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(54) **Electromagnetically coupled microstrip antenna**

Elektromagnetisch gekoppelte Mikrostreifenleiterantenne

Antenne microruban à couplage électromagnétique

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EP 0 957 535 B1

Description

[0001] The present invention relates to a microstrip antenna device and a reception apparatus for receiving a broadcast signal comprising a microstrip antenna device.

[0002] Electromagnetically coupled microstrip antennas (also referred to as "proximity-coupled" antennas) like microstrip antennas in general exhibit only a small bandwidth. Different attempts have been made to increase the bandwidth of microstrip antennas, including the use of thicker substrates, of parasitic elements and of impedance-matching networks.

[0003] In ELECTRONICS LETTERS, 9th April 1987, Vol. 23, No.8, pp. 368-369 an electromagnetically coupled microstrip patch antenna is disclosed consisting of a rectangular microstrip patch on a first substrate and a microstrip feeding line on a second substrate beneath the first substrate. A ground plane is provided beneath the second substrate. The feeding line is centred with respect to the patch width and is inset half the patch length. A feeding line inset smaller and greater than half the patch length is mentioned but an inset equal to half the patch length is described to be advantageous for maximum coupling between the microstrip feeding line and the microstrip patch. To increase the bandwidth of the microstrip antenna a small tuning stub is provided which is connected in shunt with the microstrip feeding line and is located either near the edge of the microstrip patch or about lamda/2 away.

[0004] In IEEE TRANSACTIONS ON ANTENNAS AND PROPAGATION, Vol. AP-38, No. 7, pp. 1136-1140, July 1990, G. Splitt et al, "Guidelines for Design of Electromagnetically Coupled Microstrip Patch Antennas on Two-Layer Substrates", a design rule is disclosed for determining the position of the end of a microstrip feeding line end under a square microstrip patch with reference to the centre of the patch in a two layer structure. According to this design rule the end of the feeding line should be located at a distance of ±0,2 of the patch length from the centre of the microstrip patch.

[0005] In M+RF 97, 30 September - 2 October 1997, London, UK, pp. 59-64, Ammann, Max J., "A broadband proximity-coupled microstrip patch antenna for wireless LANs", the design and evaluation of a two layer electromagnetically coupled microstrip patch antenna is discussed. A microstrip antenna is disclosed consisting of a first substrate on which the square radiator is printed and a second substrate on which the feeding line is printed below the first substrate. To increase radiation efficiency and bandwidth of the radiator the first substrate is relatively thick and consists of a material having a low relative permittivity. To reduce radiation efficiency of the feeding line the second substrate is relatively thin and consists of a material having a high relative permittivity. The feeding line is centred with respect to the patch width. It is described that the patch overlap may be adjusted for best match and optimum impedance bandwidth. In the given example, the open end of the feeding line of the microstrip antenna overlaps the patch by slightly more than half the patch length. The bandwidth is increased by providing a small matching stub positioned on the feeding line.

[0006] US 5,471,664 discloses an input probe LNB (Low Noise Block Converter) for commonly receiving clockwise and counterclockwise circularly polarized waves. The probe comprises a rectangular microstrip patch which is provided at the centre of a circular-shaped ground pattern. Four input probes are arranged adjacent to individual edges of the rectangular microstrip patch.

[0007] US 5,165,109 discloses a microstrip patch antenna having a laminated structure and comprising a microstrip patch on a first surface of a first substrate as well as two feed lines provided on the first surface of a second substrate.

[0008] EP 0 627 783 discloses multi-layer and multi-element array antennas having radiating elements, which are implemented by microstrip technique. According to EP 0 627 783, it is mentioned to be difficult to obtain simultaneously acceptable bandwidth with determined directivity and polarization for communication applications. To provide an antenna of variable directivity, EP 0 627 783 proposes to arrange radiating elements at the interfaces of polarity of dielectric spaces stacked over successive levels in a multi-layer radiating structure. Furthermore, it is mentioned that the multi-layer radiating structure itself is disposed on excitation means. An exciter is shown to be of circular shape and is provided on the surface of a first substrate. A second substrate is disposed on said surface of the first substrate and radiating elements are provided on the free surface of second substrate.

[0009] EP 0 707 357 discloses a receiver which includes a focussing device, such as an electromagnetic lens or a parabolic reflector. A first feed is placed at the focus of the reflector and other feeds are placed on either side of it. The feeds are slot antennas which are preferably in angular form. The receiver multiplexes the incoming signals to a frequency converter which is formed on the same substrate as the feeds.

[0010] In IEEE TRANSACTIONS ON ANTENNAS AND PROPAGATION, April 1988, Vol. 46, No. 4, pp. 475-483, Parrikar et Kuldip, "Multiport Network Model for CAD of Electromagnetically Coupled Microstrip Patch Antennas", an electromagnetically coupled microstrip patch antenna is disclosed consisting basically of a ground plate, a feed circuitry and a patch. As an advantage of a two-layer configuration an increase in radiated power and, consequently, increased bandwidth and efficiency is mentioned. In view of these advantages, a minimum patch overlay of 10% is suggested.

[0011] In IEEE TRANSACTIONS ON ANTENNAS AND PROPAGATION, August 1989, Vol. 37, No. 8, pp. 949-958, Davidovitz et Lo, "Rigorous Analysis of a Cir-

cular Patch Antenna Excited by a Microstrip Transmission Line" a theoretical investigation of an electromagnetically coupled microstrip patch antenna is disclosed, wherein the patch antenna is of circular shape.

[0012] Although the bandwidth may be increased by using a stub positioned on the feeding line of an electromagnetically coupled microstrip antenna, the values achieved in the prior art are not sufficient for employing this kind of antennas in several applications, for example in a reception unit of Direct-To-Home (DTH) satellite reception antennas. These antennas are designed for the reception of direct broadcast signals and conventionally comprise a feedhorn and a LNB as, for example, disclosed in EP-A-0735 610. In order to avoid the transition from hollow waveguide technology, i.e. the feedhorn, to planar waveguide technology, i.e. the LNB, and the losses introduced thereby it is desirable that a microstrip antenna should be available which can be connected as a feed to the LNB of a reception apparatus capable of receiving directly broadcast signals.

[0013] The present invention considers a new field of use for microstrip antenna devices with two-layered dielectric substrates, namely the reception of direct broadcast signals. For this kind of field, the bandwidth values achieved in the prior art are not sufficient.

[0014] Therefore, it is an object of the invention to provide an electromagnetically coupled microstrip antenna exhibiting an increased bandwidth.

[0015] This object is solved by the a microstrip antenna device according to the claims 1 - 18 and according to the claims 19 - 33. Furthermore, according to the claims 34 - 36 a reception apparatus for receiving broadcast signals comprises a microstrip antenna device according to the claims 1 - 18 or the claims 19 - 33.

[0016] The inventive solution is based on the cognition that the microstrip antenna is essentially free from an overlap between the main antenna element and the feeding element or elements.

[0017] The microstrip antenna device according to the claims 1 - 18 refers to the case in which horizontally and vertically polarized waves can be received if more than one feeding element is provided.

[0018] The microstrip antenna device according to the claims 19 - 33 refers to a range outside the range of the microstrip antenna device according to the claims 1 - 18 specifically for the reception of horizontally and vertically polarized waves. It has been observed that this solution leads to a better port isolation and a better cross-polar rejection of the horizontally and vertically polarized waves.

[0019] It is essential to realize that according to the invention no overlap between the antenna element and the feeding element is required. In contrast to prior art devices, an overlap-free arrangement is the basis for the design and evaluation of microstrip antennas suitable for different purposes. Therefore, a microstrip antenna essentially free from overlap between the main antenna element and the feeding element or elements is the preferred embodiment.

[0020] The object is solved according to a first solution of the invention by a microstrip antenna device according to the claims 1 - 18 comprising a first substrate; an antenna element provided on a first surface of the first substrate; a second substrate; and a first feeding element provided between a second surface of the first substrate and a first surface of the second substrate; wherein an end portion of the first feeding element is positioned within a range of -0,3L and +0,1L from an edge portion of the antenna element, wherein L is the extension of the antenna element in a direction parallel to the direction of overlap.

[0021] According to an aspect of the first solution of the invention, a second feeding element is provided between the second surface of the first substrate and the first surface of the second substrate, an end portion of the second feeding element is positioned within a range of -0,3L and +0,1L from an edge portion of the antenna element, wherein L is the extension of the antenna element in a direction parallel to the direction of overlap.

[0022] Typically, said first and/or second feeding elements are elongated feeding lines. Further, said first and second feeding elements are usually arranged substantially perpendicularly to each other.

[0023] To match impedances, an impedance-matching means can be provided in a microstrip antenna according to the invention. Typically, impedance-matching means is an impedance-matching network connected to the first and/or second feeding element.

[0024] Advantageously, the first and/or second feeding element is centred with respect to the respective edge portion of the antenna element.

[0025] The antenna element can be square-shaped, rectangular-shaped, circular-shaped or elliptical-shaped.

[0026] A ground element can be provided on a second surface of said second substrate.

[0027] To improve gain and for beam forming a third substrate can be provided. On a first surface of the third substrate additional antenna elements are arranged. The third substrate is arranged such that the main antenna element is interposed between the first surface of the first substrate and a second surface of the third substrate.

[0028] Preferably, the additional antenna elements are arranged symmetrically with respect to the centre of the main antenna element.

To achieve electromagnetical coupling, the additional antenna elements are arranged to overlap with the main antenna element.

[0029] The additional antenna elements may be square-shaped, rectangular-shaped, circular-shaped or elliptical-shaped.

[0030] The antenna device may have a stacked structure.

[0031] Furthermore, the object is solved according to a second solution of the invention by the microstrip an-

tenna device according to the claims 19 - 33 comprising a first substrate; a square-shaped antenna element provided on a first surface of the first substrate; a second substrate; a first elongated feeding element provided between a second surface of the first substrate and a first surface of the second substrate; and a second elongated feeding element provided between the second surface of the first substrate and the first surface of the second substrate; wherein an end portion of the first elongated feeding element and an end portion of the second elongated feeding element are positioned within a range of -0,3L and -0,5 (L-W) from a respective edge portion of the square-shaped antenna element. Here, L is the extension of the square-shaped antenna element in a direction parallel to the direction of overlap and W is the width of the respective elongated feeding element having a range of $0 < W < 0,4L$.

[0032] Also in this embodiment, it is essential to realize that according to the invention no overlap between the antenna element and the feeding element is required. In contrast to prior art devices, an overlap-free arrangement is the basis for the design and evaluation of microstrip antennas suitable for different purposes. Therefore, a microstrip antenna essentially free from overlap between the main antenna element and the feeding element or elements is the preferred embodiment.

[0033] Moreover, by employing two feeding elements a microstrip antenna device is achieved for receiving horizontally and vertically polarized waves with the same antenna device.

[0034] Typically, the first and second feeding elements are arranged substantially perpendicularly to each other.

[0035] For matching impedances, an impedance-matching means can be provided which usually takes the form of an impedance-matching network connected to the first and second elongated feeding element, respectively.

[0036] The first and/or second elongated feeding element is arranged at the centre of the respective edge portion of the square-shaped antenna element.

[0037] A ground element can be provided on a second surface of the second substrate.

[0038] To improve gain and for beam forming a third substrate can be provided. On a first surface of the third substrate additional antenna elements are provided. The third substrate is arranged such that the square-shaped antenna element is interposed between the first surface of the first substrate and a second surface of the third substrate.

[0039] Preferably, the additional antenna elements are arranged symmetrically with respect to the centre of the square-shaped antenna element.

[0040] To improve gain and for beam forming a third substrate can be provided. On a first surface of the third substrate additional antenna elements are provided. The third substrate is arranged such that the antenna element is interposed between the first surface of the first substrate and a second surface of the third substrate.

[0041] Preferably, the additional antenna elements are arranged symmetrically with respect to the centre of the square-shaped antenna element.

[0042] The additional antenna elements are arranged to overlap with said main antenna element to achieve an electromagnetical coupling.

[0043] The additional antenna elements may be square-shaped, rectangular-shaped, circular-shaped or elliptical-shaped.

[0044] The antenna device may have a stacked structure.

[0045] A reception apparatus for receiving a broadcast signal comprises a microstrip antenna device according to the first solution or according to the second solution of the invention and further comprises a converter means for converting the frequency of the received broadcast signal. Advantageously, the converter means is provided in planar waveguide technology to avoid transition losses.

[0046] A switching matrix can be provided for distributing on demand signals received from said converter means.

[0047] Any reception apparatus described above is suitable for receiving broadcast signals from satellites at two orbital positions. If broadcast signals from more than two orbital positions shall be received additional microstrip antenna device according to the invention can be added to a reception apparatus according to the invention.

[0048] In the following a preferred embodiment and further embodiments of the invention will be described with reference to the drawings.

Fig. 1 and 2	show a top-view and a side-view of a first embodiment of the invention;
Fig. 3 and 4	show a top-view and a side-view of a second embodiment of the invention;
Fig. 5 and 6	show a top-view and a side-view of a third embodiment of the invention;
Fig. 7	shows a DTH satellite reception antenna arrangement;
Fig. 8	shows a first embodiment of the reception apparatus according to the invention;
Fig. 9	shows an arrangement of two microstrip antennas according to the invention for reception of two orbital positions; and
Fig. 10	shows a second embodiment of the reception apparatus according to the in-

vention;

Fig. 11 shows a third embodiment of the reception apparatus according to the invention; and

Fig. 12 shows a fourth embodiment of the reception apparatus according to the invention.

[0049] In a preferred embodiment of an electromagnetically coupled microstrip antenna according to the invention as shown in Fig. 1 and 2, a first substrate 1 has a height h1 and consists of a dielectric material having a relative permittivity E1. An antenna element 2 is provided on a first surface 1a of the first substrate 1. In this embodiment, the antenna element 2 takes the form of a rectangular microstrip patch element having an length of L. A second substrate 3 is provided below the first substrate 1. The second substrate 3 has a height h2 and consists of a dielectric material having a relative permittivity E2. A feeding element 4 is interposed between the first and second substrate. The feeding element 4 may be provided on the second surface 1b of the first substrate 1 or a first surface 3a of the second substrate 3. In this embodiment, the feeding element 4 takes the form of an elongated feeding line.

[0050] In this preferred embodiment of the invention, an end portion 4a of the elongated feeding line 4 is located underneath an edge portion 2a of the microstrip patch element 2 substantially without any overlap (O = 0%). Preferably, the feeding line 4 is centered with respect to the edge portion 2a. In accordance with the invention and as indicated in Fig. 2, the end portion 4a of the elongated feeding line 4 may be located within a range of -0,3L and +0,3L from the edge portion of the microstrip patch element 2 (O = ±30%), wherein L is the extension of the antenna element 2 in a direction parallel to the direction of overlap with the feeding element 4. In other words, according to the invention an end portion of the feeding element is positioned within an area symmetrically arranged with respect to an respective edge portion of the antenna element. In the preferred embodiment, the antenna element and the feeding element do not overlap.

[0051] As shown in Fig. 2 a ground element 5 is provided on a second surface 3b of the second substrate 3, the ground element 5 taking the form of a ground plane substantially covering the entirety of the second surface 3b of the second substrate 3.

[0052] Two examples of the preferred embodiment of the invention have been examined. In both examples the relative permittivity of the substrates 1 and 3 was chosen to

$$E1 = E2 = 3.38 \pm 0.05.$$

[0053] In one example the heights of the substrates 1 and 3 were chosen to

$$h1 = h2 = 0{,}81 \text{ mm}.$$

[0054] In the other example the heights of the substrate 1 and 3 were chosen to

$$h1 = 1{,}52 \text{ mm and } h2 = 0{,}81 \text{ mm}.$$

[0055] The two examples were designed by means of a simulation tool based on the method of moments. The design of the microstrip antenna included on the one hand the optimization of the patch length L, the feeding line width W and the overlap O, and on the other hand the impedance-matching network. The patch length L corresponds to the specified resonant frequency (center frequency of the considered frequency range). The feeding line width W was optimized and the best bandwidth was achieved using a 50 Ohm feeding line. The feeding line did not overlap with the antenna element (overlap O = 0%) whereby a broadband matching was realized. The optimized values for the second example (h1 = 1,52 mm and h2 = 0,81 mm) are L = 5,2 mm, W = 1,9 mm and O = 0 mm.

[0056] With both examples a bandwidth of more than 17.5 % (VSWR <= 2) was achieved.

[0057] In a further preferred embodiment of the electromagnetically coupled microstrip antenna according to the invention, which is capable of receiving two perpendicular polarized broadcast signals, as shown in Fig. 3 and 4, a first substrate 11 has a height h11 and consists of a dielectric material having a relative permittivity E11. An antenna element 12 is provided on a first surface 11a of the first substrate 11. In this embodiment, the antenna element 12 takes the form of a square microstrip patch element having an edge length L. A second substrate 13 is provided below the first substrate 11. The second substrate 13 has a height h12 and consists of a dielectric material having a relative permittivity E12. A first feeding element 14 is interposed between the first and second substrate. The first feeding element 14 may be provided on the second surface 11b of the first substrate 11 or a first surface 13a of the second substrate 13. In this embodiment, the first feeding element 14 takes the form of an elongated feeding line. A second feeding element 15 is interposed between the first and second substrate. The second feeding element 15 may be provided on the second surface 11b of the first substrate 11 or a first surface 13a of the second substrate 13. In this embodiment, the second feeding element 15 takes the form of an elongated feeding line. The second feeding element 15 extends in a direction substantially perpendicular to said first feeding element 14.

[0058] In this preferred embodiment of the invention, an end portion 14a of the first elongated feeding line 14

is located underneath a first edge portion 12a of the square microstrip patch element 12 substantially without any overlap (O = 0%). Likewise, an end portion 15a of the second elongated feeding line 15 is located underneath a second edge portion 12b of the square microstrip patch element 12 substantially without any overlap (O = 0%). Preferably, the feeding lines 14 and 15 are centered with respect to the respective edge portion 12a and 12b. In accordance with the invention and as indicated in Fig.3, the end portion 14a of the first elongated feeding line 14 and the end portion 15a of the second elongated feeding line 15 may be located such that the first and second elongated feeding line are separated from each other within a range of -1/2· (L-W) and +1/2· (L-W) from the respective edge portion of the microstrip patch element 12, wherein L is generally the extension of the antenna element 12 in the direction of overlap with the respective feeding element 14, 15 and W is the width of the feeding element 14, 15. In other words, according to the invention an end portion of the feeding element is positioned within an area symmetrically arranged with respect to an respective edge portion of the antenna element.

[0059] As shown in Fig. 3 a ground element 16 is provided on a second surface 13b of the second substrate 13, the ground element 16 taking the form of ground plane substantially covering the entirety of the second surface 13b of the second substrate 13.

[0060] In Fig. 1 and 3 impedance-matching networks 20 are shown which are provided to match the impedance of the microstrip antenna to, for example, a 50 Ohm system which is usually used in DTH satellite antennas. Each impedance-matching network 20 comprises a first section 21 having a length L1 and a width W1 and a second section 22 having a length L2 and a width W2. The appropriate variation of these values makes it possible to realize impedance matching. The impedance networks 20 are not necessarily identical but may be adapted to the conditions given by the design of the individual feeding element. However, it is advantageous to realize the impedance networks in planar waveguide technology to avoid transition losses.

[0061] To improve beam forming and gain of the electromagnetically coupled microstrip antenna according to the invention, as shown in Fig. 1 to 4, can be provided, as shown in Fig. 5 and 6, with a third substrate 31 on a first surface 31a of which additional antenna elements 32 are provided and which is positioned with a second surface 31b on the first surface 1a, 11a of the first substrate 1, 11. In other words, the main antenna element 2 is interposed between the first and third substrates. The third substrate 31 has a height h31 and consists of a dielectric material having a relative permittivity E31.

[0062] In Fig. 5 and 6 an electromagnetically coupled microstrip antenna having such a third substrate 31 and additional antenna elements 32 is shown which is based on the embodiment of Fig. 1 and 2, however, comprising a square microstrip antenna element 2 provided on the first surface 1a of the first substrate 1. The remaining elements of the embodiment of Fig. 1 and 2 are unchanged and therefore not discussed in further detail. Instead, reference is made to the above description of Fig. 1 and 2.

[0063] As shown in Fig. 5, four additional antenna elements 32a to 32d are provided on the first surface 31a of the third substrate 31. The four additional square antenna elements 32a to 32d are positioned symmetrically with respect to the center of the antenna element 2 on the first surface 1a of the first substrate 1 with a distance d between adjacent edges. The additional square antenna elements 32a to 32d have an edge length of L'. The symmetrical arrangement in both directions secures the same reception conditions for both polarizations. Therefore, the four additional square antenna elements 32a to 32d can be provided advantageously also in the embodiment of Fig. 3 and 4. The additional antenna elements 32 are fed through the overlapping between these elements and the antenna element 2 provided on the first substrate 1. A constructive superposition of the waves and therefore beam forming is possible with this embodiment of the invention.

[0064] With an electromagnetically coupled microstrip antenna according to the invention it is nor required to use an adhesive film for attaching the substrates to each other. This kind of attachment achieved by adhesive films is known in the prior art and usually addressed as a multilayer structure. Instead, according to another aspect of the invention the substrates are attached to each other by mechanical attaching means like screws, bolts etc. The resulting structure is called stacked structure. The advantage achieved thereby is that losses which are caused by the presently available adhesive films can be avoided.

[0065] With an electromagnetically coupled microstrip antenna it is possible to provide a reception apparatus which is capable of receiving directly broadcast signals. In a DTH reception arrangement as shown in Fig. 7 a reflector 40 is combined with a reception apparatus 41.

[0066] According to the invention, as shown in Fig. 8, a first embodiment of the reception apparatus 41 comprises an electromagnetically coupled microstrip antenna 42 as described and an LNB 43. Advantageously, the embodiment of Fig. 3 and 4 is employed to supply a signal H for horizontally polarized waves and a signal V for vertically polarized waves to the LNB 43. Since the antenna 42 and the LNB 43 are realized in planar waveguide technology transition losses are avoided. -

[0067] For reception of two orbital satellite positions a first and a second antenna 42a and 42b can be provided in a reception apparatus 41 as shown in Fig. 9 showing only a top-view of the microstrip antenna device. Reference is made to Fig. 1 to 6 for further details. The first and the second antenna 42a and 42b are spaced from each other such that broadcast signals from a satellite at a first orbital position can be received

simultaneously with broadcast signals from a satellite at a second orbital position. Either the first or the second antenna 42a or 42b is positioned in the focus of the reflector 40 (see Fig. 7) or both antennas 42a and 42b are positioned out of but close to the focus of the reflector 40 (see Fig. 7). These approaches are well known from DTH satellites antenna arrangements comprising a reception apparatus having a feedhorn in hollow waveguide technology and are therefore not discussed here in further detail.

[0068] A second embodiment of the reception apparatus according to the invention is shown in Fig. 10. In this reception apparatus 61, the output signals of the electromagnetically coupled microstrip antennas 62a and 62b, which correspond to the antennas 42a and 42b in Fig. 9 and which are shown in Fig. 10 to output a signal H corresponding to a received horizontally polarized broadcast wave and a signal V corresponding to a received vertically polarized broadcast wave, may be supplied to a single LNB 63 comprising low-noise amplifiers 64a and 64b, frequency mixers 65a and 65b and a local oscillator 66 via a connecting means 67 being adapted for supplying selectively the output signals H, V of one of the microstrip antennas 62a, 62b to the low-noise amplifiers 64a, 64b. The connecting means 67 can be realized by means of a switch for connecting the inputs of the low-noise amplifiers 64a, 64b with either the outputs H, V of the first microstrip antenna 62a or of the second microstrip antenna 62b. A control signal C is supplied to the connecting means 67 accordingly. The output signals RF of the low-noise amplifiers 64a, 64b are supplied to the frequency mixers 65a, 65b which are also supplied with an output signal from the local oscillator 66. The frequency mixers 65a, 65b comprise outputs 68a, 68b each of which supplying an output signal from the reception apparatus to individual user devices.

[0069] A third embodiment of the reception apparatus according to the invention is shown in Fig. 11. In this reception apparatus 71 the output signals of the electromagnetically coupled microstrip antennas 72a and 72b, which also correspond to the antennas 42a and 42b in Fig. 9 and which are shown in Fig. 11 to output a signal H corresponding to a received horizontally polarized broadcast wave and a signal V corresponding to a received vertically polarized broadcast wave, may be supplied to an individual one of low-noise amplifiers 73a, 73b, 73c, 73d. The output signals of the low-noise amplifiers 73a, 73b, 73c, 73d are supplied to a connecting means 74 being adapted for supplying selectively the output signals RF of the low-noise amplifiers 73a, 73b, 73c, 73d to individual frequency mixers 75a, 75b which are also supplied with an output signal of a local oscillator 76. The connecting means 74 can be realized by means of a switch for connecting the inputs of the frequency mixers 75a, 75b with either the outputs of the low-noise amplifiers 73a, 73b connected to the first antenna 72a or the outputs of the low-noise amplifiers 73c, 73d connected to the second antenna 72b. A control signal C is supplied to the connecting means 74 accordingly. The frequency mixers 75a, 75b comprise outputs 77a, 77b each of which supplying an output signal from the reception apparatus to individual user devices.

[0070] In a fourth embodiment a switching matrix is provided in the reception apparatus 51 according to the invention. The switching matrix distributes the signals from one or more microstrip antennas, LNBs or frequency mixers to outputs supplying an output signal from the reception apparatus to individual user devices. In Fig. 12, a reception apparatus 51 is shown comprising two electromagnetically coupled microstrip antennas 52a and 52b each of which supplying a signal H corresponding to a received horizontally polarized broadcast wave and a signal V corresponding to a received vertically polarized broadcast wave to low-noise amplifiers 53a to 53d. RF signals from the low-noise amplifiers 53a to 53d are supplied to frequency mixers 54a to 54d each of which receiving a reference frequency from a local oscillator 55. IF signals from the individual frequency mixers 54a to 54d are fed to a switching matrix 56 distributing on demand the received IF signals to anyone of the four outputs 57a to 57d. The switching matrix 56 may be realized in planar waveguide technology, like the microstrip antennas and the LNB, to reduce the complexity of the overall system and to further avoid transition losses. The switching matrix may be combined with any one of the first to third embodiment of the reception apparatus according to the invention as described above with reference to Fig. 8 to 11.

Claims

1. Microstrip antenna device, comprising:

- a first substrate (1, 11);
- an antenna element (2, 12) provided on a first surface (1a, 11a) of said first substrate;
- a second substrate (3, 13); and
- a first feeding element (4, 14) provided between a second surface (1b, 11b) of said first substrate and a first surface (3a, 13a) of said second substrate;

characterized in that

- an end portion (4a, 14a) of said first feeding element (4, 14) is positioned within a range of -0,3L and +0,1L from an edge portion (2a, 12a) of said antenna element (2, 12), wherein L is the extension of said antenna element (2, 12) in a direction parallel to the direction of overlap.

2. Microstrip antenna device according to claim 1,

wherein a second feeding element (15) is provided between said second surface (1b, 11b) of said first substrate (1, 11) and said first surface (3a, 13a) of said second substrate (3, 13), an end portion (15a) of said second feeding element (15) is positioned within a range of - 0,3L and +0,1L from an edge portion (12b) of said antenna element (2, 12), wherein L is the extension of said antenna element (2, 12) in a direction parallel to the direction of overlap.

3. Microstrip antenna device according to one of the claims 1 - 2, wherein said first and/or second feeding elements (4, 14, 15) are elongated feeding lines.

4. Microstrip antenna device according to claim 3, wherein said first and second feeding elements (4, 14, 15) are arranged substantially perpendicularly to each other.

5. Micostrip antenna device according to one of the claims 1 - 4, wherein an impedance-matching means (20) is provided.

6. Microstrip antenna device according to claim 5, wherein said impedance-matching means is an impedance-matching network (20, 21, 22) connected to said first and/or second feeding element (4, 14, 15).

7. Microstrip antenna device according to one of the claims 1 - 6, wherein said first and/or second feeding element (4, 14, 15) is arranged at the centre of said edge portion (2a, 12a, 12b) of said antenna element (2, 12).

8. Microstrip antenna device according to one of the claims 1 - 7, wherein said antenna element (2, 12) is square-shaped.

9. Microstrip antenna device according to one of the claims 1 - 7, wherein said antenna element (2, 12) is rectangular-shaped.

10. Microstrip antenna device according to of one of the claims 1 - 7, wherein said antenna element (2, 12) is circular-shaped or elliptical-shaped.

11. Microstrip antenna device according to of one of the claims 1 - 10, wherein a ground element (5, 16) is provided on a second surface (3b, 13b) of said second substrate (3, 13).

12. Microstrip antenna device according to one of the claims 1 - 11, wherein a third substrate (31) on a first surface (31a) of which additional antenna elements (32a, 32b, 32c, 32d) are provided, said third substrate (31) being provided such that said antenna element (2) is interposed between said first surface (1a, 11a) of said first substrate (1, 11) and a second surface (31b) of said third substrate (31).

13. Microstrip antenna device according to claim 12, wherein said additional antenna elements (32a, 32b, 32c, 32d) are arranged symmetrically with respect to the centre of said antenna element (2).

14. Microstrip antenna device according to one of the claims 12 and 13, wherein said additional antenna elements 32a, 32b, 32c, 32d) are arranged to overlap with said first antenna element (2).

15. Microstrip antenna device according to one of the claims 12 - 14, wherein said additional antenna elements (32a, 32b, 32c, 32d) are square-shaped.

16. Microstrip antenna device according to one of the claims 12 - 14, wherein said additional antenna elements (32a, 32b, 32c, 32d) are rectangular-shaped.

17. Microstrip antenna device according to one of the claims 12 - 14, wherein said additional antenna elements (32a, 32b, 32c, 32d) are circular-shaped or elliptical-shaped.

18. Microstrip antenna device according to one of the claims 1 - 17, wherein the antenna device has a stacked structure.

19. Microstrip antenna device, comprising:

- a first substrate (11);
- a square-shaped antenna element (12) provided on a first surface (11a) of said first substrate;
- a second substrate (13);
- a first elongated feeding element (14) provided between a second surface (11b) of said first substrate (11) and a first surface (13a) of said second substrate (13); and
- a second elongated feeding element (15) provided between said second surface (11b) of said first substrate (11) and said first surface (13a) of said second substrate (13);

characterized in that

- an end portion (14a) of said first elongated feeding element (14) and an end portion (15a) of said second elongated feeding element are positioned within a range of -0,3L and -0,5 (L-W) from a respective edge portion (12a, 12b) of said square-shaped antenna element (12),

wherein L is the extension of said square-shaped antenna element (12) in a direction parallel to the direction of overlap and W is the width of the respective elongated feeding element having a range of 0 < W < 0,4L.

20. Microstrip antenna device according to claim 19, wherein said first and second feeding elements (4, 14, 15) are arranged substantially perpendicularly to each other.

21. Microstrip antenna device according to one of the claims 19 - 20, wherein an impedance-matching means (20) is provided.

22. Microstrip antenna device according to claim 21, wherein said impedance-matching means is an impedance-matching network (20, 21, 22) connected to said first and second feeding element (4, 14, 15), respectively.

23. Microstrip antenna device according to one of the claims 19 - 22, wherein said first and/or second elongated feeding element (14, 15) is arranged at the centre of the respective edge portion (12a, 12b) of said square-shaped antenna element (12).

24. Microstrip antenna device according to one of the claims 19 - 23, wherein a ground element (16) is provided on a second surface (13b) of said second substrate (13).

25. Microstrip antenna device according to one of the claims 19 - 24, wherein a third substrate (31) on a first surface (31a) of which additional antenna elements (32a, 32b, 32c, 23d) are provided, said third substrate (31) being provided such that said square-shaped antenna element (12) is interposed between said first surface (1a, 11a) of said first substrate (1, 11) and a second surface (31b) of said third substrate (31).

26. Microstrip antenna device according to claim 25, wherein said additional antenna elements (32a, 32b, 32c, 32d) are arranged symmetrically with respect to the centre of said square-shaped antenna element (12).

27. Microstrip antenna device according to one of the claims 19 - 26, wherein a third substrate (31) on a first surface (31a) of which additional antenna elements (32a, 32b, 32c, 32d) are provided, said third substrate (31) being provided such that said antenna element (2) is interposed between said first surface (1a, 11a) of said first substrate (1, 11) and a second surface (31b) of said third substrate (31).

28. Microstrip antenna device according to claim 27, wherein said additional antenna elements (32a, 32b, 32c, 32d) are arranged symmetrically with respect to the centre of said antenna element (2).

29. Microstrip antenna device according to one of the claims 27 - 28, wherein said additional antenna elements (32a, 32b, 32c, 32d) are arranged to overlap with said first antenna element (2).

30. Microstrip antenna device according to one of the claims 27 - 29, wherein said additional antenna elements (32a, 32b, 32c, 32d) are square-shaped.

31. Microstrip antenna device according to one of the claims 27 - 29, wherein said additional antenna elements (32a, 32b, 32c, 32d) are rectangular-shaped.

32. Microstrip antenna device according to one of the claims 27 - 29, wherein said additional antenna elements (32a, 32b, 32c, 32d) are circular-shaped or elliptical-shaped.

33. Microstrip antenna device according to one of the claims 19 - 32, wherein the antenna device has a stacked structure.

34. Reception apparatus for receiving a broadcast signal comprising a microstrip antenna device (42) according to one of the claims 1 - 18 or one of the claims 19 - 33 and a converter means (43) for converting the frequency of the received broadcast signal.

35. Reception apparatus according to claim 34, wherein said converter means (43) is provided in planar waveguide technology.

36. Reception apparatus for receiving broadcast signals according to one of the claims 34 - 35, wherein a switching matrix (56) is provided for distributing on demand signals received from said converter means (43; 53a, 53b, 53c, 53d, 54a, 54b, 54c, 54d, 55).

Patentansprüche

1. Mikrostrip-Antenneneinheit, umfassend:

- ein erstes Substrat (1, 11);
- ein Antennenelement (2, 12), das auf einer ersten Oberfläche (1a, 11a) des ersten Substrats vorgesehen ist;
- ein zweites Substrat (3, 13); und

- ein erstes Zuführungselement (4, 14), das zwischen einer zweiten Oberfläche (1b, 11b) des ersten Substrats und einer ersten Oberfläche (3a, 13a) des zweiten Substrats vorgesehen ist;

dadurch gekennzeichnet, dass

- ein Endbereich (4a, 14a) des ersten Zuführungselements (4, 14) in einem Bereich von -0,3L und +0,1L von einem Randbereich (2a, 12a) des Antennenelements (2, 12) positioniert ist, wobei L die Ausdehnung des Antennenelements (2, 12) in einer zur Überlappungsrichtung parallelen Richtung ist.

2. Mikrostrip-Antenneneinheit gemäß Anspruch 1, wobei ein zweites Zuführungselement (15) zwischen der zweiten Oberfläche (1b, 11b) des ersten Substrats (1, 11) und der ersten Oberfläche (3a, 13a) des zweiten Substrats (3, 13) vorgesehen ist, wobei ein Endbereich (15a) des zweiten Zuführungselements (15) in einem Bereich von -0,3L und +0,1L von einem Randbereich (12b) des Antennenelements (2, 12) positioniert ist, wobei L die Ausdehnung des Antennenelements (2, 12) in einer zur Überlappungsrichtung parallelen Richtung ist.

3. Mikrostrip-Antenneneinheit gemäß einem der Ansprüche 1 - 2, wobei besagte erste und/oder zweite Zuführungselemente (4, 14, 15) verlängerte Zuführungsleitungen sind.

4. Mikrostrip-Antenneneinheit gemäß Anspruch 3, wobei besagte erste und zweite Zuführungselemente (4, 14, 15) im Wesentlichen senkrecht zueinander angeordnet sind.

5. Mikrostrip-Antenneneinheit gemäß einem der Ansprüche 1 - 4, wobei ein Mittel zur Impedanzanpassung (20) vorgesehen ist.

6. Mikrostrip-Antenneneinheit gemäß Anspruch 5, wobei das Mittel zur Impedanzanpassung ein mit dem ersten und/oder dem zweiten Zuführungselement (4, 14, 15) verbundenes Impedanzanpassungsnetz (20, 21, 22) ist.

7. Mikrostrip-Antenneneinheit gemäß einem der Ansprüche 1 - 6, wobei besagtes erstes und/oder zweites Zuführungselement (4, 14, 15) im Mittelpunkt des Randbereichs (2a, 12a, 12b) des Antennenelements (2, 12) angeordnet ist.

8. Mikrostrip-Antenneneinheit gemäß einem der Ansprüche 1 - 7, wobei besagtes Antennenelement (2, 12) quadratisch geformt ist.

9. Mikrostrip-Antenneneinheit gemäß einem der Ansprüche 1 - 7, wobei besagtes Antennenelement (2, 12) rechteckig geformt ist.

10. Mikrostrip-Antenneneinheit gemäß einem der Ansprüche 1 - 7, wobei besagtes Antennenelement (2, 12) kreisförmig oder elliptisch geformt ist.

11. Mikrostrip-Antenneneinheit gemäß einem der Ansprüche 1 - 10, wobei ein Masseelement (5, 16) auf einer zweiten Oberfläche (3b, 13b) des besagten zweiten Substrats (3, 13) vorgesehen ist.

12. Mikrostrip-Antenneneinheit gemäß einem der Ansprüche 1 - 11, wobei ein drittes Substrat (31), auf dessen erster Oberfläche (31a) sich zusätzliche Antennenelemente (32a, 32b, 32c, 32d) befinden, derart angeordnet ist, dass sich das Antennenelement (2) zwischen der ersten Oberfläche (1a, 11a) des ersten Substrats (1, 11) und einer zweiten Oberfläche (31b) des dritten Substrats (31) befindet.

13. Mikrostrip-Antenneneinheit gemäß Anspruch 12, wobei die zusätzlichen Antennenelemente (32a, 32b, 32c, 32d) in Bezug auf den Mittelpunkt des Antennenelements (2) symmetrisch angeordnet sind.

14. Mikrostrip-Antenneneinheit gemäß einem der Ansprüche 12 und 13, wobei sich die zusätzlichen Antennenelemente (32a, 32b, 32c, 32d) mit dem ersten Antennenelement (2) überlappen.

15. Mikrostrip-Antenneneinheit gemäß einem der Ansprüche 12 - 14, wobei die zusätzlichen Antennenelemente (32a, 32b, 32c, 32d) quadratisch geformt sind.

16. Mikrostrip-Antenneneinheit gemäß einem der Ansprüche 12 - 14, wobei die zusätzlichen Antennenelemente (32a, 32b, 32c, 32d) rechteckig geformt sind.

17. Mikrostrip-Antenneneinheit gemäß einem der Ansprüche 12 - 14, wobei die zusätzlichen Antennenelemente (32a, 32b, 32c, 32d) kreisförmig oder elliptisch geformt sind.

18. Mikrostrip-Antenneneinheit gemäß einem der Ansprüche 1 - 17, wobei die Antenneneinheit eine Stapelstruktur aufweist.

19. Mikrostrip-Antenneneinheit, umfassend:

- ein erstes Substrat (11);

- ein quadratisch geformtes Antennenelement (12), das auf einer ersten Oberfläche (11a) des

besagten ersten Substrats vorgesehen ist;

- ein zweites Substrat (13);
- ein erstes verlängertes Zuführungselement (14), das zwischen einer zweiten Oberfläche (11b) des besagten ersten Substrats (11) und einer ersten Oberfläche (13a) des besagten zweiten Substrats (13) vorgesehen ist; und
- ein zweites verlängertes Zuführungselement (15), das zwischen der zweiten Oberfläche (11b) des ersten Substrats (11) und der ersten Oberfläche (13a) des zweiten Substrats (13) vorgesehen ist;

dadurch gekennzeichnet, dass

- ein Endbereich (14a) des ersten verlängerten Zuführungselements (14) und ein Endbereich (15a) des zweiten verlängerten Zuführungselements in einem Bereich von -0,3L und -0,5 (L-W) von einem entsprechenden Randbereich (12a, 12b) des quadratisch geformten Antennenelements (12) positioniert sind, wobei L die Ausdehnung des quadratisch geformten Antennenelements (12) in einer zur Überlappungsrichtung parallelen Richtung ist und W die Breite des entsprechenden verlängerten Zuführungselements mit einem Bereich von $0 < W < 0,4L$ ist.

20. Mikrostrip-Antenneneinheit gemäß Anspruch 19, wobei besagte erste und zweite Zuführungselemente (4, 14, 15) im Wesentlichen senkrecht zueinander angeordnet sind.

21. Mikrostrip-Antenneneinheit gemäß einem der Ansprüche 19 - 20, wobei ein Mittel zur Impedanzanpassung (20) vorgesehen ist.

22. Mikrostrip-Antenneneinheit gemäß Anspruch 21, wobei das Mittel zur Impedanzanpassung ein mit besagtem ersten und zweiten Zuführungselement (4, 14, 15) verbundenes Impedanzanpassungsnetz (20, 21, 22) ist.

23. Mikrostrip-Antenneneinheit gemäß einem der Ansprüche 19 - 22, wobei besagtes erstes und/oder zweites verlängertes Zuführungselement (14, 15) im Mittelpunkt des entsprechenden Randbereichs (12a, 12b) des quadratisch geformten Antennenelements (12) angeordnet ist.

24. Mikrostrip-Antenneneinheit gemäß einem der Ansprüche 19 - 23, wobei ein Masseelement (16) auf einer zweiten Oberfläche (13b) des besagten zweiten Substrats (13) vorgesehen ist.

25. Mikrostrip-Antenneneinheit gemäß einem der Ansprüche 19 - 24, wobei ein drittes Substrat (31), auf dessen erster Oberfläche (31a) sich zusätzliche Antennenelemente (32a, 32b, 32c, 32d) befinden, derart angeordnet ist, dass sich das quadratisch geformte Antennenelement (12) zwischen der ersten Oberfläche (1a, 11a) des ersten Substrats (1, 11) und einer zweiten Oberfläche (31b) des dritten Substrats (31) befindet.

26. Mikrostrip-Antenneneinheit gemäß Anspruch 25, wobei die zusätzlichen Antennenelemente (32a, 32b, 32c, 32d) in Bezug auf den Mittelpunkt des quadratisch geformten Antennenelements (12) symmetrisch angeordnet sind.

27. Mikrostrip-Antenneneinheit gemäß einem der Ansprüche 19 - 26, wobei ein drittes Substrat (31), auf dessen erster Oberfläche (31a) sich zusätzliche Antennenelemente (32a, 32b, 32c, 32d) befinden, derart angeordnet ist, dass sich das Antennenelement (2) zwischen der ersten Oberfläche (1a, 11a) des ersten Substrats (1, 11) und einer zweiten Oberfläche (31b) des dritten Substrats (31) befindet.

28. Mikrostrip-Antenneneinheit gemäß Anspruch 27, wobei die zusätzlichen Antennenelemente (32a, 32b, 32c, 32d) in Bezug auf den Mittelpunkt des Antennenelements (2) symmetrisch angeordnet sind.

29. Mikrostrip-Antenneneinheit gemäß einem der Ansprüche 27 - 28, wobei sich die zusätzlichen Antennenelemente (32a, 32b, 32c, 32d) mit dem ersten Antennenelement (2) überlappen.

30. Mikrostrip-Antenneneinheit gemäß einem der Ansprüche 27 - 29, wobei die zusätzlichen Antennenelemente (32a, 32b, 32c, 32d) quadratisch geformt sind.

31. Mikrostrip-Antenneneinheit gemäß einem der Ansprüche 27 - 29, wobei die zusätzlichen Antennenelemente (32a, 32b, 32c, 32d) rechteckig geformt sind.

32. Mikrostrip-Antenneneinheit gemäß einem der Ansprüche 27 - 29, wobei die zusätzlichen Antennenelemente (32a, 32b, 32c, 32d) kreisförmig oder elliptisch geformt sind.

33. Mikrostrip-Antenneneinheit gemäß einem der Ansprüche 19 - 32, wobei die Antenneneinheit eine Stapelstruktur aufweist.

34. Empfangsvorrichtung zum Empfangen eines Rundfunksignals, umfassend eine Mikrostrip-Antenneneinheit (42) gemäß einem der Ansprüche 1 - 18 oder

einem der Ansprüche 19 - 33 und ein Umwandlungsmittel (43) zum Umwandeln der Frequenz des empfangenen Rundfunksignals.

35. Empfangsvorrichtung gemäß Anspruch 34, wobei das Umwandlungsmittel (43) in planarer Wellenleitertechnologie vorgesehen ist.

36. Empfangsvorrichtung zum Empfangen von Rundfunksignalen gemäß einem der Ansprüche 34 - 35, wobei eine Vermittlungsmatrix (56) zum Verteilen von Anforderungssignalen vorgesehen ist, die von dem Umwandlungsmittel (43; 53a, 53b, 53c, 53d, 54a, 54b, 54c, 54d, 55) empfangen wurden.

Revendications

1. Dispositif d'antenne à microruban, comprenant :

- un premier substrat (1, 11) ;
- un élément d'antenne (2, 12) disposé sur une première surface (1a, 11a) dudit premier substrat ;
- un second substrat (3, 13) ; et
- un premier élément d'alimentation (4, 14) disposé entre une seconde surface (1b, 11b) dudit premier substrat et une première surface (3a, 13a) dudit second substrat ;

caractérisé en ce que

- une partie d'extrémité (4a, 14a) dudit premier élément d'alimentation (4, 14) est positionnée à l'intérieur d'une plage de -0,3 L et +0,1 L depuis une partie de bord (2a, 12a) dudit élément d'antenne (2, 12), dans laquelle L est le prolongement dudit élément d'antenne (2, 12) dans une direction parallèle à la direction du chevauchement.

2. Dispositif d'antenne à microruban selon la revendication 1, dans lequel un second élément d'alimentation (15) est disposé entre ladite seconde surface (1b, 11b) dudit premier substrat (1, 11) et ladite première surface (3a, 13a) dudit second substrat (3, 13), une partie d'extrémité (15a) dudit second élément d'alimentation (15) est positionnée à l'intérieur d'une plage de -0,3 L et +0,1 L à partir d'une partie de bord (12b) dudit élément d'antenne (2, 12), dans laquelle L est le prolongement dudit élément d'antenne (2, 12) dans une direction parallèle à la direction du chevauchement.

3. Dispositif d'antenne à microruban selon l'une quelconque des revendications 1 et 2, dans lequel lesdits premier et/ou second éléments d'alimentation (4, 14, 15) sont des lignes d'alimentation allongées.

4. Dispositif d'antenne à microruban selon la revendication 3, dans lequel lesdits premier et second éléments d'alimentation (4, 14, 15) sont agencés sensiblement de manière perpendiculaire l'un à l'autre.

5. Dispositif d'antenne à microruban selon l'une quelconque des revendications 1 à 4, dans lequel un moyen d'adaptation d'impédance (20) est prévu.

6. Dispositif d'antenne à microruban selon la revendication 5, dans lequel ledit moyen d'adaptation d'impédance est un réseau d'adaptation d'impédance (20, 21, 22) connecté aux dits premier et/ou second éléments d'alimentation (4, 14, 15).

7. Dispositif d'antenne à microruban selon l'une quelconque des revendications 1 à 6, dans lequel lesdits premier et/ou second éléments d'alimentation (4, 14, 15) sont agencés au centre de ladite partie de bord (2a, 12a, 12b) dudit élément d'antenne (2, 12).

8. Dispositif d'antenne à microruban selon l'une quelconque des revendications 1 à 7, dans lequel ledit élément d'antenne (2, 12) est de forme carrée.

9. Dispositif d'antenne à microruban selon l'une quelconque des revendications 1 à 7, dans lequel ledit élément d'antenne (2, 12) est de forme rectangulaire.

10. Dispositif d'antenne à microruban selon l'une quelconque des revendications 1 à 7, dans lequel ledit élément d'antenne (2, 12) est de forme circulaire ou de forme elliptique.

11. Dispositif d'antenne à microruban selon l'une quelconque des revendications 1 à 10, dans lequel un élément de masse (5, 16) est disposé sur une seconde surface (3b, 13b) dudit second substrat (3, 13).

12. Dispositif d'antenne à microruban selon l'une quelconque des revendications 1 à 11, dans lequel un troisième substrat (31) sur une première surface (31a) sur lequel des éléments d'antenne supplémentaires (32a, 32b, 32c, 32d) sont prévus, ledit troisième substrat (31) étant disposé de sorte que ledit élément d'antenne (2) est interposé entre ladite première surface (1a, 11a) dudit premier substrat (1, 11) et une seconde surface (31b) dudit troisième substrat (31).

13. Dispositif d'antenne à microruban selon la revendi-

cation 12, dans lequel lesdits éléments d'antenne supplémentaires (32a, 32b, 32c, 32d) sont agencés symétriquement par rapport au centre dudit élément d'antenne (2).

14. Dispositif d'antenne à microruban selon l'une quelconque des revendications 12 et 13, dans lequel lesdits éléments d'antenne supplémentaires (32a, 32b, 32c, 32d) sont agencés pour se chevaucher avec ledit premier élément d'antenne (2).

15. Dispositif d'antenne à microruban selon l'une quelconque des revendications 12 à 14, dans lequel lesdits éléments d'antenne supplémentaires (32a, 32b, 32c, 32d) sont de forme carrée.

16. Dispositif d'antenne à microruban selon l'une quelconque des revendications 12 à 14, dans lequel lesdits éléments d'antenne supplémentaires (32a, 32b, 32c, 32d) sont de forme rectangulaire.

17. Dispositif d'antenne à microruban selon l'une quelconque des revendications 12 à 14, dans lequel lesdits éléments d'antenne supplémentaires (32a, 32b, 32c, 32d) sont de forme circulaire ou de forme elliptique.

18. Dispositif d'antenne à microruban selon l'une quelconque des revendications 1 à 17, dans lequel le dispositif d'antenne présente une structure empilée.

19. Dispositif d'antenne à microruban, comprenant :

- un premier substrat (11) ;
- un élément d'antenne (12) de forme carrée disposé sur une première surface (11a) dudit premier substrat ;
- un second substrat (13) ;
- un premier élément d'alimentation allongé (14) disposé entre une seconde surface (11b) dudit premier substrat (11) et une première surface (13a) dudit second substrat (13) ; et
- un second élément d'alimentation allongé (15) disposé entre ladite seconde surface (11b) dudit premier substrat (11) et ladite première surface (13a) dudit second substrat (13) ;

caractérisé en ce que

- une partie d'extrémité (14a) dudit premier élément d'alimentation allongé (14) et une partie d'extrémité (15a) dudit second élément d'alimentation allongé sont positionnées à l'intérieur d'une plage de -0,3 L et -0,5 (L-W) à partir d'une partie de bord respective (12a, 12b) dudit élément d'antenne de forme carrée (12), dans lesquelles L est le prolongement dudit élément d'antenne de forme carrée (12) dans une direction parallèle à la direction du chevauchement et W est la largeur de l'élément d'alimentation allongé respectif ayant une plage de $0 < W < 0,4$ L.

20. Dispositif d'antenne à microruban selon la revendication 19, dans lequel lesdits premier et second éléments d'alimentation (4, 14, 15) sont agencés de manière sensiblement perpendiculaire l'un à l'autre.

21. Dispositif d'antenne à microruban selon l'une quelconque des revendications 19 et 20, dans lequel un moyen d'adaptation d'impédance (20) est prévu.

22. Dispositif d'antenne à microruban selon la revendication 21, dans lequel ledit moyen d'adaptation d'impédance est un réseau d'adaptation d'impédance (20, 21, 22) connecté aux dits premier et second éléments d'alimentation (4, 14, 15), respectivement.

23. Dispositif d'antenne à microruban selon l'une quelconque des revendications 19 à 22, dans lequel lesdits premier et/ou second éléments d'alimentation allongés (14, 15) sont agencés au centre de la partie de bord respective (12a, 12b) dudit élément d'antenne de forme carrée (12).

24. Dispositif d'antenne à microruban selon l'une quelconque des revendications 19 à 23, dans lequel un élément de masse (16) est disposé sur une seconde surface (13b) dudit second substrat (13).

25. Dispositif d'antenne à microruban selon l'une quelconque des revendications 19 à 24, dans lequel un troisième substrat (31) sur une première surface (31a) sur lequel des éléments d'antenne supplémentaires (32a, 32b, 32c, 32d) sont prévus, ledit troisième substrat (31) étant disposé de sorte que ledit élément d'antenne (12) de forme carrée est interposé entre ladite première surface (1a, 11a) dudit premier substrat (1, 11) et une seconde surface (31b) dudit troisième substrat (31).

26. Dispositif d'antenne à microruban selon la revendication 25, dans lequel lesdits éléments d'antenne supplémentaires (32a, 32b, 32c, 32d) sont agencés symétriquement par rapport au centre dudit élément d'antenne (12) de forme carrée.

27. Dispositif d'antenne à microruban selon l'une quelconque des revendications 19 à 26, dans lequel un troisième substrat (31) sur une première surface

(31a) sur lequel des éléments d'antenne supplémentaires (32a, 32b, 32c, 32d) sont prévus, ledit troisième substrat (31) étant disposé de sorte que ledit élément d'antenne (2) est interposé entre ladite première surface (1a, 11a) dudit premier substrat (1, 11) et une seconde surface (31b) dudit troisième substrat (31).

28. Dispositif d'antenne à microruban selon la revendication 27, dans lequel lesdits éléments d'antenne supplémentaires (32a, 32b, 32c, 32d) sont agencés symétriquement par rapport au centre dudit élément d'antenne (2).

29. Dispositif d'antenne à microruban selon l'une quelconque des revendications 27 et 28, dans lequel lesdits éléments d'antenne supplémentaires (32a, 32b, 32c, 32d) sont agencés pour se chevaucher avec ledit premier élément d'antenne (2).

30. Dispositif d'antenne à microruban selon l'une quelconque des revendications 27 à 29, dans lequel lesdits éléments d'antenne supplémentaires (32a, 32b, 32c, 32d) sont de forme carrée.

31. Dispositif d'antenne à microruban selon l'une quelconque des revendications 27 et 29, dans lequel lesdits éléments d'antenne supplémentaires (32a, 32b, 32c, 32d) sont de forme rectangulaire.

32. Dispositif d'antenne à microruban selon l'une quelconque des revendications 27 à 29, dans lequel lesdits éléments d'antenne supplémentaires (32a, 32b, 32c, 32d) sont de forme circulaire ou de forme elliptique.

33. Dispositif d'antenne à microruban selon l'une quelconque des revendications 19 à 32, dans lequel le dispositif d'antenne présente une structure empilée.

34. Appareil de réception pour recevoir un signal diffusé à large bande comprenant un dispositif d'antenne à microruban (42) selon l'une quelconque des revendications 1 à 18 ou selon l'une quelconque des revendications 19 à 33 et un moyen de convertisseur (43) pour convertir la fréquence du signal diffusé à large bande reçu.

35. Appareil de réception selon la revendication 34, dans lequel ledit moyen de convertisseur (43) est proposé dans une technologie de guide d'onde plan.

36. Appareil de réception pour recevoir les signaux diffusés à large bande selon l'une quelconque des revendications 34 et 35, dans lequel une matrice de commutation (56) est prévue pour distribuer sur demande des signaux reçus à partir dudit moyen de convertisseur (43 ; 53a, 53b, 53c, 53d, 54a, 54b, 54c, 54d, 55).

FIG.1

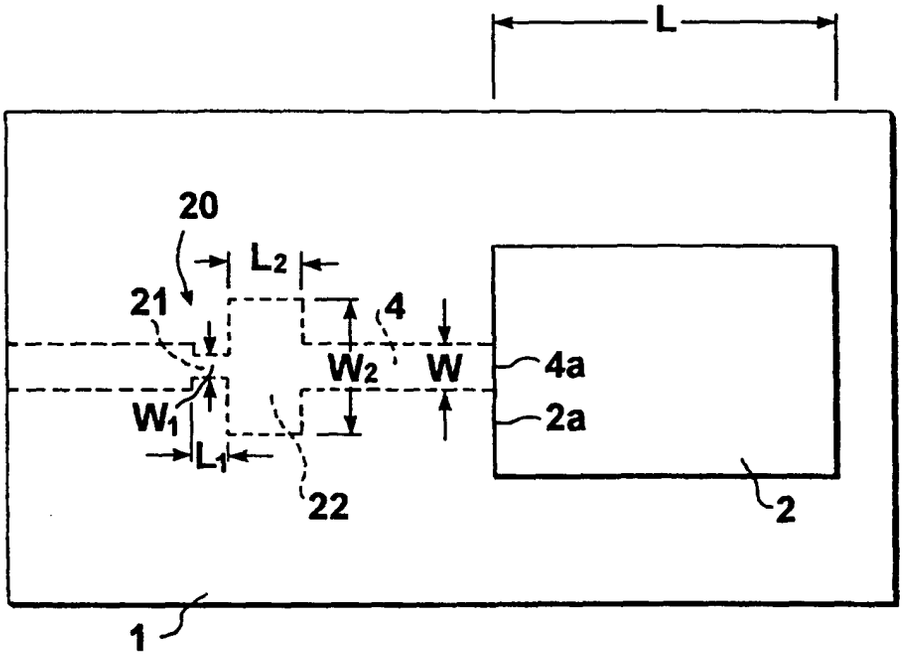


FIG.2

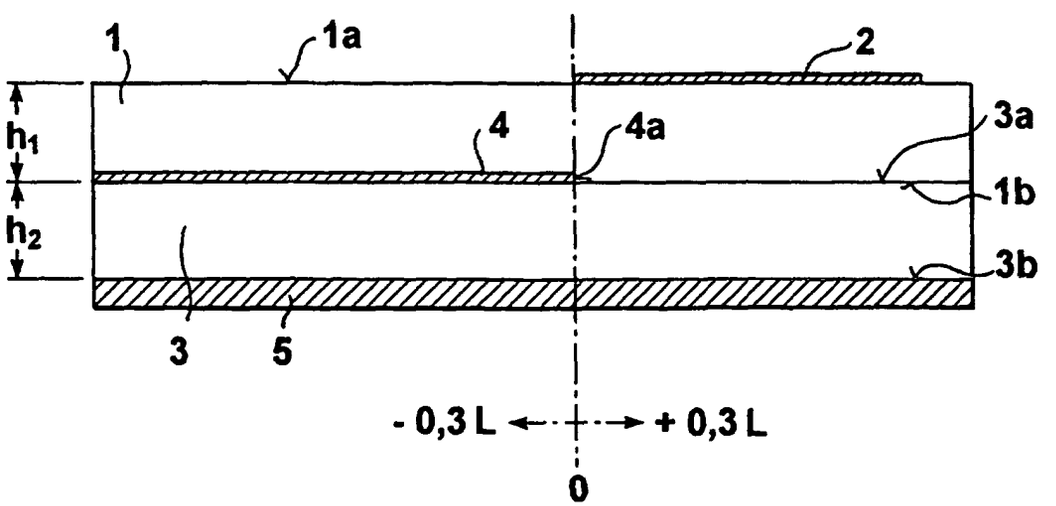


FIG.3

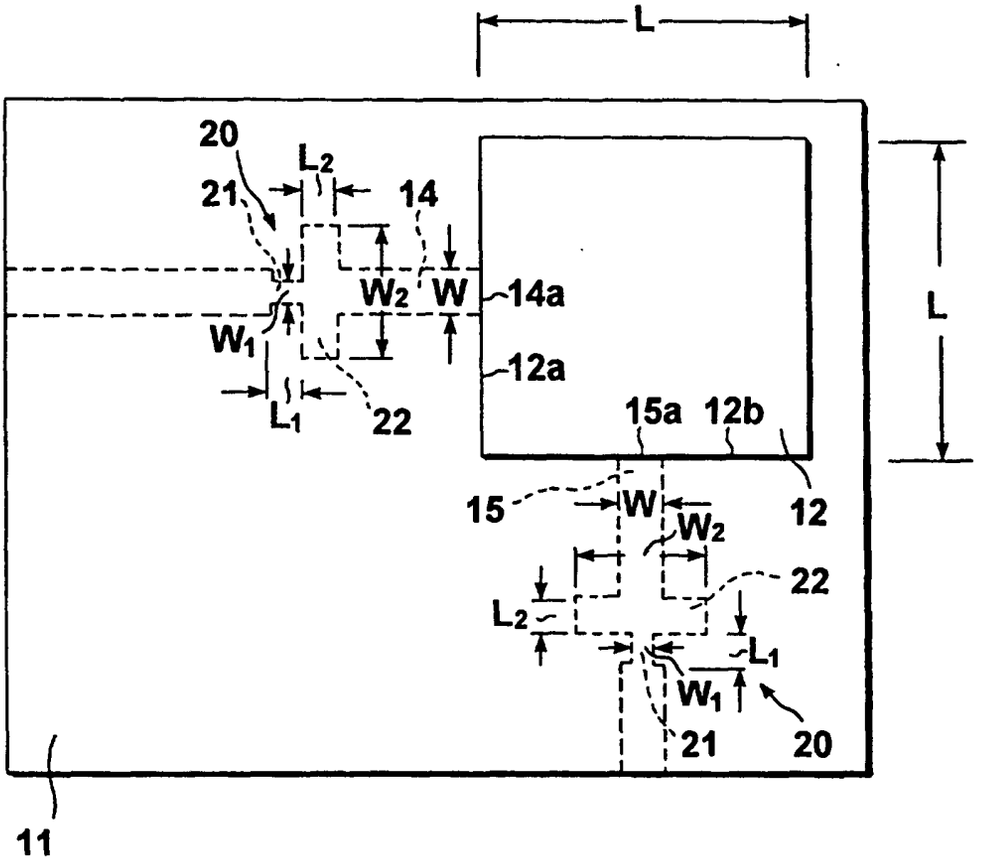

L
20
21
L_2
14
W_2
W
14a
W_1
12a
L_1
22
15a
12b
L
15
W
12
W_2
22
L_2
L_1
W_1
21
20
11

FIG.4

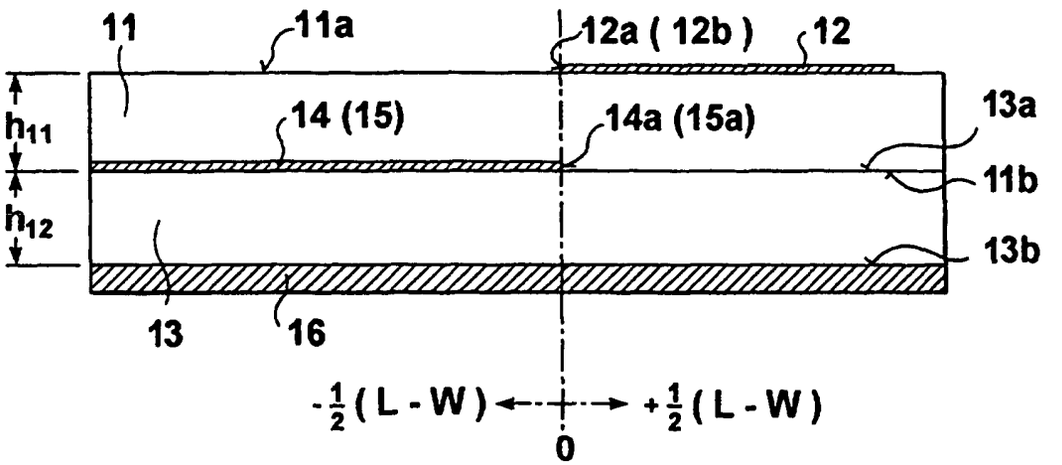

11
11a
12a (12b)
12
h_{11}
14 (15)
14a (15a)
13a
11b
h_{12}
13b
13
16
$-\frac{1}{2}(L-W)$
$+\frac{1}{2}(L-W)$
0

FIG.5

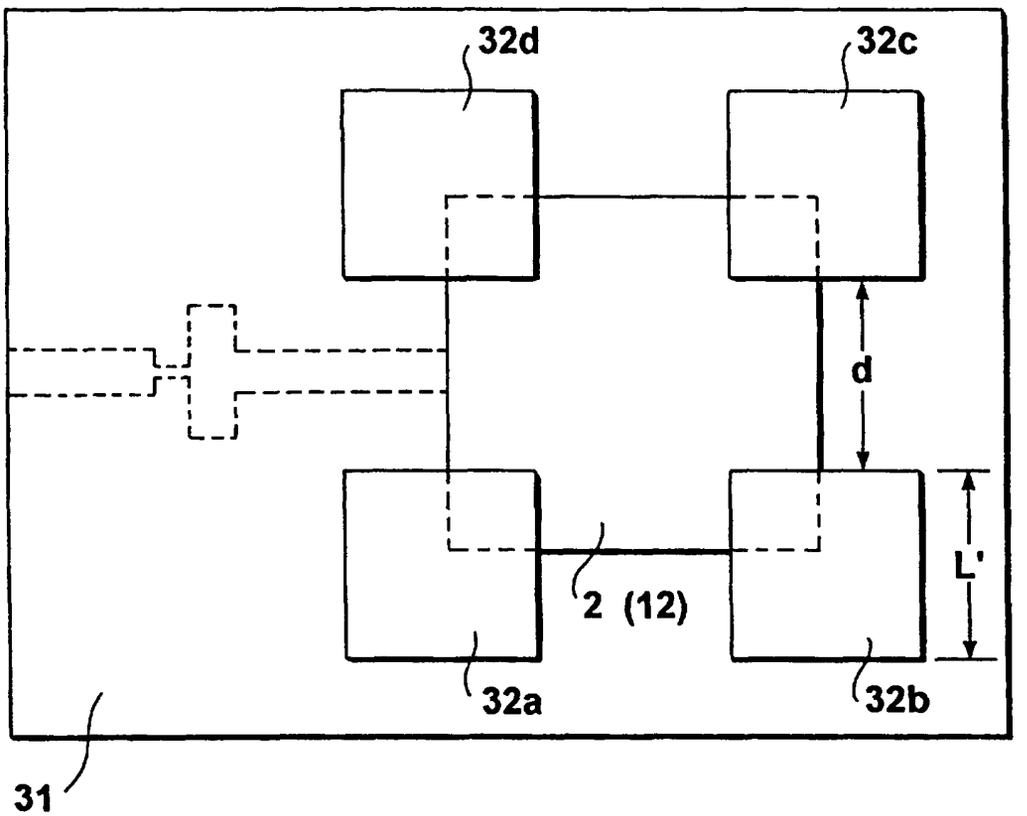

32d
32c
d
L'
2 (12)
32a
32b
31

FIG.6

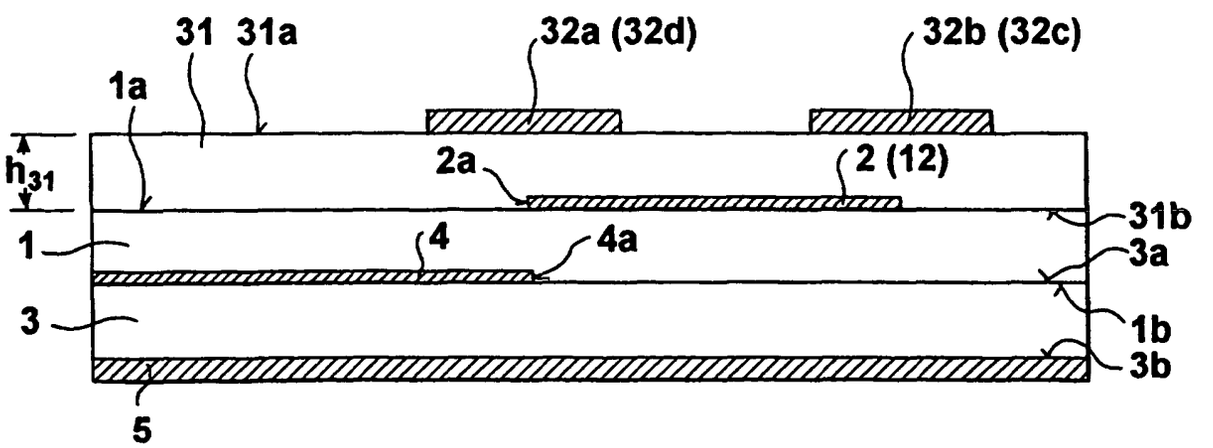

31
31a
32a (32d)
32b (32c)
1a
h31
2a
2 (12)
31b
1
4
4a
3a
3
1b
3b
5

FIG.7

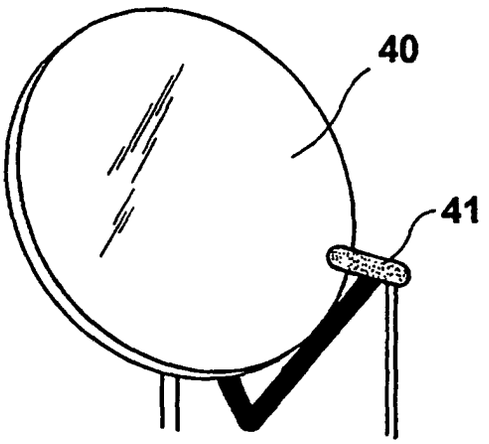


FIG.8

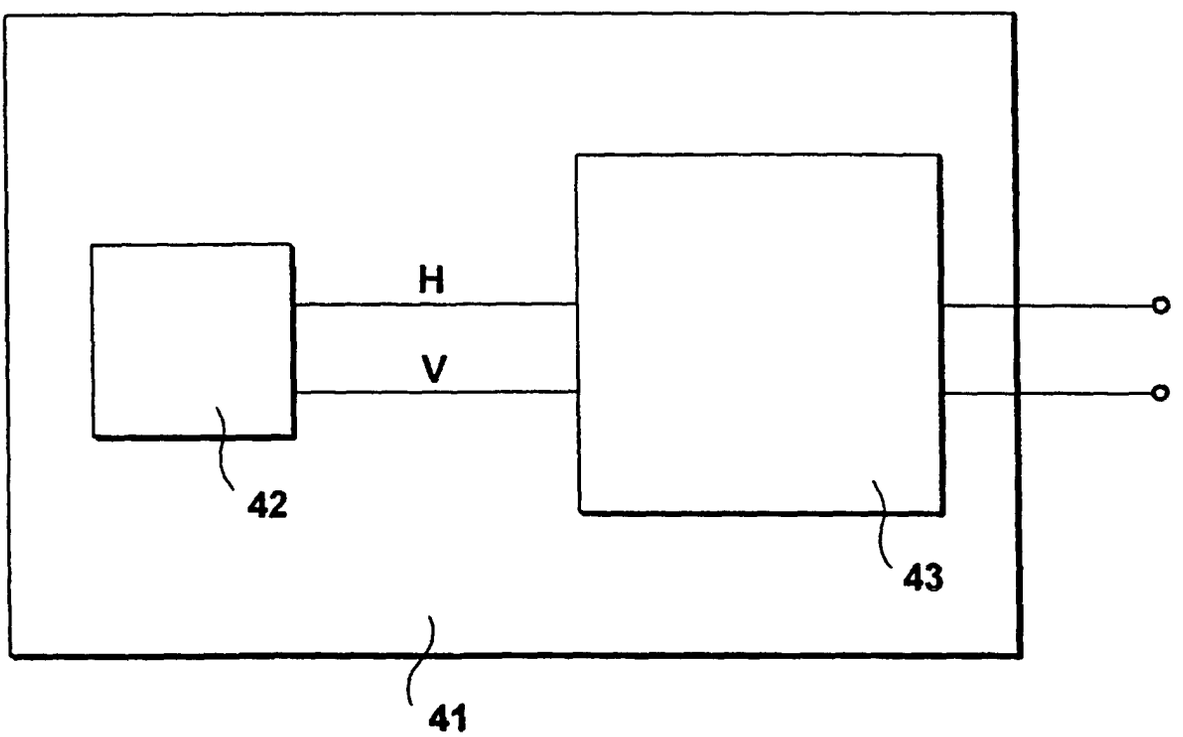


FIG.9

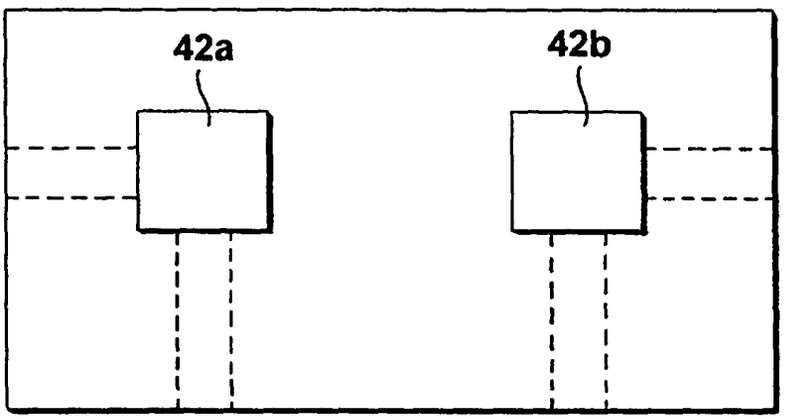


FIG.10

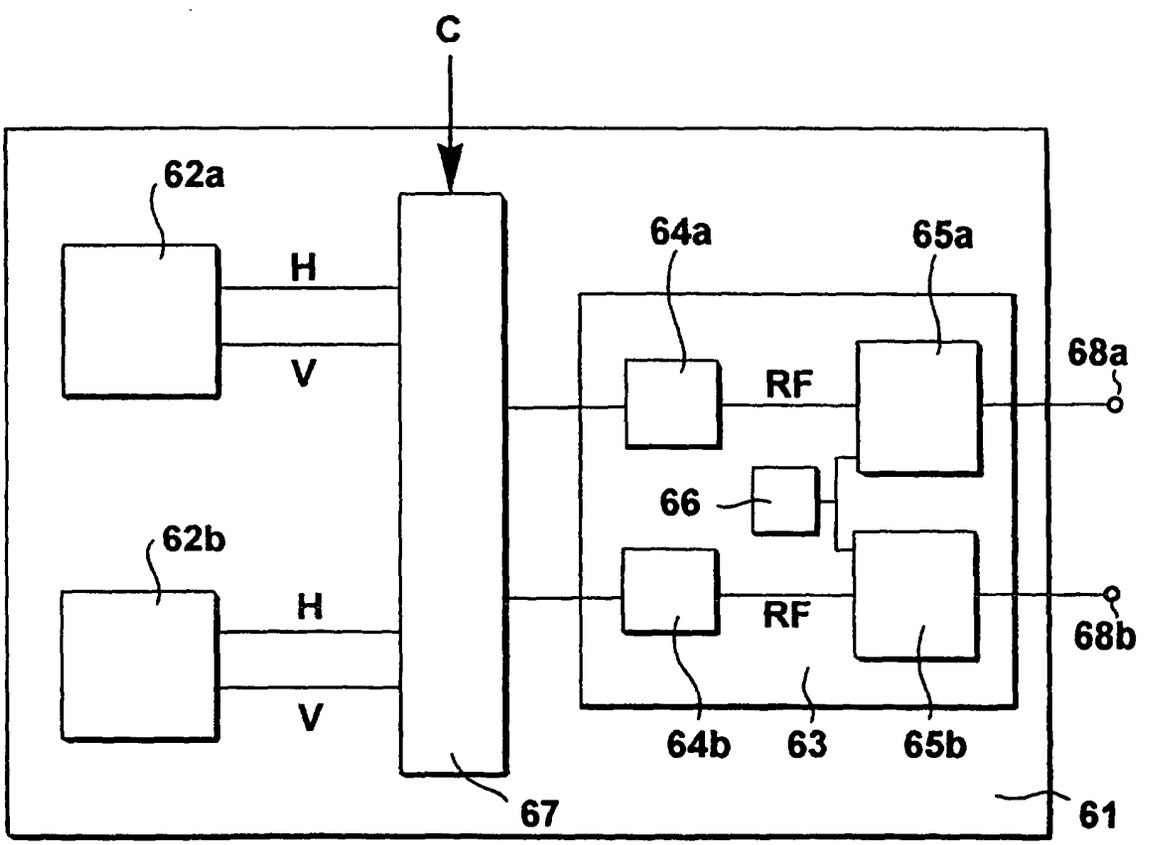


FIG.11

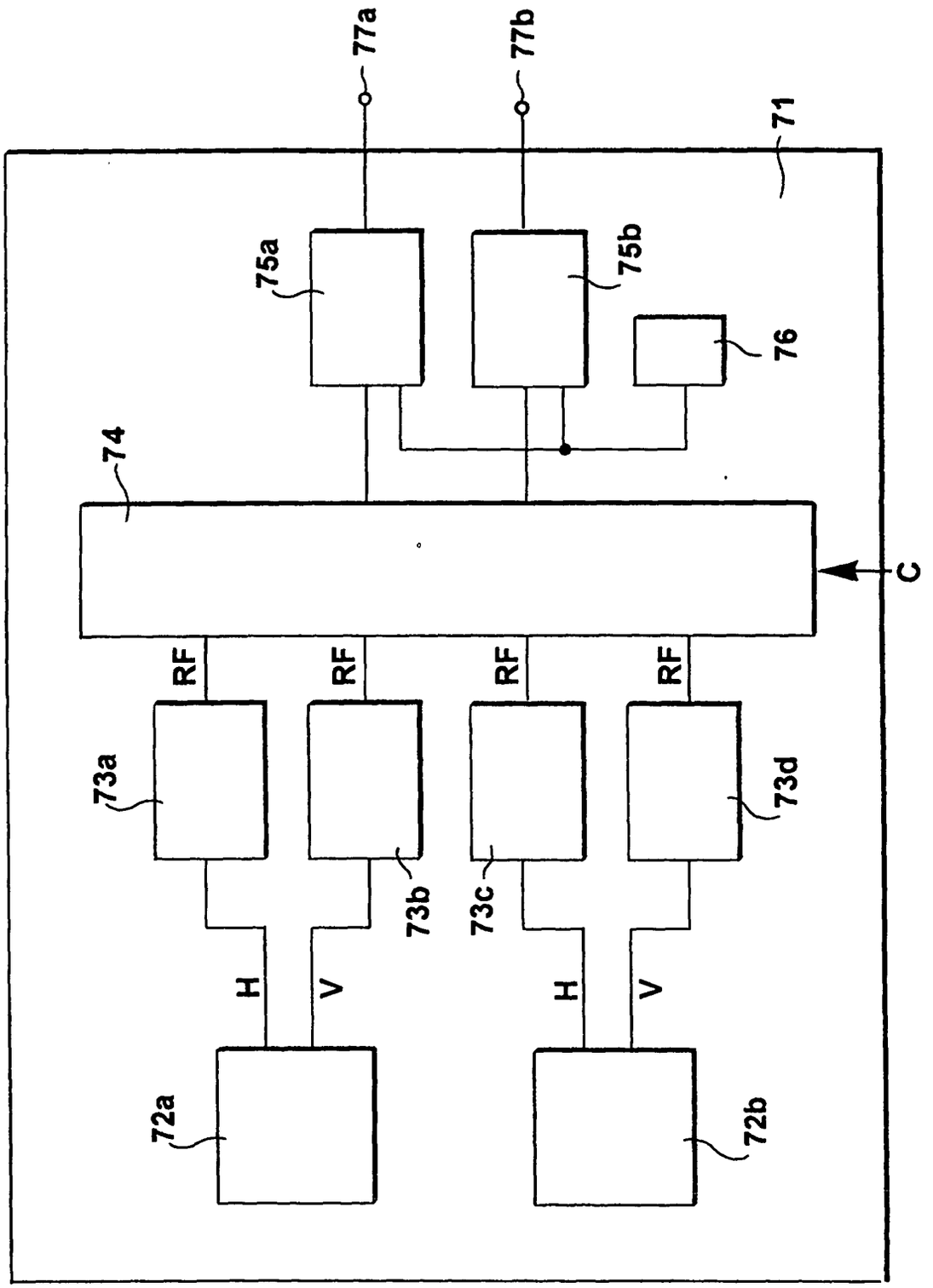
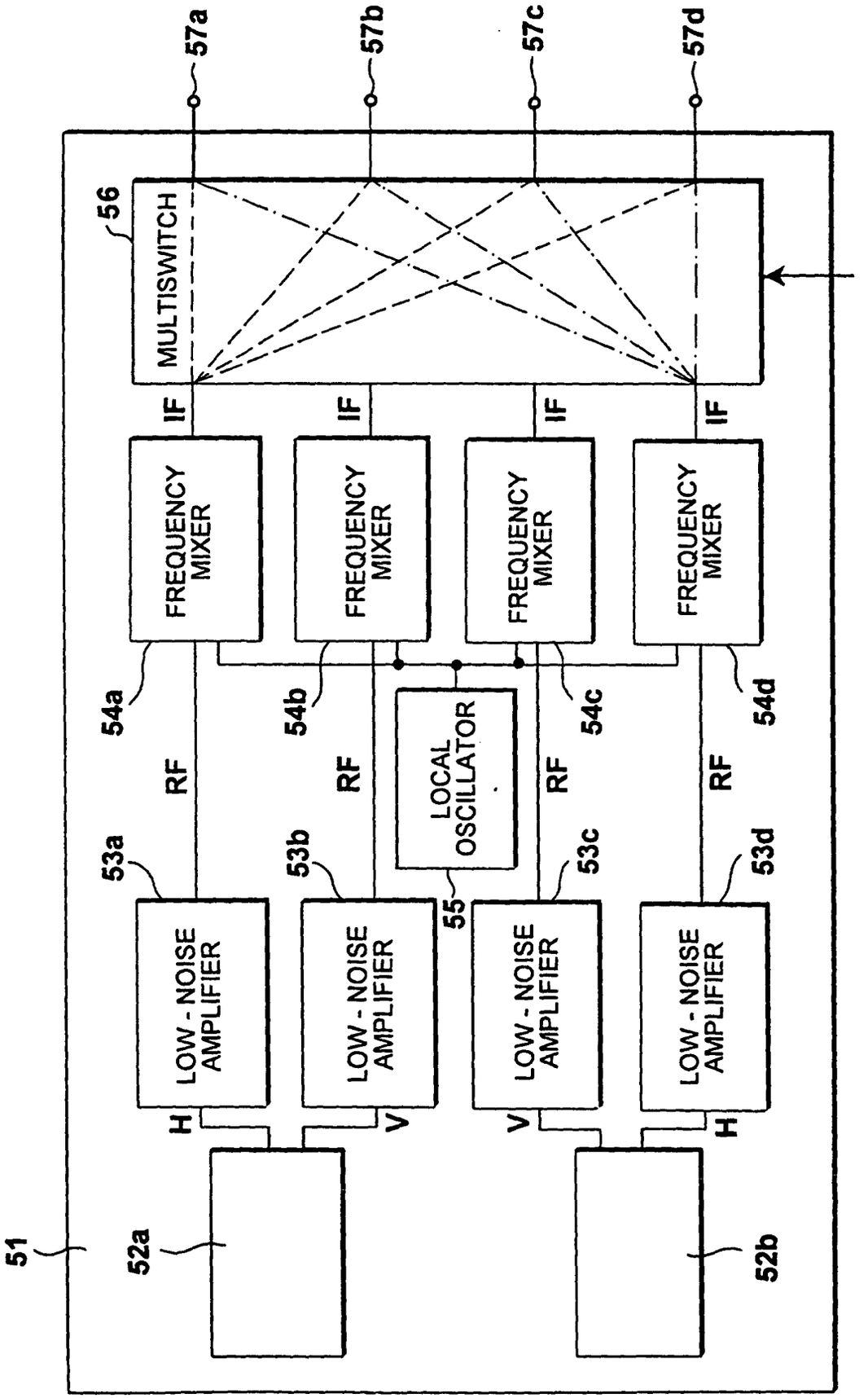


FIG.12


51
52a
52b
56
MULTISWITCH
57a
57b
57c
57d
IF
FREQUENCY MIXER
54a
54b
54c
54d
RF
LOCAL OSCILLATOR
55
53a
53b
53c
53d
LOW - NOISE AMPLIFIER
H
V