interval, and feeding terminals for feeding power to the antenna elements via transmission lines in the same phase. The antenna elements and the feeding terminals are disposed symmetrically with respect to the center of the conductor ground plate. Even when the number of operating frequencies is increased to three or more, the composite antenna is thin and small and can provide a predetermined directional characteristic.

4 Claims, 4 Drawing Sheets





US007193572B2

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

(10) **Patent No.:** **US 7,193,572 B2**
(45) **Date of Patent:** **Mar. 20, 2007**

- (54) **ROOF ANTENNA FOR MOTOR VEHICLES**
- (75) Inventors: **Christian Magg**, Garching (DE); **Peter Karl Prassmayer**, Grosskarolinenfeld (DE); **Frank Mierke**, Rosenheim (DE)
- (73) Assignee: **Kathrein-Werke KG**, Rosenheim (DE)
- (*) 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.: **10/499,363**
- (22) PCT Filed: **May 8, 2003**
- (86) PCT No.: **PCT/EP03/04843**

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

- (87) PCT Pub. No.: **WO03/098735**
- PCT Pub. Date: **Nov. 27, 2003**

- (65) **Prior Publication Data**
US 2005/0062658 A1 Mar. 24, 2005

- (30) **Foreign Application Priority Data**
May 16, 2002 (DE) 102 21 877

- (51) **Int. Cl.**
H01Q 1/32 (2006.01)
- (52) **U.S. Cl.** **343/713; 343/711**
- (58) **Field of Classification Search** **343/713, 343/711, 712, 715, 717, 700 MS**
See application file for complete search history.

- (56) **References Cited**
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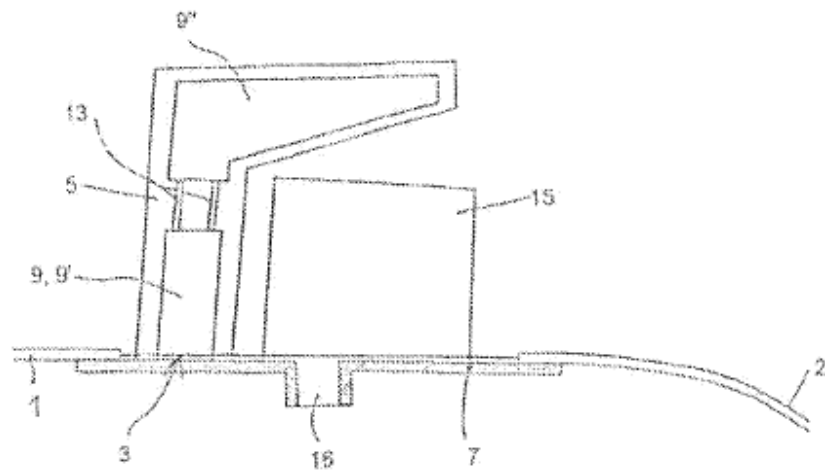
(Continued)

Primary Examiner—Hoanganh Le
(74) *Attorney, Agent, or Firm*—Nixon & Vanderhye P.C.

(57) **ABSTRACT**

The invention concerns a space craft, such as a telecommunication geostationary satellite, comprising a body, at least one main telecommunication antenna having a specific orientation relative to the body, at least an omnidirectional antenna having a field of view opposite to that of the main antennae and at least a radiator extensible by tilting about an axis linked to the craft body between a slowing position wherein it is pressed against the body and an extended position. Said axis is positioned substantially in the plane of one surface of the body parallel to the orientation of the omnidirectional antenna and to the surfaces or the surface bearing the main antenna. The radiator tilts at an angle close to 180° from a position wherein it is pressed against one surface bearing a solar panel to a position wherein it extends substantially in the plane of the surface which bears it when it is slowed.

14 Claims, 3 Drawing Sheets





(12) **United States Patent**
Mohammadian

(10) **Patent No.:** **US 7,193,575 B2**
(45) **Date of Patent:** **Mar. 20, 2007**

(54) **WIDEBAND ANTENNA WITH TRANSMISSION LINE ELBOW**
(75) Inventor: **Alireza Hormoz Mohammadian**, San Diego, CA (US)

4,500,887 A * 2/1985 Nester 343/700 MS
4,723,305 A * 2/1988 Phillips et al. 455/575.7
6,366,254 B1 * 4/2002 Sievenpiper et al. 343/770
6,703,985 B2 * 3/2004 Lee 343/786

(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 5 days.

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(21) Appl. No.: **10/819,558**

(22) Filed: **Apr. 7, 2004**

(65) **Prior Publication Data**
US 2004/0212537 A1 Oct. 28, 2004

(Continued)

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

Related U.S. Application Data
(60) Provisional application No. 60/465,664, filed on Apr. 25, 2003.

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/38 (2006.01)
H01Q 13/10 (2006.01)

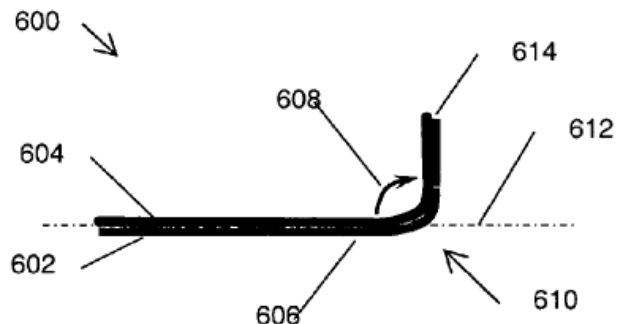
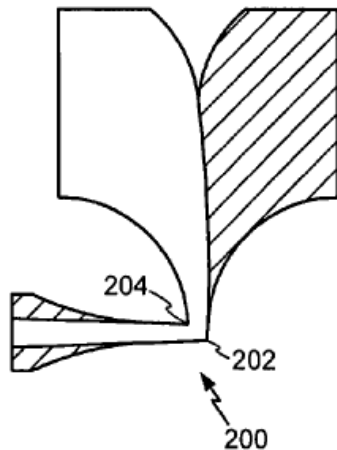
(57) **ABSTRACT**

An antenna (100) includes overlapping conductive plates (102, 104) having a radiating end (112) and a feed end (114). The plates include partially overlapping edges (106) that flare away from each other as each edge progresses toward the radiating end (112). A dual conductor microstrip feed (110) is also provided. A transmission line (108) connects each plate to a different conductor (113, 115) of the microstrip feed. The transmission line comprises two substantially overlapping, parallel conductive ribbons (130, 131) that form an elbow (107) with a prescribed turn (109).

(52) **U.S. Cl.** 343/767; 343/702; 455/575.7
(58) **Field of Classification Search** 343/702, 343/767, 795, 770; 455/575.7
See application file for complete search history.

(56) **References Cited**
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18 Claims, 4 Drawing Sheets





US007193576B2

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

(10) **Patent No.:** **US 7,193,576 B2**
(45) **Date of Patent:** **Mar. 20, 2007**

(54) **ULTRA WIDEBAND BOW-TIE SLOT ANTENNA** 2003/0043084 A1 3/2003 Egashira 343/767

(75) Inventors: **Kamya Yekeh Yazdandoost**, Tokyo (JP); **Ryuji Kohno**, Tokyo (JP)

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(73) Assignee: **National Institute of Information and Communications Technology**, Koganei (JP)

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

(21) Appl. No.: **11/023,454**

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

(65) **Prior Publication Data**

US 2005/0184919 A1 Aug. 25, 2005

(Continued)

(30) **Foreign Application Priority Data**

Feb. 19, 2004 (JP) 2004-043395

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(51) **Int. Cl.**
H01Q 13/10 (2006.01)
H01Q 1/38 (2006.01)
H01Q 21/00 (2006.01)

(Continued)

Primary Examiner—Shih-Chao Chen

(52) **U.S. Cl.** **343/767; 343/700 MS; 343/725**

(57) **ABSTRACT**

(58) **Field of Classification Search** **343/700 MS, 343/725, 727, 767, 770, 795**
See application file for complete search history.

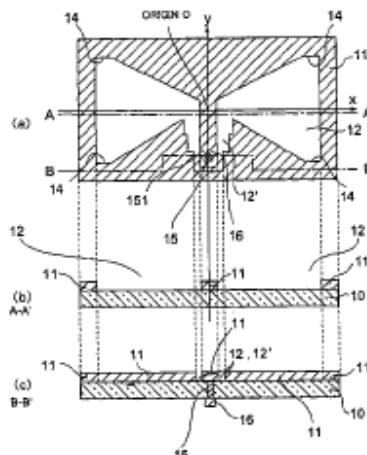
A slot antenna includes an insulation substrate, a metal layer provided on the insulation substrate, a slot formed in the metal layer, and a feeding part connected to the metal layer. The slot is symmetric with respect to a centerline. When an x-y coordinate system is defined on the metal layer so that the y-axis is the symmetric line, the origin is the center of the slot antenna, and the x-axis through the origin is perpendicular to the y-axis, the width of the slot in the direction of the y-axis increasing in proportion to the absolute value of the x-axis.

(56) **References Cited**

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2002/0180654 A1	12/2002	Acher et al.	343/700 MS

6 Claims, 16 Drawing Sheets





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

(10) **Patent No.:** **US 7,193,578 B1**
(45) **Date of Patent:** **Mar. 20, 2007**

(54) **HORN ANTENNA ARRAY AND METHODS FOR FABRICATION THEREOF**

(75) Inventors: **Daniel W. Harris**, Mount Laurel, NJ (US); **Joseph W. Hahn**, Clementon, NJ (US)

(73) Assignee: **Lockhead 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 0 days.

(21) Appl. No.: **11/245,831**

(22) Filed: **Oct. 7, 2005**

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

(52) **U.S. Cl.** **343/767; 343/786**

(58) **Field of Classification Search** **343/767, 343/770, 700 MS, 768, 790**
See application file for complete search history.

(56) **References Cited**

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Primary Examiner—Trinh Dinh

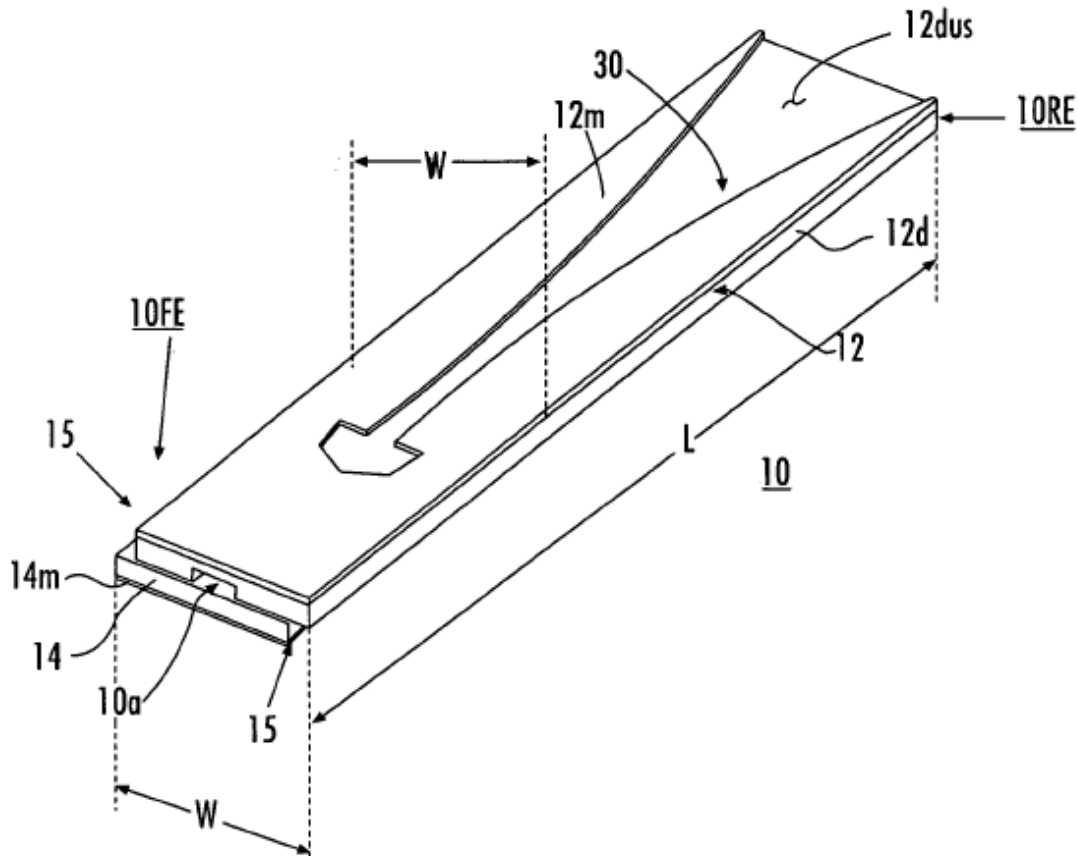
Assistant Examiner—Huedung Mancuso

(74) *Attorney, Agent, or Firm*—Duane Morris,LLP

(57) **ABSTRACT**

A method for making a horn antenna array includes the steps of making first and second equal-size printed-circuit half-horn-elements, and offset-juxtaposing element pairs to make horn elements having a dielectric lip or step. A ground plane defining mutually intersecting crossed slot sets is loaded with horn elements with their lips interlocking near the slot crossings, to define the horn antenna array. The horn elements can be fed by pins extending through portions of the ground plane and into an aperture adjacent the feed elements of the horn elements. Electrical connections are made by fusion joining after the array is assembled.

19 Claims, 9 Drawing Sheets





US007193580B2

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

(10) **Patent No.:** **US 7,193,580 B2**
(45) **Date of Patent:** **Mar. 20, 2007**

- (54) **ANTENNA DEVICE**
- (75) Inventors: **Ten-Long Deng**, ZhuDng Township, Hsinchu County (TW); **Hsiao-Ming Tsai**, Taipei (TW)
- (73) Assignee: **Asustek Computer Inc.**, Taipei (TW)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 20 days.

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- (21) Appl. No.: **11/147,890**
- (22) Filed: **Jun. 8, 2005**
- (65) **Prior Publication Data**
US 2006/0017645 A1 Jan. 26, 2006

* cited by examiner
Primary Examiner—Hoang V. Nguyen
(74) Attorney, Agent, or Firm—Thomas, Kayden, Horstemeier & Risley

- (30) **Foreign Application Priority Data**
Jul. 23, 2004 (CN) 93 1 22019

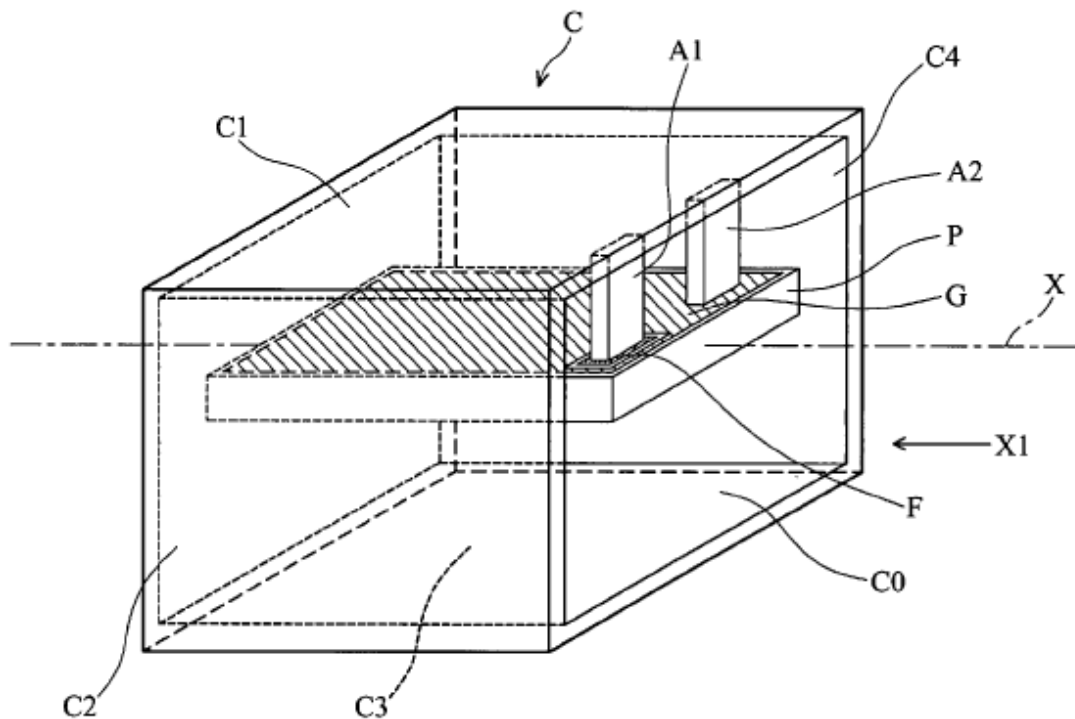
(57) **ABSTRACT**

An antenna device. The antenna device includes a printed circuit board, a conductive shield, a first connection portion and a second connection portion. The printed circuit board has a feed point and a ground plane insulated from the feed point. The conductive shield surrounds the printed circuit board. The first connection portion is substantially perpendicular to the printed circuit board, electrically connecting the feed point and the conductive shield. The second connection portion is substantially perpendicular to the printed circuit board, electrically connecting the ground plane and the conductive shield.

- (51) **Int. Cl.**
H01Q 1/52 (2006.01)
- (52) **U.S. Cl.** 343/841; 343/702; 343/872
- (58) **Field of Classification Search** 343/702, 343/841, 851, 846, 872
See application file for complete search history.

- (56) **References Cited**
U.S. PATENT DOCUMENTS
4,975,711 A 12/1990 Lee 343/702

7 Claims, 4 Drawing Sheets





US007193582B2

(12) **United States Patent**
Wang

(10) **Patent No.:** **US 7,193,582 B2**
(45) **Date of Patent:** **Mar. 20, 2007**

(54) **DIGITAL RECEIVING ANTENNA DEVICE FOR A DIGITAL TELEVISION**

(75) Inventor: **Cheng-Si Wang, Hua Tan Hsiang (TW)**

(73) Assignee: **Trans Electric Co., Ltd., Hua Tan Hsiang (TW)**

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

(21) Appl. No.: **11/151,623**

(22) Filed: **Jun. 13, 2005**

(65) **Prior Publication Data**

US 2006/0290578 A1 Dec. 28, 2006

(51) **Int. Cl.**

H01Q 1/42 (2006.01)
H01Q 9/04 (2006.01)
H01Q 7/00 (2006.01)
H01Q 1/24 (2006.01)

(52) **U.S. Cl.** **343/872; 343/791; 343/866; 343/702**

(58) **Field of Classification Search** **343/702, 343/788, 791, 842, 866, 850, 857, 872**
See application file for complete search history.

(56) **References Cited**

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Primary Examiner—Don Wong

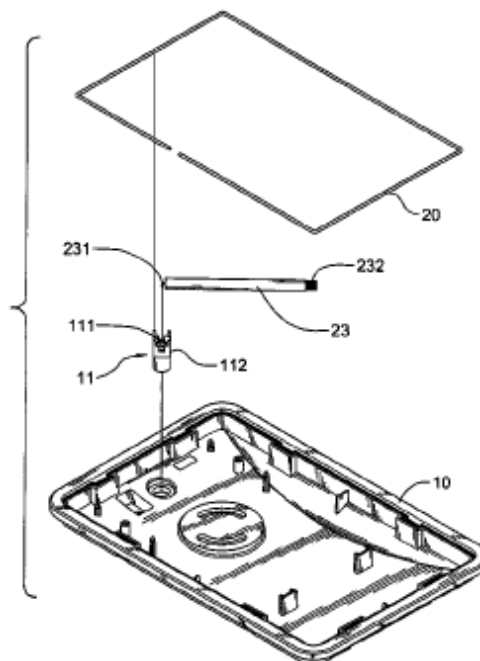
Assistant Examiner—Marie Antoinette Cabucos

(74) *Attorney, Agent, or Firm*—Alan D. Kamrath; Nikolai & Mersereau, P.A.

(57) **ABSTRACT**

A digital receiving antenna device is connected to a digital television through a coaxial cable and has a casing, a flat antenna, a coaxial cable connector and a coaxial transmission line. The flat antenna is mounted in the casing and connected electronically to the coaxial cable through the coaxial transmission line. Since the coaxial transmission line has a fixed capacitance without regard to the distance between the feed point and the coaxial cable connector, a fixed capacitor is connected between the flat antenna and the coaxial cable connector. Therefore, the coaxial transmission line can be used as a transmission line for different size flat antennas, and each coaxial transmission line will have the same impedance. These different size digital receiving antenna devices can use the same antenna signal processing circuit and still have an impedance match between the flat antenna and the antenna signal processing circuit.

5 Claims, 6 Drawing Sheets





US007196663B2

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

(10) **Patent No.:** **US 7,196,663 B2**
(45) **Date of Patent:** **Mar. 27, 2007**

(54) **DIELECTRIC RESONATOR TYPE ANTENNAS**

(75) Inventors: **Francoise Le Bolzer**, Rennes (FR);
Corinne Nicolas, La Chapelle des
Fougeretz (FR); **Delia Cormos**, Rennes
(FR); **Raphael Gillard**, Rennes (FR);
Alexandre Laisne, Avranches (FR)

(73) Assignee: **Thomson Licensing**,
Boulogne-Billancourt (FR)

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

(21) Appl. No.: **10/659,653**

(22) Filed: **Sep. 9, 2003**

(65) **Prior Publication Data**
US 2004/0130489 A1 Jul. 8, 2004

(30) **Foreign Application Priority Data**
Sep. 9, 2002 (FR) 02/11114

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

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

(58) **Field of Classification Search** **343/700 MS,**
343/702, 749, 785, 789, 790, 829, 846, 848,
343/860, 861, 862, 873, 898, 899, 900, 905;
333/202, 204, 206, 210

See application file for complete search history.

(56) **References Cited**

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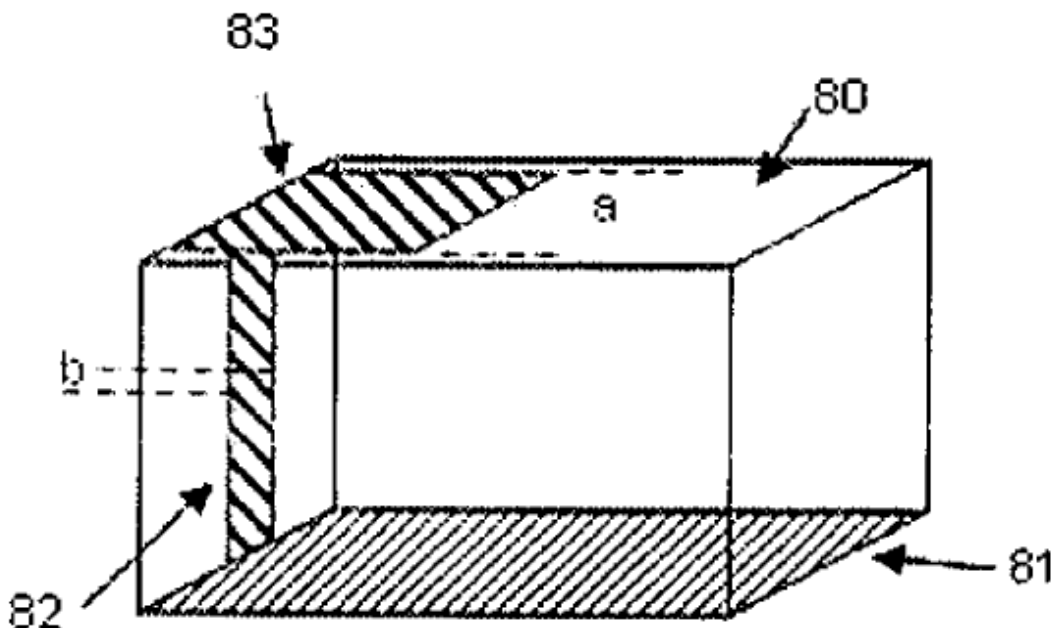
Primary Examiner—Trinh Vo Dinh

(74) *Attorney, Agent, or Firm*—Joseph J. Laks; Robert D.
Shedd; Brian J. Cromarty

(57) **ABSTRACT**

The present invention relates to a dielectric resonator
antenna comprising a block (10) of dielectric material of
which a first face intended to be mounted on an earth plane
is covered with a metallic layer (11). According to the
invention, at least one second face perpendicular to the first
face is covered with a partial metallic layer (12) having a
width less than the width of this second face. The invention
applies in particular to DRA antennas for domestic wireless
networks.

9 Claims, 4 Drawing Sheets





US007196664B2

(12) **United States Patent**
Asai

(10) **Patent No.:** **US 7,196,664 B2**
(45) **Date of Patent:** **Mar. 27, 2007**

- (54) **DIELECTRIC ANTENNA AND COMMUNICATION DEVICE INCORPORATING THE SAME**
- (75) Inventor: **Hidekatsu Asai**, Gunma (JP)
- (73) Assignee: **Yokowo Co., Ltd.**, Tokyo (JP)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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Primary Examiner—Michael C. Wimer

(74) *Attorney, Agent, or Firm*—Morgan, Lewis & Bockius LLP

(21) Appl. No.: **11/001,318**

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

(65) **Prior Publication Data**

US 2005/0134510 A1 Jun. 23, 2005

(30) **Foreign Application Priority Data**

Dec. 4, 2003 (JP) P2003-405515

(51) **Int. Cl.**

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

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

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

See application file for complete search history.

(56) **References Cited**

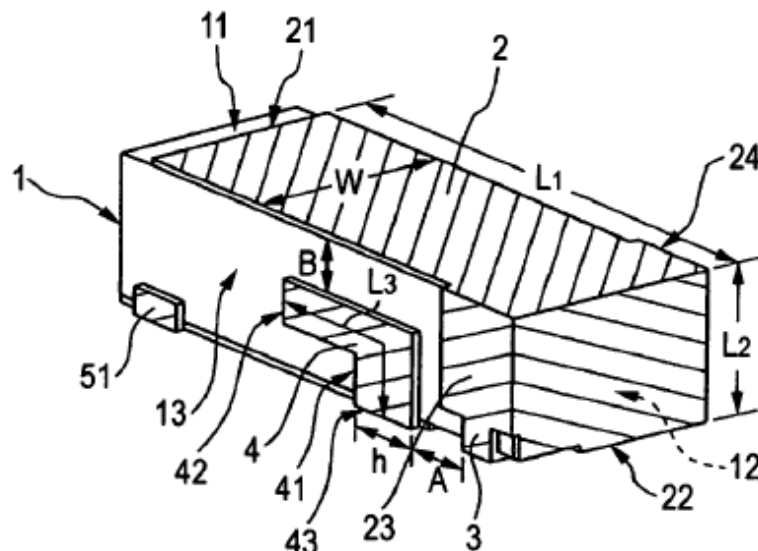
U.S. PATENT DOCUMENTS

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2001/0048390 A1* 12/2001 Nagumo et al. 343/700 MS

(57) **ABSTRACT**

A dielectric substrate has a first face, a second face opposing to the first face, and side faces connecting the first face and the second face. A grounding electrode is provided on the first face. A first radiation electrode is configured to resonate with an electromagnetic wave having a first frequency. The first radiation electrode extends parallel to at least one of the second face and the side faces. A feeder electrode extends parallel to one of the side faces, and is electromagnetically coupled with the first radiation electrode. A second radiation electrode is configured to resonate with an electromagnetic wave having a second frequency. The second radiation electrode extends parallel to one of the side faces and is electromagnetically coupled with at least one of the first radiation electrode and the feeder electrode. One end of the feeder electrode serves as a terminal for supplying power to the first radiation electrode and the second radiation electrode.

9 Claims, 8 Drawing Sheets





US007196665B2

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

(10) **Patent No.:** **US 7,196,665 B2**
(45) **Date of Patent:** **Mar. 27, 2007**

- (54) **ANTENNA DEVICE**
- (75) Inventors: **Kazumine Koshi**, Tsuyama (JP);
Hideto Sadamori, Okayama (JP);
Kazuto Kume, Moriguchi (JP)
- (73) Assignee: **Matsushita Electric Industrial Co., Ltd.**, Osaka (JP)

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

(21) Appl. No.: **11/109,989**

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

(65) **Prior Publication Data**
US 2005/0237245 A1 Oct. 27, 2005

(30) **Foreign Application Priority Data**
Apr. 21, 2004 (JP) 2004-125208

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

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

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

(56) **References Cited**
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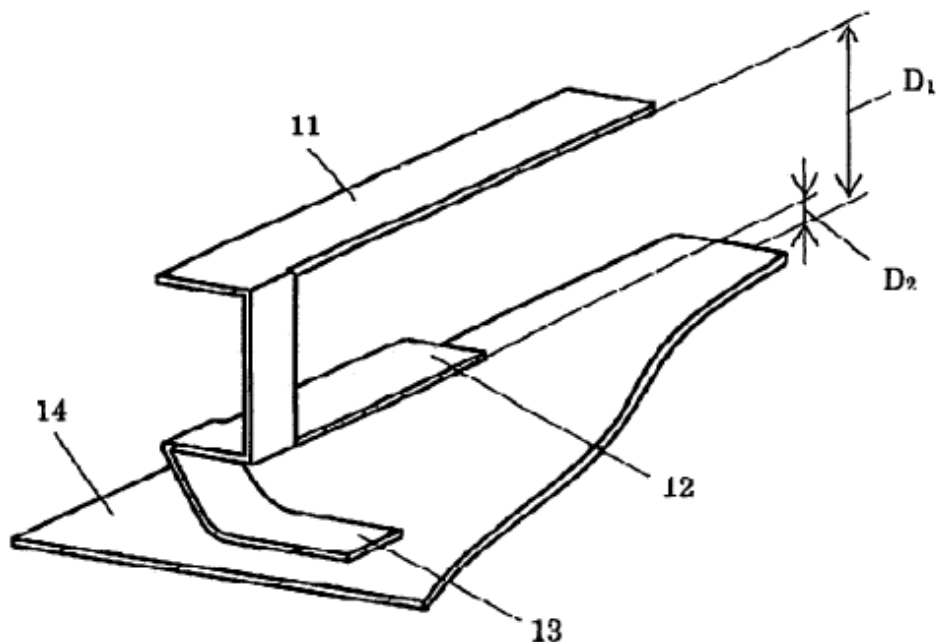
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Primary Examiner—Trinh Vo Dinh
(74) *Attorney, Agent, or Firm*—RatnerPrestia

(57) **ABSTRACT**

An antenna device has a first antenna element supporting a low frequency band and a second antenna element supporting a high frequency band. The first antenna element and the second antenna element are disposed so as to face to each other, on the wiring board of a radio device, and at positions separated from each other by a predetermined distance. The distance between the first antenna element and the ground of wiring board is longer than the distance between the second antenna element and the ground of the wiring board. The antenna device supports two frequency bands with the first antenna element and the second antenna element.

3 Claims, 3 Drawing Sheets





US007196667B2

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

(10) **Patent No.:** **US 7,196,667 B2**
(45) **Date of Patent:** **Mar. 27, 2007**

(54) **SURFACE-MOUNT TYPE ANTENNA AND ANTENNA APPARATUS EMPLOYING THE SAME, AND WIRELESS COMMUNICATION APPARATUS**

6,806,832 B2* 10/2004 Sato et al. 343/700 MS
6,903,691 B2* 6/2005 Sato et al. 343/700 MS
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2004/0125032 A1 7/2004 Ikuta, et al.

(75) Inventors: **Kazuo Watada**, Kyoto (JP); **Shunichi Murakawa**, Kyoto (JP); **Akinori Sato**, Kyoto (JP); **Koji Hamada**, Kyoto (JP)

(Continued)

(73) Assignee: **Kyocera Corporation**, Kyoto (JP)

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

JP 11-317612 11/1999

(21) Appl. No.: **11/212,491**

(Continued)

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

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(65) **Prior Publication Data**

US 2006/0049990 A1 Mar. 9, 2006

Korean Language Office Action for Korean Appl. No. 2005-79053 lists the references cited above.

(30) **Foreign Application Priority Data**

Aug. 26, 2004 (JP) P2004-247515

Primary Examiner—Tan Ho

(74) Attorney, Agent, or Firm—Hogan & Hartson LLP

(51) **Int. Cl.**

H01Q 1/24 (2006.01)

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.

(57) **ABSTRACT**

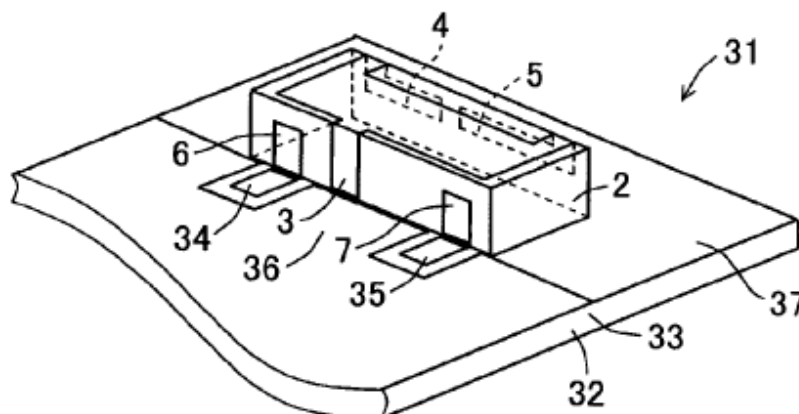
A surface-mount type antenna includes a rectangular-parallelepiped base body made of a dielectric or magnetic material, having a first surface to be placed on a target substrate, second to fifth surfaces that are continuous with the first surface, and a sixth surface located in parallel with the first surface; a ground electrode formed on at least one of the second to fifth surfaces; two radiating electrodes that are continuous with the ground electrode and extend over two or more adjacent surfaces of the second to sixth surfaces; and two feeding electrodes formed on at least one of the second to fifth surfaces so as to be spaced apart circumferentially of the continuum of the second to fifth surfaces to provide the ground electrode in between. The feeding electrode is capacitance-coupled to the radiating electrode for effecting feeding.

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15 Claims, 14 Drawing Sheets





US007196672B2

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

(10) **Patent No.:** **US 7,196,672 B2**
(45) **Date of Patent:** **Mar. 27, 2007**

(54) **PORTABLE RADIO COMMUNICATION APPARATUS PROVIDED WITH A PART OF A HOUSING OPERATING AS AN ANTENNA**

(75) Inventors: **Hiroshi Iwai**, Katano (JP); **Atsushi Yamamoto**, Osaka (JP); **Kenichi Yamada**, Yokohama (JP)

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

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

(21) Appl. No.: **11/320,812**

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

(65) **Prior Publication Data**

US 2006/0109185 A1 May 25, 2006

Related U.S. Application Data

(62) Division of application No. 10/771,392, filed on Feb. 5, 2004, now Pat. No. 7,009,567.

(30) **Foreign Application Priority Data**

Feb. 6, 2003 (JP) P2003-29217
Feb. 20, 2003 (JP) P2003-42822

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H04M 1/00 (2006.01)

(52) **U.S. Cl.** **343/702; 455/575.3; 455/575.5**

(58) **Field of Classification Search** **343/702, 343/767, 876; 455/575.3, 575.5**
See application file for complete search history.

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

(57) **ABSTRACT**

In a portable radio communication apparatus including a housing, at least one part of the housing is formed as a housing electrical conductor portion by an electrically conductive material. The housing electrical conductor portion is connected with a radio communication circuit of the portable radio communication apparatus so as to operate as at least one part of an unbalanced type antenna of the radio communication circuit.

28 Claims, 46 Drawing Sheets

FIRST PREFERRED EMBODIMENT

