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(71) Applicant: **Huawei Technologies Co., Ltd.**
Longgang
Shenzhen, Guangdong 518129 (CN)

(72) Inventors:
• **SHAO, Jinjin**
Guangdong 518129 (CN)
• **YU, Zhongyang**
Guangdong 518129 (CN)

(74) Representative: **Gill Jennings & Every LLP**
The Broadgate Tower
20 Primrose Street
London EC2A 2ES (GB)

(54) **ANTENNA**

(57) Embodiments of this application disclose an antenna. The antenna is disposed on an insulation medium of a circuit board, and the antenna includes a loop radiator, a signal feed-in part, a first conductive ground structure, and a second conductive ground structure. A first end of the loop radiator is connected to the first conductive ground structure, a second end of the loop radiator is connected to the signal feed-in part, and the loop radiator independently generates a first radiation signal based on a function of a current. The loop radiator and the second conductive ground structure form a groove,

the loop radiator and the second conductive ground structure jointly generate a second radiation signal in an opening direction of the groove based on a function of a current, and a radiation direction of the first radiation signal is different from a radiation direction of the second radiation signal. All of the signal feed-in part, the first conductive ground structure, and the second conductive ground structure are connected to a radio frequency circuit of the circuit board. The antenna provided in the embodiments of this application can send signals in two directions, so that the antenna has a wider radiation range.

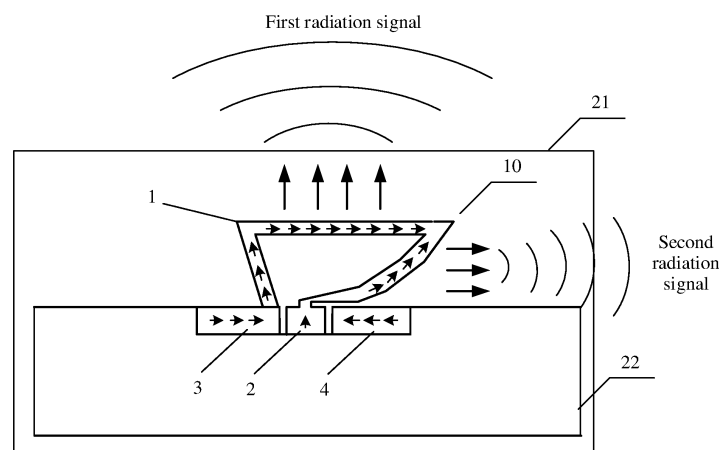


FIG. 1

Description

TECHNICAL FIELD

[0001] Embodiments of this application relate to the field of communications technologies, and in particular, to an antenna.

BACKGROUND

[0002] Currently, printed antennas commonly used in Wi-Fi products mainly include a monopole antenna, a printed inverted F antenna, a loop antenna, and the like. A main feature of such type of printed antennas is that a signal of each printed antenna is radiated in a single direction, offering a limited coverage angle.

[0003] To ensure better coverage performance of a Wi-Fi product, a combination of a plurality of printed antennas needs to be disposed on a circuit board of the Wi-Fi product, so that the Wi-Fi product has a plurality of signal radiation directions, to implement wider coverage.

[0004] However, increasing a quantity of printed antennas on the circuit board of the Wi-Fi product not only increases manufacturing costs, but also occupies more space on the circuit board of the Wi-Fi product.

SUMMARY

[0005] Embodiments of this application provide an antenna, so that the antenna can send signals in two directions, to increase a radiation range of the antenna.

[0006] The embodiments of this application are implemented as follows:

[0007] According to a first aspect, an embodiment of this application provides an antenna, where the antenna is disposed on an insulation medium of a circuit board, and the antenna includes a loop radiator, a signal feed-in part, a first conductive ground structure, and a second conductive ground structure, where

a first end of the loop radiator is connected to the first conductive ground structure, a second end of the loop radiator is connected to the signal feed-in part, and the loop radiator independently generates a first radiation signal based on a function of a current; the loop radiator and the second conductive ground structure form a groove, the loop radiator and the second conductive ground structure jointly generate a second radiation signal in an opening direction of the groove based on a function of a current, and a radiation direction of the first radiation signal is different from a radiation direction of the second radiation signal; and all of the signal feed-in part, the first conductive ground structure, and the second conductive ground structure are connected to a radio frequency circuit of the circuit board.

[0008] In the first aspect, a radio frequency signal on the radio frequency circuit of the circuit board passes through the signal feed-in part, the first conductive

ground structure, and the second conductive ground structure to feed the loop radiator, and flows to two ends of the loop radiator respectively through the signal feed-in part and the first conductive ground structure. The loop radiator independently generates the first radiation signal based on the function of the current. The loop radiator and the second conductive ground structure further jointly generate the second radiation signal in the opening direction of the groove based on the function of the current. The radiation direction of the first radiation signal is different from the radiation direction of the second radiation signal. Therefore, the antenna provided in this embodiment of this application can send signals in two directions, thereby increasing a radiation range of the antenna. Because the antenna provided in this embodiment of this application has a wider radiation range, a quantity of antennas on a circuit board of a Wi-Fi product can be decreased, thereby not only reducing manufacturing costs, but also reducing occupied space on the circuit board of the Wi-Fi product.

[0009] In a possible implementation, an opening of the groove is outward, and an opening width of the groove gradually increases from the inside to the outside.

[0010] Because the opening width of the groove gradually increases from the inside to the outside, enabling wave impedance of the groove in air to gradually increase from the inside to the outside, reflection of the second radiation signal on an inside-to-outside transmission path in the groove is lower, thereby ensuring a better transmission effect of the second radiation signal in the air.

[0011] In a possible implementation, an opening width of a tail end of the groove is a quarter wavelength corresponding to a center frequency of the antenna.

[0012] In a possible implementation, the loop radiator includes a first radiator, a second radiator, and a third radiator, where

a first end of the first radiator is connected to the first conductive ground structure, a second end of the first radiator is connected to a first end of the second radiator, a second end of the second radiator is connected to a first end of the third radiator, and a second end of the third radiator is connected to the signal feed-in part; the second radiator independently generates the first radiation signal based on the function of the current, and the radiation direction of the first radiation signal is perpendicular to the second radiator; and the third radiator and the second conductive ground structure jointly form the groove whose opening is outward, and the third radiator and the second conductive ground structure jointly generate the second radiation signal in the opening direction of the groove based on the function of the current.

[0013] A current in the radio frequency circuit of the circuit board flows to the signal feed-in part, the first conductive ground structure, and the second conductive ground structure, a current flows to the second radiator through the first conductive ground structure and the first radiator, and a current flows to the third radiator through

the signal feed-in part. The second radiator independently generates the first radiation signal based on the function of the current, the third radiator and the second conductive ground structure further jointly generate the second radiation signal in the opening direction of the groove based on the function of the current, and the radiation direction of the first radiation signal is different from the radiation direction of the second radiation signal. Therefore, the antenna provided in this embodiment of this application can send signals in two directions, thereby increasing a radiation range of the antenna.

[0014] In a possible implementation, the antenna further includes at least one horizontal radiator, where the at least one horizontal radiator is disposed on a side surface of the second radiator, the at least one horizontal radiator and the second radiator jointly generate a third radiation signal based on a function of a current, a radiation direction of the third radiation signal is the same as the radiation direction of the first radiation signal, and radiant intensity of the third radiation signal is greater than radiant intensity of the first radiation signal.

[0015] The current in the radio frequency circuit of the circuit board flows to the second radiator through the first conductive ground structure and the first radiator, and the second radiator independently generates the first radiation signal based on the function of the current. Under the function of the first radiation signal, the at least one horizontal radiator generates a current having a direction the same as a direction of the current in the second radiator. Therefore, under the joint function of the current in the at least one horizontal radiator and the current in the second radiator, the at least one horizontal radiator and the second radiator jointly generate the third radiation signal. Because the third radiation signal is jointly generated by the at least one horizontal radiator and the second radiator, the radiant intensity of the third radiation signal is greater than the radiant intensity of the first radiation signal. Therefore, the at least one horizontal radiator can improve radiant intensity of the antenna.

[0016] In a possible implementation, a length range of the at least one horizontal radiator is the quarter wavelength to a half wavelength corresponding to the center frequency of the antenna.

[0017] In a possible implementation, a first gap is formed between the signal feed-in part and the first conductive ground structure, and an opening formed between the first radiator and the third radiator communicates with the first gap; and

a second gap is formed between the signal feed-in part and the second conductive ground structure, and the groove formed between the third radiator and the second conductive ground structure communicates with the second gap.

[0018] A width of the signal feed-in part, a width of the first gap, and a width of the second gap may be adjusted based on an impedance calculation principle of a coplanar waveguide, to ensure that impedance of the antenna matches impedance of the radio frequency circuit of the

circuit board. In this way, a signal reflection loss in a feed-in process can be avoided, to ensure that efficiency of feed-in the antenna by the radio frequency circuit of the circuit board is the highest.

[0019] In a possible implementation, the third radiator is of a straight line structure or a curved structure.

[0020] In a possible implementation, all of the loop radiator, the signal feed-in part, the first conductive ground structure, and the second conductive ground structure are printed on the insulation medium of the circuit board.

[0021] In a possible implementation, all of the loop radiator, the signal feed-in part, the first conductive ground structure, and the second conductive ground structure are fixedly connected to the insulation medium of the circuit board, and all of the loop radiator, the signal feed-in part, the first conductive ground structure, and the second conductive ground structure are made of metal materials.

BRIEF DESCRIPTION OF DRAWINGS

[0022]

FIG. 1 is a schematic diagram of an antenna 10 according to an embodiment of this application;

FIG. 2 is a schematic diagram of another antenna 10 according to an embodiment of this application;

FIG. 3 is a schematic diagram of still another antenna 10 according to an embodiment of this application;

and

FIG. 4 is a schematic diagram of still another antenna 10 according to an embodiment of this application.

DESCRIPTION OF EMBODIMENTS

[0023] The following describes the technical solutions in the embodiments of this application with reference to the accompanying drawings in the embodiments of this application.

[0024] As shown in FIG. 1, FIG. 1 is a schematic diagram of an antenna 10 according to an embodiment of this application. The antenna 10 shown in FIG. 1 is disposed on an insulation medium 21 of a circuit board. The antenna 10 includes a loop radiator 1, a signal feed-in part 2, a first conductive ground structure 3, and a second conductive ground structure 4.

[0025] A first end of the loop radiator 1 is connected to the first conductive ground structure 3, a second end of the loop radiator 1 is connected to the signal feed-in part 2, and the loop radiator 1 independently generates a first radiation signal based on a function of a current. The loop radiator 1 and the second conductive ground structure 4 form a groove, the loop radiator 1 and the second conductive ground structure 4 jointly generate a second radiation signal in an opening direction of the groove based on a function of a current, and a radiation direction of the first radiation signal is different from a radiation direction of the second radiation signal. All of the signal feed-in

part 2, the first conductive ground structure 3, and the second conductive ground structure 4 are connected to a radio frequency circuit 22 of the circuit board.

[0026] In FIG. 1, the radiation direction of the first radiation signal is perpendicular to a horizontal plane and is upward, and the radiation direction of the second radiation signal is horizontally rightward. Therefore, it can be learned from the embodiment of FIG. 1 that the radiation direction of the first radiation signal is different from the radiation direction of the second radiation signal, and the radiation direction of the first radiation signal is perpendicular to the radiation direction of the second radiation signal. Certainly, a shape of the antenna 10 may be fine-adjusted, to adjust the radiation direction of the first radiation signal and the radiation direction of the second radiation signal.

[0027] In the embodiment shown in FIG. 1, a radio frequency signal on the radio frequency circuit 22 of the circuit board passes through the signal feed-in part 2, the first conductive ground structure 3, and the second conductive ground structure 4 to feed the loop radiator 1, and a current flows to two ends of the loop radiator 1 respectively through the signal feed-in part 2 and the first conductive ground structure 3. The loop radiator 1 independently generates the first radiation signal based on the function of the current. The loop radiator 1 and the second conductive ground structure 4 further jointly generate the second radiation signal in the opening direction of the groove based on the function of the current. The radiation direction of the first radiation signal is different from the radiation direction of the second radiation signal. Therefore, the antenna 10 provided in this embodiment of this application can send signals in two directions, thereby increasing a radiation range of the antenna 10. Because the antenna 10 provided in this embodiment of this application has a wider radiation range, a quantity of antennas 10 on a circuit board of a Wi-Fi product can be decreased, thereby not only reducing manufacturing costs, but also reducing occupied space on the circuit board of the Wi-Fi product.

[0028] As shown in FIG. 1, in an optional technical solution, an opening of the groove is outward, and an opening width of the groove gradually increases from the inside to the outside.

[0029] In the technical solution provided in this embodiment of this application, because the opening width of the groove gradually increases from the inside to the outside, enabling wave impedance of the groove in air to gradually increase from the inside to the outside, reflection of the second radiation signal on an inside-to-outside transmission path in the groove is lower, thereby ensuring a better transmission effect of the second radiation signal in the air.

[0030] As shown in FIG. 1, in an optional technical solution, an opening width of a tail end of the groove is a quarter wavelength corresponding to a center frequency of the antenna 10.

[0031] In the technical solution provided in this embod-

iment of this application, a wavelength may be calculated according to a formula $r=c/f$, where r represents a wavelength in a unit of meter, c represents a speed of light in a unit of meter/second, and f is the center frequency of the antenna 10 in a unit of Hz.

[0032] As shown in FIG. 1, in an optional technical solution, all of the loop radiator 1, the signal feed-in part 2, the first conductive ground structure 3, and the second conductive ground structure 4 are printed on the insulation medium 21 of the circuit board. Certainly, the loop radiator 1, the signal feed-in part 2, the first conductive ground structure 3, and the second conductive ground structure 4 may be directly printed on the insulation medium 21 of the circuit board of the Wi-Fi product. In addition, the loop radiator 1, the signal feed-in part 2, the first conductive ground structure 3, and the second conductive ground structure 4 may be alternatively printed on an insulation medium 21 of a micro circuit board having a relatively small area, and then the micro circuit board is inserted into or welded onto the circuit board of the Wi-Fi product for use. Therefore, requirements of different Wi-Fi products are met by using different printing manners.

[0033] As shown in FIG. 1, in an optional technical solution, all of the loop radiator 1, the signal feed-in part 2, the first conductive ground structure 3, and the second conductive ground structure 4 are fixedly connected to the insulation medium 21 of the circuit board, and all of the loop radiator 1, the signal feed-in part 2, the first conductive ground structure 3, and the second conductive ground structure 4 are made of metal materials.

[0034] There are a plurality of fixed connection manners. For example, all of the loop radiator 1, the signal feed-in part 2, the first conductive ground structure 3, and the second conductive ground structure 4 may be adhered to the insulation medium 21 of the circuit board.

[0035] After all of the loop radiator 1, the signal feed-in part 2, the first conductive ground structure 3, and the second conductive ground structure 4 are fixedly connected to the insulation medium 21 of the micro circuit board, the micro circuit board may be inserted into or welded onto the circuit board of the Wi-Fi product for use.

[0036] As shown in FIG. 2, FIG. 2 is a schematic diagram of another antenna 10 according to an embodiment of this application. Compared with the embodiment shown in FIG. 1, a specific structure of the loop radiator 1 is described in more details in the embodiment shown in FIG. 2. The loop radiator 1 includes a first radiator 11, a second radiator 12, and a third radiator 13.

[0037] A first end of the first radiator 11 is connected to the first conductive ground structure 3, a second end of the first radiator 11 is connected to a first end of the second radiator 12, a second end of the second radiator 12 is connected to a first end of the third radiator 13, and a second end of the third radiator 13 is connected to the signal feed-in part 2. The second radiator 12 independently generates the first radiation signal based on the function of the current, and the radiation direction of the

first radiation signal is perpendicular to the second radiator 12. The third radiator 13 and the second conductive ground structure 14 jointly form the groove whose opening is outward, and the third radiator 13 and the second conductive ground structure 4 jointly generate the second radiation signal in the opening direction of the groove based on the function of the current.

[0038] In the embodiment shown in FIG. 2, a current in the radio frequency circuit 22 of the circuit board flows to the signal feed-in part 2, the first conductive ground structure 3, and the second conductive ground structure 4, a current flows to the second radiator 12 through the first conductive ground structure 3 and the first radiator 11, and a current flows to the third radiator 13 through the signal feed-in part 2. The second radiator 12 independently generates the first radiation signal based on the function of the current, the third radiator 13 and the second conductive ground structure 4 further jointly generate the second radiation signal in the opening direction of the groove based on the function of the current, and the radiation direction of the first radiation signal is different from the radiation direction of the second radiation signal. Therefore, the antenna 10 provided in this embodiment of this application can send signals in two directions, thereby increasing a radiation range of the antenna 10.

[0039] As shown in FIG. 3, FIG. 3 is a schematic diagram of still another antenna 10 according to an embodiment of this application. Based on the embodiment shown in FIG. 2, an extra component is added in the embodiment shown in FIG. 3. The antenna 10 may further include at least one horizontal radiator 5.

[0040] The at least one horizontal radiator 5 is disposed on a side surface of the second radiator 12, the at least one horizontal radiator 5 and the second radiator 12 jointly generate a third radiation signal based on a function of a current, a radiation direction of the third radiation signal is the same as the radiation direction of the first radiation signal, and radiant intensity of the third radiation signal is greater than radiant intensity of the first radiation signal.

[0041] In the embodiment shown in FIG. 3, the current in the radio frequency circuit 22 of the circuit board flows to the second radiator 12 through the first conductive ground structure 3 and the first radiator 11, and the second radiator 12 independently generates the first radiation signal based on the function of the current. Under the function of the first radiation signal, the at least one horizontal radiator 5 generates a current having a direction the same as a direction of the current in the second radiator 12. Therefore, under the joint function of the current in the at least one horizontal radiator 5 and the current in the second radiator 12, the at least one horizontal radiator 5 and the second radiator 12 jointly generate the third radiation signal. Because the third radiation signal is jointly generated by the at least one horizontal radiator 5 and the second radiator 12, the radiant intensity of the third radiation signal is greater than the radiant intensity

of the first radiation signal. Therefore, the at least one horizontal radiator 5 can improve radiant intensity of the antenna 10.

[0042] As shown in FIG. 4, FIG. 4 is a schematic diagram of still another antenna 10 according to an embodiment of this application. In the embodiment shown in FIG. 4, there are three horizontal radiators 5. In the embodiment shown in FIG. 3, there is one horizontal radiator 5. Certainly, a quantity of the horizontal radiators 5 is not limited in this embodiment of this application. The quantities of the horizontal radiators 5 in FIG. 3 and FIG. 4 are merely for the convenience of a user to better understand the technical solution.

[0043] As shown in FIG. 3 and FIG. 4, in an optional technical solution, a length range of the at least one horizontal radiator 5 is the quarter wavelength to a half wavelength corresponding to the center frequency of the antenna 10. A wavelength may be calculated according to the formula $r=c/f$ in the foregoing embodiment, where r represents a wavelength in a unit of meter, c represents a speed of light in a unit of meter/second, and f is the center frequency of the antenna 10 in a unit of Hz.

[0044] As shown in FIG. 3 and FIG. 4, in an optional technical solution, the third radiator 13 may be of a straight line structure or a curved structure. If the third radiator 1 is of the curved structure, the third radiator 1 protrudes towards the opening direction of the groove, so that the third radiator 1 forms the curved structure.

[0045] As shown in FIG. 3 and FIG. 4, in an optional technical solution, a first gap is formed between the signal feed-in part 2 and the first conductive ground structure 3, and an opening formed between the first radiator 11 and the third radiator 13 communicates with the first gap. A second gap is formed between the signal feed-in part 2 and the second conductive ground structure 4, and the groove formed between the third radiator 13 and the second conductive ground structure 4 communicates with the second gap.

[0046] In the technical solution provided in this embodiment of this application, a width of the signal feed-in part 2, a width of the first gap, and a width of the second gap may be adjusted based on an impedance calculation principle of a coplanar waveguide, to ensure that impedance of the antenna 10 matches impedance of the radio frequency circuit 22 of the circuit board. In this way, a signal reflection loss in a feed-in process can be avoided, to ensure that efficiency of feed-in the antenna 10 by the radio frequency circuit 22 of the circuit board is the highest.

[0047] In the embodiments shown in FIG. 1 to FIG. 4, small arrows on each component of the antenna 10 represent a direction of a current, and large arrows outside the antenna 10 represent a radiation direction of a radiation signal.

Claims

1. An antenna, wherein the antenna is disposed on an insulation medium of a circuit board, and the antenna comprises a loop radiator, a signal feed-in part, a first conductive ground structure, and a second conductive ground structure, wherein
a first end of the loop radiator is connected to the first conductive ground structure, a second end of the loop radiator is connected to the signal feed-in part, and the loop radiator independently generates a first radiation signal based on a function of a current;
the loop radiator and the second conductive ground structure form a groove, the loop radiator and the second conductive ground structure jointly generate a second radiation signal in an opening direction of the groove based on a function of a current, and a radiation direction of the first radiation signal is different from a radiation direction of the second radiation signal; and
all of the signal feed-in part, the first conductive ground structure, and the second conductive ground structure are connected to a radio frequency circuit of the circuit board.
2. The antenna according to claim 1, wherein an opening of the groove is outward, and an opening width of the groove gradually increases from the inside to the outside.
3. The antenna according to claim 1 or 2, wherein an opening width of a tail end of the groove is a quarter wavelength corresponding to a center frequency of the antenna.
4. The antenna according to any one of claims 1 to 3, wherein
the loop radiator comprises a first radiator, a second radiator, and a third radiator, wherein
a first end of the first radiator is connected to the first conductive ground structure, a second end of the first radiator is connected to a first end of the second radiator, a second end of the second radiator is connected to a first end of the third radiator, and a second end of the third radiator is connected to the signal feed-in part;
the second radiator independently generates the first radiation signal based on the function of the current, and the radiation direction of the first radiation signal is perpendicular to the second radiator; and
the third radiator and the second conductive ground structure jointly form the groove whose opening is outward, and the third radiator and the second conductive ground structure jointly generate the second radiation signal in the opening direction of the groove based on the function of the current.
5. The antenna according to claim 4, wherein the antenna further comprises at least one horizontal radiator, wherein
the at least one horizontal radiator is disposed on a side surface of the second radiator, the at least one horizontal radiator and the second radiator jointly generate a third radiation signal based on a function of a current, a radiation direction of the third radiation signal is the same as the radiation direction of the first radiation signal, and radiant intensity of the third radiation signal is greater than radiant intensity of the first radiation signal.
6. The antenna according to claim 5, wherein a length range of the at least one horizontal radiator is the quarter wavelength to a half wavelength corresponding to the center frequency of the antenna.
7. The antenna according to claim 4, wherein
a first gap is formed between the signal feed-in part and the first conductive ground structure, and an opening formed between the first radiator and the third radiator communicates with the first gap; and
a second gap is formed between the signal feed-in part and the second conductive ground structure, and the groove formed between the third radiator and the second conductive ground structure communicates with the second gap.
8. The antenna according to claim 4, wherein the third radiator is of a straight line structure or a curved structure.
9. The antenna according to claim 1, wherein all of the loop radiator, the signal feed-in part, the first conductive ground structure, and the second conductive ground structure are printed on the insulation medium of the circuit board.
10. The antenna according to claim 1, wherein all of the loop radiator, the signal feed-in part, the first conductive ground structure, and the second conductive ground structure are fixedly connected to the insulation medium of the circuit board, and all of the loop radiator, the signal feed-in part, the first conductive ground structure, and the second conductive ground structure are made of metal materials.

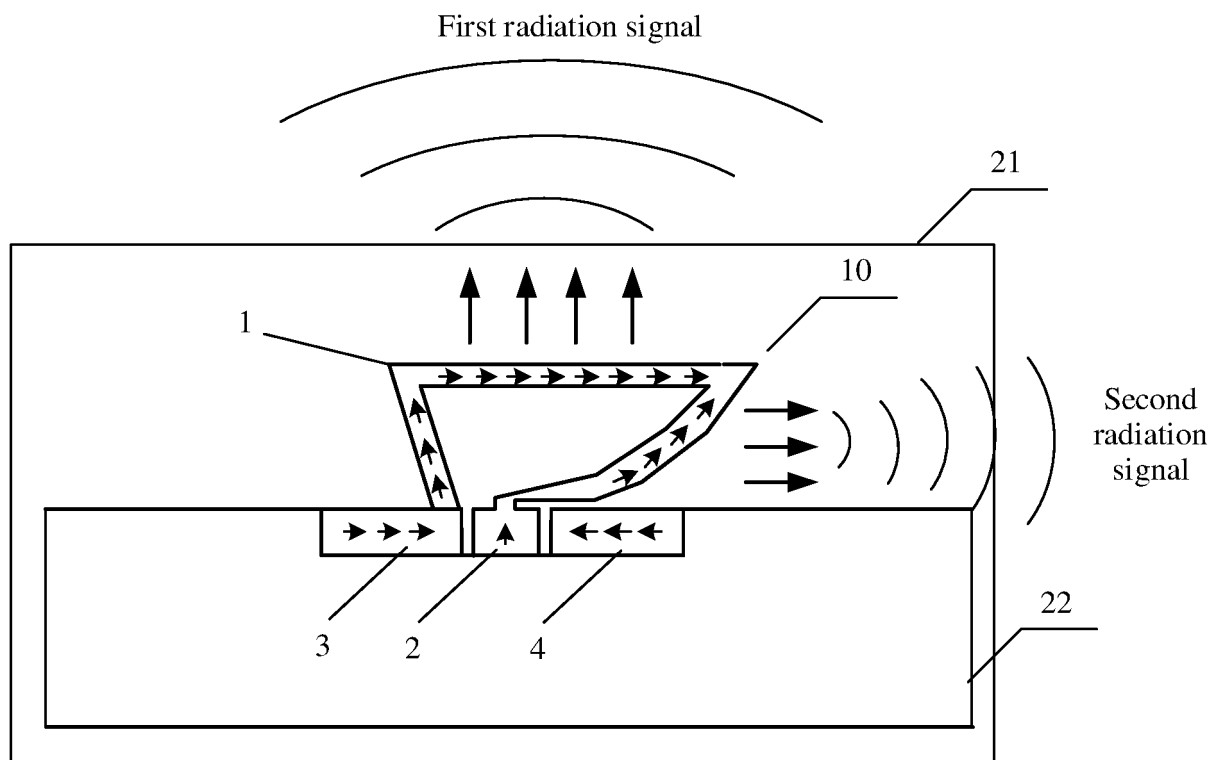


FIG. 1

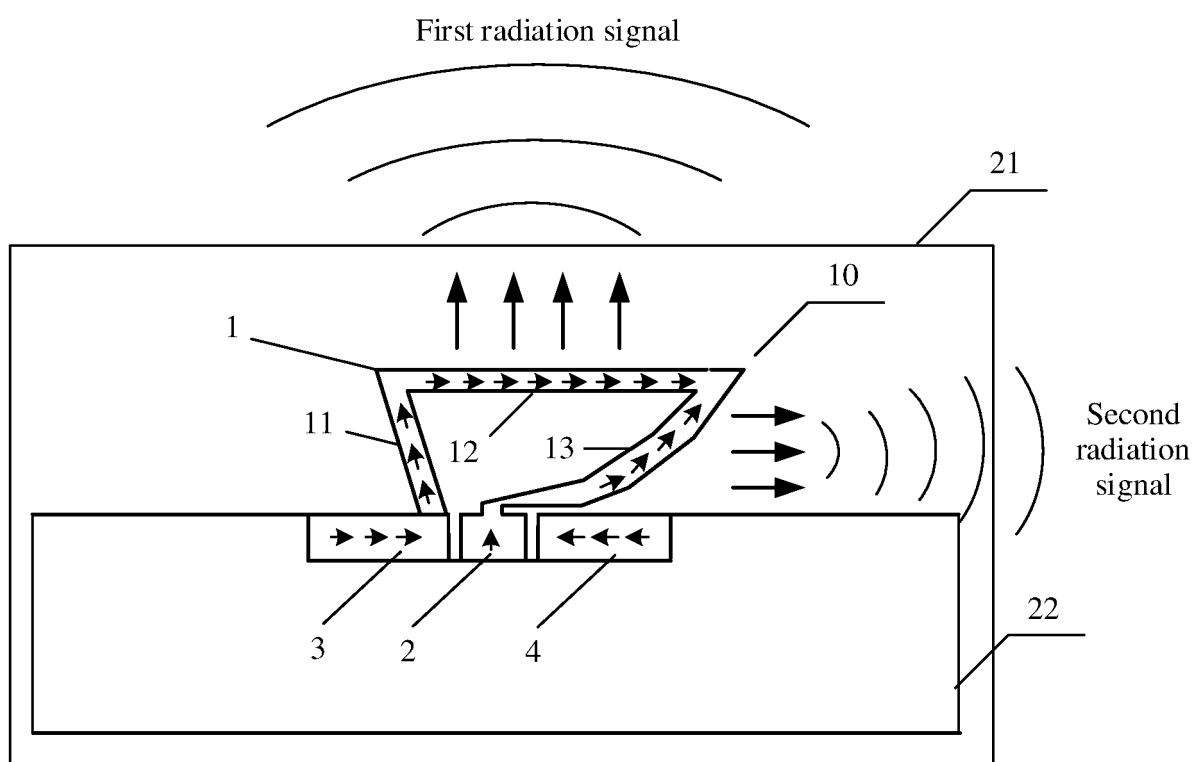


FIG. 2

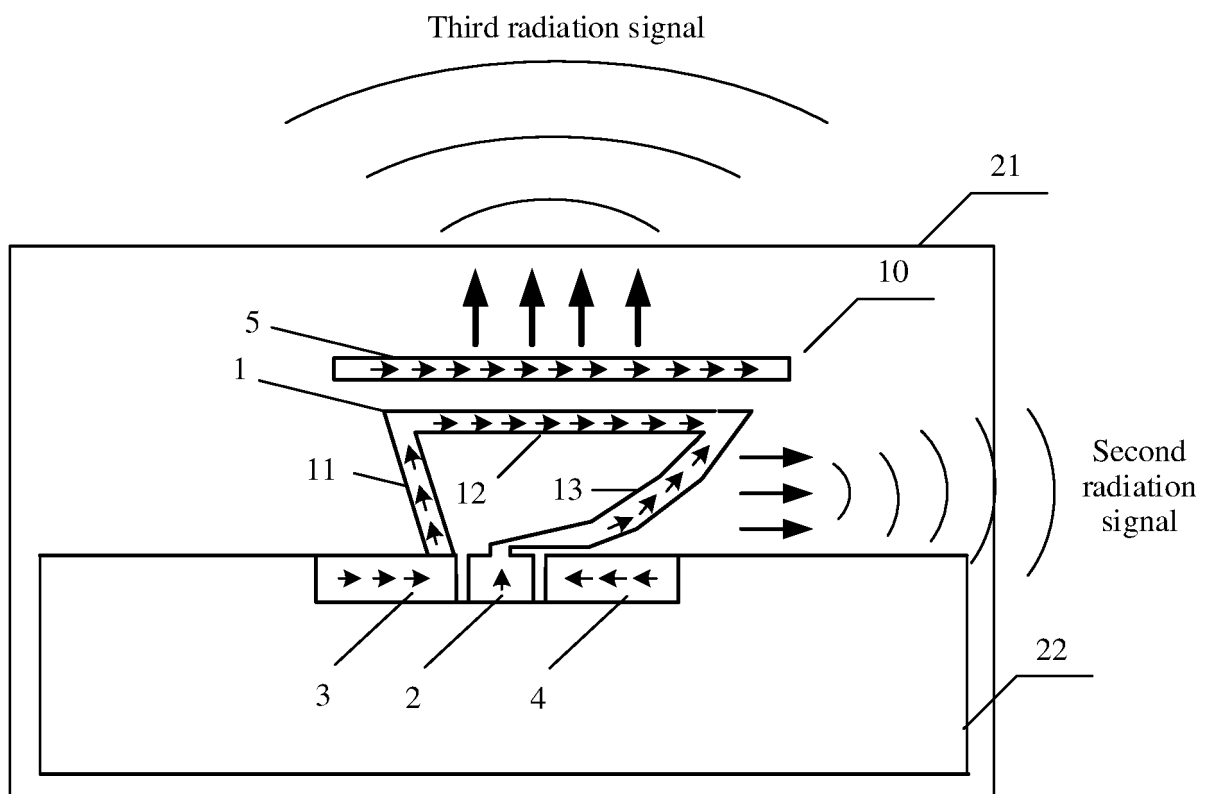


FIG. 3

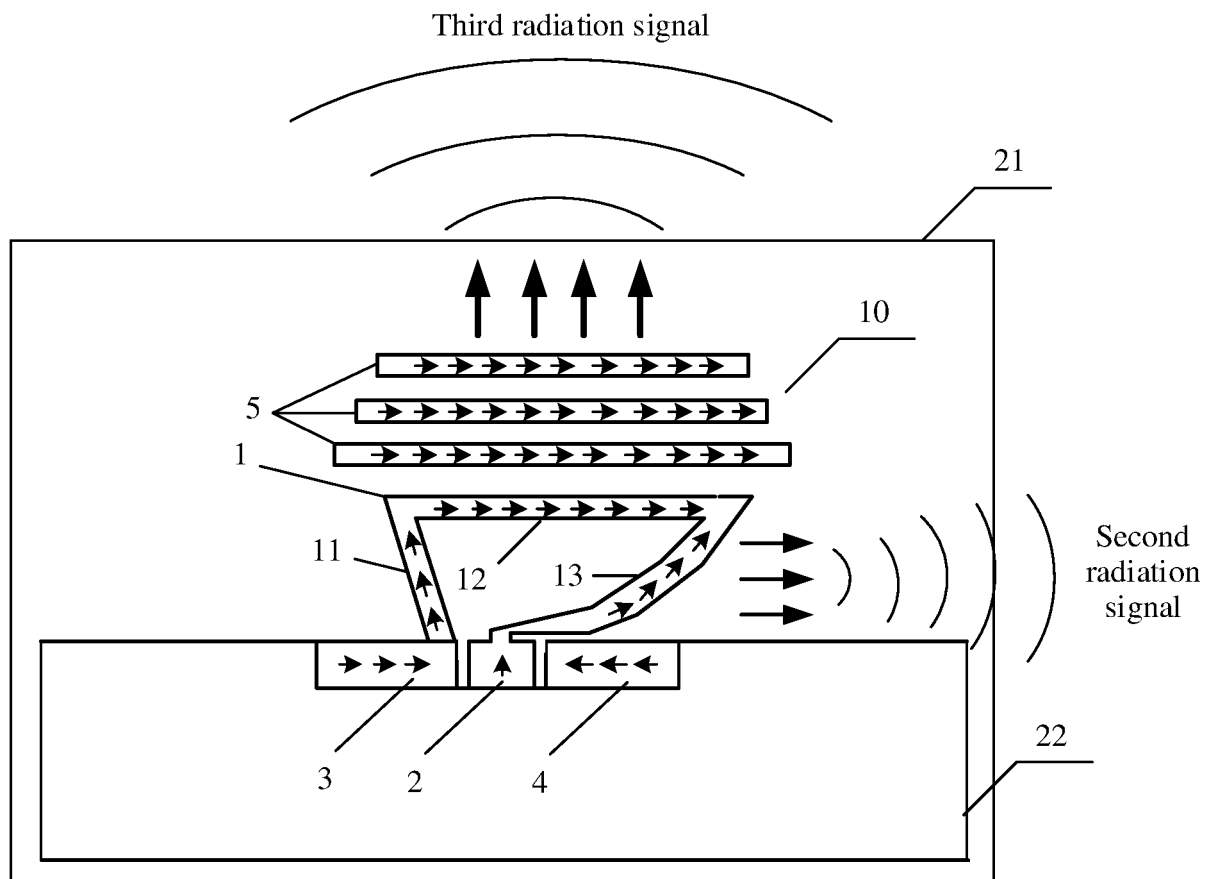


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2018/080678

A. CLASSIFICATION OF SUBJECT MATTER H01Q 1/38(2006.01)i According to International Patent Classification (IPC) or to both national classification and IPC															
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) H01Q Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) CNABS, CNTXT, CNKI, VEN, WOTXT, USTXT, EPTXT: 天线, 电流, 辐射方向, 垂直, 环形, 开口, 凹槽, 缝隙, 辐射体, ring, radiator, loop, direction, current, slot, groove, opening, gap, ground, feed, signal															
C. DOCUMENTS CONSIDERED TO BE RELEVANT <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>CN 1965445 A (PANASONIC CORPORATION) 16 May 2007 (2007-05-16) description, page 9, line 16 to page 11, line 8 and page 17, lines 18-20</td> <td>1-10</td> </tr> <tr> <td>A</td> <td>CN 106159431 A (MERRY ELECTRONICS (SHENZHEN) CO., LTD.) 23 November 2016 (2016-11-23) entire description</td> <td>1-10</td> </tr> <tr> <td>A</td> <td>CN 102396110 A (ACE TECHNOLOGIES CORP.) 28 March 2012 (2012-03-28) entire description</td> <td>1-10</td> </tr> <tr> <td>A</td> <td>US 2008111748 A1 (DUNN, D.L. ET AL.) 15 May 2008 (2008-05-15) entire description</td> <td>1-10</td> </tr> </tbody> </table>	Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	A	CN 1965445 A (PANASONIC CORPORATION) 16 May 2007 (2007-05-16) description, page 9, line 16 to page 11, line 8 and page 17, lines 18-20	1-10	A	CN 106159431 A (MERRY ELECTRONICS (SHENZHEN) CO., LTD.) 23 November 2016 (2016-11-23) entire description	1-10	A	CN 102396110 A (ACE TECHNOLOGIES CORP.) 28 March 2012 (2012-03-28) entire description	1-10	A	US 2008111748 A1 (DUNN, D.L. ET AL.) 15 May 2008 (2008-05-15) entire description	1-10
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☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.															
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Date of the actual completion of the international search 20 September 2018	Date of mailing of the international search report 30 September 2018														
Name and mailing address of the ISA/CN State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088 China Facsimile No. (86-10)62019451	Authorized officer Telephone No.														

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

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