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(54) **Wideband printed antenna**

(57) There is proposed a wideband printed antenna including a substrate (1), a first pattern layer (2) and a second pattern layer (3). The first pattern layer (2) and second pattern layer (3) are disposed on opposite parallel first surface (11) and second surface (12) of the substrate (1). A first radiating portion (21), a first feed-in portion (22), a first grounding portion (25) on the first surface (11) of the first pattern layer (2) and the first radiating portion (21) form a first antenna by coupling energy to a second radiating portion (34) of the second pattern layer (3) of the second surface (12). A third radiating portion (31), a

second feed-in portion (32), and a second grounding portion (35) of the second pattern layer (3) on the second surface (12) and the third radiating portion (31) form a second antenna by coupling energy to a fourth radiating portion (24) of the first pattern layer (2) on the first surface (11). After the first feed-in portion (22) sends out a signal, the first connecting portion (23) synergizes energies radiated by the first antenna and the second antenna to form a third antenna. Similarly, after the second feed-in portion (32) sends out a signal, the second connecting portion (33) synergizes energies radiated by the first antenna and the second antenna to form a fourth antenna.

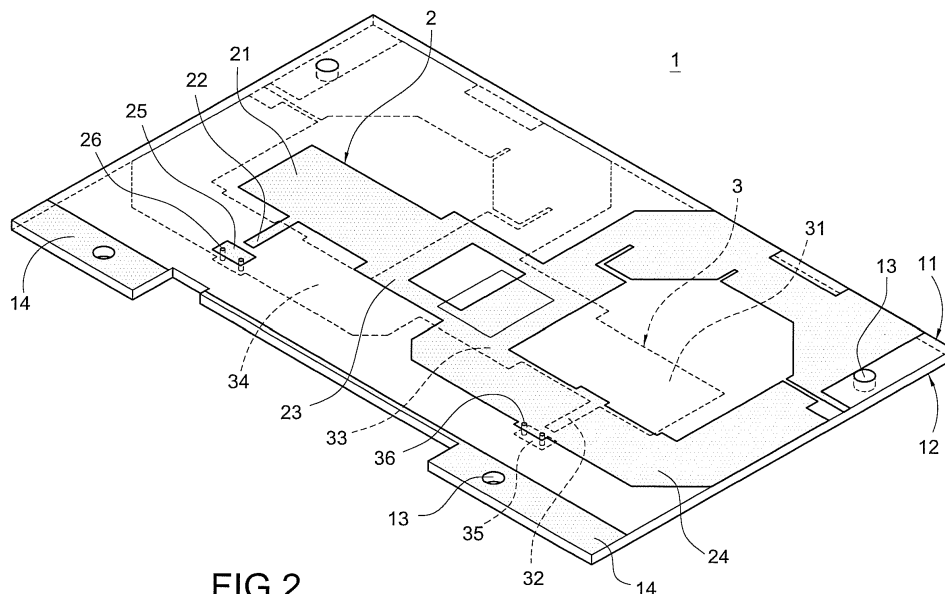


FIG.2

Description

FIELD OF THE INVENTION

[0001] The present invention relates to an antenna, in particular to a wideband printed antenna.

BACKGROUND OF THE INVENTION

[0002] As wireless communication equipments and consumer electronic products have more diversified functions day after day, the design requirements of an antenna becomes increasingly stricter, and thus the stylish design of related products has to consider the receiving performance as well as the requirements for different electromagnetic properties of the wireless communication technology concurrently. It is an important subject for related manufacturers to develop antennas with a wideband and miniaturized design, and provide an aesthetic stylish appearance of the end products and a smaller sized antenna.

[0003] Present existing wideband antennas (such as the wideband antenna disclosed in R.O.C. Pat. No I325196) generally comprise a radiating portion 10a, a feed-in portion 30a and a pair of rectangular grounding portions 40a. The radiating portion 10a, feed-in portion 30a and grounding portions 40a are disposed on a same surface of the substrate 50a. The feed-in portion 30a and grounding portion 40a are extended from a bottom edge 52a of the substrate 50a into the substrate 50a, and the feed-in portion 30a is used for inputting an electromagnetic signal to the radiating portion 10a. The grounding portions 40a are disposed on both sides of the feed-in portion 30a respectively. The radiating portion 10a is used for receiving the electromagnetic signal and it includes a first radiating segment 12a and a second radiating segment 14a. The radiating portion 10a further includes a long-strip shaped connecting portion 16a. The connecting portion 16a is disposed in the first radiating segment 12a, and both ends of the connecting portion 176a are coupled to the first radiating segment 12a and the second radiating segment 14a respectively. The connecting portion 16a has an axis superimposed with the axis of the feed-in portion 30a, and both centers of the first radiating segment 12a and the second radiating segment 14a are situated on the axis of the connecting portion 16a. The feed-in portion 30a further includes an inverted conical extending portion 19a coupled to the first radiating segment 14a for achieving an impedance matching to enhance the radiation efficiency of the radiating portion 10a.

[0004] After signals are inputted from the feed-in portion 30a, current passes through a radiating portion 10a of the wideband antenna only, so that when the antenna receives and transmits signals, the properties of the antenna are restricted.

SUMMARY OF THE INVENTION

[0005] Therefore, it is a primary objective of the present invention to improve the signal transmitting and receiving functions of a wideband antenna by forming two pattern layers on different surfaces of a same substrate respectively, and the two pattern layers are formed on two parallel opposite surfaces of the substrate respectively by the principle of an array antenna. After one of the feed-in portions sends out a signal during an operation of the antenna, the connecting portion synergizes energies produced by the first antenna and the second antenna to achieve the effect of a third antenna or a fourth antenna.

[0006] To achieve the foregoing objectives, the present invention discloses a wideband printed antenna, comprising:

[0007] a substrate, having a first surface and a second surface, and the first surface and the second surface being parallel to each other, and the substrate further having a plurality of through holes penetrated through the first surface and the second surface;

[0008] a first pattern layer, horizontally disposed on the first surface, and the first pattern layer being an electrically conductive material and having a first radiating portion in a polygonal shape of four or more sides, and a side of the first radiating portion being coupled to a first feed-in portion for feeding a signal, and the other side of the first radiating portion being coupled to a U-shaped bridge structured first connecting portion, and the first connecting portion being coupled to a circular loop structured fourth radiating portion, and a first grounding portion being formed at a position corresponding to the first feed-in portion, and the first grounding portion including two first penetrating holes formed thereon and penetrated through a second radiating portion on the second surface; and

[0009] a second pattern layer, having the same structure of the first pattern layer, and disposed on an opposite parallel second surface of the substrate with respect to the first pattern layer, and the second pattern layer being made of an electrically conductive material and having a third radiating portion in a polygonal shape of four or more sides, and a side of the third radiating portion being coupled to a second feed-in portion provided for feeding a signal, and the other side of the third radiating portion being coupled to a U-shaped bridge structured second connecting portion, and the second connecting portion being coupled to a circular loop structured second radiating portion, and a second grounding portion disposed at a position corresponding to the second feed-in portion having two second penetrating holes penetrated through a fourth radiating portion of the first surface.

[0010] The first feed-in portion and the first radiating portion on the first surface form a first antenna by coupling energy to the second radiating portion and the first grounding portion on the second surface. The second feed-in portion and the third radiating portion on the second surface form a second antenna with the same struc-

ture of the first antenna by coupling energy to the fourth radiating portion and the second grounding portion on the first surface.

[0011] After the first feed-in portion sends out a signal, the first connecting portion forms a third antenna by synergizing the energies radiated by the first antenna and the second antenna. Similarly, after the second feed-in portion sends out a signal, the second connecting portion forms a fourth antenna by synergizing the energies radiated by the first antenna and the second antenna.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIG. 1 is a schematic view of a conventional wideband antenna disclosed in R.O.C. Pat. No. I325196;

[0013] FIG. 2 is a perspective view of a wideband printed antenna of the present invention;

[0014] FIG. 3 is a front view of FIG. 2;

[0015] FIG. 4 is a rear view of FIG. 2;

[0016] FIG. 5 is a first schematic view of stacking a first pattern layer with a second pattern layer of a wideband printed antenna in accordance with the present invention;

[0017] FIG. 6 is a second schematic view of stacking a first pattern layer with a second pattern layer of a wideband printed antenna in accordance with the present invention;

[0018] FIG. 7 is a third schematic view of stacking a first pattern layer with a second pattern layer of a wideband printed antenna in accordance with the present invention;

[0019] FIG. 8 is a fourth schematic view of stacking a first pattern layer with a second pattern layer of a wideband printed antenna in accordance with the present invention;

[0020] FIG. 9 is a fifth schematic view of stacking a first pattern layer with a second pattern layer of a wideband printed antenna in accordance with the present invention;

[0021] FIG. 10 is a graph of return loss versus frequency in accordance with the present invention;

[0022] FIG. 11 is a sixth schematic view of stacking a first pattern layer with a second pattern layer of a wideband printed antenna in accordance with the present invention;

[0023] FIG. 12 is a schematic view of connecting a wideband printed antenna and a coaxial cable in accordance with the present invention; and

[0024] FIG. 13 is a schematic view of directions of currents of FIG. 12.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0025] With reference to FIGS. 2 to 4 for a perspective view, a front view and a rear view of a wideband printed antenna in accordance with the present invention respectively, the wideband printed antenna comprises a substrate 1, a first pattern layer 2, and a second pattern layer

3.

[0026] The substrate 1 is a circuit board having a first surface 11 and a second surface 12, and the first surface 11 and the second surface 12 are parallel to each other, and the substrate 1 further includes a plurality of through holes 13 penetrated through the first surface 11 and the second surface 12. The first surface 11 or the second surface 12 includes a reflecting portion 14 disposed on a side of the first or second surface 11, 12 and includes two of the through holes 13.

[0027] The first pattern layer 2 is installed horizontally on the first surface 11, and the first pattern layer 2 is made of an electrically conductive material. The first pattern layer 2 has a first radiating portion 21 in a polygonal shape of four or more sides, and a first feed-in portion 22 provided for feeding a signal is upwardly extended from a side of the first radiating portion 21, and a U-shaped bridge structured first connecting portion 23 is coupled to the other side of the first radiating portion 21, and a circular loop structured fourth radiating portion 24 is coupled to the first connecting portion 23. The first feed-in portion 22 includes a first grounding portion 25 disposed at a corresponding position on the first surface 11, and the first grounding portion 25 includes two first penetrating holes 26 penetrated through a second radiating portion 34 of the second surface 12 and provided for electrically coupling a grounding metal mesh layer (not shown in the figure) of the coaxial cable.

[0028] The second pattern layer 3 has the same structure of the first pattern layer 2 and is disposed on the second surface 12 of the substrate 1, wherein the second pattern layer is situated on an opposite parallel side of the first pattern layer 2. The second pattern layer 3 is made of an electrically conductive material and includes a third radiating portion 31 in a polygonal shape of four or more sides, a second feed-in portion 32 provided for feeding a signal is upwardly extended from a side of the third radiating portion 31, and a U-shaped bridge structured second connecting portion 33 coupled to the other side of the third radiating portion 31, and the second connecting portion 33 is coupled to a circular loop structured second radiating portion 34. The second feed-in portion 32 includes a second grounding portion 35 disposed at a position corresponding to the second surface 12, and the second grounding portion 35 includes two second penetrating holes 36 penetrated through a fourth radiating portion 24 on the first surface 11 and the second grounding portion 35 is provided for electrically coupling a grounding metal mesh layer (not shown in the figure) of the coaxial cable.

[0029] The first feed-in portion 22 and the first radiating portion 21 on the first surface 11 are provided for coupling energy to a second radiating portion 34 and a first grounding portion 25 on the second surface 12 to form a first antenna.

[0030] The second feed-in portion 32 and the third radiating portion 31 on the second surface 12 are provided for coupling energy to a fourth radiating portion 24 and

a second grounding portion 35 on the first surface 11 to form a second antenna having the same structure of the first antenna.

[0031] After the first feed-in portion 22 sends out a signal, the first connecting portion 23 synergizes energies radiated by the first antenna and the second antenna to form a third antenna. Similarly, after the second feed-in portion 32 sends out a signal, the second connecting portion 33 synergizes energies radiated by the first antenna and the second antenna to form a fourth antenna.

[0032] With reference to FIGS. 5 and 6 for first and second schematic views of a second pattern layer and a third pattern layer superimposed with each other on a wideband printed antenna of the present invention respectively, both of the first radiating portion 21 and third radiating portion 31 are in a polygonal shape of four or more sides, and the length L1 is equal to a half wavelength of an operating frequency of the antenna and the width W1 is equal to a quarter wavelength of an operating frequency of the antenna, and the length is an odd multiple of the half wavelength and the width is an odd multiple of the quarter wavelength.

[0033] Both of the second radiating portion 34 and the fourth radiating portion 24 are a circular loop structure, having an internal length L2 and an internal width W2 equal to an odd multiple of a half wavelength of an operating frequency of the antenna.

[0034] With reference to FIGS. 7 and 8 for third and fourth schematic views of a second pattern layer and a third pattern layer of a wideband printed antenna superimposed with each other in accordance with the present invention respectively, more than one rectangular slot 341, 241, and more than one edge cut corner 342, 242 are formed at external edges of the second radiating portion 34 and the fourth radiating portion 24. The foregoing shaped structure of the edge cut corners 342, 242 and rectangular slots 341, 241 is intended for narrowing the original paths of the current passing through metal surfaces of the second radiating portion 34 and fourth radiating portion 24, such that the current density can be increased to achieve the effect of increasing the magnetic field produced by the current as well as the gain of the antenna effectively.

[0035] More than one L-shaped slot line 343, 243, more than one linear slot line 344, 244, more than one oblique corner 345, 245, and more than one rectangular bump 346, 246 are formed and coupled to internal edges of the second radiating portion 34 and fourth radiating portion 24. The L-shaped slot lines 343, 243, linear slot lines 344, 244, oblique corners 345, 245, and rectangular bumps 346, 246 are provided for changing the original path of a current passing through the metal surfaces of the second radiating portion 34 and fourth radiating portion 24 for increasing the current density, the magnetic field produced by the current, and the gain of the antenna effectively.

[0036] The dimensions (shape, area, and length) of the L-shaped slot lines 343, 243, linear slot lines 344,

244, oblique corners 345, 245, and rectangular bumps 346, 246 will affect the operating frequency of the antenna.

[0037] With reference to FIG. 9 for a fifth schematic view of a second pattern layer and a third pattern layer of a wideband printed antenna superimposed with each other in accordance with the present invention respectively, and FIG. 10 for a graph of return loss versus frequency, more than one L-shaped or rectangular gap 347, 247 is formed on the second radiating portion 34 and the fourth radiating portion 24. The gap 347, 247 will produce a capacitance effect, and the capacitance effect changes the magnetic field produced by the magnetic fields at the rectangular slots 341, 241, edge cut corners 342, 242, L-shaped slot lines 343, 243, linear slot lines 344, 244, oblique corners 345, 245, and rectangular bumps 346, 246 to produce another resonance frequency point A as shown in the graph of return loss versus frequency (as shown in FIG. 10), and resonance frequency points produced by the first radiating portion 21, second radiating portion 34, third radiating portion 31 and fourth radiating portion 24 are used for providing a wideband feature of the antenna.

[0038] With reference to FIG. 11 for a sixth schematic view of a second pattern layer and a third pattern layer of a wideband printed antenna superimposed with each other in accordance with the present invention, a distance D1 from a center point of the first feed-in portion 22 to an edge of the fourth radiating portion 24 is equal to an odd multiple of a half wavelength of an operating frequency of the antenna.

[0039] A distance D2 from a center point of the second feed-in portion 32 to an edge of the second radiating portion 34 is equal to an odd multiple of a half wavelength of an operating frequency of the antenna.

[0040] With reference to FIGS. 12 and 13 for a schematic view of connecting a wideband printed antenna and a coaxial cable and a schematic view of a current direction in accordance with the present invention respectively, core wires 41, 51 of coaxial cables 4, 5 are respectively and electrically coupled to the first feed-in portion 22 and the second feed-in portion 32, and grounding metal mesh layers 42 and 52 of the coaxial cables 4, 5 are respectively and electrically coupled to the first grounding portion 25 and the second grounding portion 35, and passed through the first penetrating hole 26 and the second penetrating hole 36 to electrically couple the second radiating portion 34 and the fourth radiating portion 24.

[0041] During the operation of the antenna, signals are sent out from a feed-in point of a first feed-in portion 22 or a second feed-in portion 32 to produce radiations of the two antennas. For example, the first current path enters from the first feed-in portion 22, and the first radiating portion 21 couples energy through the first connecting portion 23 of the U-shaped bridge structure to the second radiating portion 34 of the second surface 12 there below, such that the current direction forms a circular path, and

some of the energies are radiated (as indicated by the dotted line portion of FIG. 13). At the same time, the second current path enters from the first feed-in portion 22 through first radiating portion 21, and the first connecting portion 23 of the U-shaped bridge structure guides the energy to the fourth radiating portion 24, and the current direction forms a circular path for radiating the energy (as indicated by the dotted line portion of FIG. 13). Since the length of the first connecting portion 23 of the U-shaped bridge structure is equal to a half wavelength of an operating frequency of the antenna, therefore the energies of the second current path and the first current path will have a phase difference of a delay of 180 degrees, so that the U-shaped bridge structure can be designed to add the radiation of the fourth radiating portion 24 with the radiation of the second radiating portion 34 to achieve the synergy effect, similar to the principle of an array antenna.

[0042] Besides the U-shaped bridge structure, the first connecting portion 23 and the second connecting portion 33 of the present invention can also be in a rectangular shape with a polygonal shape cut off from the rectangular shape. In other words, the U-shaped bridge structure is the internal polygonal shaped portion cut off from a larger rectangular shaped structure.

In summary there is proposed a wideband printed antenna including a substrate 1, a first pattern layer 2 and a second pattern layer 3. The first pattern layer 2 and second pattern layer 3 are disposed on opposite parallel first surface 11 and second surface 12 of the substrate 1. A first radiating portion 21, a first feed-in portion 22, a first grounding portion 25 on the first surface 11 of the first pattern layer 2 and the first radiating portion 21 form a first antenna by coupling energy to a second radiating portion 34 of the second pattern layer 3 of the second surface 12. A third radiating portion 31, a second feed-in portion 32, and a second grounding portion 35 of the second pattern layer 3 on the second surface 12 and the third radiating portion 31 form a second antenna by coupling energy to a fourth radiating portion 24 of the first pattern layer 2 on the first surface 11. After the first feed-in portion 22 sends out a signal, the first connecting portion 23 synergizes energies radiated by the first antenna and the second antenna to form a third antenna. Similarly, after the second feed-in portion 32 sends out a signal, the second connecting portion 33 synergizes energies radiated by the first antenna and the second antenna to form a fourth antenna.

Claims

1. A wideband printed antenna, comprising:

a substrate (1), having a first surface (11) and a second surface (12), and the first surface (11) and the second surface (12) being parallel to each other;

a first pattern layer (2), having a first radiating portion (21), a first feed-in portion (22), a first connecting portion (23), a fourth radiating portion (24) and a first grounding portion (25), horizontally on the first surface (11), and a side of the first radiating portion (21) being coupled to the first feed-in portion (22), and the other side of the first radiating portion (21) being coupled to the first connecting portion (23), and the first connecting portion (23) being coupled to the fourth radiating portion (24), and the first feed-in portion (21) including a first grounding portion (25) disposed at a position corresponding to the first feed-in portion (21);

and

a second pattern layer (3), and the first pattern layer (2) being formed on opposite parallel sides of the second surface (12) respectively, and the second pattern layer (3) having a third radiating portion (31), a second feed-in portion (32), a second connecting portion (33), a second radiating portion (34) and a second grounding portion (35) thereon, and a side of the third radiating portion (31) being coupled to the second feed-in portion (32), and the other side of the third radiating portion (31) being coupled to the second connecting portion (33), and the second connecting portion (33) being coupled to the second radiating portion (34), and the second feed-in portion (32) having the second grounding portion (35) disposed at a corresponding position; thereby, after the first feed-in portion (22) sends out a signal, the first connecting portion (23) forms a third antenna by synergizing energies radiated from the first antenna and the second antenna; and after the second feed-in portion (32) sends out a signal, the second connecting portion (33) forms a fourth antenna by synergizing energies radiated from the first antenna and the second antenna.

2. The wideband printed antenna of claim 1, wherein the first feed-in portion (22) and first radiating portion (21) of the first surface (11) are provided for coupling energy to the second radiating portion (34) and first grounding portion (25) of the second surface (12) to form a first antenna; and the second feed-in portion (32) and third radiating portion (31) of the second surface (12) are provided for coupling energy to the fourth radiating portion (24) and second grounding portion (35) of the first surface (11) to form a second antenna.
3. The wideband printed antenna of claim 2, wherein the substrate (1) is a circuit board, and the substrate (1) includes a plurality of through holes (13) penetrated through the first surface (11) and the second surface (12), and a reflecting portion (14) disposed

at a side of the first surface (11) or the second surface (12), and two through holes (13) are formed on the reflecting portion (14), and the first pattern layer (2) of the first surface (11) and the second pattern layer (3) of the second surface (12) are made of an electrically conductive material.

4. The wideband printed antenna of claim 3, wherein the first radiating portion (21) and the third radiating portion (31) are in a polygonal shape of four or more sides, and the first connecting portion (23) and the second connecting portion (33) are of a U-shaped bridge structure for connecting the first radiating portion (21) with the fourth radiating portion (24), and the third radiating portion (31) with the second radiating portion (34), and the length of the first radiating portion (23) and the second connecting portion (33) are equal to an odd multiple of half wavelength of an operating frequency of the antenna.
5. The wideband printed antenna of claim 4, wherein the first connecting portion (23) and the second connecting portion (33) are in a shape formed by cutting an internal polygon from a rectangle with a larger area than the area of the internal polygon.
6. The wideband printed antenna of claim 5, wherein the second radiating portion (34) and fourth radiating portion (24) are circular loop structures.
7. The wideband printed antenna of claim 6, wherein the first grounding portion (25) includes two first penetrating holes (26), and the first penetrating hole (26) is penetrated through the second radiating portion (34) of the second surface (12), and the second grounding portion (35) includes two second penetrating holes (36), and the second penetrating hole (36) is penetrated through the fourth radiating portion (24) of the first surface (11).
8. The wideband printed antenna of claim 7, further comprising two coaxial cables (4, 5), and a core wire (41, 51) and a grounding metal mesh layer (42, 52) disposed on each of the coaxial cables (4, 5), and the two core wires (41, 51) being respectively and electrically coupled to the first feed-in portion (22) and the second feed-in portion (32), and the grounding metal mesh layer (42, 52) being electrically coupled to the first grounding portion (25) and the second grounding portion (35).
9. The wideband printed antenna of claim 8, wherein the first radiating portion (21) and the third radiating portion (31) have a length (L1) equal to one-half wavelength of an operating frequency of the antenna and a width (W1) equal to one-quarter wavelength of the operating frequency of the antenna, and the length is an odd multiple of the half wavelength, and

the width is an odd multiple of the quarter wavelength.

10. The wideband printed antenna of one of the preceding claims, wherein the second radiating portion (34) and the fourth radiating portion (24) have an internal length (L2) and a width (W2), both being an odd multiple of half wavelength of an operating frequency of the antenna, and the second radiating portion (34) and fourth radiating portion (24) have more than one rectangular slot (341, 241), and more than one edge cut corner (342, 242) formed at external edges of the second radiating portion (34) and fourth radiating portion (24).
11. The wideband printed antenna of claim 10, wherein the second radiating portion (34) and the fourth radiating portion (24) include more than one L-shaped slot line (343, 243), more than one linear slot line (344, 244), and more than one oblique corner (345, 245) and more than one rectangular bump (346, 246) formed at internal edges of the second radiating portion (34) and the fourth radiating portion (24).
12. The wideband printed antenna of claim 11, wherein the slot lines (343, 243, 344, 244), the oblique corners (345, 245), and the rectangular bumps (346, 246) have a size determined by an operating frequency of the antenna.
13. The wideband printed antenna of claim 12, wherein the second radiating portion (34) and the fourth radiating portion (24) include more than one L-shaped or rectangular gap (347, 247) formed at internal edges of the second radiating portion (34) and the fourth radiating portion (24).
14. The wideband printed antenna of claim 13, wherein the distance (D1) between a center point of the first feed-in portion (22) to an edge of the fourth radiating portion (24) is equal to an odd multiple of a half wavelength of an operating frequency of the antenna.
15. The wideband printed antenna of claim 14, wherein the distance (D2) between a center point of the second feed-in portion (32) to an edge of the second radiating portion (34) is equal to an odd multiple of a half wavelength of an operating frequency of the antenna.

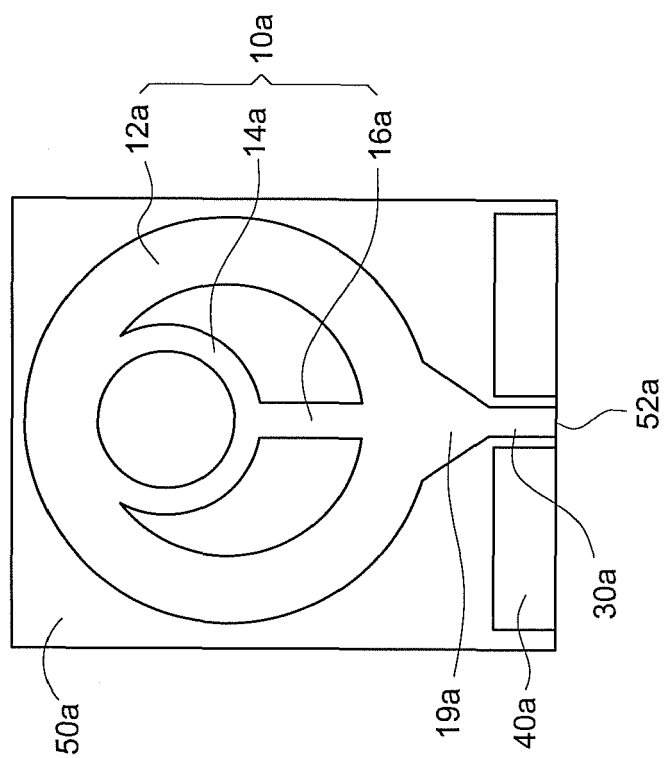


FIG. 1
(Prior Art)

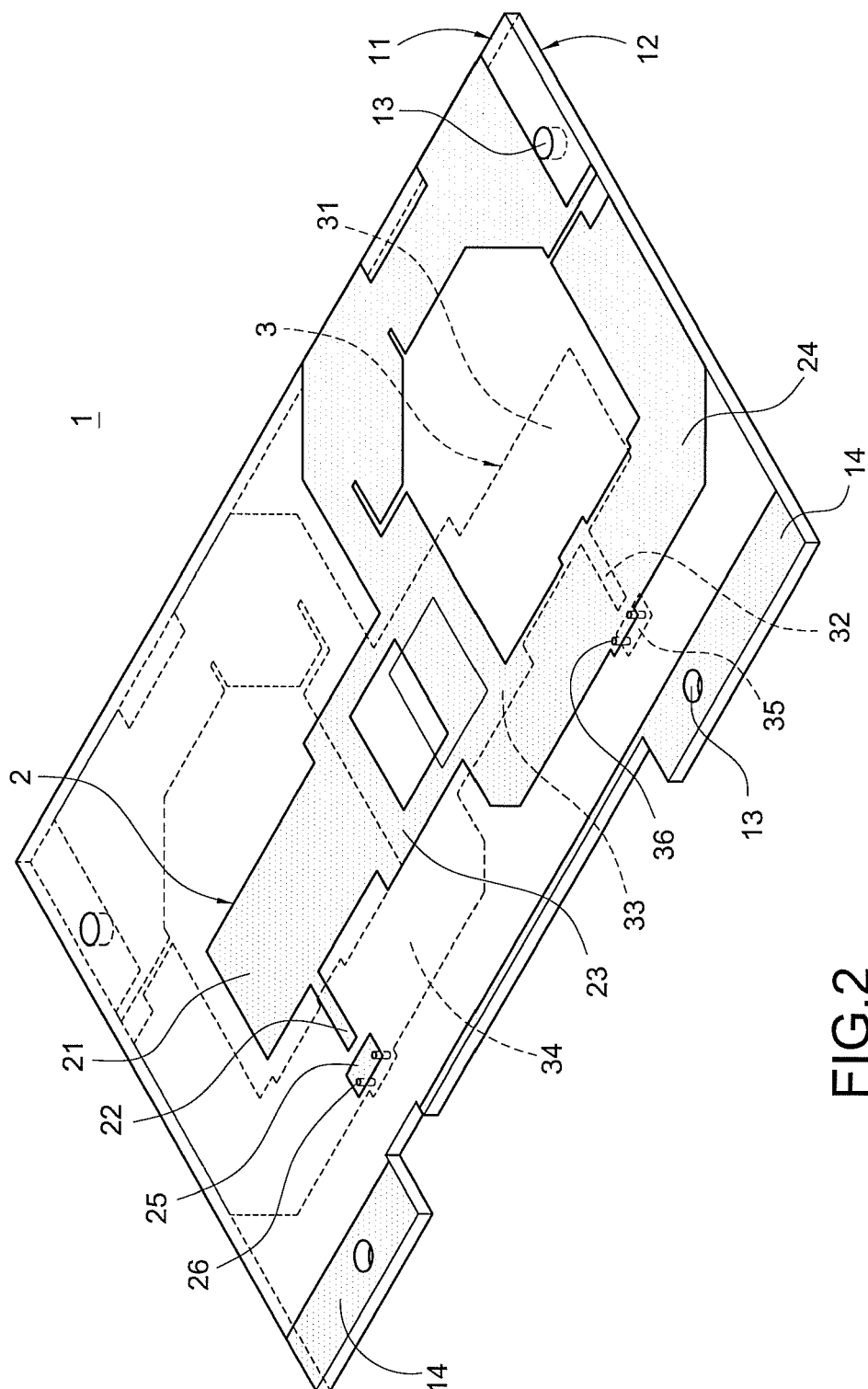


FIG. 2

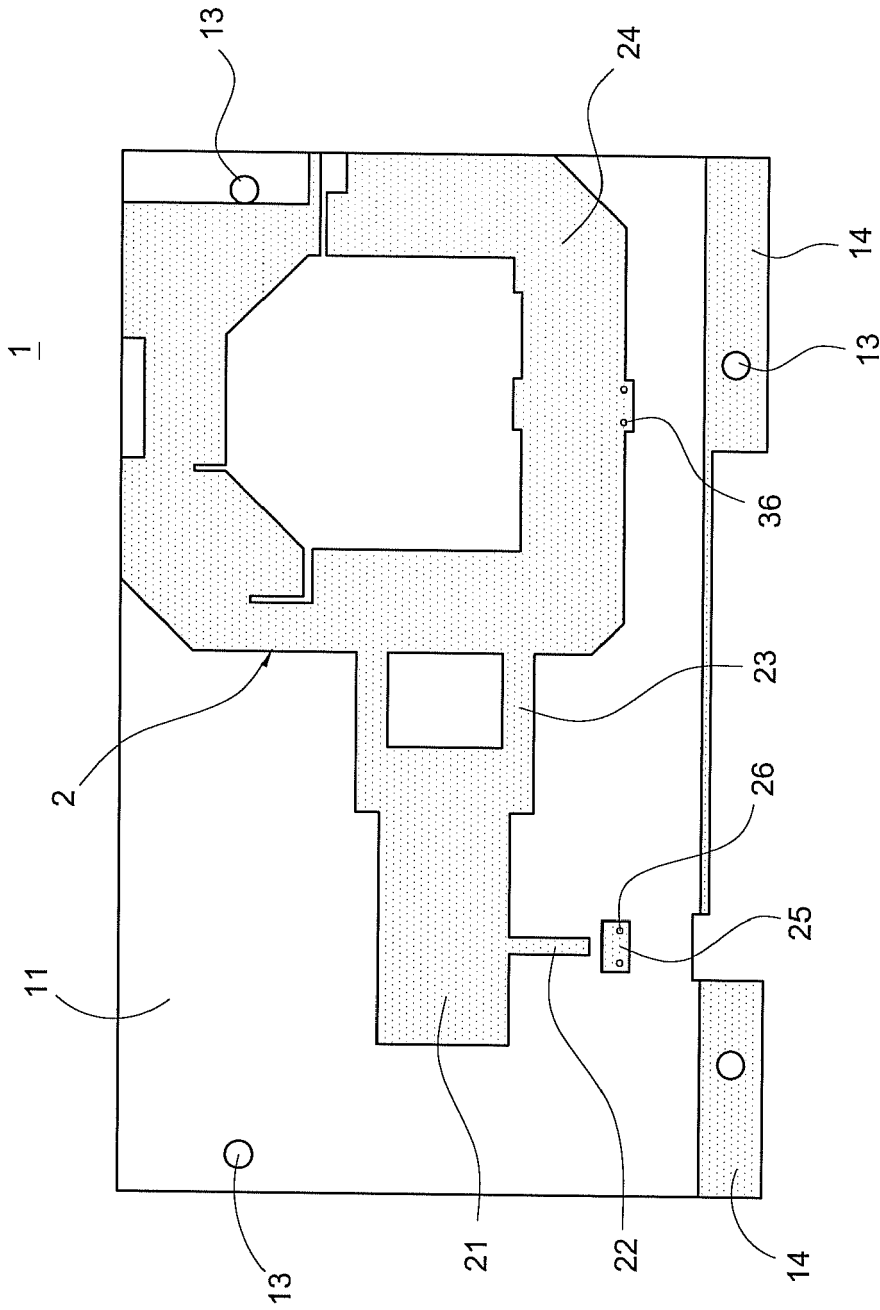


FIG.3

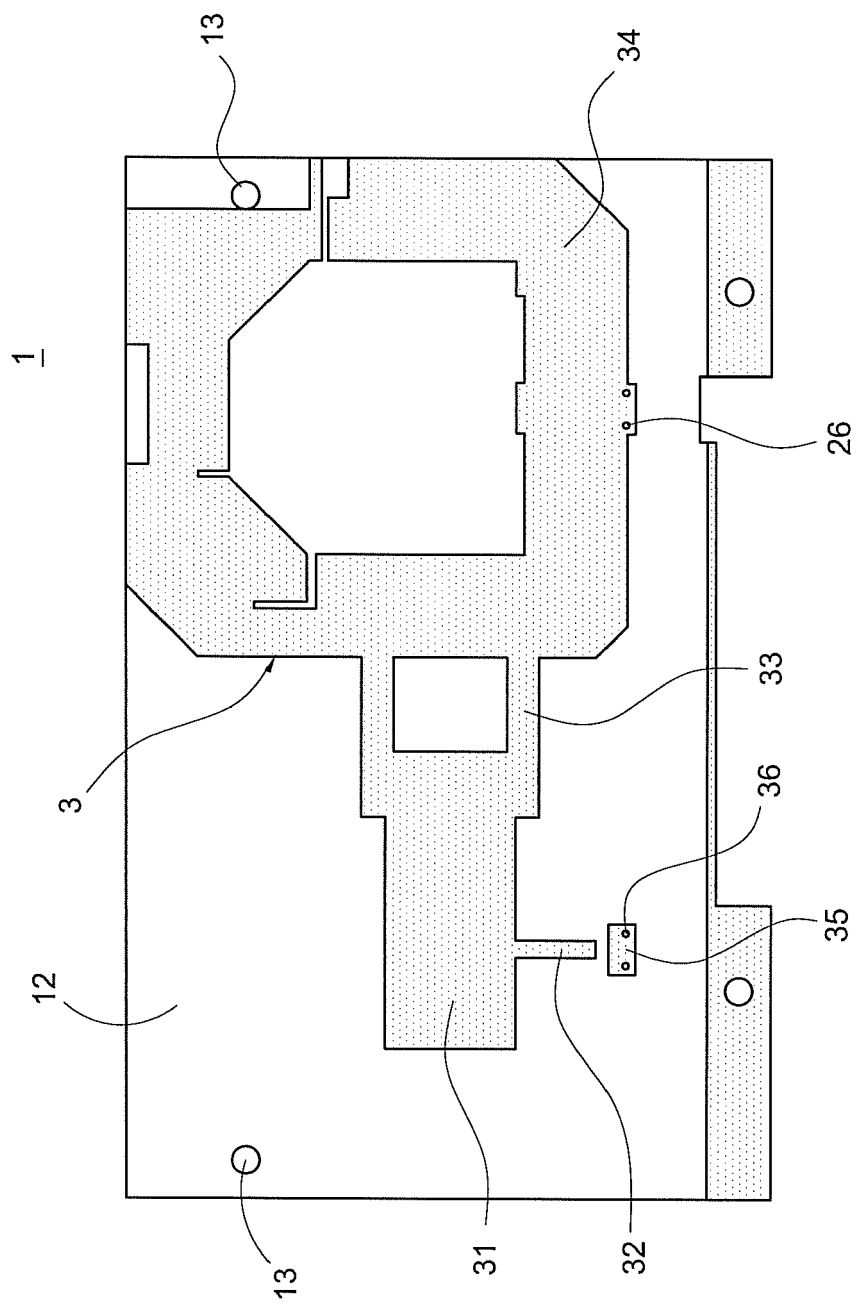


FIG. 4

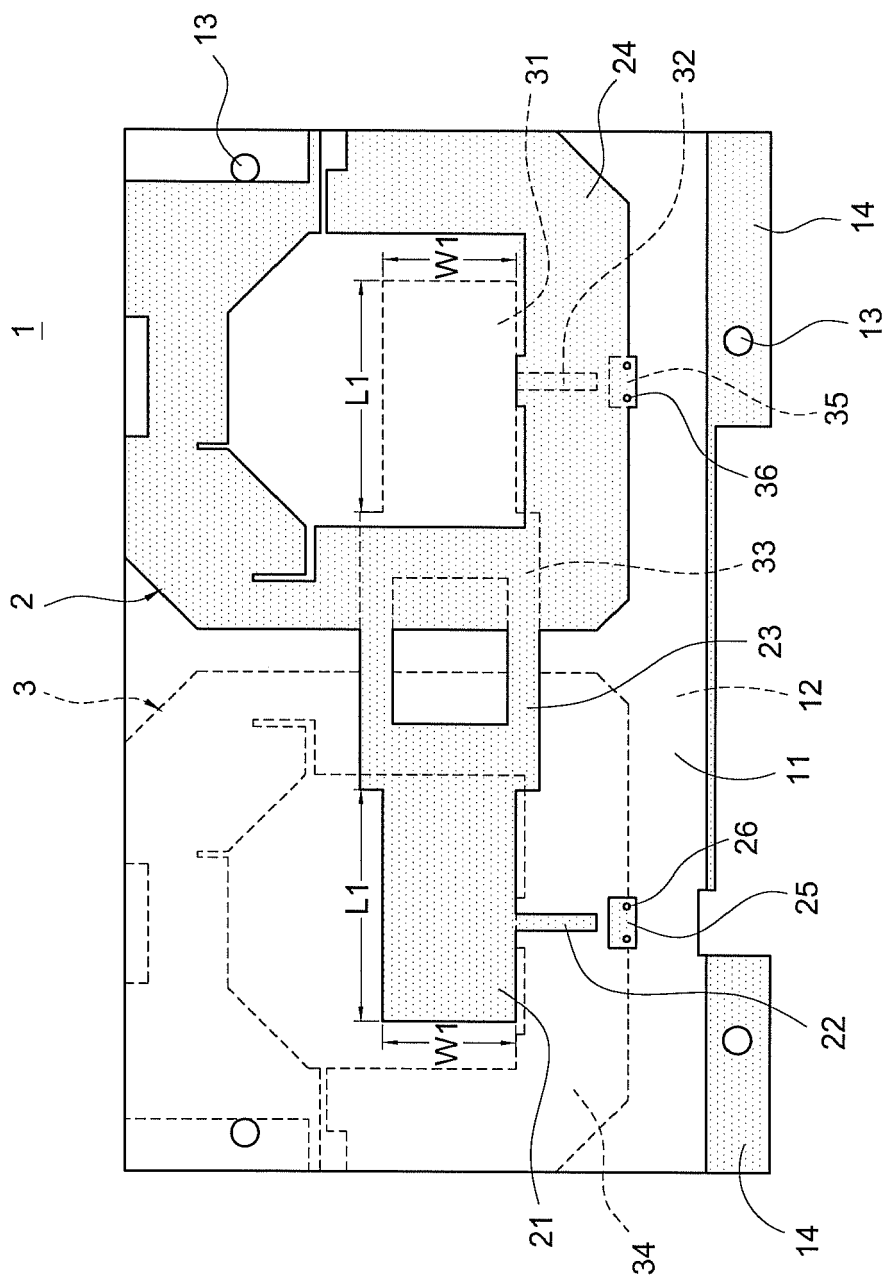


FIG. 5

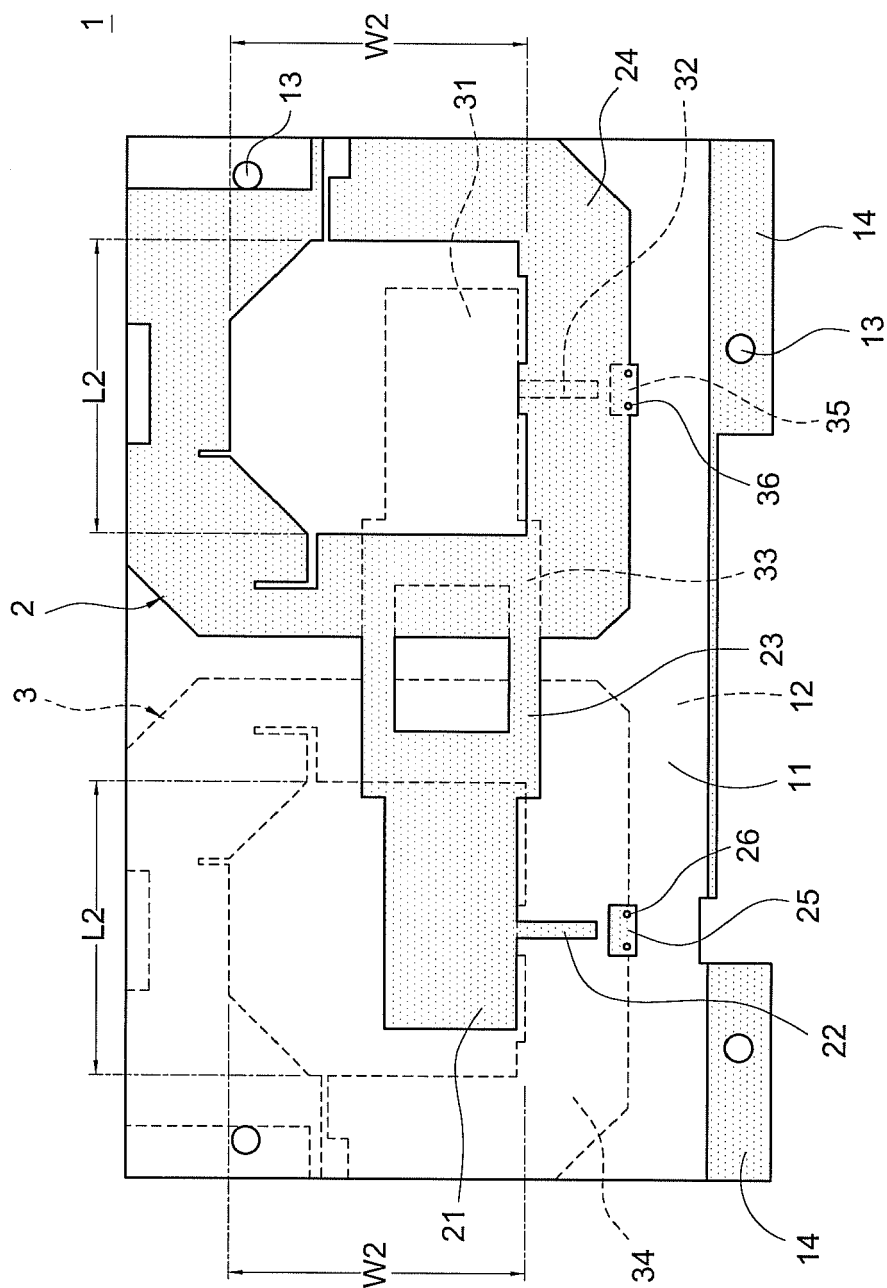


FIG.6

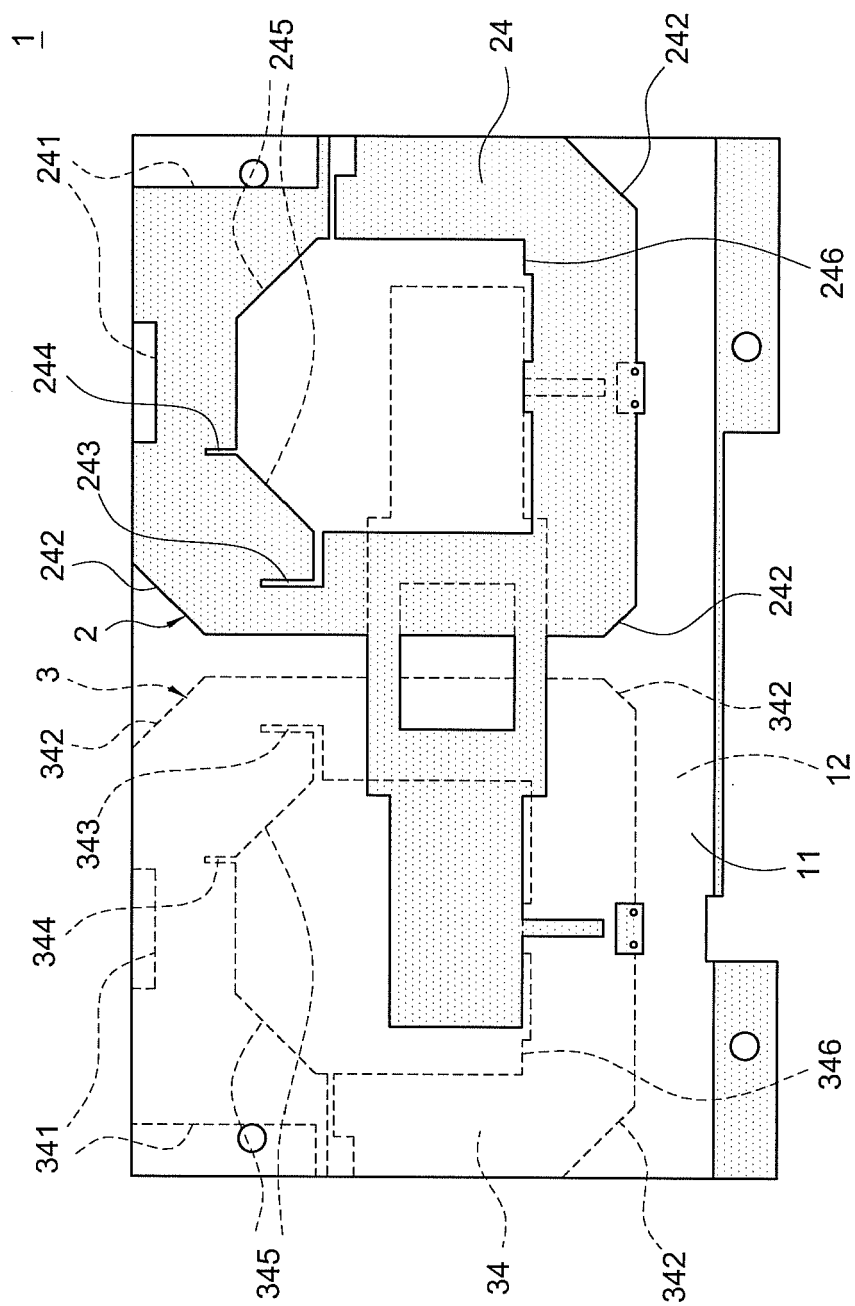


FIG. 7

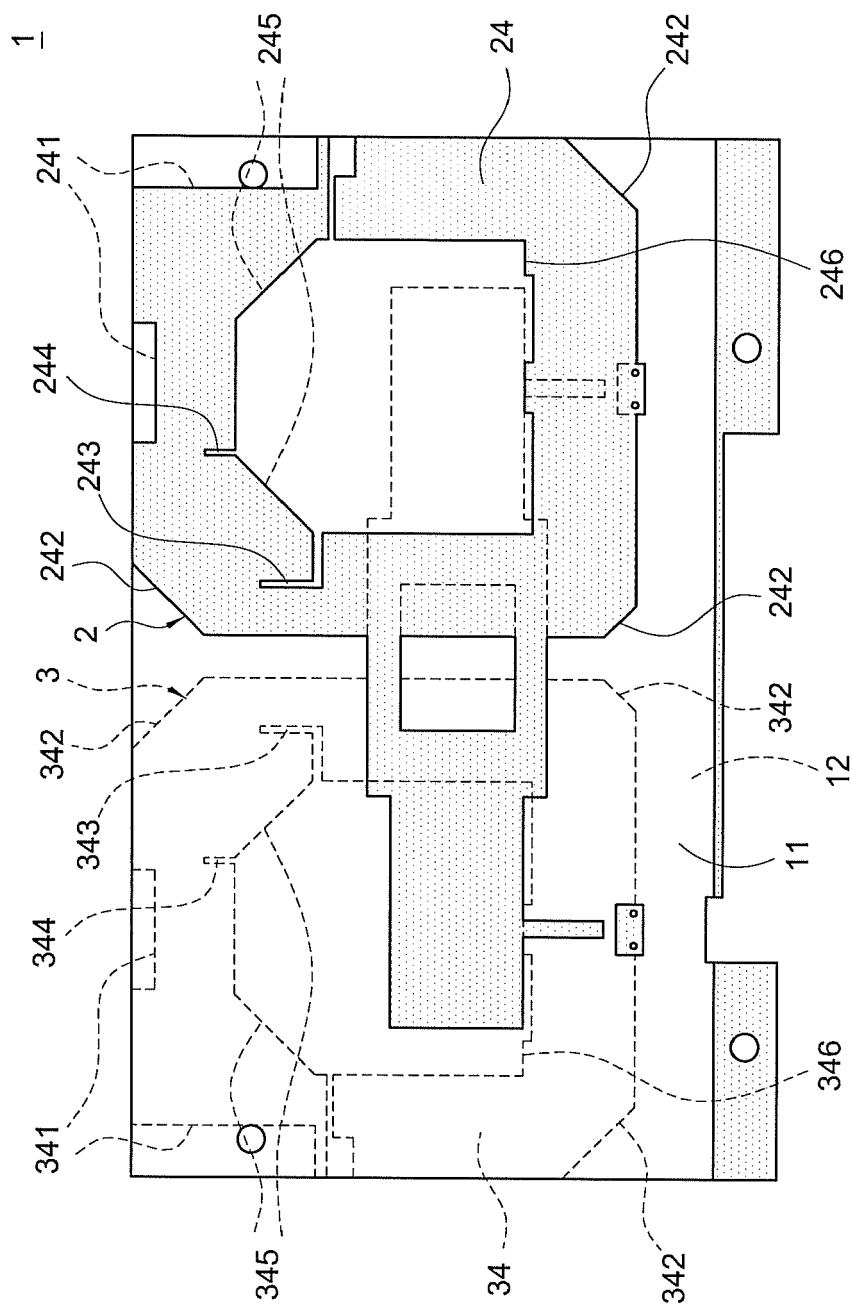


FIG. 8

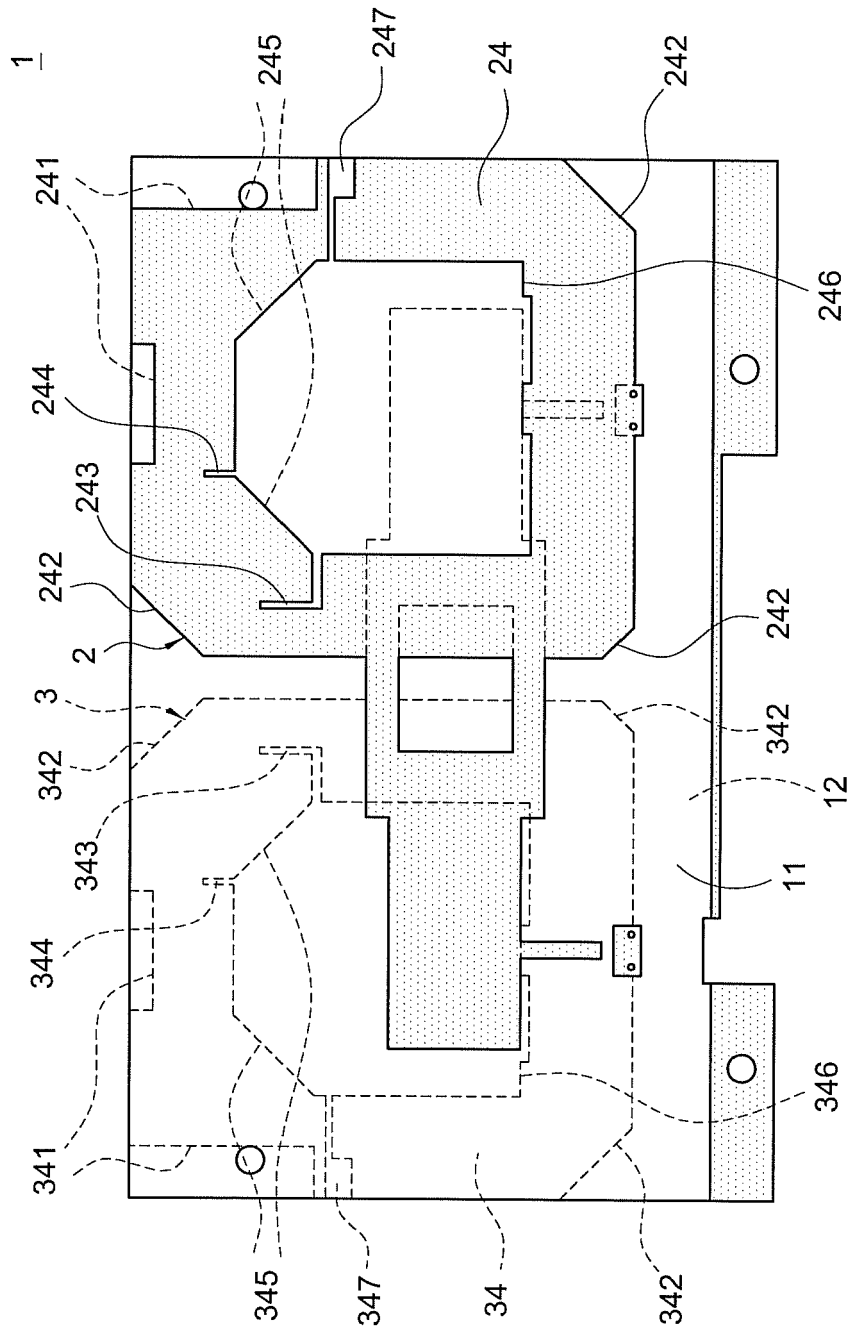


FIG. 9

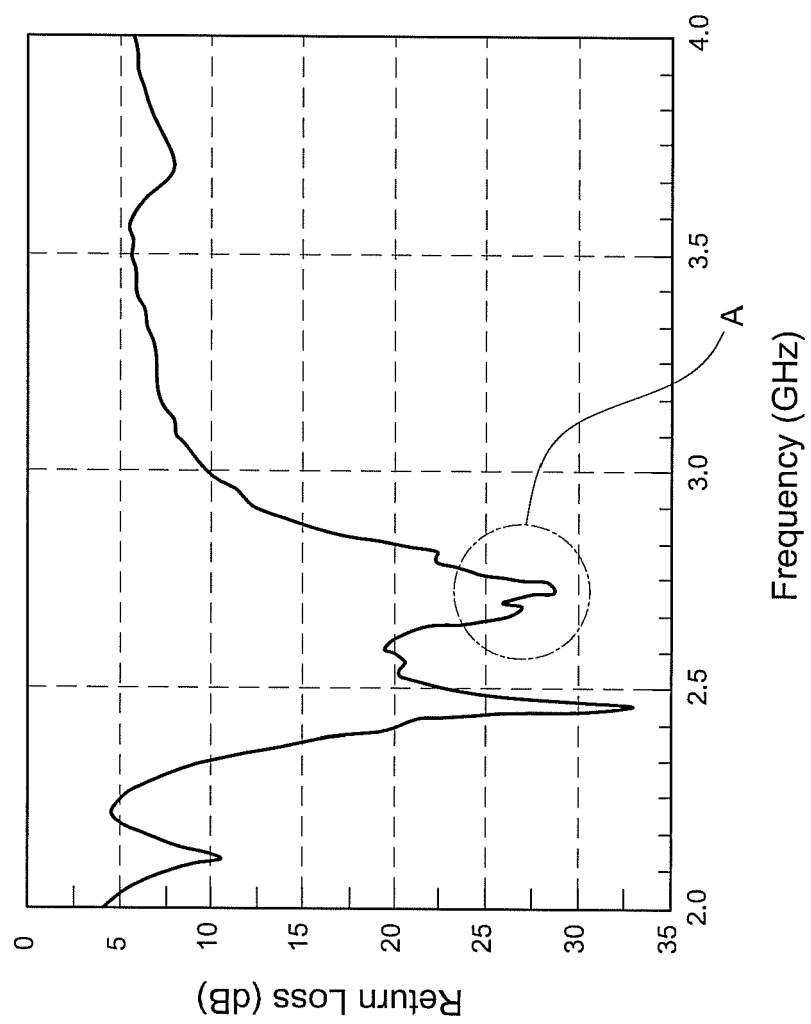


FIG.10

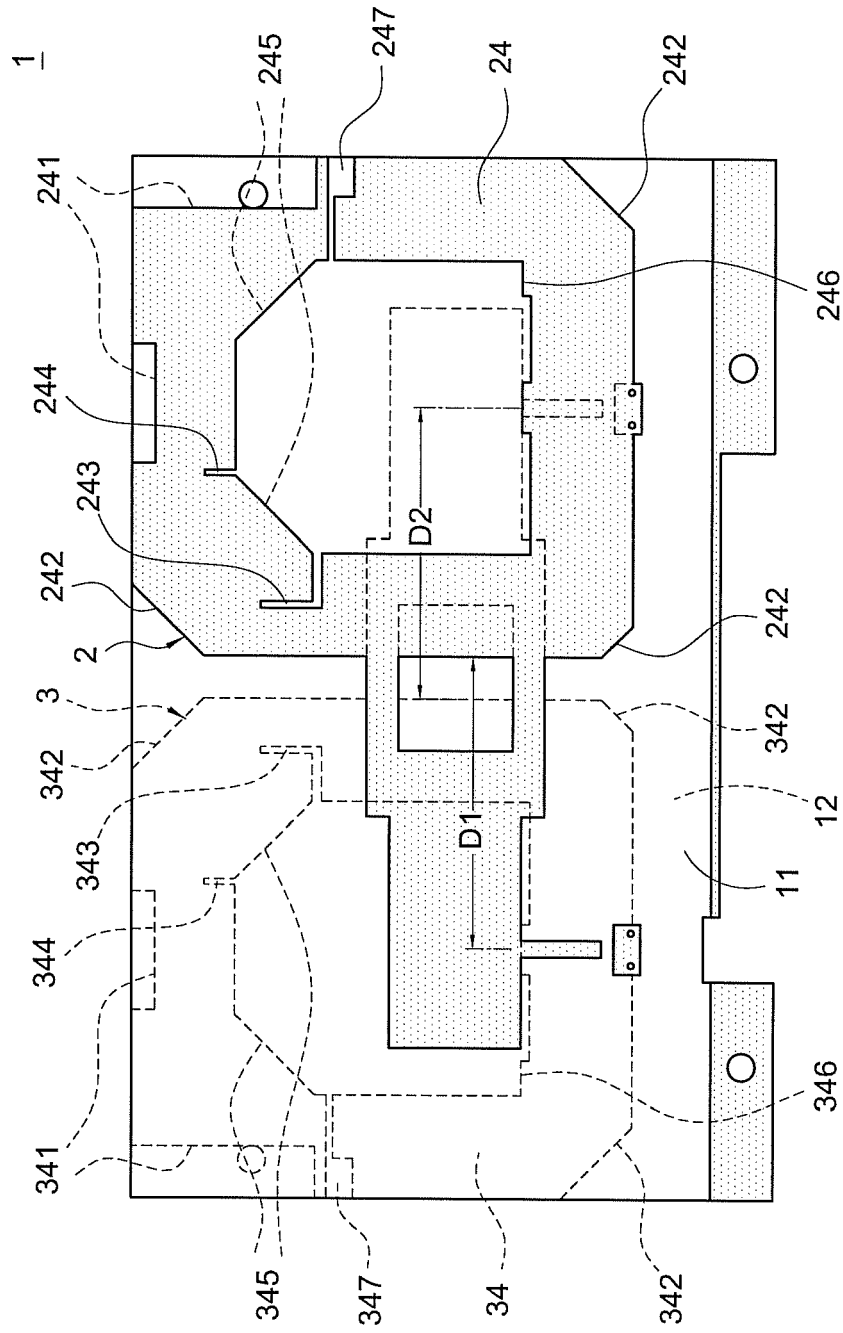


FIG.11

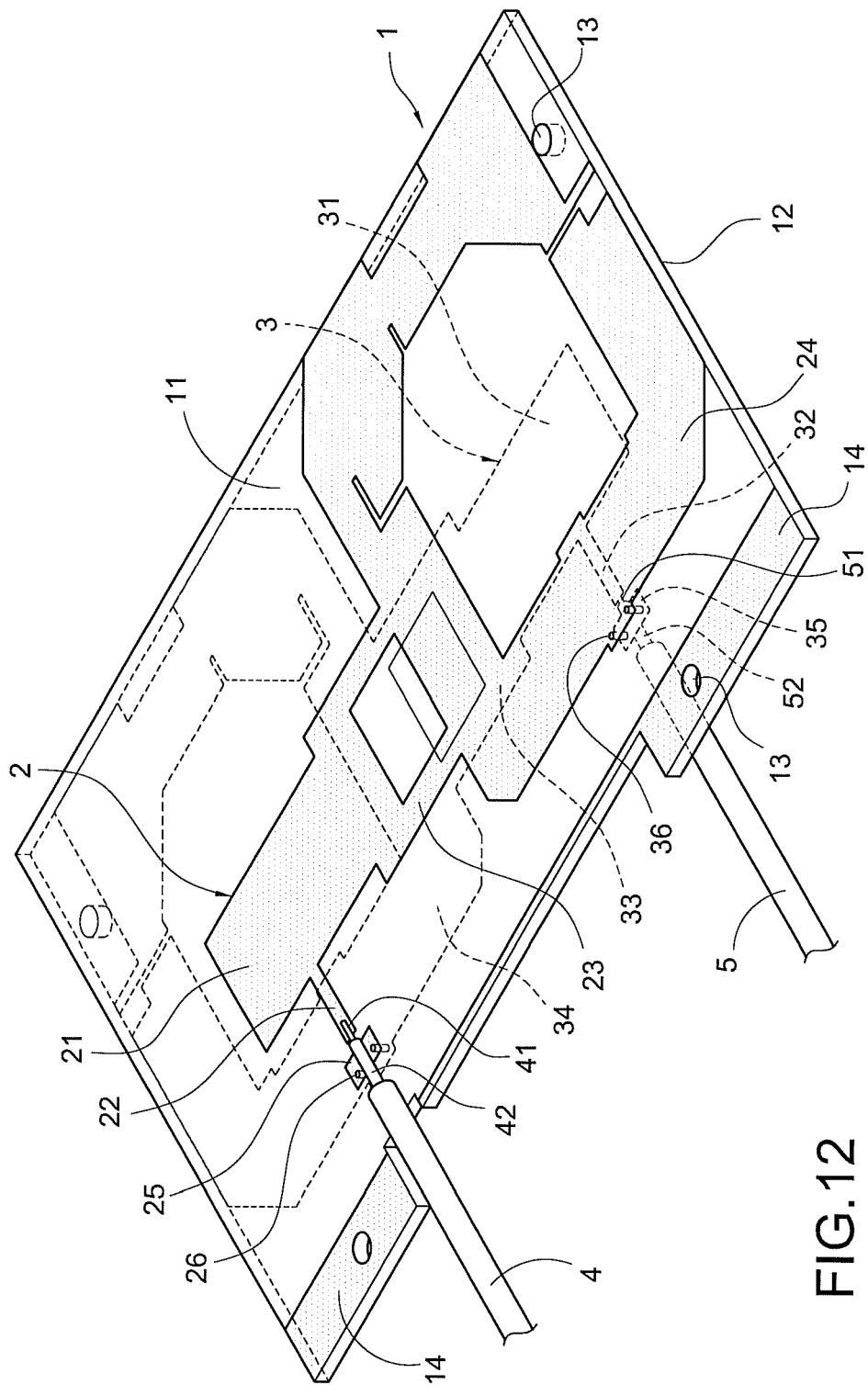


FIG.12

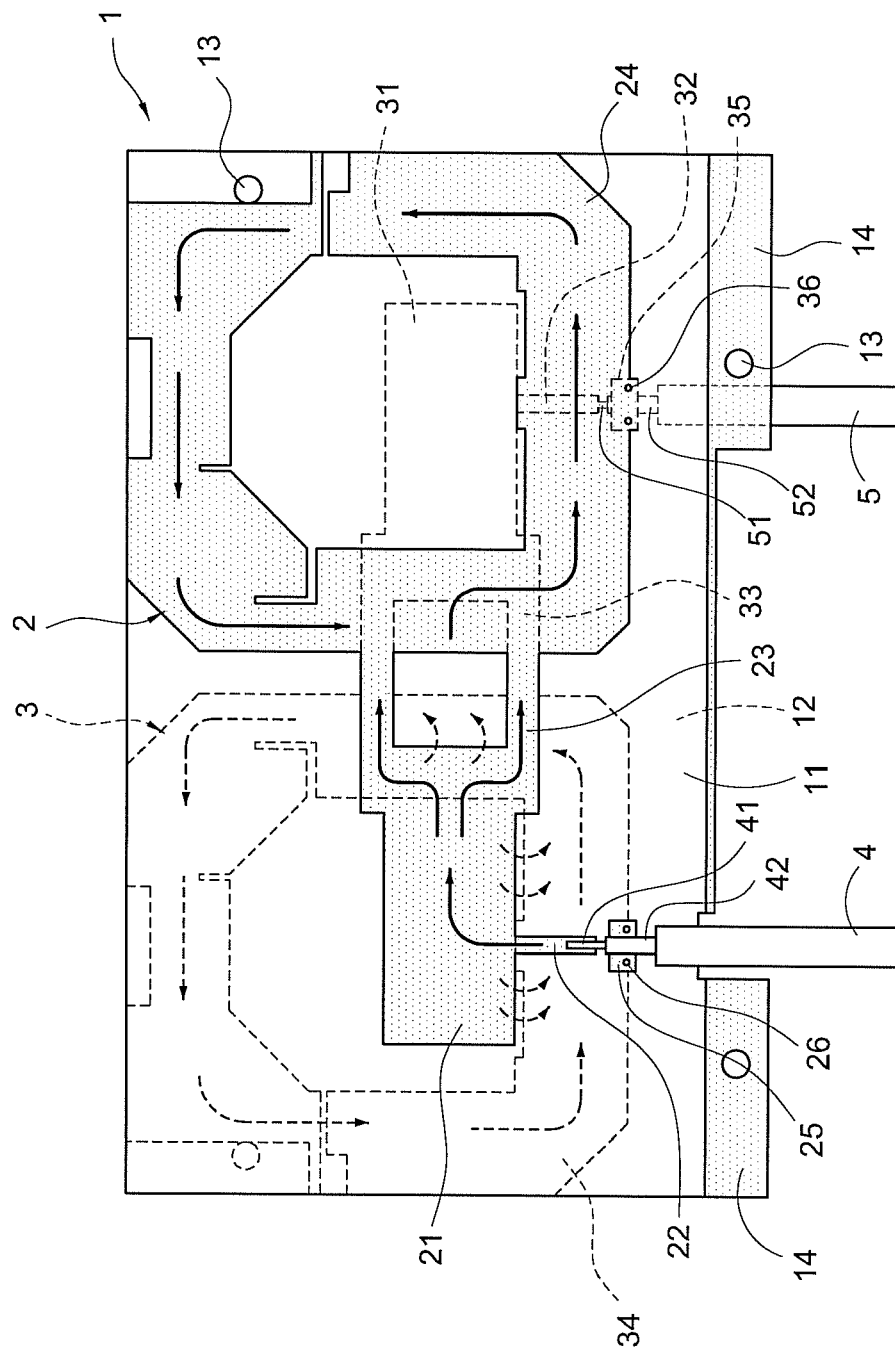


FIG.13



EUROPEAN SEARCH REPORT

Application Number
EP 11 16 1940

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2008/094282 A1 (QIN XIANG-HONG [CN]) 24 April 2008 (2008-04-24) * abstract; figures 1-3 * * paragraph [0001] - paragraph [0025] * -----	1,2	INV. H01Q1/38 H01Q21/29 H01Q25/00 H01Q7/00
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