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(45) **Date of Patent:** Mar. 28, 2023

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- Primary Examiner* — Hasan Islam

- (74) *Attorney, Agent, or Firm* — Lin & Associates
Intellectual Property, Inc.

- (57) **ABSTRACT**

- An antenna structure is provided, including a substrate, an impedance control line, a first impedance control area, and a metal element. The impedance control line is located on the first side of the substrate. The first impedance control area is arranged on the substrate, located on one side of the impedance control line, close to the second end of the impedance control line, and separated from the impedance control line by a first hollow part. The metal element is arranged on the substrate and connected to the first end and the second end of the impedance control line, and the first impedance control area. As such, the present invention controls the impedance in the high frequency range between 5.85 and 7.25 GHz through the impedance control line and the first impedance control area, provides a complete current flow area, and improves the impedance control effect, efficiency, and gain.

- US 2022/0173514 A1 Jun. 2, 2022

- (30) **Foreign Application Priority Data**

- Nov. 30, 2020 (TW) 109142103

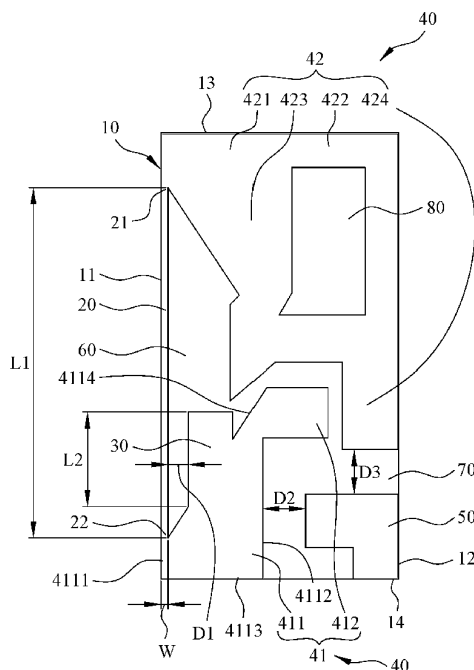
- (51) **Int. Cl.**
H01Q 5/50 (2015.01)
H01Q 9/04 (2006.01)
H04W 84/12 (2009.01)

- (52) **U.S. Cl.**
CPC **H01Q 9/0407** (2013.01); **H01Q 5/50**
(2015.01); **H04W 84/12** (2013.01)

- (58) **Field of Classification Search**
CPC H01Q 1/243; H01Q 1/38; H01Q 5/30-50;
H01Q 9/0407

See application file for complete search history.

13 Claims, 5 Drawing Sheets





US011621473B2

(12) **United States Patent**
Tsai

(10) **Patent No.:** **US 11,621,473 B2**
(45) **Date of Patent:** **Apr. 4, 2023**

(54) **ANTENNA STRUCTURE AND ELECTRONIC DEVICE USING SAME**

(71) Applicant: **Chiun Mai Communication Systems, Inc.**, New Taipei (TW)

(72) Inventor: **Pang-Chun Tsai**, New Taipei (TW)

(73) Assignee: **Chiun Mai Communication Systems, 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 71 days.

(21) Appl. No.: **17/332,334**

(22) Filed: **May 27, 2021**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

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(51) **Int. Cl.**

H01Q 1/28 (2006.01)

H01Q 1/22 (2006.01)

H01Q 21/28 (2006.01)

H01Q 1/38 (2006.01)

H01Q 1/24 (2006.01)

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

CPC **H01Q 1/2266** (2013.01); **H01Q 21/28** (2013.01); **H01Q 1/2283** (2013.01); **H01Q 1/243** (2013.01); **H01Q 1/38** (2013.01)

(58) **Field of Classification Search**

CPC H01Q 1/38; H01Q 1/243; H01Q 21/28; H01Q 1/2266

See application file for complete search history.

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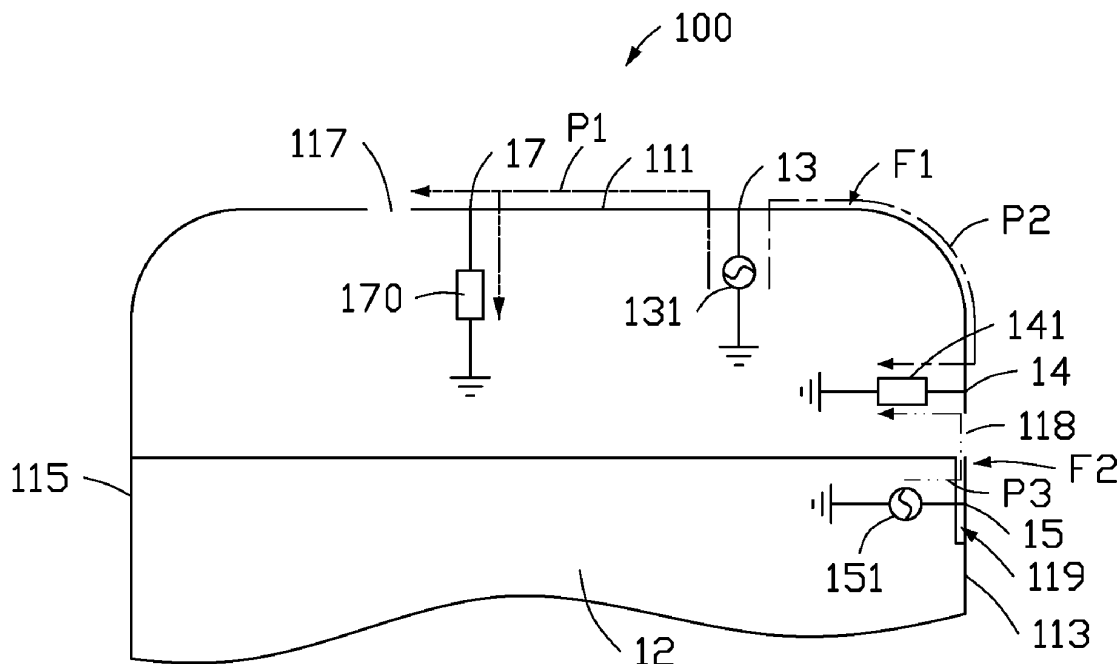
Primary Examiner — Graham P Smith

(74) Attorney, Agent, or Firm — ScienBiziP, P.C.

(57) **ABSTRACT**

An antenna structure of reduced size but able to operate at multiple frequencies, and applied to an electronic device, includes a housing, a first feed point, a first radiation portion, a first ground point, a second radiation portion, and a second feed point. The housing has at least one portion made of metal material with first and second gaps therein. The housing between first and second gaps forms the first radiation portion. The first feed point feeds current and signal to the first radiation portion. The first ground point is spaced from the first feed point and is grounded through a first inductive element. The second radiation portion is adjacent to the first radiation portion. The second feed point is electrically connected to a second signal point and feeds current and signal to the second radiation portion.

18 Claims, 15 Drawing Sheets





US011621498B2

(12) **United States Patent**
Chen

(10) **Patent No.:** **US 11,621,498 B2**
(45) **Date of Patent:** **Apr. 4, 2023**

(54) **ANTENNA STRUCTURE AND ELECTRONIC
DEVICE USING SAME**

H01Q 5/335; H01Q 5/378; H01Q 9/42;
H01Q 13/106; H01Q 21/064; H01Q
21/28

(71) Applicant: **Chiun Mai Communication Systems,
Inc.**, New Taipei (TW)

See application file for complete search history.

(72) Inventor: **Yi-Ting Chen**, New Taipei (TW)

(56) **References Cited**

(73) Assignee: **Chiun Mai Communication Systems,
Inc.**, New Taipei (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 51 days.

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(21) Appl. No.: **17/313,305**

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(22) Filed: **May 6, 2021**

Primary Examiner — Hoang V Nguyen

(65) **Prior Publication Data**

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

US 2021/0391656 A1 Dec. 16, 2021

(30) **Foreign Application Priority Data**

(57) **ABSTRACT**

Jun. 12, 2020 (CN) 202010537241.5

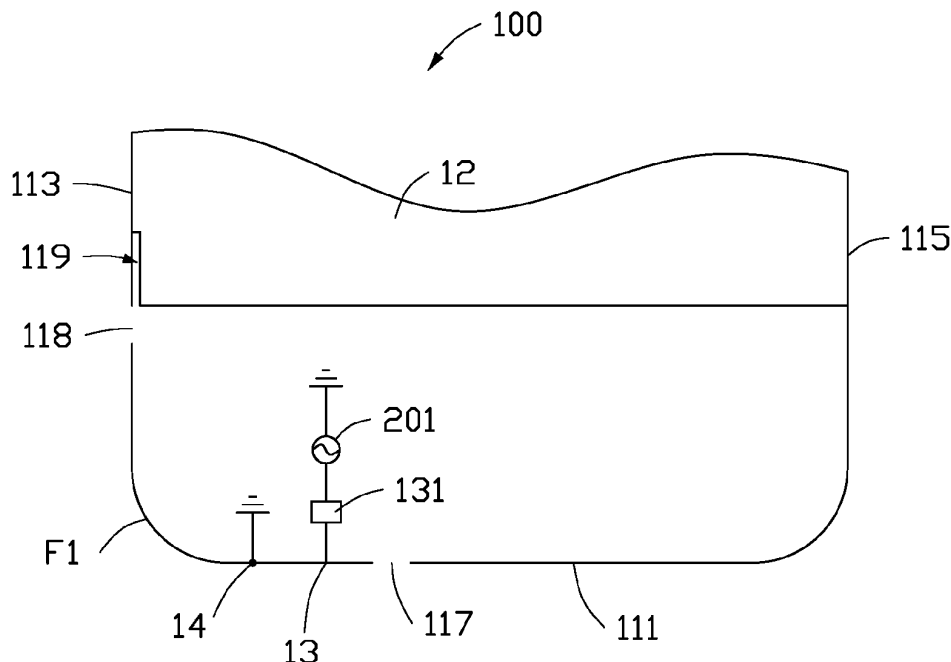
An antenna structure of reduced size but operating at multiple frequencies, applied to an electronic device, includes a housing, a system ground plane, and a first feed point. The housing has at least one portion made of metal material and defines a first gap and a second gap. The housing between the first gap and the second gap forms a first radiation portion. The system ground plane is positioned in the housing and defines a first slit. The first slit corresponds to the first radiation portion and communicates with the second gap. The first feed point is positioned on the first radiation portion and is electrically connected to a first feed source for feeding current and signal to the first radiation portion.

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

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

(58) **Field of Classification Search**
CPC H01Q 1/242; H01Q 1/243; H01Q 1/44;
H01Q 1/48; H01Q 5/30; H01Q 5/328;

18 Claims, 14 Drawing Sheets





US011626662B2

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

(10) **Patent No.:** **US 11,626,662 B2**
(45) **Date of Patent:** **Apr. 11, 2023**

(54) **MULTI-BAND ANTENNA AND MOBILE
TERMINAL**

(71) Applicant: **HUAWEI TECHNOLOGIES CO.,
LTD.**, Shenzhen (CN)

(72) Inventors: **Liang Xue**, Shanghai (CN); **Dong Yu**,
Shanghai (CN); **Lijun Ying**, Shanghai
(CN); **Meng Hou**, Shanghai (CN);
Jiaqing You, Shanghai (CN)

(73) Assignee: **HUAWEI TECHNOLOGIES CO.,
LTD.**, Shenzhen (CN)

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patent is extended or adjusted under 35
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(21) Appl. No.: **16/957,492**

(22) PCT Filed: **Dec. 26, 2018**

(86) PCT No.: **PCT/CN2018/124026**

§ 371 (c)(1),

(2) Date: **Jun. 24, 2020**

(87) PCT Pub. No.: **WO2019/129098**

PCT Pub. Date: **Jul. 4, 2019**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

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H01Q 5/335 (2015.01)

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

CPC **H01Q 5/335** (2015.01); **H01Q 5/25**
(2015.01)

(58) **Field of Classification Search**

CPC H01Q 5/335; H01Q 5/25; H01Q 1/52;
H01Q 9/42; H01Q 5/392; H01Q 1/44;

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Primary Examiner — Hai V Tran

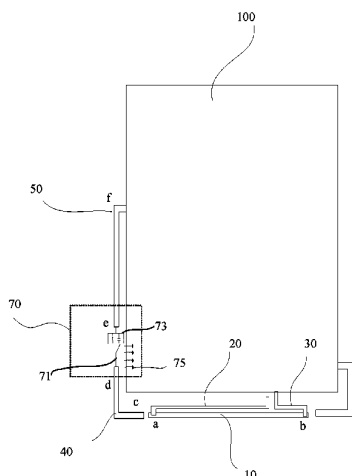
Assistant Examiner — Michael M Bouizza

(74) *Attorney, Agent, or Firm* — Rimon PC

(57) **ABSTRACT**

This application provides a multi-band antenna. The antenna
includes a feeder and a radiating element connected to the
feeder, and further includes: a first notch structure, where the
first notch structure is located on a side of the radiating
element and is coupled to the radiating element; and a
second notch structure, where the second notch structure is
located on a side of the first notch structure and far from the
radiating element, and an end that is of the second notch
structure and that is far from the radiating element is
grounded. The first notch structure may be selectively con-
nected to the ground or to the second notch structure. The
first notch structure may be connected to the second notch
structure in some embodiments using a first tuning device.

16 Claims, 13 Drawing Sheets





US011611148B2

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

(10) **Patent No.:** **US 11,611,148 B2**
(45) **Date of Patent:** **Mar. 21, 2023**

(54) **OPEN-APERTURE WAVEGUIDE FED SLOT ANTENNA**

(71) Applicant: **City University of Hong Kong**, Hong Kong (HK)

(72) Inventors: **Hang Wong**, Hong Kong (HK); **Qingyi Guo**, Hong Kong (HK)

(73) Assignee: **City University of Hong Kong**, Hong Kong (HK)

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(21) Appl. No.: **17/527,077**

(22) Filed: **Nov. 15, 2021**

(65) **Prior Publication Data**
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Related U.S. Application Data

(60) Provisional application No. 63/130,547, filed on Dec. 24, 2020.

(51) **Int. Cl.**
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H01Q 13/22 (2006.01)
H01Q 13/10 (2006.01)

(52) **U.S. Cl.**
CPC **H01Q 13/18** (2013.01); **H01Q 13/106** (2013.01); **H01Q 13/22** (2013.01)

(58) **Field of Classification Search**
CPC H01Q 13/18; H01Q 13/22; H01Q 13/16; H01Q 13/106

See application file for complete search history.

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Primary Examiner — Ab Salam Alkassim, Jr.

Assistant Examiner — Anh N Ho

(74) *Attorney, Agent, or Firm* — Idea Intellectual Limited; Margaret A. Burke; Sam T. Yip

(57) **ABSTRACT**

The present invention provides an open-aperture waveguide fed slot antenna including a feeding section on a substrate integrated waveguide, an H-shaped slot, a matched end, and a bottom metal layer. One end of the feeding section is open and connected to the slot, providing energy feeding to the slot. A long side of the center section of the slot is connected to a top metal part of the feeding section. Another side is connected to the matching end. The matching end includes metal which is connected to the slot, the metallic via wall and the bottom metal of the feeding section which is connected to the metallic via wall. The antenna has high gain, wide gain bandwidth, a simple structure, and low processing cost and can be applied to millimeter-wave frequency bands as well as other frequency bands.

9 Claims, 9 Drawing Sheets

