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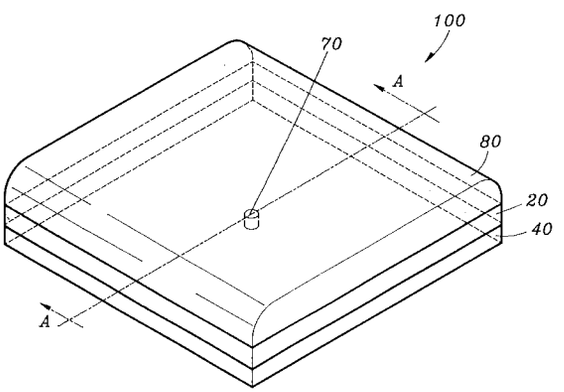
(54) Planar antenna with helical antenna array and strip line feeder pattern coupled thereto.

(57) A planar antenna, intended for reception of the Direct Satellite Communication television signals, having a novel structure and improved performance, comprises an array of M x N helical antenna elements, each of the helical antenna elements including a helical antenna and a straight stem end portion attached thereto; a first dielectric layer (20) provided with M x N array of through holes, each through hole extending from the top thereof to the bottom thereof; a second dielectric layer (40) provided with a strip line feeder pattern on top thereof; an output probe (70) coupled to the strip line feeder pattern to thereby output the combined output signals; and a protective cover (80). Each of the helical antennas is coupled to the strip line feeder pattern through the straight stem end portion attached thereto and passes through the through hole to thereby support thereof.

FIG. 1



EP 0 637 096 A1

Field of the Invention

The present invention relates to a planar antenna for the reception of Direct Broadcast Satellite(DBS) television signals; and, more particularly, to an improved planar antenar for providing higher aperture efficiency, improved polarization and increased production tolerability.

Background of the Invention

Reception of direct broadcast satellite signals having 12 GHz carrier frequency requires a circularly polarized antenna with high gain and low axial ratio. Recently, various types of planar antennas have been proposed for DBS reception at this frequency range. The planar antenna is made of an array of antenna elements, each antenna element being capable of receiving 12 GHz signals. Since these antenna elements constituting the array must be able to receive signals of a short wavelength, e.g., in the neighborhood of 2.5 cm, they must be small in size and a large array of elements is required in order to provide sufficient energy for satisfactory television pictures.

Two of such planar antennas are disclosed in U.S. Patents 4,680,591 and 4,907, 012, each comprising an array of helical antenna elements with probes located with in a common resonant cavity of square cross section. The cavity is used to combine all the outputs from the elements with a low loss. Specifically, in U.S. patent 4,907,012, four inwardly-protruding buttresses are provided in the antenna, wherein each buttress is positioned midway along a side of the cavity to promote the formation of standing waves of a different mode thereby to improve the frequency range characteristics of the array.

Since, however, these antennas employ resonant cavity to combine the outputs from the antenna elements by forming standing waves, the antenna elements must be arranged precisely, which will in turn reduce the production tolerability.

Summary of the Invention

It is, therefore, an object of the present invention to provide an improved planar antenna capable of providing higher aperture efficiency, improved polarization and increased production tolerability through the use of an array of helical antenna elements and a strip line feeder pattern coupled thereto.

In accordance with the present invention, there is provided a planar antenna for the reception of Direct Broadcast Satellite television signals, comprising: an array of M x N helical antenna elements, each helical antenna element including a helical antenna and a straight stem end portion attached thereto, wherein M and N are integers; a first dielectric layer having a top and a bottom surfaces and provided with an array of M x N through holes, wherein each of the through holes extends from the top surface to the bottom surface thereof, and each of the straight stem end portions passes through each of the through holes to thereby support each of the helical antenna elements; a second dielectric layer having an upper and a bottom surfaces with a strip line feeder pattern deposited over the upper surface, wherein the straight stem end portion of each helical antenna element is electrically coupled to the strip line feeder pattern to thereby combine in phase output signals from each of the helical antenna elements; an output probe coupled electrically to the strip line feeder pattern to thereby output combined output signals; and a protective cover, consisting of a radome and a protective layer, completely enclosing the top surface of the first dielectric layer, including the array of M x N helical antenna elements.

Brief Description of the Drawings

The above and other objects and feature of the present invention will become apparent from the following description of preferred embodiments given in conjunction with the accompanying drawings, wherein:

Fig. 1 represents a perspective view of a planar antenna in accordance with the present invention;

Fig. 2 is a cross sectional view taken along a line A-A shown in Fig. 1, its mid portion being omitted for simplicity;

Fig. 3 illustrates a top view of the planner antenna shown in Fig. 1 showing an array of M x N helical antenna elements;

Fig. 4 shows a strip line feeder pattern; and

Fig. 5 depicts a portion of the strip line feeder pattern shown in fig. 4.

Detailed Description of the Preferred Embodiments

There are illustrated in Figs. 1 and 2 a perspective view of a planar antenna 100 in accordance with the present invention and a cross section view thereof taken along a line A-A shown in Fig. 1, respectively, comprising an array 10 of M x N helical antenna elements, e.g. , $1_{[(M-i),(N-j)]}$, a first dielectric layer 20 having a top and a bottom surfaces 2, 3 and provided with an array 30 of M x N through holes, e.g., $4_{[(M-i),(N-j)]}$, extending from the top surface 2 to the bottom surface 3 thereof, a second dielectric layer 40 having an upper and a bottom surfaces 5, 6 with a strip line feeder pattern

50 deposited over the upper surface 5, an output probe 70 coupled electrically to the strip line feeder pattern 50, and a protective cover 80, consisting of a radome 7 and a protective layer 8, completely covering the top surface 2 of the first dielectric layer 20, and the array 10 of M x N helical antenna elements, e.g., $1_{[(M-i),(N-j)]}$, wherein M, N, i and j are integers and i and j are individually equal to or less than M and N, respectively, and helical antenna elements, e.g., $1_{[(M-i),(N-j)]}$ are placed on the top surface 2 of the first dielectric layer 20. Furthermore, as shown in Fig. 2, each of the M x N helical antenna elements, e.g., $1_{[(M-i),(N-j)]}$, includes a helical antenna $9_{[(M-i),(N-j)]}$ and a straight stem end portion $11_{[(M-i),(N-j)]}$ attached thereto, and each of the straight stem end portions, e.g., $11_{[(M-i),(N-j)]}$, passes through the corresponding through hole $4_{[(M-i),(N-j)]}$ and is electrically coupled to the strip line feeder pattern 50 to thereby combine in phase the output signals from each of the helical antenna elements. In addition, the output probe 70 is coupled electrically to the strip line feeder pattern 50 to thereby output the combined output signals.

There is illustrated in Fig. 3 a top view of the planar antenna showing an array of M x N helical antenna elements. The distance(Sd) between neighboring helical antenna elements was determined with the object of reducing the effect of neighboring helical antenna elements on each other, and this distance is found to be 3/4 λ_g which is approximately 18 mm in the present invention, wherein λ_g is a wavelength of the signal.

As an example of the strip line feeder pattern 50 that might be used, there is shown in Fig. 4 a strip line feeder pattern suitable for an antenna comprising an array of 16 x 16 helical antenna elements.

As shown in Fig. 4, the signals received by the helical antenna elements are combined 8 times before they reach the output probe 70 coupled to the center portion 13 via the strip line pattern 50. Since the length of the path each of the received signals travels and the structure the received signals pass through before they reach the center portion 13 are identical, the signals are in phase. Furthermore, as shown in Fig. 5, the width of the strip line pattern varies in order to match the impedance at the point where the signal get divided.

While the present invention has been described with respect to certain preferred embodiment only, other modification and variations may be without departing from the scope of the present invention as set forth in the following claims.

Claims

1. An antenna for receiving Direct Broadcast Satellite television signals comprising:

an array of M x N helical antenna elements, each helical antenna element including a helical antenna and a straight stem end portion attached thereto, wherein M and N are integers;

a first dielectric layer having a top and a bottom surfaces and provided with an array of M x N through holes, wherein each of the through holes extends from the top surface to the bottom surface thereof, and each of the straight stem end portions passes through each of the through holes to thereby support each of the helical antenna elements;

a second dielectric layer having an upper and a bottom surfaces with a strip line feeder pattern deposited over the upper surface, wherein the straight stem end portion of each helical antenna element is electrically coupled to the strip line feeder pattern to thereby combine in phase the output signals from each of the helical antenna elements;

an output probe coupled electrically to the strip line feeder pattern to thereby output combined output signals; and

a protective cover, consisting of a radome and a protective layer, completely enclosing the top surface of the first dielectric layer, including the array of M x N helical antenna elements.

FIG. 1

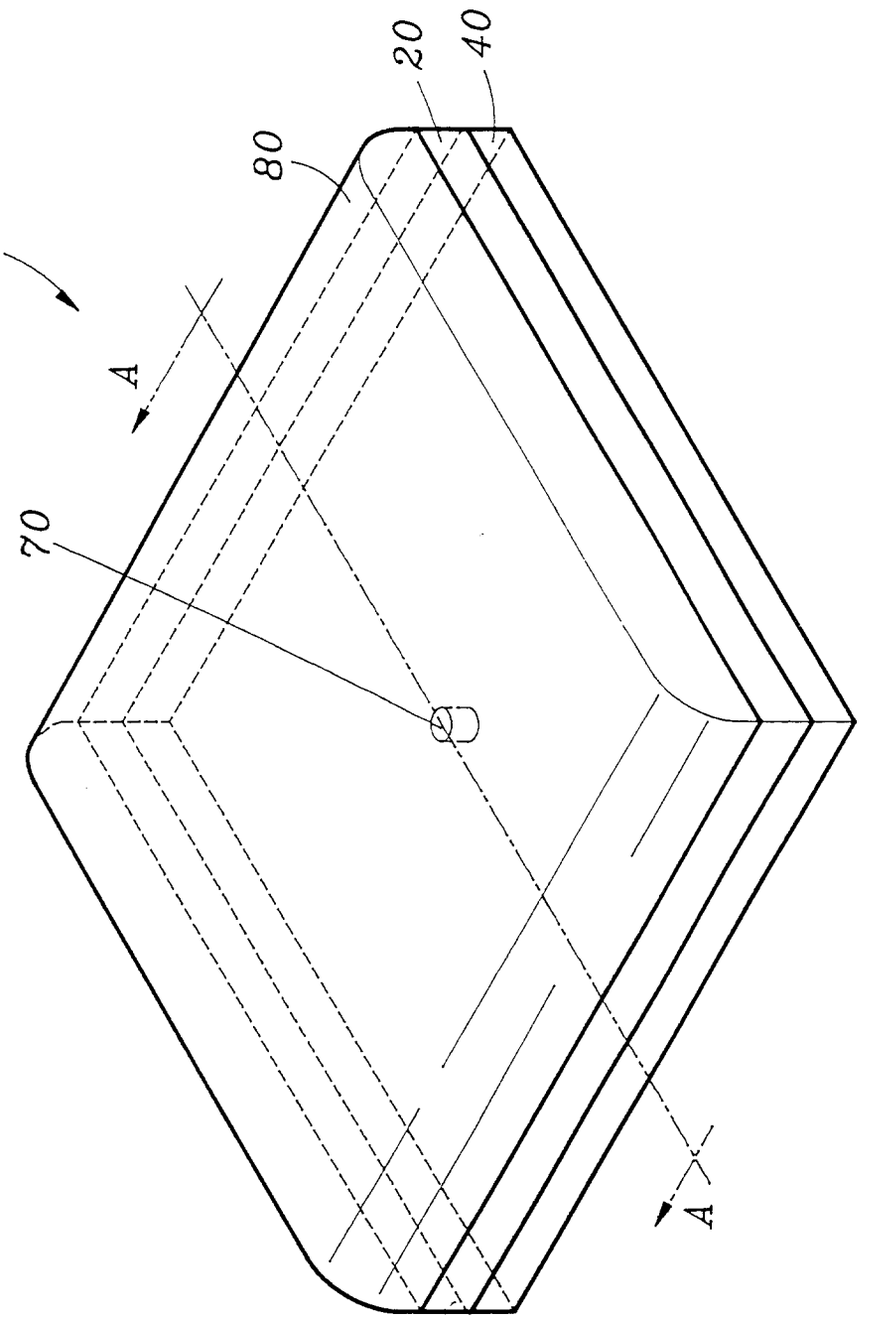


FIG. 2

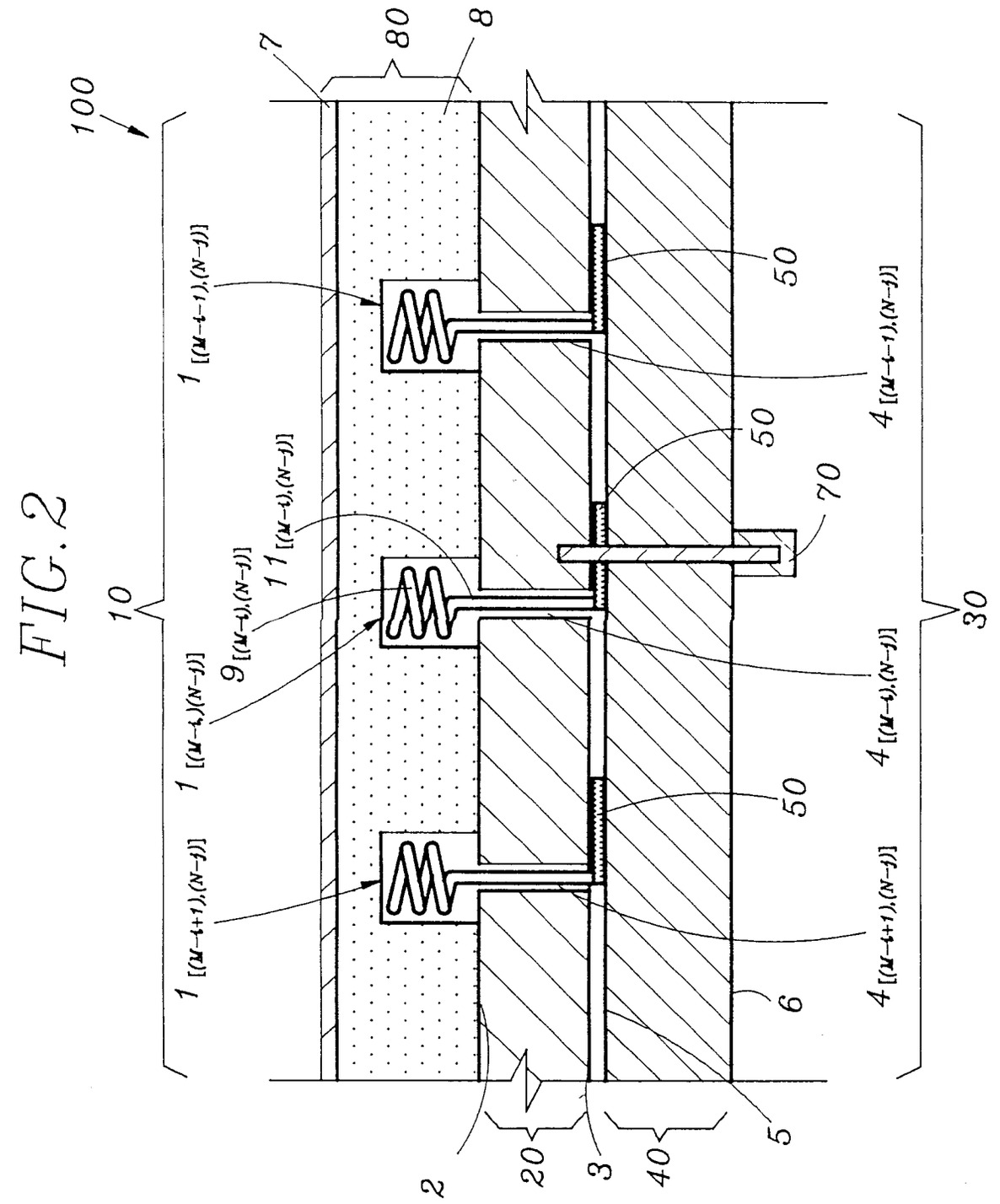

100
10
30
7
80
8
50
70
6
5
2
20
3
40
1 [(M-i-1),(N-j)]
1 [(M-i),(N-j)]
1 [(M-i+1),(N-j)]
9 [(M-i),(N-j)]
11 [(M-i),(N-j)]
4 [(M-i-1),(N-j)]
4 [(M-i),(N-j)]
4 [(M-i+1),(N-j)]

FIG. 3

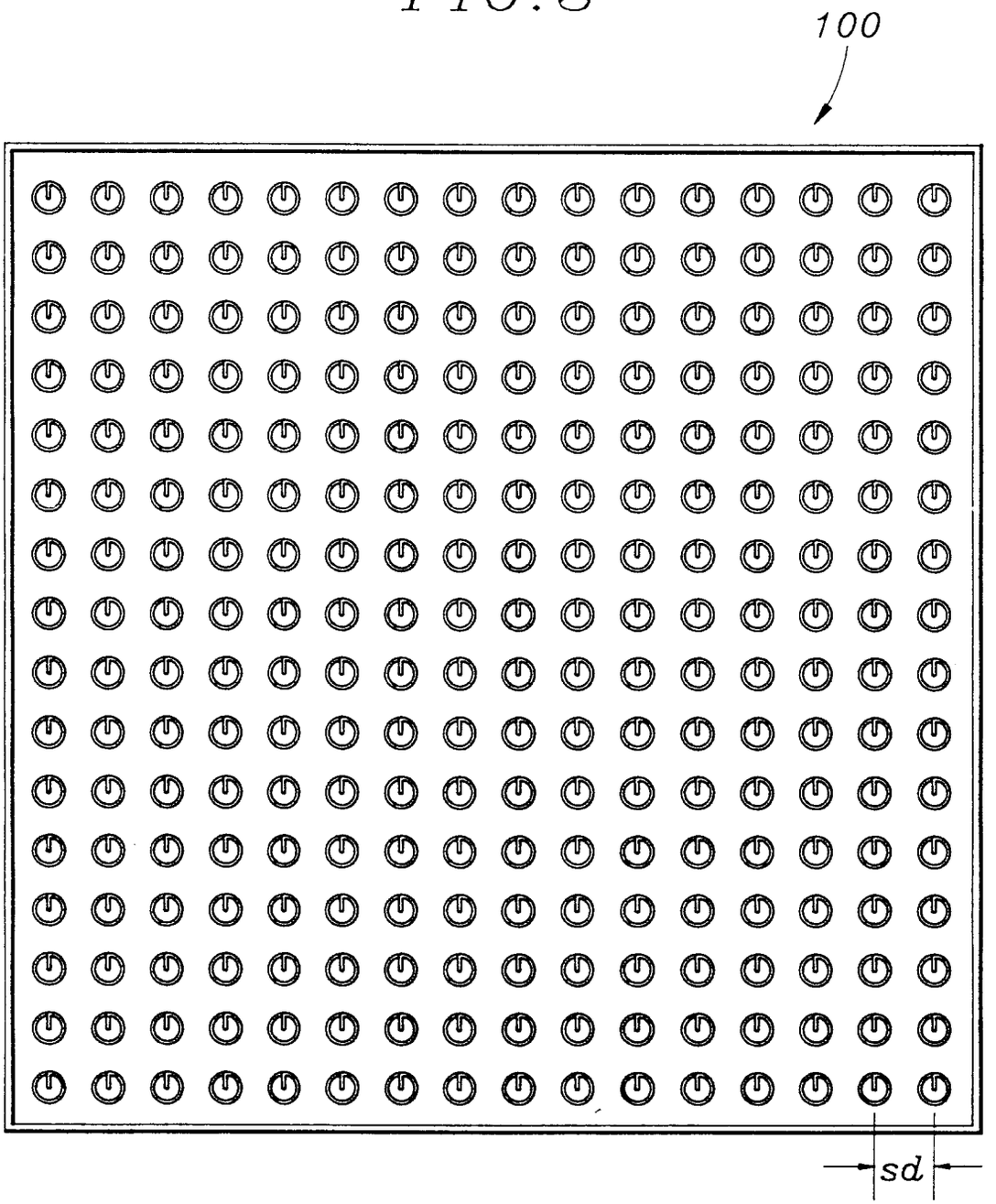


FIG. 4

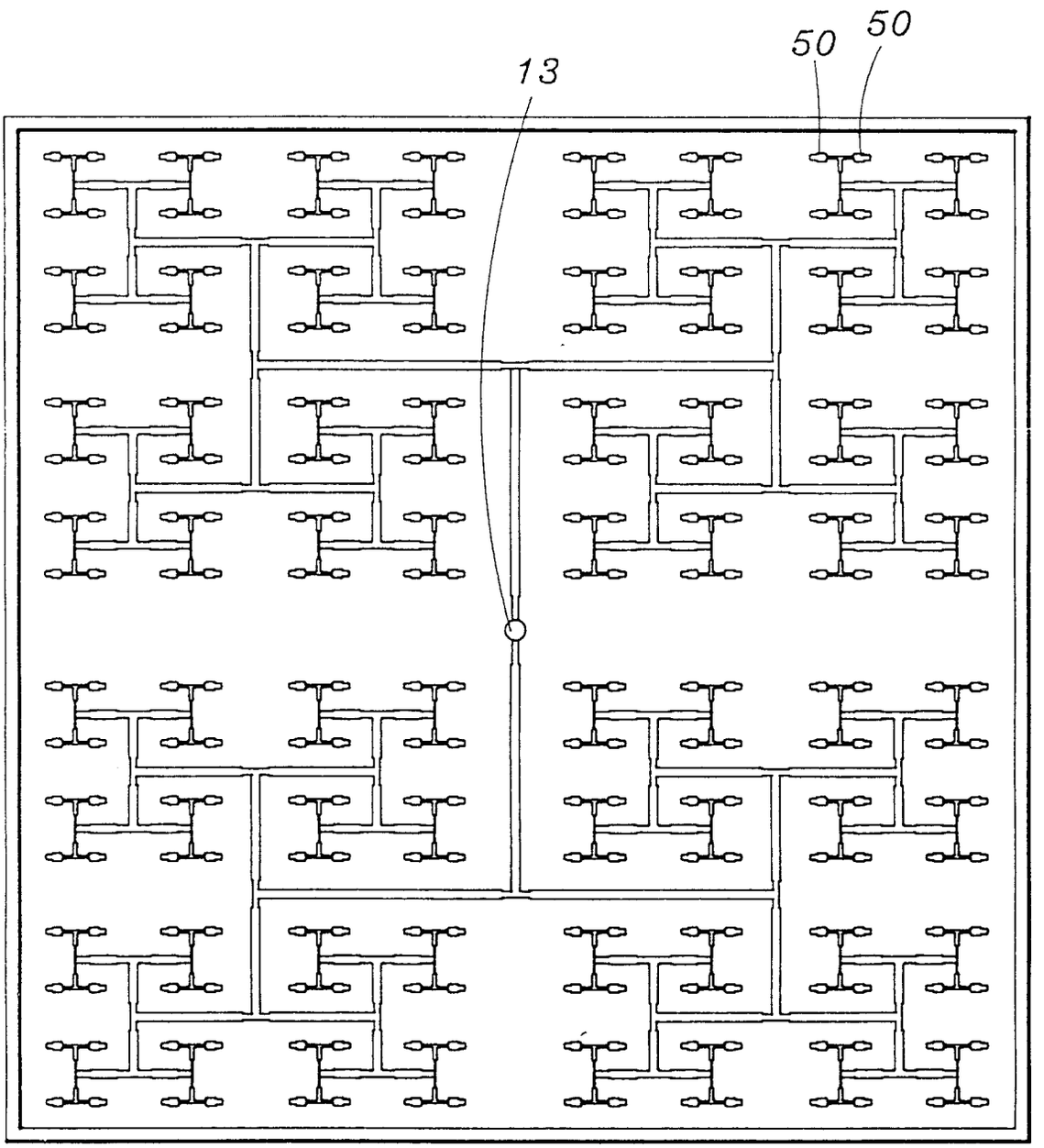
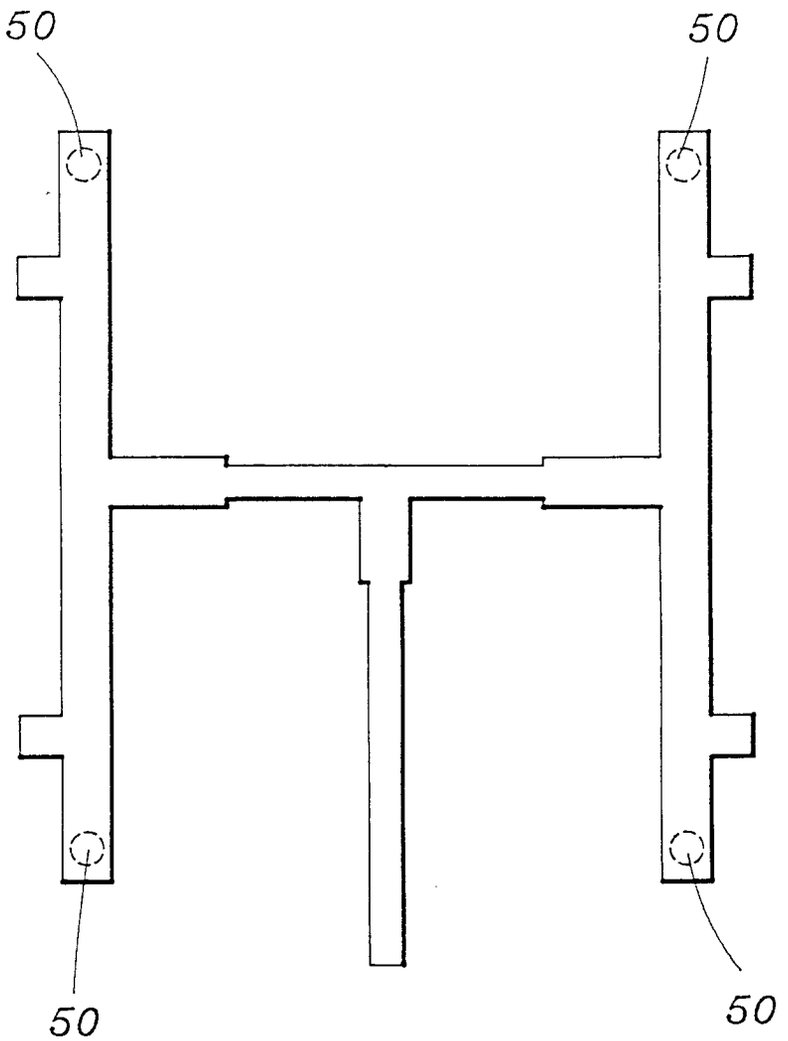


FIG. 5



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 94 11 1998

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	GB-A-2 227 369 (TDK CORP.) * abstract; figures 4,10,12 * * page 12, line 3 - line 13 *	1	H01Q21/00
A	IEEE ANTENNAS & PROPAGATION SOCIETY INTERNATIONAL SYMPOSIUM 1993, vol.2, 28 June 1993, MICHIGAN, U.S.A pages 972 - 975, XP420012 KITAO ET AL. 'KU-BAND PLANAR ARRAY USING RING SHAPED PATCH ANTENNA' * the whole document *	1	
A D	EP-A-0 132 945 (EMI LTD.) * abstract; figures 1,5 * * page 4, line 1 - line 12 * & US-A-4680591(AXFORD ET AL.)	1	
A	GB-A-2 128 416 (ROGERS CORP.) * the whole document *		

TECHNICAL FIELDS SEARCHED (Int.Cl.6)
H01Q

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	27 October 1994	Danielidis, S

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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