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(19) United States

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(10) Pub. No.: US 2008/0211722 A1

(43) Pub. Date: Sep. 4, 2008

Sanz et al.

(54) **MULTI-BAND MONOPOLE ANTENNA FOR A MOBILE COMMUNICATIONS DEVICE**

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(21) Appl. No.: **12/055,748**

(22) Filed: **Mar. 26, 2008**

Related U.S. Application Data

(63) Continuation of application No. 11/713,324, filed on Mar. 2, 2007, now Pat. No. 7,403,164, which is a continuation of application No. 11/124,768, filed on May 9, 2005, which is a continuation of application No. PCT/EP02/14706, filed on Dec. 22, 2002.

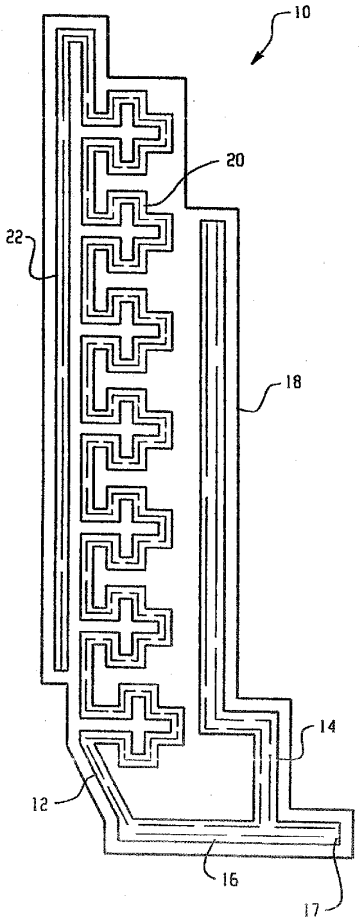
Publication Classification

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

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

(57) **ABSTRACT**

A multi-band monopole antenna for a mobile communications device includes a common conductor coupled to both a first radiating arm and a second radiating arm. The common conductor includes a feeding port for coupling the antenna to communications circuitry in a mobile communications device. In one embodiment, the first radiating arm includes a space-filling curve. In another embodiment, the first radiating arm includes a meandering section extending from the common conductor in a first direction and a contiguous extended section extending from the meandering section in a second direction.



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(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2008/0211725 A1**

(43) **Pub. Date: Sep. 4, 2008**

Ollikainen

(54) **ANTENNA HAVING A PLURALITY OF RESONANT FREQUENCIES**

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(21) Appl. No.: **12/151,293**

(22) Filed: **May 5, 2008**

Related U.S. Application Data

(62) Division of application No. 11/107,159, filed on Apr. 15, 2005.

Publication Classification

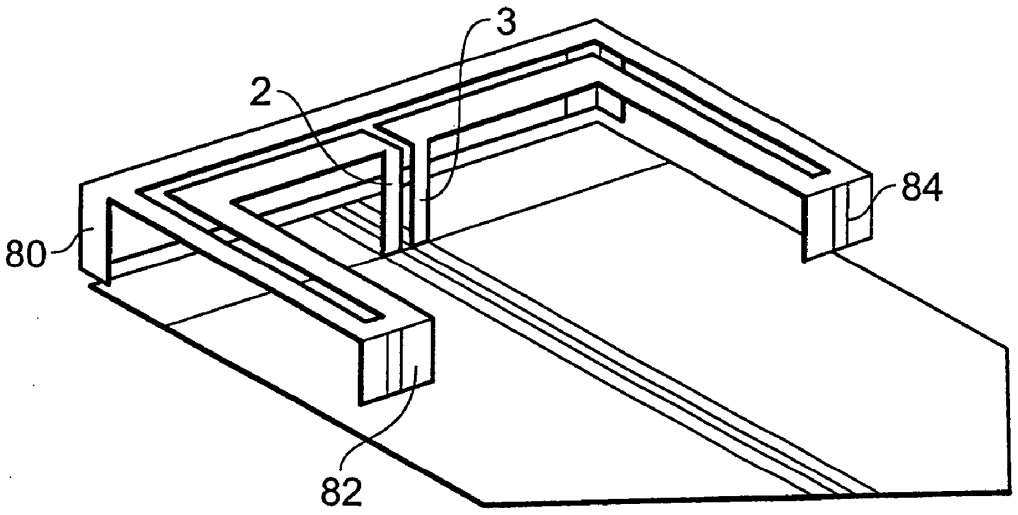
(51) **Int. Cl.**
H01Q 1/48 (2006.01)
H01Q 9/00 (2006.01)

(52) **U.S. Cl.** **343/749**; 343/848

(57) **ABSTRACT**

An antenna having a plurality of resonant frequencies and including a ground plane having an edge; a feed point; a ground point; and

an antenna track extending between the feed point and the ground point and comprising, in series connection, a first loop and a second loop wherein a least a portion of the first loop and a portion of the second loop are adjacent at least the edge of the ground plane.



US 20080211726A1

(19) United States

(12) Patent Application Publication

(10) Pub. No.: US 2008/0211726 A1

(43) Pub. Date: Sep. 4, 2008

Elsallal et al.

(54) **WIDE BANDWIDTH BALANCED ANTIPODAL TAPERED SLOT ANTENNA AND ARRAY INCLUDING A MAGNETIC SLOT**

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(21) Appl. No.: **11/899,920**

(22) Filed: **Sep. 7, 2007**

Related U.S. Application Data

(60) Provisional application No. 60/843,630, filed on Sep. 11, 2006.

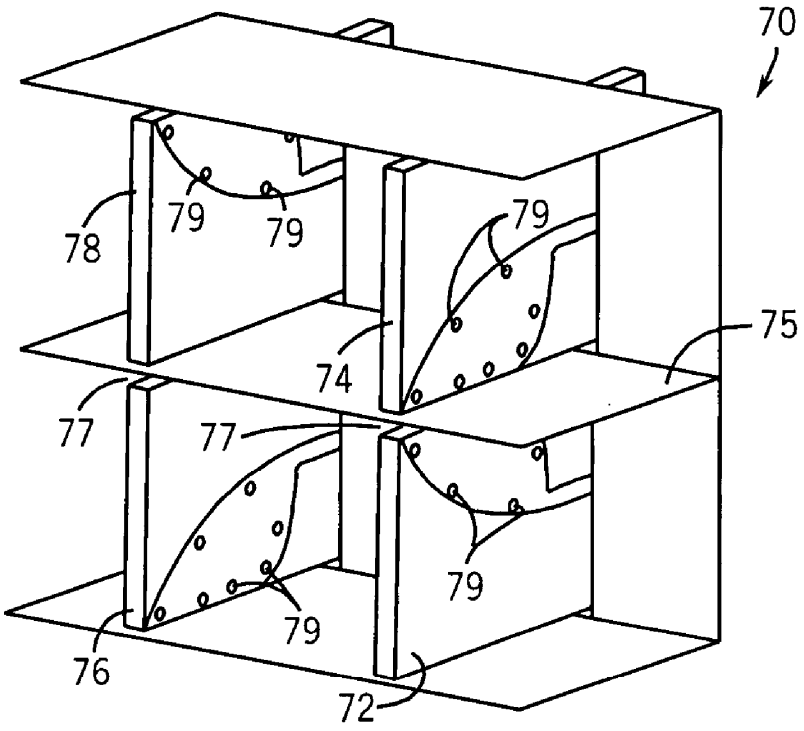
Publication Classification

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

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

(57) **ABSTRACT**

A balanced, antipodal tapered slot antenna includes one or more antenna elements or unit cells having metallic cross walls that are located in spaces between the adjacent elements of the antenna. The elements can include vias interconnecting metallic conductors of the elements and one or more magnetic slots in the metallic conductors. A plurality of the antenna elements or unit cells can be arranged in an antenna array that has a mirrored configuration with adjacent intermediate neighboring elements of the antenna array mirrored one-dimensionally with elements reversed along the E-plane, or doubly-mirrored, two-dimensionally, in the E-plane and the H-plane by reversing the orientation of alternate elements. Metallic cross walls and metallic rods are disposed in a non-electrically contacting relationship with adjacent antenna elements. The substrate of the antenna includes dielectric material located at the aperture of the antenna element.



US 20080211728A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2008/0211728 A1**

(43) **Pub. Date: Sep. 4, 2008**

Eray

(54) **ELECTRONIC ENTITY HAVING A MAGNETIC ANTENNA**

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(21) Appl. No.: **11/993,879**

(22) PCT Filed: **Jun. 20, 2006**

(86) PCT No.: **PCT/FR2006/001393**

§ 371 (c)(1),
(2), (4) Date: **Dec. 26, 2007**

(30) **Foreign Application Priority Data**

Jun. 27, 2005 (FR) 0506521

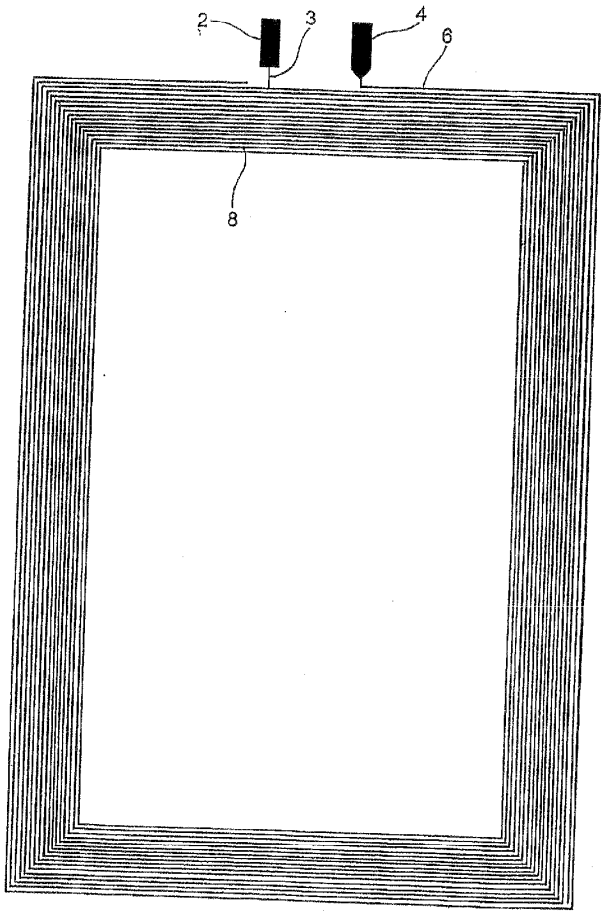
Publication Classification

(51) **Int. Cl.**
H01Q 7/00 (2006.01)

(52) **U.S. Cl.** **343/788**; 343/870

(57) **ABSTRACT**

An electronic entity includes an electronic circuit (**21**) having at least one first terminal (**22**) and a second terminal (**24**) to which an antenna is connected. The antenna includes a conducting element (**26**) electrically connected to the first terminal (**22**) of the electronic circuit (**21**) and includes a resonator (**28**) insulated from the conducting element (**26**) at the antenna, electrically connected to the second terminal (**24**) of the electronic circuit (**21**) and coupled to the conducting element (**26**).



US 20080218415A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2008/0218415 A1**

(43) **Pub. Date: Sep. 11, 2008**

Oomuro

(54) **NULL-FILL ANTENNA, OMNI ANTENNA, AND RADIO COMMUNICATION EQUIPMENT**

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(21) Appl. No.: **11/869,310**

(22) Filed: **Oct. 9, 2007**

Related U.S. Application Data

(62) Division of application No. 11/178,948, filed on Jul. 12, 2005.

(30) **Foreign Application Priority Data**

Jul. 12, 2004 (JP) 205149/2004
Dec. 17, 2004 (JP) 365860/2004
Mar. 3, 2005 (JP) 059655/2005

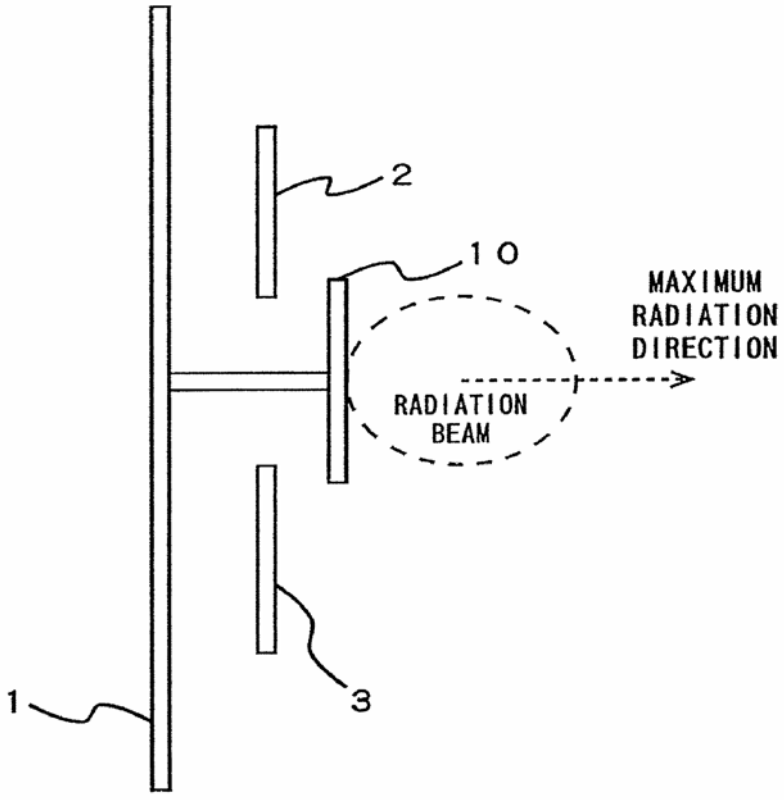
Publication Classification

(51) **Int. Cl.**
H01Q 3/00 (2006.01)

(52) **U.S. Cl.** **342/368**

(57) **ABSTRACT**

A wide-angle null-fill antenna with no null in the depression angle range, an omni antenna using the same, and radio communication equipment. A null-fill antenna comprises a first antenna array including antenna elements arranged with a prescribed point as the center, and a second antenna array having amplitude characteristics substantially equal to those of the antenna elements forming the first antenna array. The first antenna array is excited so that the excitation amplitude distribution is to have symmetry with respect to the prescribed point, while the excitation phase distribution is to have point symmetry with respect to the prescribed point. The phase center of the first antenna array is substantially coincident with that of the second antenna array.



US 20080218417A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2008/0218417 A1**

(43) **Pub. Date: Sep. 11, 2008**

Gillette

(54) **PROBE FED PATCH ANTENNA**

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(21) Appl. No.: **11/713,914**

(22) Filed: **Mar. 5, 2007**

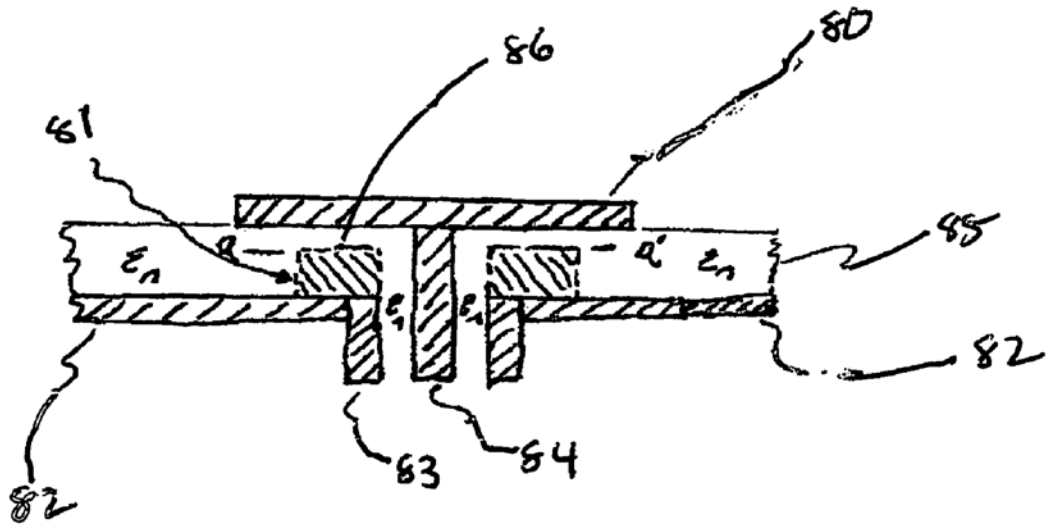
Publication Classification

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

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

(57) **ABSTRACT**

A microstrip antenna configuration employs a metallic patch which is positioned on the top surface of a dielectric substrate. The dielectric substrate has the bottom surface coated with a suitable metal to form a ground plane. A hole is formed through the ground plane, through the dielectric to allow access to the bottom surface of the patch. A center conductor of a coaxial cable is directly connected to the patch. The center conductor of the coaxial cable is surrounded by a metallic housing within the substrate area. The patch forms a first plate for the capacitance while the diameter of the outer housing of the coaxial cable within the substrate is increased to form another plate on the end of the coaxial cable. The value of capacitance can be adjusted by the area of the metallic housing the relative dielectric constant of the spacing material, and the spacing between the plates. The sum of the probe inductive impedance and microstrip patch antenna input impedance using the direct probe connection is adjusted and centered at a desired design center frequency and many such frequencies can be accommodated.



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(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2008/0218418 A1**

(43) **Pub. Date: Sep. 11, 2008**

Gillette

(54) **PATCH ANTENNA INCLUDING SEPTA FOR BANDWIDTH CONROL**

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(21) Appl. No.: **11/821,674**

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

Related U.S. Application Data

(63) Continuation-in-part of application No. 11/713,914, filed on Mar. 5, 2007.

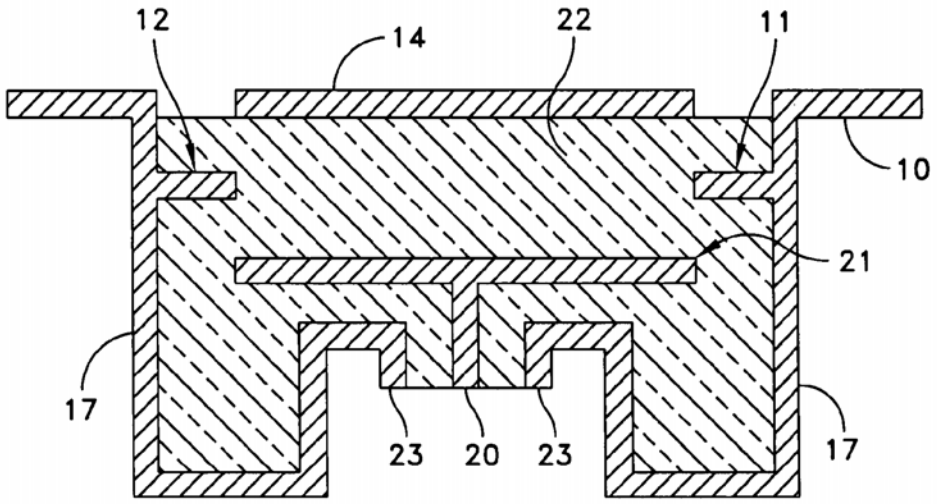
Publication Classification

(51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 9/04 (2006.01)

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

(57) **ABSTRACT**

A patch antenna element includes a parasitic patch which is positioned on a top surface of a substrate. Located beneath the parasitic patch is a driven patch. The driven patch is coupled either directly or capacitively to the center conductor of a coaxial cable and hence provides a signal which signal is coupled to the parasitic patch. The parasitic patch, as well as the driven patch is surrounded by a metal wall cavity. The metal wall cavity increases mutual coupling between antenna patch elements of similar types. Disposed between the parasitic patch and the driven patch are septa elements. The septa elements are oriented parallel to the edges of the patch and are DC connected to the cavity metal sidewalls. The septa operate to reduce total cavity thickness and patch to patch mutual coupling while further allowing control of the bandwidth.



US 20080218426A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2008/0218426 A1**

(43) **Pub. Date: Sep. 11, 2008**

QIN et al.

(54) **ULTRA WIDEBAND ANTENNA**

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(21) Appl. No.: **11/847,357**

(22) Filed: **Aug. 30, 2007**

(30) **Foreign Application Priority Data**

Mar. 8, 2007 (CN) 200710200260.3

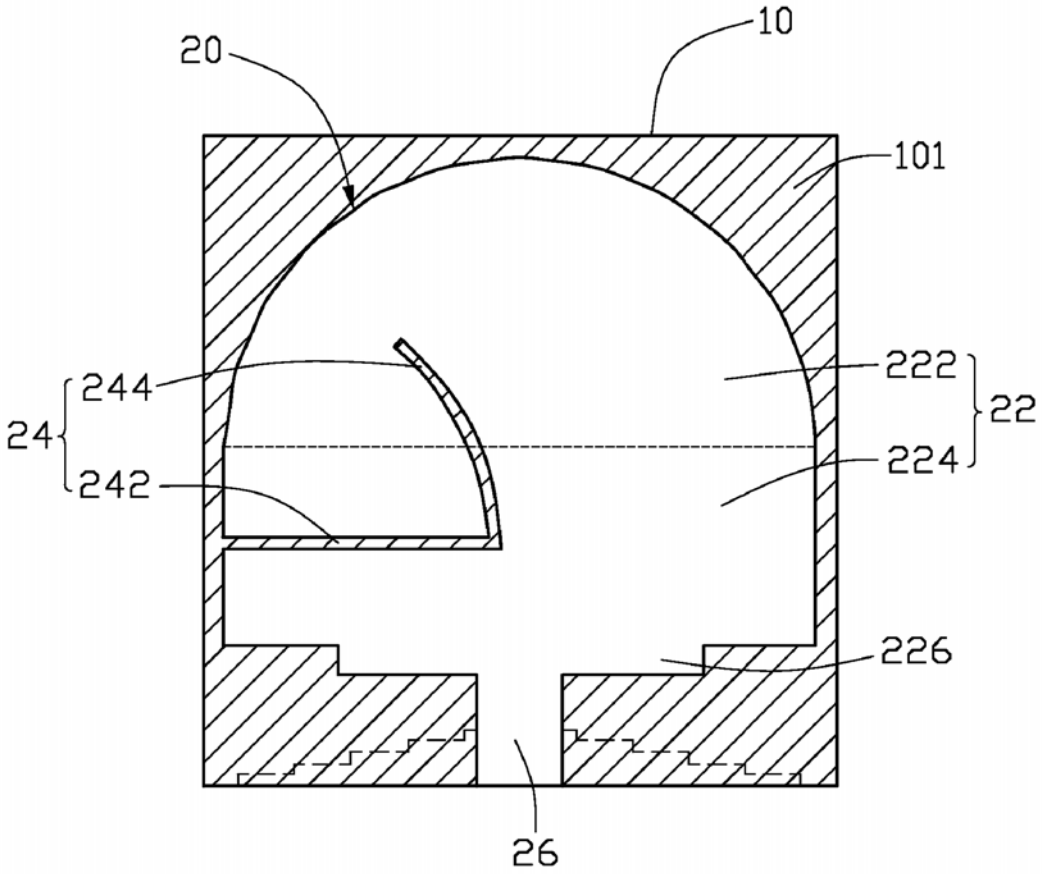
Publication Classification

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

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

(57) **ABSTRACT**

An ultra wideband antenna (**20**) is disposed on a substrate (**10**). The substrate includes a first surface (**101**) and a second surface (**102**). The ultra wideband antenna includes a radiation body (**22**), a feeding portion (**26**), and a grounded portion (**28**). The radiation body disposed on the first surface is used for transceiving electromagnetic signals. The radiation body includes a semicircle-shaped metal portion (**222**) and a rectangle-shaped metal portion (**224**) and defines a slot (**24**) starting at an edge therein. The feeding portion is electronically connected to the radiation body for feeding signals to the radiation body. The grounded portion is disposed on the second surface.



US 20080224935A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2008/0224935 A1**

(43) **Pub. Date: Sep. 18, 2008**

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(54) **ANTENNA**

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(21) Appl. No.: **11/688,290**

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

Related U.S. Application Data

(60) Provisional application No. 60/745,884, filed on Apr. 28, 2006.

(30) **Foreign Application Priority Data**

Apr. 14, 2006 (JP) 2006-112352
Sep. 20, 2006 (JP) 2006-254153
Nov. 17, 2006 (JP) 2006-311546

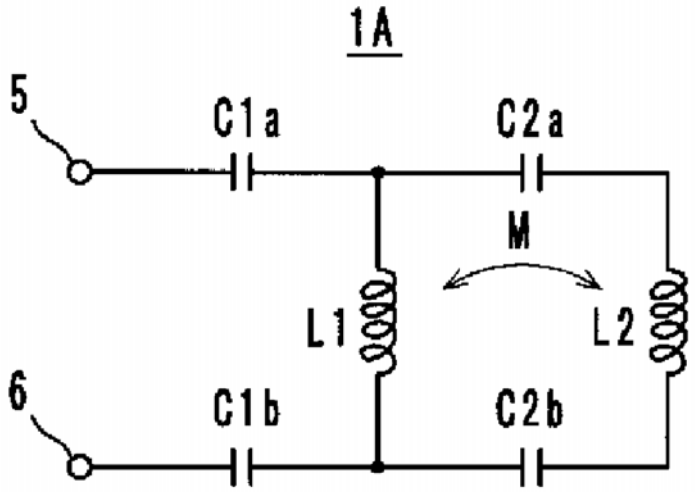
Publication Classification

(51) **Int. Cl.**
H01Q 9/00 (2006.01)
H01Q 1/50 (2006.01)

(52) **U.S. Cl.** **343/749**; 343/860

(57) **ABSTRACT**

An antenna includes inductance elements that are magnetically coupled together, an LC series resonant circuit that includes one of the inductance elements and capacitance elements, and an LC series resonant circuit that includes another of the inductance elements and capacitance elements. The plurality of LC series resonant circuits are used to radiate radio waves and are used as inductances of a matching circuit that matches an impedance when a power supply side is viewed from power supply terminals and a radiation impedance of free space.



L1	L2
Q:100	Q:100
F:0.915GHz	F:0.915GHz
M:1	M:1

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(19) **United States**

(12) **Patent Application Publication**

Lee et al.

(10) **Pub. No.: US 2008/0224946 A1**

(43) **Pub. Date: Sep. 18, 2008**

(54) **CHIP ANTENNA**

(75) Inventors: **Jae-Man Lee**, Goyang-si (KR); **Sae-Won Oh**, Incheon (KR); **Seung-Yong Lee**, Pucheon-si (KR)

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(21) Appl. No.: **12/067,796**

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

(86) PCT No.: **PCT/KR2006/003785**

§ 371 (c)(1),
(2), (4) Date: **Mar. 21, 2008**

(30) **Foreign Application Priority Data**

Sep. 23, 2005 (KR) 10-2005-0088706
Sep. 23, 2005 (KR) 10-2005-0088726
Dec. 30, 2005 (KR) 10-2005-0134843

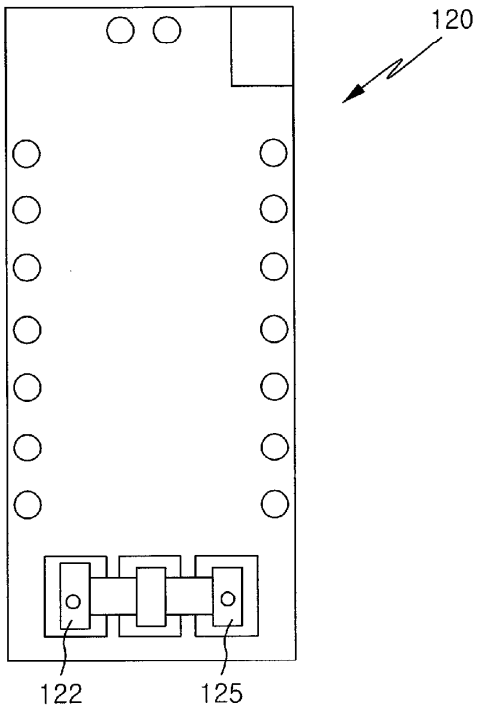
Publication Classification

(51) **Int. Cl.**
H01Q 1/36 (2006.01)
H01Q 9/04 (2006.01)

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

(57) **ABSTRACT**

The present invention relates in general, to a chip antenna and, more particularly, to a dual-band small-sized chip antenna, in which a first antenna element, including a plurality of coil members, is coupled with a second antenna element, having a plurality of circuit patterns, in a zigzag fashion, thus forming resonance frequencies, and relates to a multi-band chip antenna fed with current from external part wherein the third antenna element having coil formed in helical form and the fourth antenna formed parallel with the third antenna element and in helical form are connected to the fifth antenna having a plurality of circuit pattern on the layered-substrate, and relates to chip antenna using multi-layered radiator to generate the mutual coupling of two radiator by placing non-feeding radiation element having fixed pattern between the radiator for performing the radiation of the low frequency band and the radiator for performing the radiation of the high frequency band and to have wide band characteristic by forming multiple current path to radiator.



US 20080231515A1

(19) **United States**

(12) **Patent Application Publication**

Mayer et al.

(10) **Pub. No.: US 2008/0231515 A1**

(43) **Pub. Date: Sep. 25, 2008**

(54) **ANTENNA WITH LOW SAR**

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(73) Assignee: **Laird Technologies, Inc.**, Lincoln, NE (US)

(21) Appl. No.: **11/689,120**

(22) Filed: **Mar. 21, 2007**

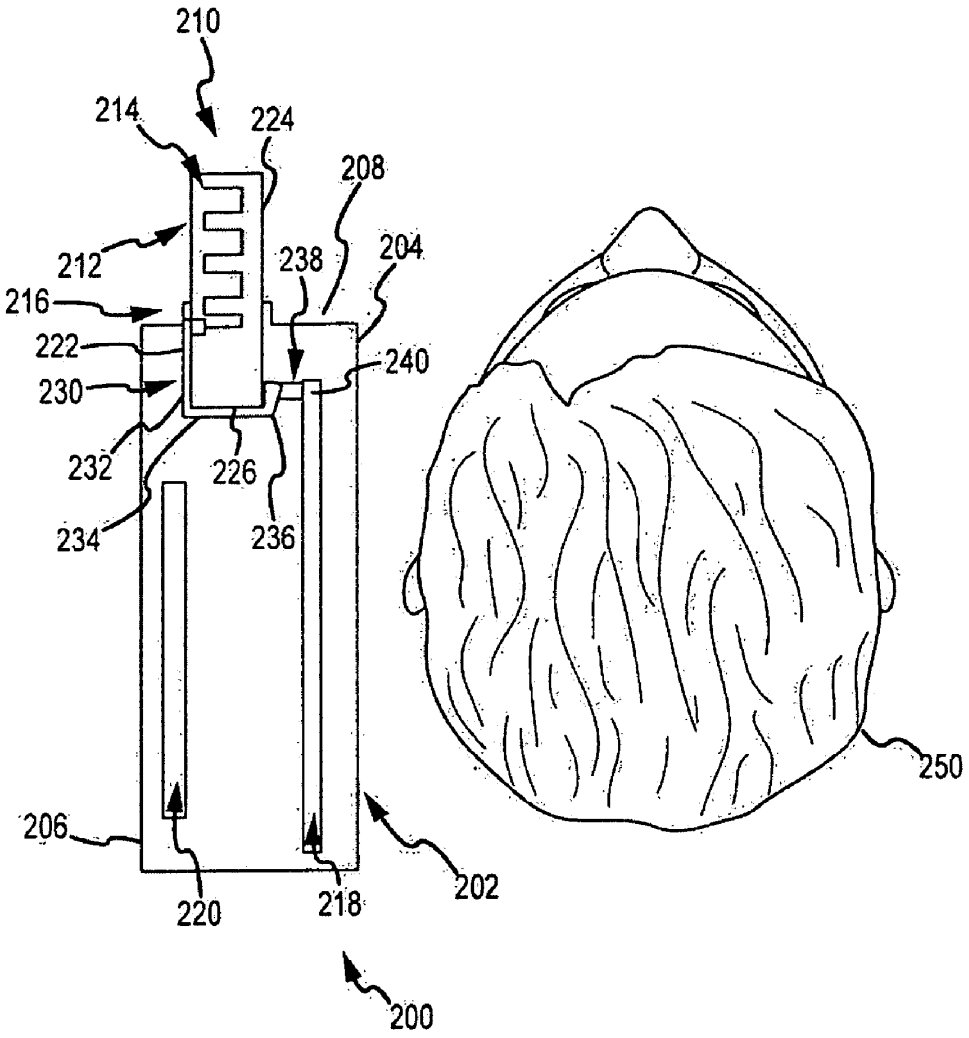
Publication Classification

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

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

(57) **ABSTRACT**

An antenna having a low specific absorption rate has it power feed connected to radio frequency power such that a connector is arranged between a head of the user and a portion of the power feed.



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(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2008/0231516 A1**

(43) **Pub. Date: Sep. 25, 2008**

Wei

(54) **MULTI-FREQUENCY ANTENNA AND AN ELECTRIC DEVICE THEREOF**

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(21) Appl. No.: **11/882,958**

(22) Filed: **Aug. 8, 2007**

(30) **Foreign Application Priority Data**

Mar. 20, 2007 (TW) 096109590

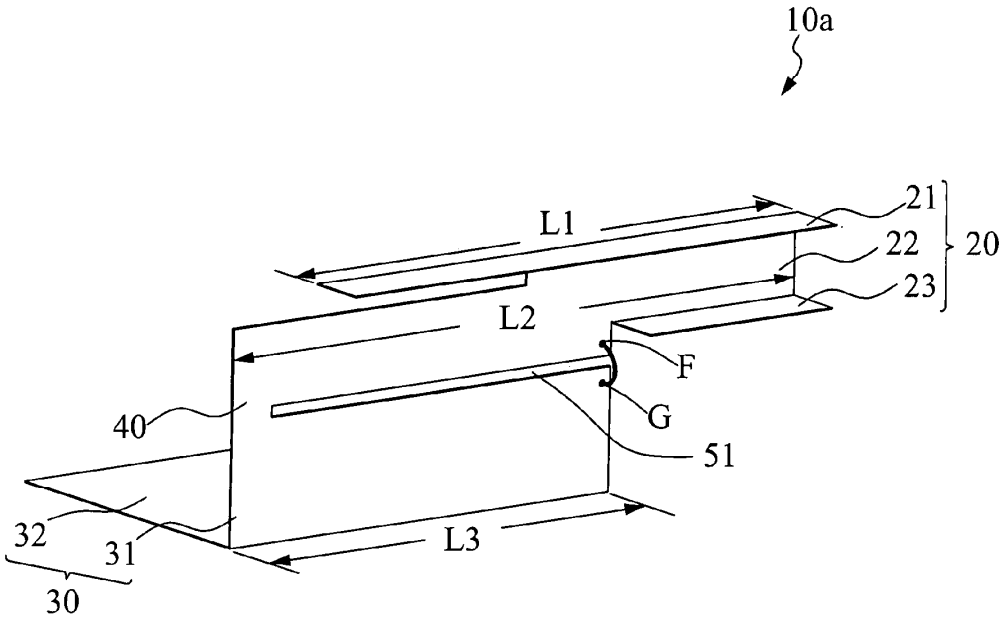
Publication Classification

(51) **Int. Cl.**
H01Q 5/00 (2006.01)
H01Q 1/36 (2006.01)

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

(57) **ABSTRACT**

A multi-frequency antenna is disclosed. The multi-frequency antenna is positioned on an electric device for transmitting Wi-Fi and Wimax wireless signals. The multi-frequency antenna comprises a radiating element, a grounding element and a connecting element. The radiating element comprises a first radiating area and a second radiating area, which are perpendicular to each other. The connecting element is connected to the second radiating area of the radiating element and the grounding element.



US 20080231517A1

(19) **United States**

(12) **Patent Application Publication**

Zheng

(10) **Pub. No.: US 2008/0231517 A1**

(43) **Pub. Date: Sep. 25, 2008**

(54) **MULTI-BAND ANTENNA**

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(73) Assignee: **Nokia Corporation**

(21) Appl. No.: **11/999,225**

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

Related U.S. Application Data

(63) Continuation of application No. 10/896,212, filed on Jul. 20, 2004, now Pat. No. 7,307,591.

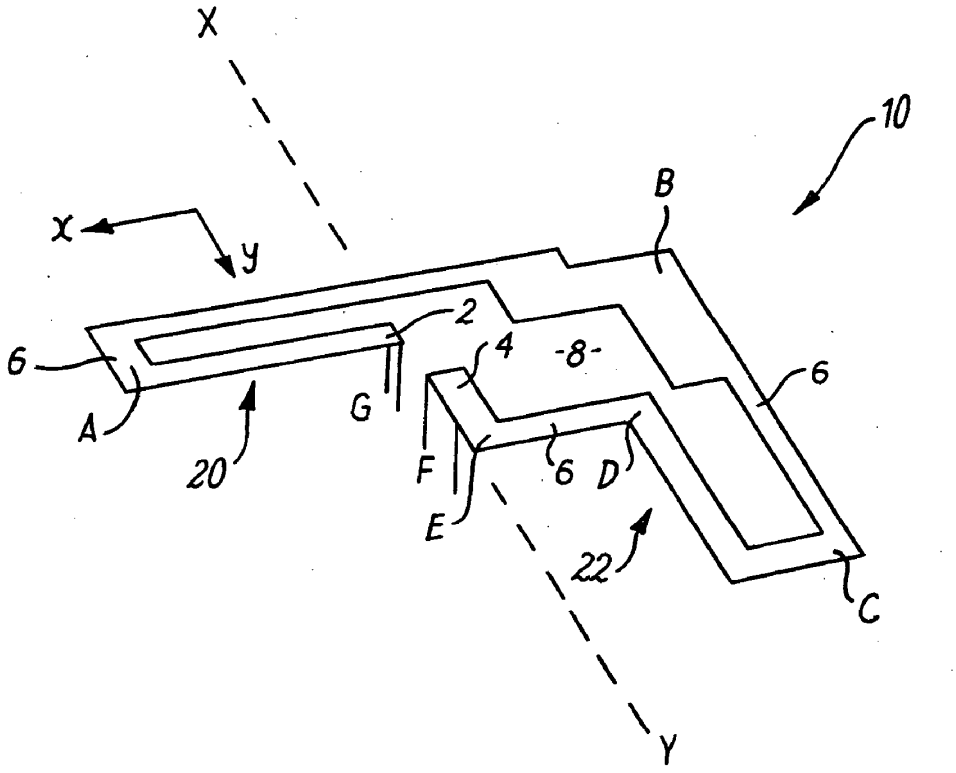
Publication Classification

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

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

(57) **ABSTRACT**

An antenna having a plurality of resonant frequencies and comprising a feed point, a ground point and a conductive track that extends from the feed point and returns to the ground point and means for locally increasing the reactance of the antenna track at a first position coincident with a maximum electromagnetic field associated with at least one of the plurality of resonant frequencies.



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(19) **United States**

(12) **Patent Application Publication**

Montgomery et al.

(10) **Pub. No.: US 2008/0231522 A1**

(43) **Pub. Date: Sep. 25, 2008**

(54) **SLOT ANTENNA**

(76) Inventors: **Mark Montgomery**, Melbourne Beach, FL (US); **Frank M. Caimi**, Vero Beach, FL (US)

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(21) Appl. No.: **12/055,259**

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

Related U.S. Application Data

(60) Provisional application No. 60/896,930, filed on Mar. 25, 2007.

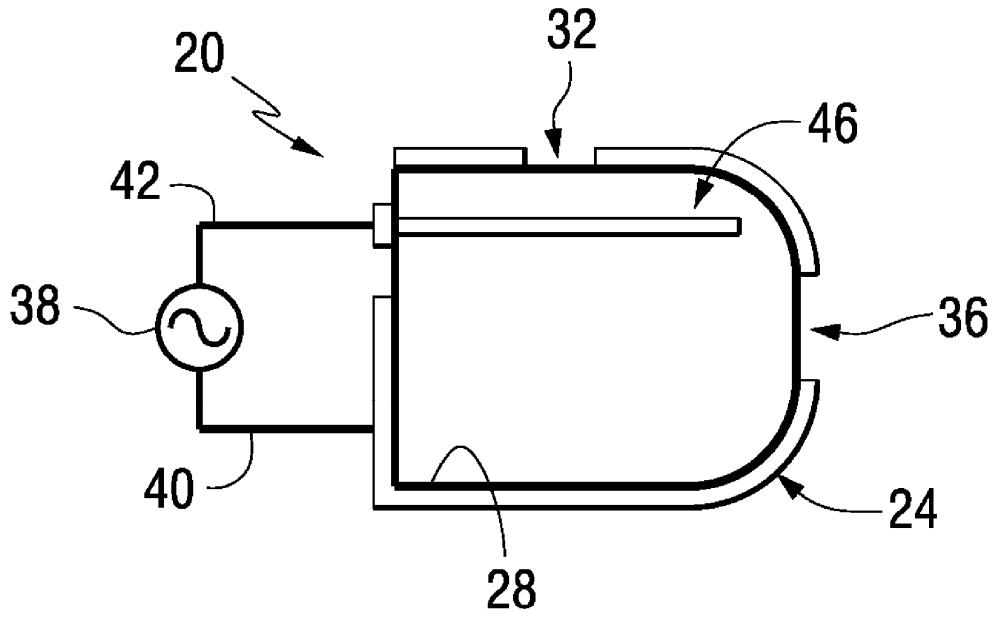
Publication Classification

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

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

(57) **ABSTRACT**

A communications device for sending and receiving an information signal. The communications device comprising an element having an opening defined therein for receiving an antenna, the element comprising first conductive material disposed proximate the opening and comprising transmitting and receiving circuits. The antenna comprises: a dielectric tubular member, second conductive material forming an exterior surface of the tubular member with the second conductive material defining a slot therein, a slot length approximately equal to one-half of a guided wavelength and a feed connected to the transmitting and receiving circuits and disposed proximate the slot for establishing currents in the second conductive material.



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(19) **United States**

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

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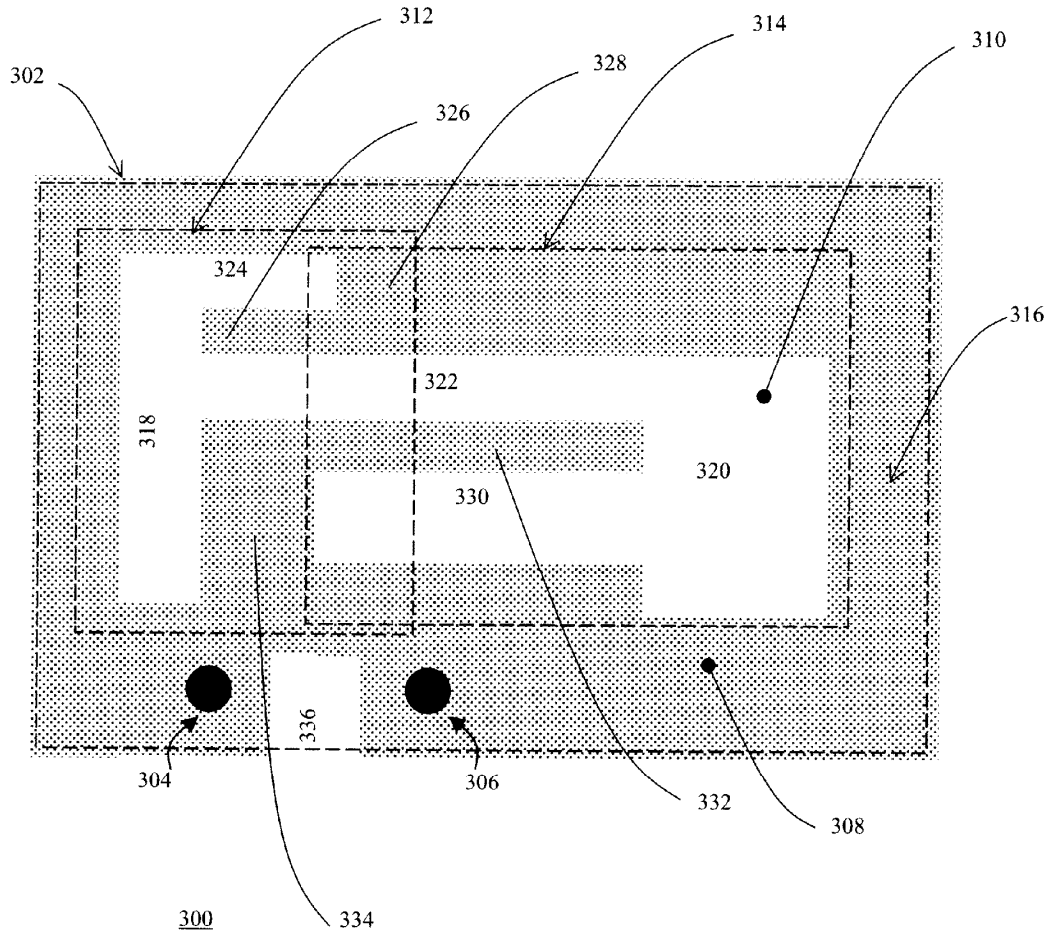
(52) **U.S. Cl.** **343/767**

(57) **ABSTRACT**

A dual-band antenna includes a planar conductive layer comprising a conductive region and a central non-conductive region. The conductive region and the non-conductive region together define a pair of interconnected F-slot structures, and a loop strip structure coupled to and disposed around the F-slot patch slot antenna structures.



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Wang et al.

(54) **ANTENNA APPARATUS, AND ASSOCIATED METHODOLOGY, FOR A MULTI-BAND RADIO DEVICE**

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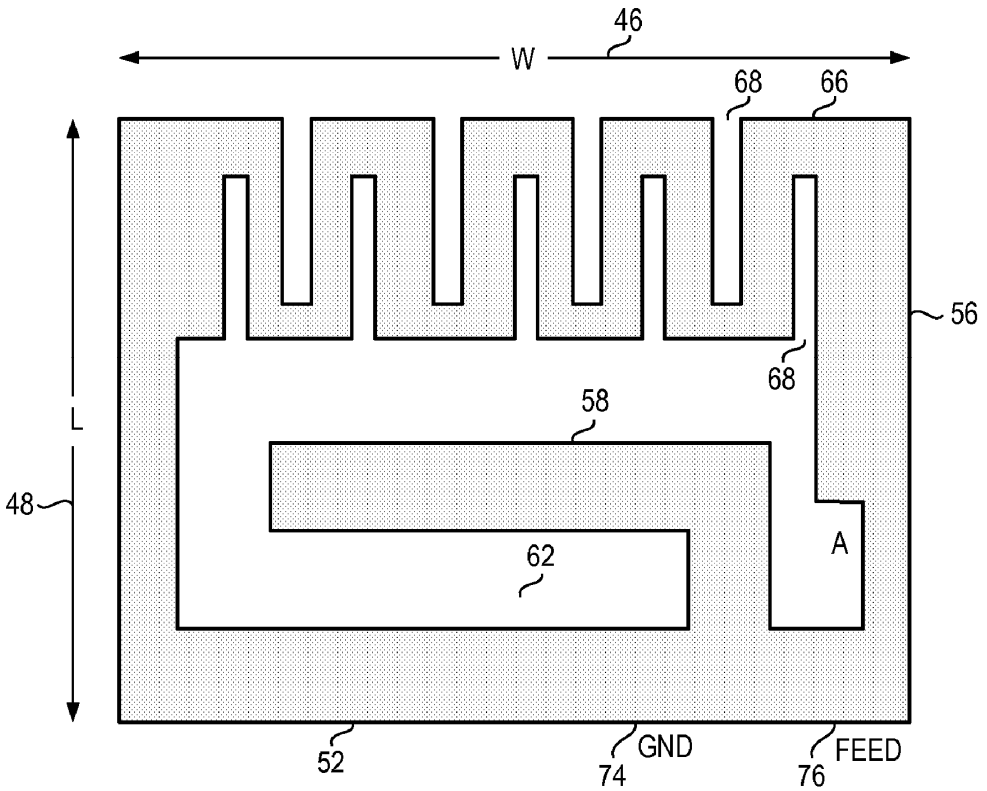
(52) **U.S. Cl.** **343/767**

(57) **ABSTRACT**

Antenna apparatus, and an associated methodology, for a multi-frequency-band-capable radio device, such as a quad-band mobile station. The antenna apparatus forms a hybrid strip antenna having a pair of resonant elements. A first resonant element forms a peripheral loop extending about the periphery of a substrate. A meander line extends along a portion of the peripheral loop. And, second resonant element is formed of an L-shaped strip. The peripheral loop is resonant at a set of frequencies, and the L-shaped strip is resonant at a single frequency. Through appropriate selection of the lengths of the resonant elements, the frequencies at which the elements are resonant are controlled.



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Rao et al.

(54) MULTI-BAND SLOT-STRIP ANTENNA

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(21) Appl. No.: **11/688,052**

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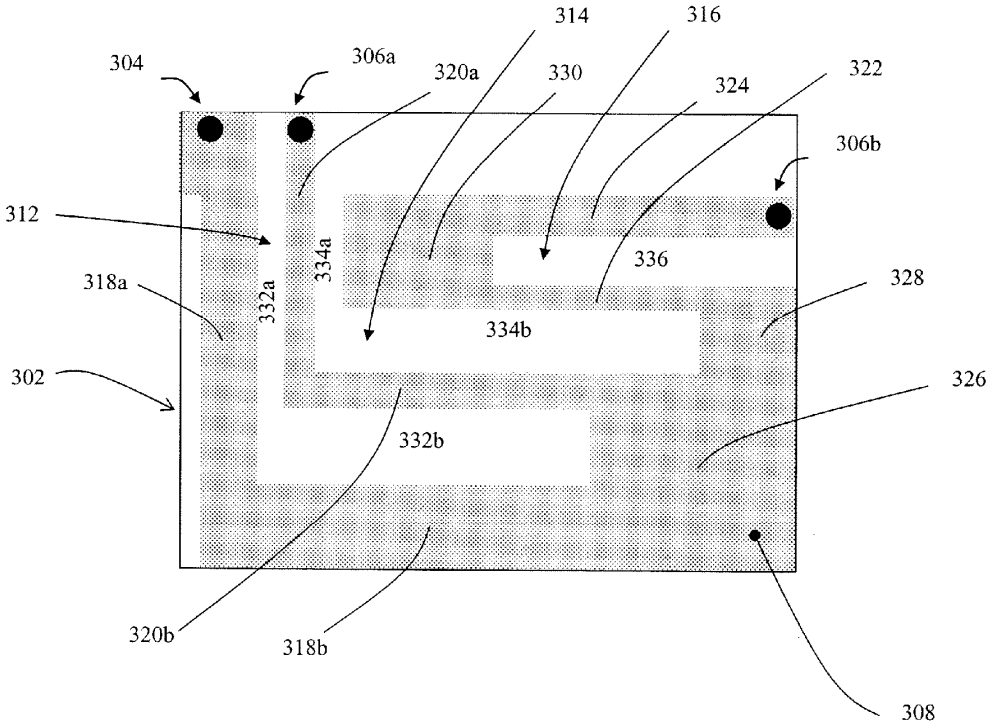
(51) **Int. Cl.**
H01Q 13/10 (2006.01)

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

(57) **ABSTRACT**

A multi-band antenna includes a planar conductive layer that comprises a conductive region and a non-conductive region. The conductive region and the non-conductive region together define a first slot-strip structure, a second slot-strip structure coupled to the first slot-strip structure, and a third slot-strip structure coupled to the second slot-strip structure. The first slot-strip structure includes a signal feed portion. The second slot-strip structure includes a first signal grounding portion. The third slot-strip structure includes a second signal grounding portion.



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Shin

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(54) **RECEIVING ANTENNA**

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(21) Appl. No.: **12/051,916**

(22) Filed: **Mar. 20, 2008**

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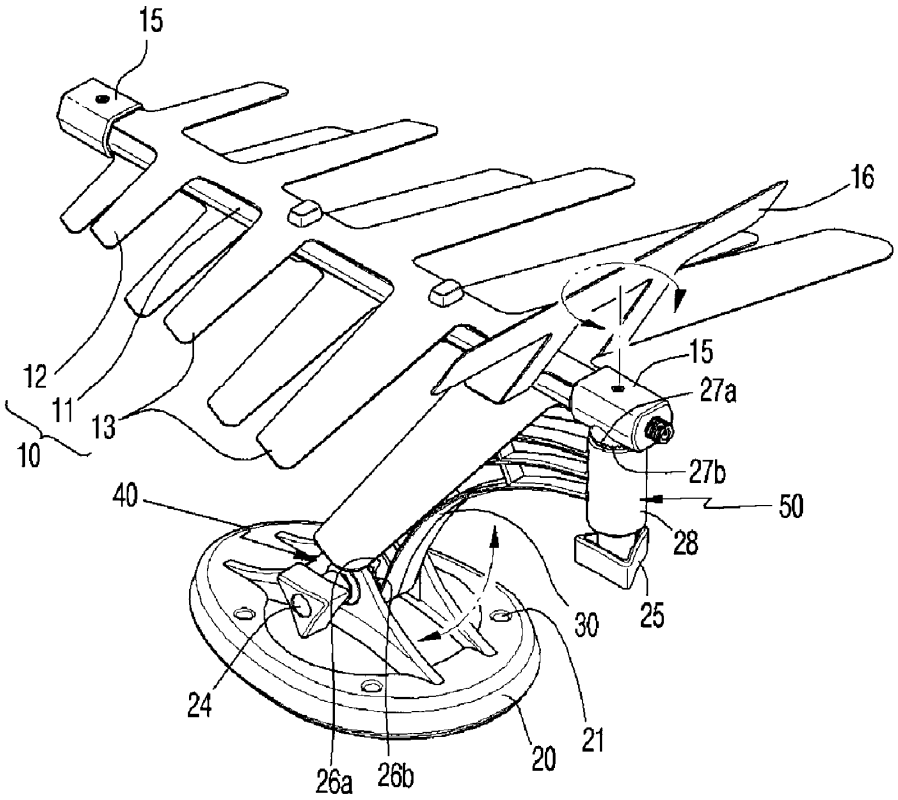
(52) **U.S. Cl.** **343/882**

(57) **ABSTRACT**

The invention provides a sky wave receiving antenna which includes a receiving element having a radiator and a plurality of directors arranged in parallel on a horizontal support boom with a constant interval in a alternatively crossed direction, a base and a vertical direction adjustor rotationally connected at its one end to the base with a use of a first joint. The receiving antenna further includes a second joint connected to the other end of the vertical direction adjustor and connected to the receiving element so as to obtain a horizontal direction adjustment of the receiving element. The receiving antenna of the invention allows the adjustment of the receiving element to be made in both vertical and horizontal directions in order to enhance the receive directivity.



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(54) CIRCULARLY POLARIZED ANTENNA AND RADAR DEVICE USING THE SAME

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(2), (4) Date: **Jul. 12, 2006**

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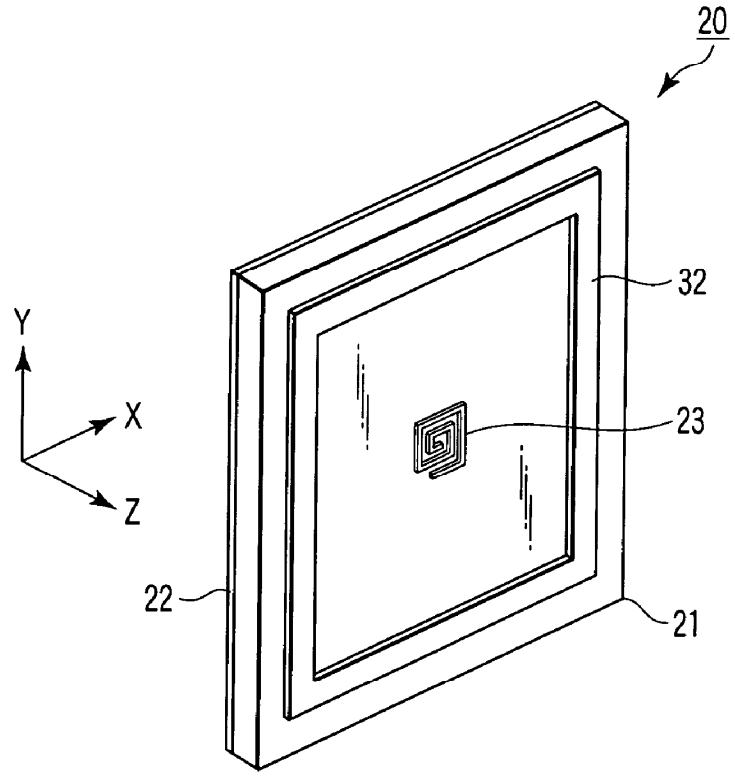
(51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 1/36 (2006.01)

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

(57) **ABSTRACT**

A circularly polarized antenna has a dielectric substrate, a ground conductor which is piled up one surface side of the dielectric substrate, a circularly polarized type of antenna element formed on an opposite surface of the dielectric substrate, a plurality of metal posts whose respective one end sides are connected to the ground conductor and penetrate the dielectric substrate along a thickness direction thereof, and whose respective other sides extend up to the opposite surface of the dielectric substrate, the plurality of metal posts configuring a cavity by being provided at predetermined intervals so as to surround the antenna element, and a conducting rim which short-circuits the respective other end sides of the plurality of metal posts along an array direction thereof, and is provided so as to extend by a predetermined distance in a direction of the antenna element at the side of the opposite surface of the dielectric substrate. With the circularly polarized antenna, a radiation characteristic of the antenna can be made to be a desired characteristic by preventing a surface wave from being generated by means of the cavity and the conducting rim, and a frequency characteristic of the antenna gain can be made to have a sharp notch within the RR prohibited band by utilizing a resonance of the cavity. Accordingly, the circularly polarized antenna is effective for reducing radio interference with the EESS or radio astronomical services.



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(54) **MULTI-FREQUENCY ANTENNA**

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(22) Filed: **Jul. 13, 2007**

(30) **Foreign Application Priority Data**

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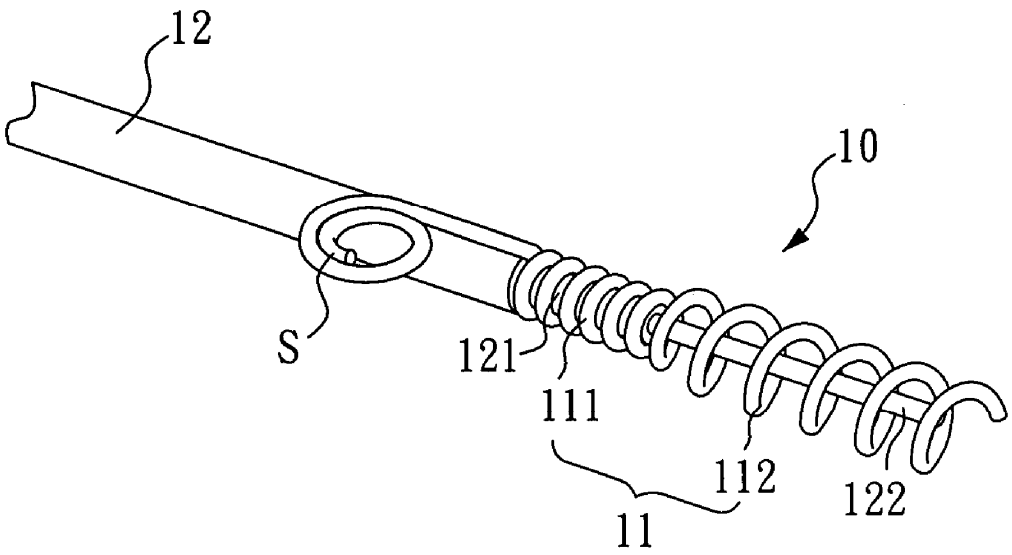
(51) **Int. Cl.**
H01Q 1/36 (2006.01)

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

(57) **ABSTRACT**

A portable electronic device with function of receiving and radiating radio frequency (RF) signal and a multi-frequency antenna thereof are disclosed. The portable electronic device comprises a RF module and a multi-frequency antenna connecting to the RF module. The multi-frequency antenna comprises a helix element and a coaxial cable disposed within the helix element. The helix element comprises a first helix portion and a second helix portion adjacent to each other, and the coaxial cable comprises a grounding portion and a radiating portion. The first helix portion covers the grounding portion, and the radiating portion is disposed within the second helix portion separated with each other.



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(12) **Patent Application Publication**

Goidas et al.

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(54) **ELECTROSTATIC DISCHARGE SAFE UNDER CONVEYOR ANTENNA**

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(21) Appl. No.: **11/726,519**

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

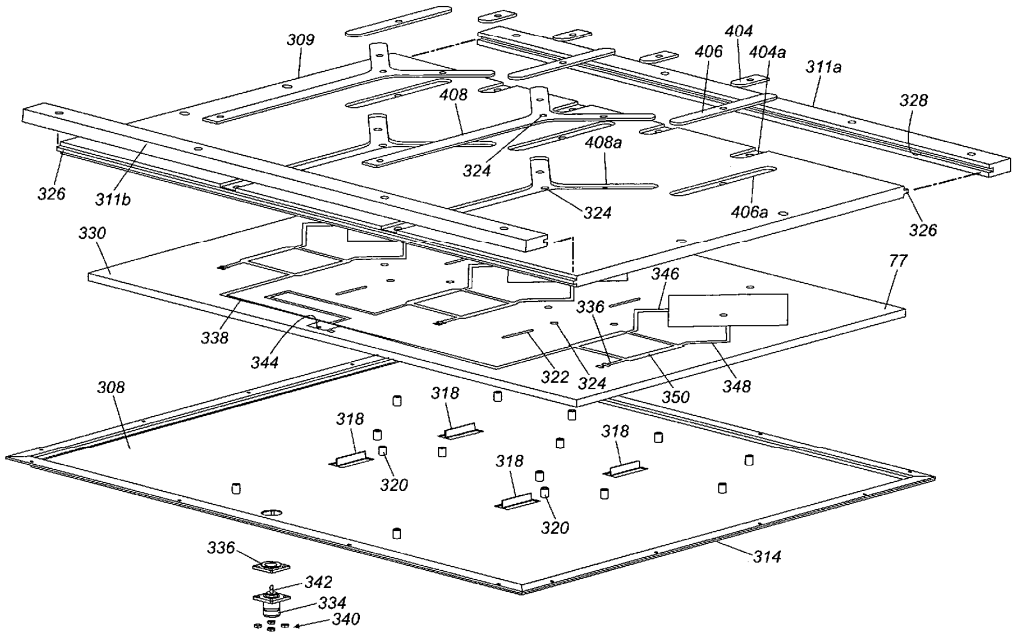
Publication Classification

(51) **Int. Cl.**
H02H 9/00 (2006.01)
H01Q 1/36 (2006.01)

(52) **U.S. Cl.** ..... **361/56**; 343/700 MS

(57) **ABSTRACT**

An antenna for use in a conveyor system in which items on which radio frequency identification tags are disposed are moved on a conveyor along a path of travel, includes a ground plane, a substrate having a bottom surface received adjacent the ground plane, at least one patch element disposed on a top surface of the substrate, a cover received adjacent the top surface of the substrate, and a front static conductive strip disposed along a front edge of the cover. The antenna is disposed beneath the conveyor and a front edge of the antenna is transverse to the path of travel. The front static conductive strip is electrically connected to the ground plane such that an electrostatic discharge event adjacent the front static conductive strip is discharged to the ground plane.



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(19) **United States**

(12) **Patent Application Publication**

Saliga

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(21) Appl. No.: **11/690,448**

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(52) **U.S. Cl.** **455/73**; 29/600; 343/848

(57) **ABSTRACT**

An antenna comprising: (a) a conductive ground plane; and (b) a rod shaped monopole element having a conductive surface, oriented out from the ground plane and having a length selected for a first radio frequency band, the monopole element having a current suppressing element conductively attached and surrounding the surface of the monopole element at a location on the monopole element determined by a second frequency band higher than the first frequency band. The rod-shaped monopole element has a relatively wide cross-section such that the antenna is operable over relatively wide ranges of frequencies in one or both of the frequency bands. The antenna is for operation in the 2.4 GHz and the 5 GHz bands as used in the IEEE 802.11a,b,g standards.