



US009923262B2

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

(10) **Patent No.:** **US 9,923,262 B2**
(45) **Date of Patent:** **Mar. 20, 2018**

- (54) **MOBILE DEVICE**
- (71) Applicant: **Quanta Computer Inc.**, Taoyuan (TW)
- (72) Inventors: **Chi-Hsuan Lee**, Taoyuan (TW);
Chung-Ting Hung, Taoyuan (TW);
Tsung-Ying Hsieh, Taoyuan (TW)
- (73) Assignee: **QUANTA COMPUTER INC.**,
Guishan Dist., Taoyuan (TW)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 50 days.

- (21) Appl. No.: **14/880,496**
- (22) Filed: **Oct. 12, 2015**
- (65) **Prior Publication Data**
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- (30) **Foreign Application Priority Data**
Jul. 20, 2015 (TW) 104123371 A

- (51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 9/04 (2006.01)
H04M 1/02 (2006.01)
- (52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H01Q 9/0421**
(2013.01); **H04M 1/026** (2013.01)
- (58) **Field of Classification Search**
CPC H01Q 1/243; H01Q 1/38; H01Q 7/00; H01Q 1/12; H01Q 13/10
USPC 343/702, 732, 748, 764, 767, 866, 878
See application file for complete search history.

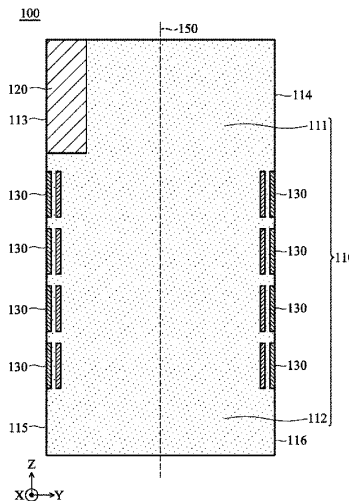
- (56) **References Cited**
- U.S. PATENT DOCUMENTS
- 5,497,164 A * 3/1996 Croq H01Q 9/0414
343/700 MS
- 6,970,137 B1 * 11/2005 Maslovski H01Q 1/243
343/700 MS
- 2011/0156975 A1 * 6/2011 Pros H01Q 1/243
343/767
- 2012/0223869 A1 9/2012 Kim et al.
- FOREIGN PATENT DOCUMENTS
- CN 103094681 5/2013
- OTHER PUBLICATIONS

Chinese language office action dated Sep. 5, 2016, issued in application No. TW 104123371.
Wahid, A., et al.; "CSRR Loaded Microstrip Array Antenna With Low Sidelobe Level;" IEEE Antennas and Wireless Propagation Letters; vol. 14; Jan. 2015; pp. 1169-1171.

* cited by examiner
Primary Examiner — Dameon E Levi
Assistant Examiner — Collin Dawkins
(74) *Attorney, Agent, or Firm* — McClure, Qualey & Rodack, LLP

(57) **ABSTRACT**
A mobile device includes a ground plane, an antenna element, and one or more ring resonators. The ground plane has a first region and a second region. The antenna element is disposed on the first region. The ring resonators are disposed on the second region. Each of the ring resonators includes a first loop structure and a second loop structure. The ring resonators are configured to enhance the radiation gain of the antenna element in a zenith direction.

8 Claims, 6 Drawing Sheets





US009923263B2

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

(10) **Patent No.:** **US 9,923,263 B2**
(45) **Date of Patent:** **Mar. 20, 2018**

- (54) **MOBILE DEVICE**
- (71) Applicant: **Acer Incorporated**, New Taipei (TW)
- (72) Inventors: **Ming-Ching Yen**, New Taipei (TW);
Kun-Sheng Chang, New Taipei (TW);
Ching-Chi Lin, New Taipei (TW)
- (73) Assignee: **ACER INCORPORATED**, New Taipei (TW)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 28 days.

- (21) Appl. No.: **15/089,201**
- (22) Filed: **Apr. 1, 2016**
- (65) **Prior Publication Data**
US 2017/0264002 A1 Sep. 14, 2017
- (30) **Foreign Application Priority Data**
Mar. 9, 2016 (TW) 105107161 A

- (51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 1/24 (2006.01)
H01Q 1/48 (2006.01)
H01Q 9/26 (2006.01)
H01Q 9/04 (2006.01)
H01Q 9/42 (2006.01)

- (52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H01Q 1/24** (2013.01); **H01Q 1/48** (2013.01); **H01Q 9/0421** (2013.01); **H01Q 9/26** (2013.01); **H01Q 9/42** (2013.01)

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

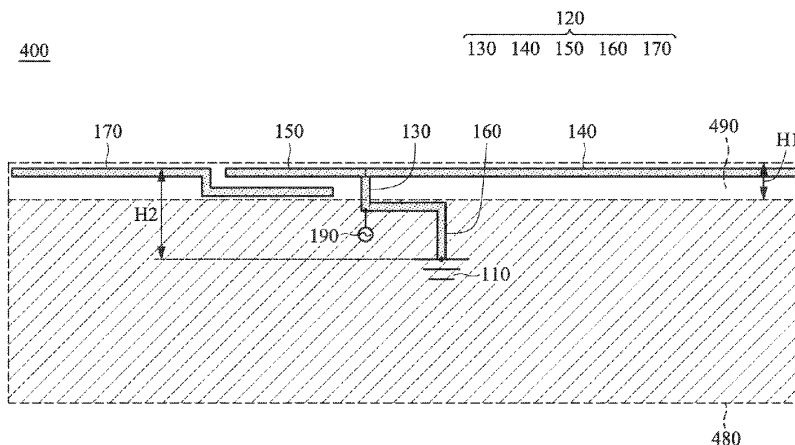
- (56) **References Cited**
U.S. PATENT DOCUMENTS
6,765,536 B2 7/2004 Phillips et al.
7,136,022 B2 * 11/2006 Sato H01Q 9/26
2005/0073462 A1 * 4/2005 Lin G06F 1/1616
343/702
2005/0093750 A1 5/2005 Vance
2005/0168384 A1 8/2005 Wang et al.
343/702
(Continued)

- FOREIGN PATENT DOCUMENTS
CN 203967235 U 11/2014

- OTHER PUBLICATIONS
Chinese language office action dated May 9, 2017, issued in application No. TW 105107161.
Primary Examiner — Jessica Han
Assistant Examiner — Hai Tran
(74) *Attorney, Agent, or Firm* — McClure, Qualey & Rodack, LLP

- (57) **ABSTRACT**
A mobile device includes a ground element and an antenna structure. The antenna structure includes a feeding connection element, a first radiation element, a second radiation element, a shorting element, and a parasitic radiation element. The feeding connection element is coupled to a signal source. The first radiation element is coupled to the feeding connection element. The first radiation element has an open end. The second radiation element is coupled to the feeding connection element. The second radiation element has an open end. The feeding connection element is coupled through the shorting element to the ground element. The parasitic radiation element is adjacent to the second radiation element.

8 Claims, 6 Drawing Sheets





US009923278B2

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

(10) **Patent No.:** **US 9,923,278 B2**
(45) **Date of Patent:** **Mar. 20, 2018**

(54) **DIVERSITY ANTENNA ARRANGEMENT FOR WLAN, AND WLAN COMMUNICATION UNIT HAVING SUCH A DIVERSITY ANTENNA ARRANGEMENT, AND DEVICE HAVING SUCH A WLAN COMMUNICATION UNIT**

(71) Applicant: **DLoG Gesellschaft fur elektronische Datentechnik mbH**, Germering (DE)

(72) Inventors: **Dejan Milankovic**, Munich (DE); **Rolf-Gunter Hauk**, Frankfurt (DE)

(73) Assignee: **DLOG GESELLSCHAFT FUR ELEKTRONISCHE DATENTECHNIK MBH**, Germering (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.

(21) Appl. No.: **14/819,290**

(22) Filed: **Aug. 5, 2015**

(65) **Prior Publication Data**
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(30) **Foreign Application Priority Data**
Aug. 6, 2014 (DE) 20 2014 103 657 U

(51) **Int. Cl.**
H01Q 21/00 (2006.01)
H01Q 21/06 (2006.01)
H01Q 1/22 (2006.01)
H01Q 1/42 (2006.01)
H01Q 1/52 (2006.01)
H01Q 21/28 (2006.01)
H04B 7/04 (2017.01)

H01Q 5/371 (2015.01)
H01Q 21/30 (2006.01)
(52) **U.S. Cl.**
CPC **H01Q 21/06** (2013.01); **H01Q 1/2291** (2013.01); **H01Q 1/42** (2013.01); **H01Q 1/521** (2013.01); **H01Q 1/526** (2013.01); **H01Q 5/371** (2015.01); **H01Q 21/28** (2013.01); **H01Q 21/30** (2013.01); **H04B 7/04** (2013.01)

(58) **Field of Classification Search**
CPC H01Q 1/526; H01Q 21/30; H01Q 1/42; H01Q 21/28; H01Q 5/371; H01Q 21/06; H01Q 1/2291; H01Q 1/521
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,784,844 B1 *	8/2004	Boakes	.....	H01Q 1/242 343/702
6,985,114 B2 *	1/2006	Egashira	.....	G06F 1/1616 29/600
8,354,964 B2 *	1/2013	Johnson	.....	H01Q 1/243 343/700 MS
2011/0169703 A1 *	7/2011	Schlub	.....	H01Q 1/243 343/702
2013/0257674 A1 *	10/2013	Li	.....	H01Q 5/321 343/853
2015/0084831 A1 *	3/2015	Liu	.....	H01Q 21/24 343/893

* cited by examiner

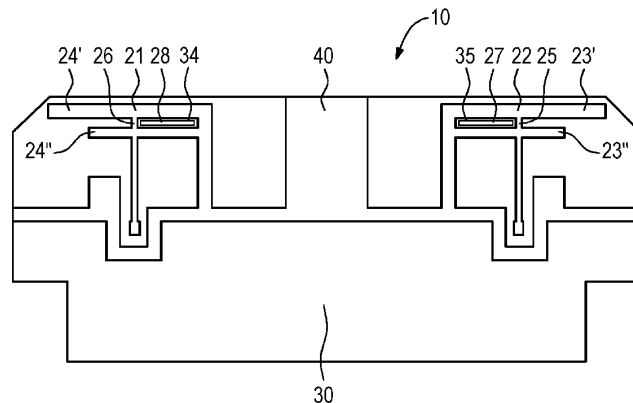
Primary Examiner — Trinh Dinh

(74) *Attorney, Agent, or Firm* — Workman Nydegger

(57) **ABSTRACT**

A diversity antenna arrangement, in particular a diversity radio antenna arrangement, for WLAN can have two or more antenna elements. In at least one implementation, the antenna elements are arranged in a manner spatially separate from one another on a printed circuit board.

16 Claims, 2 Drawing Sheets





US009929467B2

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

(10) **Patent No.:** **US 9,929,467 B2**
(45) **Date of Patent:** **Mar. 27, 2018**

(54) **ANTENNA MODULE AND MOBILE COMMUNICATION DEVICE HAVING THE SAME**

(2015.01); **H01Q 5/378** (2015.01); **H04B 1/3838** (2013.01); **H04M 1/026** (2013.01)

(71) Applicant: **PEGATRON CORPORATION**, Taipei (TW)

(58) **Field of Classification Search**
CPC H01Q 1/243; H04B 1/3838
See application file for complete search history.

(72) Inventors: **Chun-Chih Chen**, Taipei (TW); **Chien-Yi Wu**, Taipei (TW); **Chun-Wei Wang**, Taipei (TW); **Hau-Yuen Tan**, Taipei (TW); **Chia-Ho Ting**, Taipei (TW); **I-Shu Lee**, Taipei (TW)

(56) **References Cited**

U.S. PATENT DOCUMENTS

8,723,749 B2 * 5/2014 Lin H01Q 5/328
343/772
2015/0022403 A1 * 1/2015 Lin H01Q 1/44
343/702

(73) Assignee: **PEGATRON CORPORATION**, Taipei (TW)

FOREIGN PATENT DOCUMENTS

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 115 days.

TW M460421 U1 8/2013
TW M484801 U 8/2014
TW 201440319 A 10/2014
TW 201442338 A 11/2014
TW 201445814 A 12/2014

(21) Appl. No.: **15/008,231**

* cited by examiner

(22) Filed: **Jan. 27, 2016**

(65) **Prior Publication Data**

US 2016/0226143 A1 Aug. 4, 2016

Primary Examiner — Jessica Han

Assistant Examiner — Amal Patel

(74) *Attorney, Agent, or Firm* — Muncy, Geissler, Olds & Lowe, P.C.

(30) **Foreign Application Priority Data**

Jan. 30, 2015 (TW) 104103196 A

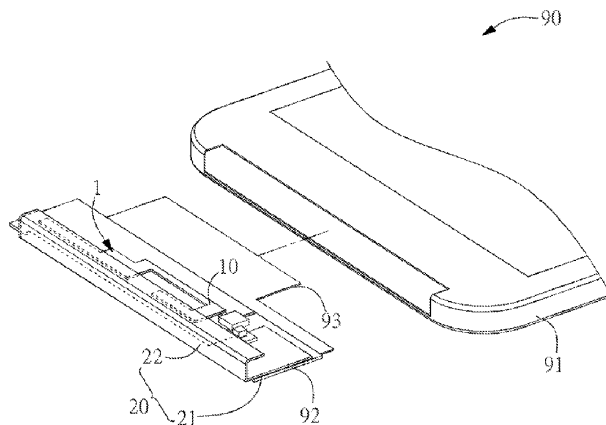
(57) **ABSTRACT**

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/48 (2006.01)
H01Q 5/10 (2015.01)
H04B 1/3827 (2015.01)
H01Q 5/371 (2015.01)
H01Q 5/378 (2015.01)
H04M 1/02 (2006.01)

An antenna module is disclosed. The antenna module is applied to a mobile communication device and includes a first radiating element and a second radiating element. The first radiating element is disposed on a base board inside the mobile communication device, and one point of the first radiating element is a feed point of the antenna module. The second radiating element is disposed on the base board and is grounded by connecting to a P-sensor inside the mobile communication device. There is a gap between one part of the second radiating element and the first radiating element.

(52) **U.S. Cl.**
CPC **H01Q 5/10** (2015.01); **H01Q 1/243** (2013.01); **H01Q 1/48** (2013.01); **H01Q 5/371**

10 Claims, 3 Drawing Sheets





US009935359B2

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

(10) **Patent No.:** **US 9,935,359 B2**
(45) **Date of Patent:** **Apr. 3, 2018**

(54) **ANTENNA AND ELECTRONICS DEVICE INCLUDING THE SAME**

(71) Applicant: **Samsung Electronics Co., Ltd.**,
Gyeonggi-do (KR)

(72) Inventors: **Jaе Hyung Kim**, Seoul (KR); **Jin U Kim**, Daejeon (KR); **Jin Kyu Bang**, Gyeonggi-do (KR); **Dong Hwan Kim**, Gyeonggi-do (KR); **Tae Gyu Kim**, Gyeonggi-do (KR); **Ki Young Chang**, Seoul (KR); **Sung Yeul Hong**, Gyeonggi-do (KR)

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

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

(21) Appl. No.: **15/180,890**

(22) Filed: **Jun. 13, 2016**

(65) **Prior Publication Data**
US 2016/0365623 A1 Dec. 15, 2016

(30) **Foreign Application Priority Data**
Jun. 11, 2015 (KR) 10-2015-0082840

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/52 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H01Q 1/38** (2013.01); **H01Q 1/48** (2013.01); **H01Q 1/50** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC H01Q 1/243; H01Q 1/38; H01Q 1/50; H01Q 1/521; H01Q 5/328; H01Q 5/371;
(Continued)

(56) **References Cited**
U.S. PATENT DOCUMENTS
7,612,725 B2 11/2009 Hill et al.
2006/0097918 A1 5/2006 Oshiyama et al.
(Continued)

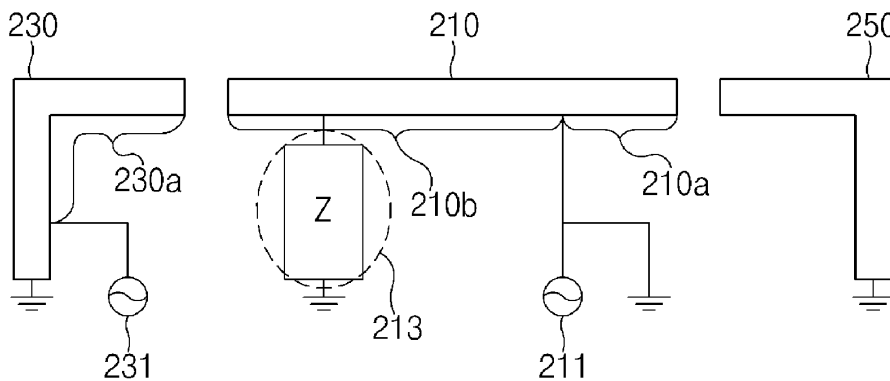
FOREIGN PATENT DOCUMENTS
CN 104577334 4/2015
KR 10-2013-0102170 9/2013

OTHER PUBLICATIONS
European Search Report dated Nov. 10, 2016 issued in counterpart application No. 16173723.4-1811, 10 pages.

Primary Examiner — Hoang Nguyen
(74) *Attorney, Agent, or Firm* — The Farrell Law Firm, P.C.

(57) **ABSTRACT**
An electronic device including a plurality of antennas is provided. The electronic device includes a first radiator including at least one matching block that is connected with a ground area and at least one side of the first radiator. The first radiator is configured to transmit and receive a first frequency signal through a first antenna resonance length corresponding to a first area of the first radiator, and to transmit and receive a second frequency signal through a second antenna resonance length corresponding to a second area opposite to the first area. A second radiator is connected with the ground area and is configured to transmit and receive a third frequency signal through a third antenna resonance length corresponding to a third area adjacent to the first radiator.

20 Claims, 19 Drawing Sheets





US009935360B2

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

(10) **Patent No.:** **US 9,935,360 B2**
(45) **Date of Patent:** **Apr. 3, 2018**

(54) **MOBILE PHONE ANTENNA STRUCTURE WITH FULL SPECTRUM BAND**

(71) Applicants: **Jianchun Mai**, Shenzhen (CN); **Renkai Li**, Shenzhen (CN)

(72) Inventors: **Jianchun Mai**, Shenzhen (CN); **Renkai Li**, Shenzhen (CN)

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

(*) 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.: **15/358,735**

(22) Filed: **Nov. 22, 2016**

(65) **Prior Publication Data**

US 2018/0006361 A1 Jan. 4, 2018

(30) **Foreign Application Priority Data**

Jul. 1, 2016 (CN) 2016 2 0689131 U

(51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 1/24 (2006.01)
H01Q 1/48 (2006.01)

(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H01Q 1/38** (2013.01); **H01Q 1/48** (2013.01)

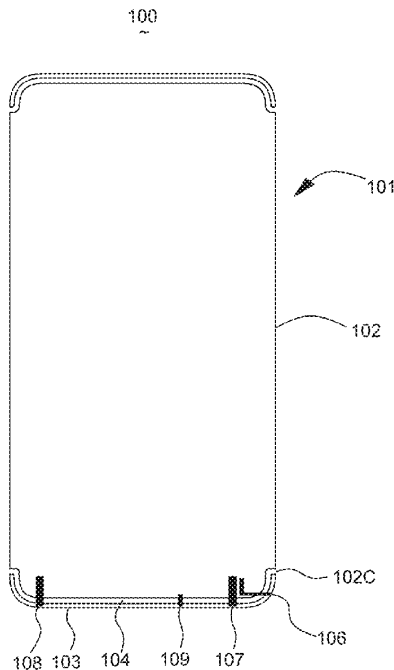
(58) **Field of Classification Search**
CPC H01Q 1/243; H01Q 1/38; H01Q 1/48
USPC 343/702
See application file for complete search history.

Primary Examiner — Andrea Lindgren Baltzell
(74) *Attorney, Agent, or Firm* — Pro, PLLC; Na Xu

(57) **ABSTRACT**

An antenna structure includes a metal shell including a grounded middle frame provided with a main body and sides bent and extending from two sides of the main body and a radiating part serving as an antenna radiating body. The radiating part forms an insulation filled gap with the middle frame. Two ends of the radiating part are arranged opposed to each other for forming an insulation filled breaking joint. A circuit board is arranged below the metal shell, and one side of the circuit board adjacent to the radiating part forms a clearance zone between the circuit board and the radiating part. The antenna further includes a feeding point, at least one ground point, and a tuning circuit. The feeding point is close to the breaking joint, and the ground point includes a first ground point and a second ground point.

4 Claims, 2 Drawing Sheets





US009935378B2

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

(10) **Patent No.:** **US 9,935,378 B2**
(45) **Date of Patent:** **Apr. 3, 2018**

(54) **ANTENNA APPARATUS CONFIGURED TO REDUCE RADIO-FREQUENCY EXPOSURE**

(71) Applicant: **TYCO ELECTRONICS CORPORATION**, Berwyn, PA (US)

(72) Inventors: **Eduardo Lopez Camacho**, Watsonville, CA (US); **Bruce Foster Bishop**, Aptos, CA (US)

(73) Assignee: **TE Connectivity Corporation**, Berwyn, PA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 217 days.

(21) Appl. No.: **14/928,216**

(22) Filed: **Oct. 30, 2015**

(65) **Prior Publication Data**
US 2017/0125916 A1 May 4, 2017

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 19/00 (2006.01)
H01Q 1/22 (2006.01)
H01Q 19/10 (2006.01)
H01Q 1/48 (2006.01)
H01Q 5/371 (2015.01)
H01Q 5/378 (2015.01)
H01Q 1/38 (2006.01)
H01Q 5/364 (2015.01)

(52) **U.S. Cl.**
CPC **H01Q 19/005** (2013.01); **H01Q 1/2266** (2013.01); **H01Q 1/38** (2013.01); **H01Q 1/48** (2013.01); **H01Q 5/364** (2015.01); **H01Q 5/371** (2015.01); **H01Q 5/378** (2015.01); **H01Q 19/10** (2013.01)

(58) **Field of Classification Search**
CPC H01Q 1/24; H01Q 19/005; H01Q 5/371; H01Q 1/48
USPC 343/702
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

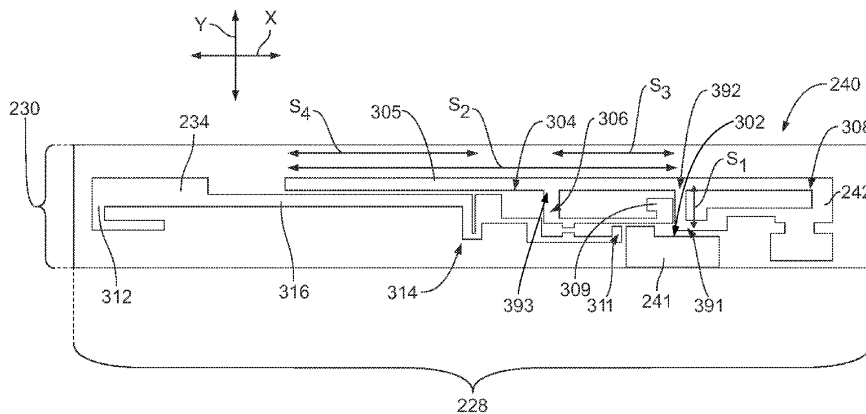
6,346,921 B1 * 2/2002 Excell H01Q 9/18 343/792.5
8,022,887 B1 * 9/2011 Zarnaghi H01Q 1/38 343/700 MS
2004/0061652 A1 * 4/2004 Ishihara H01Q 9/0421 343/752
2005/0285795 A1 * 12/2005 Puente Baliarda H01Q 1/36 343/700 MS
2017/0207529 A1 * 7/2017 Maruyama H01Q 3/24
* cited by examiner

Primary Examiner — Huedung Mancuso

(57) **ABSTRACT**

Antenna apparatus includes a system ground and an antenna sub-assembly including a feed pad and a ground pad that are configured to have a cable terminated thereto. The ground pad is electrically coupled to the system ground. The antenna sub-assembly includes a first level having a radiating trace that is electrically coupled to the feed pad. The radiating trace is configured for communication within a designated radio frequency (RF) band. The antenna sub-assembly also includes a second level that is stacked with respect to the first level and has a reflector. The reflector is vertically aligned with a portion of the radiating trace to block RF emissions therefrom.

20 Claims, 6 Drawing Sheets





US009941574B2

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

(10) **Patent No.:** **US 9,941,574 B2**
(45) **Date of Patent:** **Apr. 10, 2018**

(54) **TELEVISION RECEIVER AND ELECTRONIC APPARATUS**

(71) Applicant: **KABUSHIKI KAISHA TOSHIBA**,
Minato-ku, Tokyo (JP)

(72) Inventors: **Hiroyuki Hotta**, Ome Tokyo (JP);
Koichi Sato, Tachikawa Tokyo (JP);
Hiroaki Hirao, Ome Tokyo (JP); **Naoki Tani**, Ome Tokyo (JP)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 337 days.

(21) Appl. No.: **14/618,293**

(22) Filed: **Feb. 10, 2015**

(65) **Prior Publication Data**

US 2015/0155613 A1 Jun. 4, 2015

Related U.S. Application Data

(63) Continuation of application No. PCT/JP2013/056344, filed on Mar. 7, 2013.

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/48 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC **H01Q 1/24** (2013.01); **G06F 1/1698** (2013.01); **H01Q 1/2266** (2013.01); **H01Q 1/42** (2013.01); **H01Q 1/48** (2013.01); **H01Q 9/42** (2013.01); **H01Q 13/16** (2013.01); **H04N 5/44** (2013.01); **G06F 1/1683** (2013.01)

(58) **Field of Classification Search**
CPC H01Q 1/2266; H01Q 9/42; H01Q 13/16
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,930,644 B2 * 8/2005 Konishi G06F 1/1616
343/702
6,957,085 B2 * 10/2005 Shin G06F 1/1616
455/556.1

(Continued)

FOREIGN PATENT DOCUMENTS

JP 09-181637 7/1997
JP 2006-196994 7/2006

(Continued)

OTHER PUBLICATIONS

Antenna Theory: A Review, Balanis, Proc. IEEE vol. 80 No. 1 Jan. 1992.*

(Continued)

Primary Examiner — Jessica Han

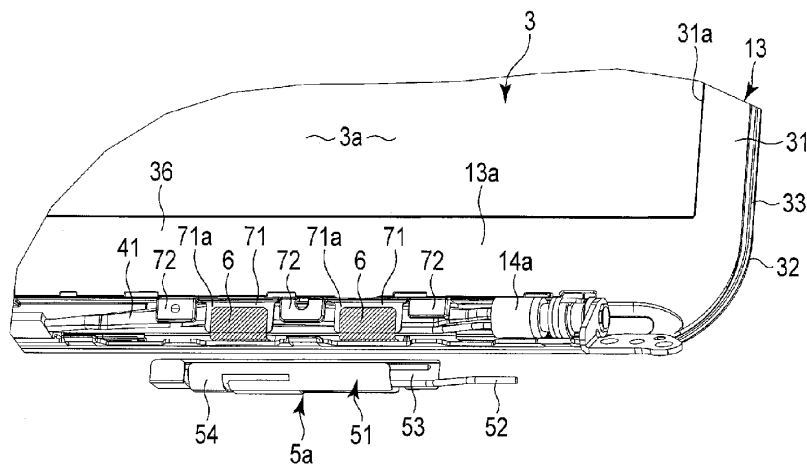
Assistant Examiner — Amal Patel

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

(57) **ABSTRACT**

According to one embodiment, an electronic apparatus includes a housing having a conductive portion in at least a part of the housing, a component which is accommodated in the housing and emits noise, an antenna which overlaps the component in a thickness direction of the housing, and a conductive member which electrically connects a ground of the antenna and the conductive portion of the housing.

8 Claims, 9 Drawing Sheets





US009941588B2

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

(10) **Patent No.:** **US 9,941,588 B2**
(45) **Date of Patent:** **Apr. 10, 2018**

(54) **ANTENNA WITH MULTIPLE COUPLED REGIONS**

(71) Applicant: **ETHERTRONICS, INC.**, San Diego, CA (US)

(72) Inventors: **Laurent Desclos**, San Diego, CA (US); **Chew Chwee Heng**, Singapore (SG); **Sebastian Rowson**, San Diego, CA (US); **Jeffrey Shamblin**, San Diego, CA (US)

(73) Assignee: **ETHERTRONICS, INC.**, San Diego, CA (US)

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

(21) Appl. No.: **14/885,981**

(22) Filed: **Oct. 16, 2015**

(65) **Prior Publication Data**

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Related U.S. Application Data

(63) Continuation-in-part of application No. 13/767,854, filed on Feb. 14, 2013, now Pat. No. 9,190,733, which is a continuation of application No. 12/536,419, filed on Aug. 5, 2009, now abandoned, and a continuation-in-part of application No. 13/289,901, filed on Nov. 4, 2011, now Pat. No. 8,717,241, which is a continuation of application No. 12/894,052, filed on Sep. 29, 2010, now Pat. No. 8,077,116, which is a (Continued)

(51) **Int. Cl.**
H01Q 5/00 (2015.01)
H01Q 5/328 (2015.01)
H01Q 5/385 (2015.01)
H01Q 7/00 (2006.01)

H01Q 9/06 (2006.01)
H01Q 9/42 (2006.01)
H01Q 19/00 (2006.01)
H01Q 5/321 (2015.01)
H01Q 5/378 (2015.01)

(52) **U.S. Cl.**
CPC **H01Q 5/328** (2015.01); **H01Q 5/321** (2015.01); **H01Q 5/378** (2015.01); **H01Q 5/385** (2015.01); **H01Q 7/005** (2013.01); **H01Q 9/06** (2013.01); **H01Q 9/42** (2013.01); **H01Q 19/005** (2013.01)

(58) **Field of Classification Search**
CPC H01Q 7/005; H01Q 1/243; H01Q 1/38
USPC 343/702, 745, 747, 846, 876
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,339,402 B1 1/2002 McKivergan
7,372,406 B2 5/2008 Shiotsu et al.
(Continued)

Primary Examiner — Dameon E Levi

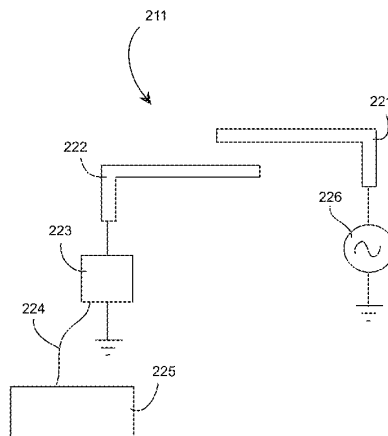
Assistant Examiner — Hasan Islam

(74) *Attorney, Agent, or Firm* — Coastal Patent Law Group, P.C.

(57) **ABSTRACT**

A device includes a plurality of antennas, including one or more active antennas, the antennas being configured in one of a plurality of possible configurations to achieve operation in WAN, LTE, WiFi, or WiMax bands, or a combination thereof. In some embodiments, a passive antenna is utilized with lumped loading to fix the antenna tuning state. A primary and auxiliary radiator can be included in the device and configured for WAN/LTE bands, while additional antennas can be incorporated for WiFi and WiMax bands. Various antenna configurations incorporate the antenna having multiple coupled regions.

12 Claims, 15 Drawing Sheets





US009942367B2

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

(10) **Patent No.:** **US 9,942,367 B2**
(45) **Date of Patent:** **Apr. 10, 2018**

(54) **ELECTRONIC DEVICE AND METHOD FOR CONTROLLING THE ELECTRONIC DEVICE THEREOF**

(71) Applicant: **SAMSUNG ELECTRONICS CO., LTD.**, Suwon-si, Gyeonggi-do (KR)

(72) Inventors: **Hyung-sun Lee**, Yongin-si (KR); **Youn-ho Choi**, Seoul (KR)

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

(*) 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.: **15/271,657**

(22) Filed: **Sep. 21, 2016**

(65) **Prior Publication Data**
US 2017/0104855 A1 Apr. 13, 2017

Related U.S. Application Data
(60) Provisional application No. 62/240,845, filed on Oct. 13, 2015.

(30) **Foreign Application Priority Data**
Jan. 13, 2016 (KR) 10-2016-0004334

(51) **Int. Cl.**
H04B 5/00 (2006.01)
H04M 1/02 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC **H04M 1/026** (2013.01); **G06F 1/165** (2013.01); **G06F 1/1652** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC G06F 1/1647; G06F 1/1652; H04B 5/00
See application file for complete search history.

(56) **References Cited**
U.S. PATENT DOCUMENTS

D745,004 S 12/2015 Kim
9,300,772 B2 3/2016 Kim
(Continued)

FOREIGN PATENT DOCUMENTS

JP 2010-200134 9/2010
JP 2011-151658 8/2011
(Continued)

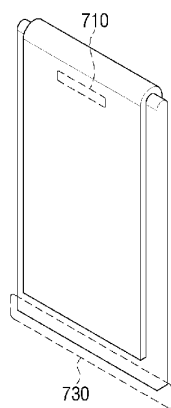
OTHER PUBLICATIONS

Search Report and Written Opinion dated Jan. 10, 2017 in counterpart International Patent Application No. PCT/KR2016/011322.

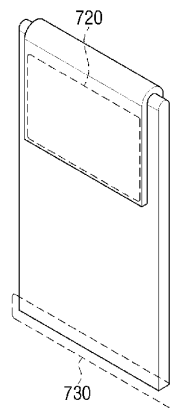
Primary Examiner — Cindy Trandai
(74) *Attorney, Agent, or Firm* — Nixon & Vanderhye P.C.

(57) **ABSTRACT**
Provided herein are an electronic device and a method for controlling the electronic device, the electronic device including a display including a main display area arranged on a front surface of the electronic device and a sub display area that extends from one side of the main display area and arranged on at least one area of a rear surface of the electronic device; a receiver including audio output circuitry configured to output audio received from an external terminal; a display antenna located on one or more of the main display area and the sub display area, and configured to perform communication with an external terminal; and a processor configured to control the display antenna based on a network state or a type of an application being executed.

13 Claims, 30 Drawing Sheets



FRONT SURFACE



REAR SURFACE



US009947992B2

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

(10) **Patent No.:** **US 9,947,992 B2**
(45) **Date of Patent:** **Apr. 17, 2018**

- (54) **MOBILE TERMINAL WITH NEW TYPE OF ANTENNA STRUCTURE**
- (71) Applicant: **Huawei Device (Dongguan) Co., Ltd.**, Dongguan (CN)
- (72) Inventors: **Xuefei Zhang**, Shenzhen (CN); **Yibo Chen**, Xi'an (CN)
- (73) Assignee: **HUAWEI DEVICE (DONGGUAN) CO., LTD.**, Dongguan (CN)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 51 days.

- (21) Appl. No.: **15/025,883**
- (22) PCT Filed: **Nov. 28, 2013**
- (86) PCT No.: **PCT/CN2013/088026**
§ 371 (c)(1),
(2) Date: **Mar. 29, 2016**
- (87) PCT Pub. No.: **WO2015/077956**
PCT Pub. Date: **Jun. 4, 2015**

- (65) **Prior Publication Data**
US 2016/0248147 A1 Aug. 25, 2016

- (51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/48 (2006.01)
H01Q 9/04 (2006.01)
H01Q 5/378 (2015.01)
H01Q 9/16 (2006.01)

- (52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H01Q 1/48** (2013.01); **H01Q 5/378** (2015.01); **H01Q 9/0421** (2013.01); **H01Q 9/16** (2013.01)

- (58) **Field of Classification Search**
USPC 343/841, 702
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

- 7,551,142 B1 * 6/2009 Zhang H01Q 1/243 343/700 MS
- 2005/0253757 A1 11/2005 Liu et al.
(Continued)

FOREIGN PATENT DOCUMENTS

- CN 2865031 Y 1/2007
- CN 102074803 A 5/2011
(Continued)

OTHER PUBLICATIONS

Foreign Communication From a Counterpart Application, European Application No. 13898147.7, Extended European Search Report dated Aug. 3, 2016, 8 pages.

(Continued)

Primary Examiner — Jessica Han

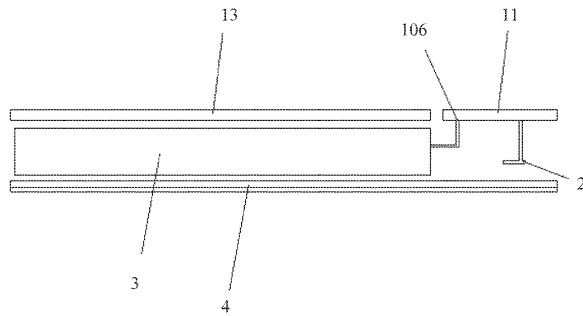
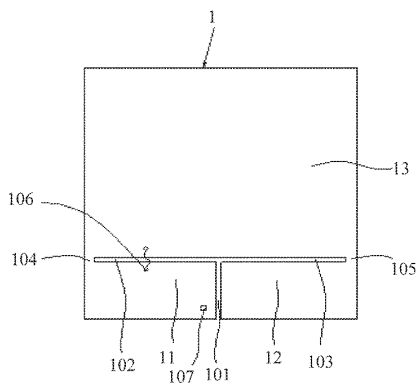
Assistant Examiner — Hai Tran

(74) *Attorney, Agent, or Firm* — Conley Rose, P.C.

(57) **ABSTRACT**

A mobile terminal with a antenna structure applicable to the field of communications equipment technologies, where the antenna structure includes a metal rear cover, a first slot which is disposed on the metal rear cover, and connects with the metal rear cover through one end, a second slot and a third slot which are disposed on the metal rear cover, and located on opposite sides of the first slot, and connects with the first slot through one end, and the metal rear cover includes a rear cover which is located on one side of the second slot and the third slot, and an antenna part located on the other side of the second slot and the third slot, and the antenna part includes a first antenna part located on one side of the first slot and a second antenna part located on the other side of the first slot.

13 Claims, 9 Drawing Sheets





US009947998B2

(12) **United States Patent**
Hsiao

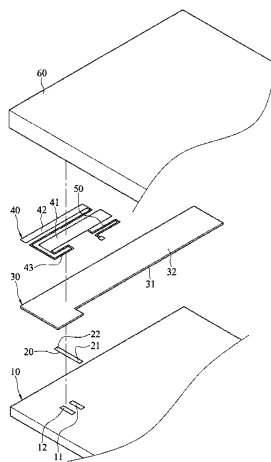
(10) **Patent No.:** **US 9,947,998 B2**
(45) **Date of Patent:** **Apr. 17, 2018**

- (54) **LAMINATED ANTENNA**
- (71) Applicant: **ADVANCED-CONNECTEK INC.**,
New Taipei (TW)
- (72) Inventor: **Fu-Ren Hsiao**, New Taipei (TW)
- (73) Assignee: **ADVANCED-CONNECTEK INC.**,
New Taipei (TW)
- (*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 48 days.
- (21) Appl. No.: **15/349,485**
- (22) Filed: **Nov. 11, 2016**
- (65) **Prior Publication Data**
US 2017/0194700 A1 Jul. 6, 2017
- (30) **Foreign Application Priority Data**
Dec. 30, 2015 (TW) 104144556 A
- (51) **Int. Cl.**
H01Q 1/36 (2006.01)
H01Q 1/24 (2006.01)
H01Q 1/48 (2006.01)
H01Q 9/04 (2006.01)
H01Q 9/42 (2006.01)
H01Q 5/364 (2015.01)
- (52) **U.S. Cl.**
CPC **H01Q 1/36** (2013.01); **H01Q 1/24**
(2013.01); **H01Q 1/48** (2013.01); **H01Q 5/364**
(2015.01); **H01Q 9/0485** (2013.01); **H01Q**
9/42 (2013.01)
- (58) **Field of Classification Search**
CPC H01Q 5/364; H01Q 9/045; H01Q 9/42;
H01Q 1/48; H01Q 1/24
See application file for complete search history.

- (56) **References Cited**
- U.S. PATENT DOCUMENTS
- 7,012,568 B2 3/2006 Poilasne et al.
- 8,547,283 B2 10/2013 Wong et al.
- 2006/0017621 A1 1/2006 Okawara et al.
- (Continued)
- FOREIGN PATENT DOCUMENTS
- TW 200840136 10/2008
- TW 201203703 1/2012
- OTHER PUBLICATIONS
- Office action issued in corresponding Taiwan patent application
10620302540 dated Mar. 20, 2017, 5 pages.
- Primary Examiner* — Hoang Nguyen
- (74) *Attorney, Agent, or Firm* — Andrew M. Calderon;
Roberts Mlotkowski Safran Cole & Calderon, P.C.

- (57) **ABSTRACT**
- A laminated antenna includes a bases board having a
grounding port and a feed-in port, a feed-in portion on the
base board, a dielectric layer, a conductive layer, and a
second winding portion. The feed-in portion has opposite
first and second ends. The first end is connected to the
feed-in port. The dielectric layer has a covering surface
covering the feed-in portion and an assembling surface. The
conductive layer is on the assembling surface. The conduc-
tive layer includes a main radiation portion, an extension
radiation portion, and a first winding portion. A segment of
the main radiation portion is overlapped with the second end
to form a coupling capacitor. The first winding portion is
extending between the main radiation portion and the exten-
sion radiation portion to form a first inductor. The second
winding portion is connected between the main radiation
portion and the grounding port to form a second inductor.

13 Claims, 9 Drawing Sheets





US009948003B2

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

(10) **Patent No.:** **US 9,948,003 B2**
(45) **Date of Patent:** ***Apr. 17, 2018**

(54) **LOOP ANTENNA FOR MOBILE HANDSET AND OTHER APPLICATIONS**

(71) Applicant: **Microsoft Technology Licensing, LLC**, Redmond, WA (US)

(72) Inventors: **Marc Harper**, Issaquah, WA (US); **Devis Iellici**, Cambridge (GB); **Christopher Tomlin**, Redmond, WA (US)

(73) Assignee: **Microsoft Technology Licensing, LLC**, Redmond, WA (US)

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

(21) Appl. No.: **15/282,100**

(22) Filed: **Sep. 30, 2016**

(65) **Prior Publication Data**
US 2017/0018839 A1 Jan. 19, 2017

Related U.S. Application Data
(60) Continuation of application No. 14/789,817, filed on Jul. 1, 2015, now Pat. No. 9,543,650, which is a (Continued)

(30) **Foreign Application Priority Data**
Oct. 15, 2010 (GB) 1017472.0

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 5/378 (2015.01)
(Continued)

(52) **U.S. Cl.**
CPC **H01Q 5/378** (2015.01); **H01Q 1/243** (2013.01); **H01Q 1/38** (2013.01); **H01Q 1/48** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC H01Q 7/00; H01Q 7/005
(Continued)

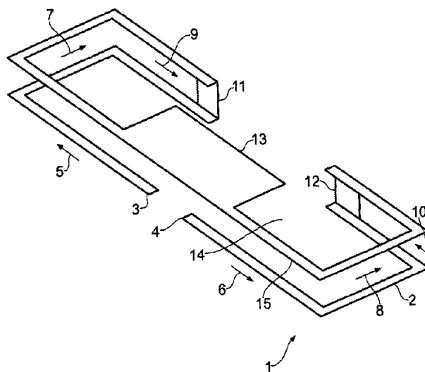
(56) **References Cited**
U.S. PATENT DOCUMENTS
3,993,998 A 11/1976 Kimmett
4,940,992 A 7/1990 Nguyen et al.
(Continued)

FOREIGN PATENT DOCUMENTS
EP 0584882 A1 3/1994
EP 1063722 A2 12/2000
(Continued)

OTHER PUBLICATIONS
"Notice of Allowance Issued in Taiwan Patent Application No. 100137082", dated Apr. 27, 2016, 4 Pages.
(Continued)

Primary Examiner — Huedung Mancuso
(74) *Attorney, Agent, or Firm* — Holzer Patel Drennan

(57) **ABSTRACT**
There is disclosed an antenna system for mobile handsets and other devices. The antenna system comprises a dielectric substrate having first and second opposed surfaces, a conductive track on the substrate, and a separate, directly driven antenna to drive the parasitic loop antenna formed by the conductive track. Two grounding points are provided adjacent to each other on the first surface of the substrate, with the arms of the conductive track extending in generally opposite directions from the grounding points. The conductive tracks then extend towards an edge of the dielectric substrate, before passing to the second surface of the dielectric substrate and then passing across the second surface of the dielectric substrate following a path generally following the path taken on the first surface of the dielectric substrate. The conductive tracks then connect to respective sides of a conductive arrangement formed on the second surface of the
(Continued)





US009948342B2

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

(10) **Patent No.:** **US 9,948,342 B2**
(45) **Date of Patent:** **Apr. 17, 2018**

(54) **SPEAKER CASING WITH INTEGRALLY FORMED ELECTRICAL CONDUCTORS**

(71) Applicant: **Nokia Technologies Oy**, Espoo (FI)

(72) Inventors: **Shengrong Shi**, San Diego, CA (US);
Yuanjia Yang, Beijing (CN); **Hongjie Li**, Beijing (CN)

(73) Assignee: **Nokia Technologies Oy**, Espoo (FI)

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

(21) Appl. No.: **15/102,337**

(22) PCT Filed: **Dec. 12, 2013**

(86) PCT No.: **PCT/CN2013/089217**

§ 371 (e)(1),

(2) Date: **Jun. 7, 2016**

(87) PCT Pub. No.: **WO2015/085539**

PCT Pub. Date: **Jun. 18, 2015**

(65) **Prior Publication Data**

US 2016/0323003 A1 Nov. 3, 2016

(51) **Int. Cl.**

H01Q 1/00 (2006.01)

H04B 1/3888 (2015.01)

H04M 1/03 (2006.01)

H01Q 1/24 (2006.01)

H01Q 1/46 (2006.01)

H04R 1/06 (2006.01)

(Continued)

(52) **U.S. Cl.**

CPC **H04B 1/3888** (2013.01); **H01Q 1/243** (2013.01); **H01Q 1/36** (2013.01); **H01Q 1/38** (2013.01); **H01Q 1/46** (2013.01); **H04M 1/03** (2013.01); **H04R 1/06** (2013.01); **H04R 2499/11** (2013.01)

(58) **Field of Classification Search**

CPC H04W 8/00

USPC 455/575.1

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2004/0036656 A1 2/2004 Nevermann
2006/0223597 A1* 10/2006 Zhu H04M 1/0202
455/575.5

(Continued)

FOREIGN PATENT DOCUMENTS

CN 101138131 A 3/2008
CN 102204275 A 9/2011
CN 102244830 A 11/2011

OTHER PUBLICATIONS

International Search Report and Written Opinion received for corresponding Patent Cooperation Treaty Application No. PCT/CN2013/089217, dated Sep. 17, 2014, 11 pages.

Primary Examiner — Wen Huang

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

(57) **ABSTRACT**

An apparatus including a sound transducer; a casing member, where the sound transducer is mounted to the casing member, and where the casing member is configured to at least partially form an enclosure for the sound transducer; and electrical conductors integrally formed with the casing member. The electrical conductors are electrically connected to the sound transducer. The electrical conductors are configured to provide electrical connectivity for the sound transducer, where at least one of the electrical conductors is configured to couple to an antenna pattern to form part of an antenna arrangement.

20 Claims, 4 Drawing Sheets

