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(54) **Dual polarisation antennas**

(57) An antenna for transmission/reception of dual polarised radio signals comprises four patch assemblies (1, 2, 3, 4) and an elongated panel (5). The panel (5) and the patch assemblies (1, 2, 3, 4) are mounted on an elongated supporting base panel (6) of aluminium. Each patch assembly is formed by a stack of two circular panels, the lower of which (11) has on its lower surface a parasitic radiating element (12) formed by a copper track. The upper surface of the lower panel (11) is coated with copper in a circular shape except for two arc-shaped slots (13, 14) which separate two copper areas (15, 16) from the radiating patch (17). The element (12) is disposed wholly within the volume defined between the patch (17) and the panel (6), and the element (12) acts to reduce unwanted cross-couplings created by radiation from within the corresponding patch assembly.

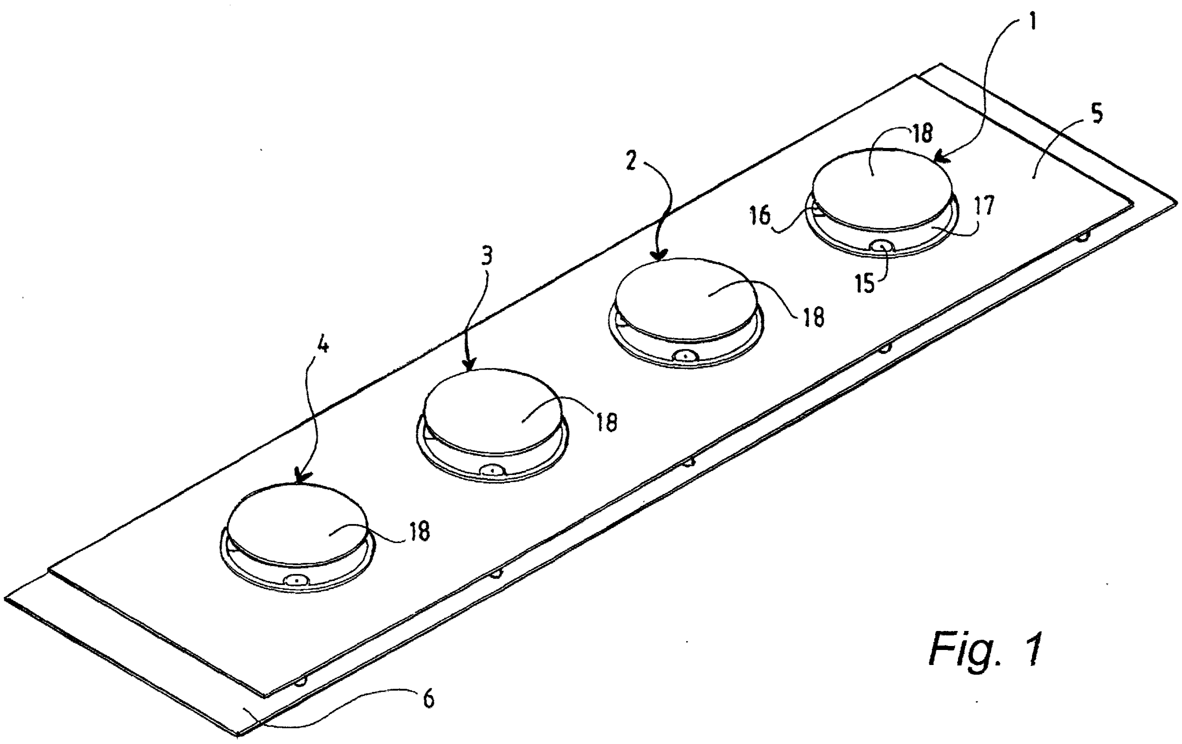

Fig. 1

EP 1 168 493 A2

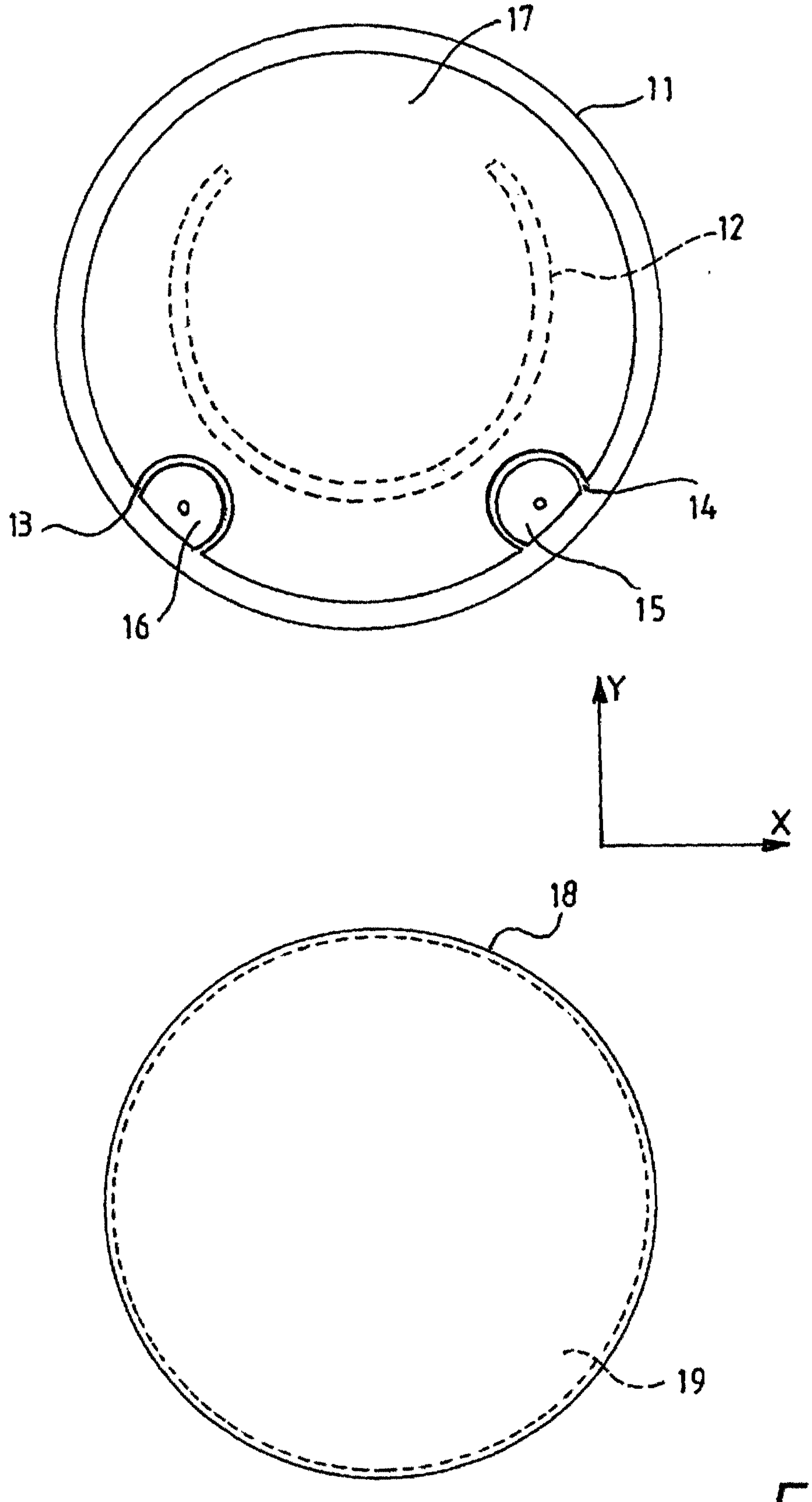

Fig. 3

Description

[0001] This invention relates to dual polarisation antennas.

[0002] Today, increasingly many wireless telecommunication systems employ a polarisation diversity scheme to overcome the undesirable effect of multipath fading which is caused by multiple reflection of radio signals in a mobile radio environment. Multipath fading introduces unpredictable changes to the phase and polarisation characteristics of the signals and often results in an amplification, or in some cases a cancellation, of signals at specific locations. This random and large fluctuation of signal strength caused by multipath fading can therefore severely affect system performance and reliability, and in extreme cases leads to momentary loss of communication between mobile units and base stations.

[0003] In a polarisation diversity system, the uncorrelated radio paths are provided by two orthogonal polarisations, which are commonly either polarisations in vertical and horizontal planes or in slant planes at +45° and -45°. One of the main advantages of employing polarisation diversity is that the antenna elements needed to provide the two polarisations can be physically integrated and manufactured as a single antenna unit. This type of antenna is commonly referred to as a dual polarisation antenna.

[0004] A dual polarisation antenna has to meet certain electrical specifications, among which the port-to-port isolation between the two polarisations is of particular importance to system operators due to the advantage of lowering the performance required on other expensive system components in a base station.

[0005] Many dual polarisation antennas are designed using microstrip transmission lines to form the feed/reception network, which carries signals of the two polarisations to and from the radiating elements in the antenna. The radiating elements that are capable of radiating and receiving dual polarisation signals are designed with patch technology due to the associated lower manufacturing cost and the desirable slim profile of the antenna. These radiating patches are associated with the feed/reception channels using aperture coupling techniques or other forms of coupling.

[0006] According to the invention there is provided an antenna for transmission/reception of dual polarised radio signals, the antenna comprising feed/reception means, a radiating patch which is mounted on a support panel and which is capacitively coupled to the feed/reception means, and a parasitic element disposed in the volume between the patch and the support panel, the parasitic element acting as a radiating element for cancelling unwanted cross-coupling radiation in the vicinity of the patch.

[0007] Preferably, the patch and the parasitic element are defined by metal areas formed on mutually opposite surfaces of a patch panel which is conveniently mounted on the support panel in spaced parallel relationship therewith.

[0008] The metal area defining the parasitic element is preferably in the shape of an elongated strip, conveniently a curved strip. In a preferred embodiment the parasitic element is a part-circular metal strip, subtending an angle of about 270° symmetrically disposed with relation to the radiating patch.

[0009] The metal area of the patch is preferably capacitively coupled, by uncoated metal areas, to two metal coated areas aligned along orthogonal axes for handling the orthogonally polarised radio signals, the two metal coated areas forming part of the feed/reception means.

[0010] The radiating patch and the parasitic element may form a patch assembly and the antenna may have a plurality of such patch assemblies, in which case the feed/reception means preferably take the form of a feed/reception network in the form of conductive tracks formed by conductive metal areas deposited on the support panel.

[0011] The provision of the parasitic element achieves high port-to-port isolation of a dual polarisation antenna.

[0012] A preferred antenna comprises an array of four separated radiating and receiving patch assemblies, which are capable of handling two independent and orthogonally polarised signals simultaneously. There are two input ports for each patch assembly and the ports that correspond to the two polarisations are capacitively coupled to the corresponding tracks of the feed/reception network. The parasitic elements, which form part of the patch assemblies, provide a mechanism which effectively reduces the undesirable cross-polarisation couplings created by radiation in the vicinity of the patch assemblies.

[0013] An antenna according to the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is an isometric view of the antenna,

Figure 2 shows the antenna with its main components in exploded view but with certain detail omitted for clarity,

Figure 3 is a view of the lower panel and upper panel of a patch assembly of the antenna of Figures 2, and

Figure 4 shows a detail of one patch assembly of the antenna.

Figure 5 is a plan view of the antenna, looking in the direction of arrow II in Figure 2 but with certain detail omitted for clarity, and

Figure 6 illustrates, in exploded view, the parts of a simplified antenna, also in accordance with the invention.

[0014] The antenna shown in the drawing is a wideband low profile dual polarisation antenna capable of receiving and transmitting (either sequentially or simultaneously), orthogonally polarised radio signals. The antenna comprises an array of four patch assemblies 1, 2, 3, 4 and an elongated, grounded panel 5. Panel 5 and patch assemblies 1, 2, 3, 4 are dielectric materials clad with copper in pre-determined patterns on one or both surfaces, preferably by an etching process. Panel 5 and the four patch assemblies 1, 2, 3, 4 are mounted on an elongated supporting base panel 6 of aluminium.

[0015] The patch assemblies 1, 2, 3 and 4 are identical in this case and each comprises a stack of two circular panels. Alternatively, the panels could be either square or a combination of circular and square. The lower circular panel 11 is held in spaced parallel relationship with respect to the panel 5 next beneath it by means of an insulating spacer. The lower surface of the lower circular panel 11 has a parasitic radiating element 12 formed by a copper track deposited on the lower surface of the panel 11. The upper surface of the lower circular panel 11 is coated with copper in a circular shape except for two arc-shaped slots 13, 14. The two slots 13, 14 are uncovered areas on the copper coated surface, which separate the two copper areas 15, 16 defined by the two slots 13, 14 from the remaining area 17 of the copper coating. The two slots 13, 14 are located near the edge of the circular panel and are disposed symmetrically at 45° with respect to the axis of symmetry which passes centrally between the two areas 15 and 16. The parasitic element 12 is also symmetrical with respect to this axis, subtending an angle of 135° on each side of the axis. Moreover, the element 12 is disposed wholly within the volume defined between the coating area 17 and the panel 6. In this case, the element 12 is wholly within the volume defined between the coating area 17 and the panel 5, and lies within the plan area or "footprint" of the area 17.

[0016] The upper circular panel 18 of each patch assembly is held in spaced parallel relationship with respect to the lower circular panel 11 next beneath it by means of an insulating spacer. The upper circular panel 18 is made of dielectric material with a circular pattern of copper coating 19 on the lower surface of the panel. This upper circular panel could be made of a solid metal, such as aluminium.

[0017] It will be appreciated that both the surface 19 and the oven 17 act as radiating patches.

[0018] The upper surface of the panel 5 is copper coated while the lower surface has a feed/reception network comprising two channels 20 and 21 each terminating in a respective terminal 22 or 23. The channels 20 and 21 are essentially mirror images of each other and are formed by copper tracks deposited on the lower surface of the panel 5. Each channel divides into four separate feed lines 20a, 20b, 20c, 20d and 21a, 21b, 21c, 21d respectively. Each feed line terminates in an open circuit whereby a small metal pin 24 is used to connect the corresponding feed line, through the panel 5, to the lower circular panel of a patch assembly. The patch assemblies 1, 2, 3, 4 and panel 5 are supported on the support base panel 6 by means of spacer 25 (Figure 4).

[0019] In use as a transmitting antenna, input signals are applied to the terminals 22 and 23, with signals polarised in one plane being applied to the terminal 22 and signals polarised in the orthogonal plane being applied to the terminal 23. The input signals are conducted along the feed channels 20 and 21 to the feed lines 20a, 20b, 20c, 20d and 21a, 21b, 21c, 21d respectively. At the open end of each feed line, the conductive pin 24 conducts the signals from the corresponding feed line to the area 15 or 16. By means of capacitive coupling through the slots 13, 14, signals are coupled to the area 17 of the copper coating on the upper surface of the lower circular panel. The position (i.e. distance from the edge) and dimension (i.e. arc length) of the two slots 13, 14 are selected for best impedance matching. The relative permittivity, thickness and, dimensions of the lower panel and the upper circular panel of the patch assembly are selected for optimal broadband impedance matching, the upper circular panelling electro magnetically coupled to the oven 17.

[0020] Unwanted cross-couplings created by radiation from within the patch assemblies 1, 2, 3, 4 are significantly reduced by the parasitic elements 12 formed on the lower surfaces of the lower circular panels. Each parasitic element 12 acts as a radiating element which radiates energy of the two polarisations into the vicinity of the patch assembly. This radiation, when adjusted properly, can actively cancel the unwanted cross-coupling radiation in the region, which results in high isolation between the polarisations. The position, shape, length and width of each parasitic element are selected for optimal isolation at the frequencies of interest.

[0021] Figure 6 illustrates a simplified antenna having only one patch assembly which in structure corresponds to one of the patch assemblies 1 to 4 of Figures 1 to 4. The antenna of Figure 6 is devoid of the panel 5 and the feed/reception tracks, signals being conducted to the respective areas 15, 16 by conductive cables rods or pins 26. As before, the areas 15, 16 are capacitively coupled to the main conductive area 17 on the upper surface of the lower panel 11, the lower surface of which has an arcuate parasitic element 12 subtending an angle of about 270° symmetrically arranged with respect to the areas 15 and 16. The parasitic element 12 lies wholly within the volume defined between the coating area 17 and the 6, and within the plan area or "footprint" of the coating area 17.

Claims

1. An antenna for transmission/reception of dual polarised radio signals, the antenna comprising feed/reception means, a radiating patch which is mounted adjacent a panel and which is coupled to the feed/reception means, and a parasitic element, **characterised in that** the parasitic element is disposed in the volume between the patch and the panel and acts as a radiating element for cancelling unwanted cross-coupling radiation in the vicinity of the patch.

2. An antenna according to claim 1 in which the panel comprises a support panel on which the radiating patch is mounted.

3. An antenna according to claim 2, in which the support panel or surface thereon acts as a ground plane.

4. An antenna according to any of the preceding claims, in which the radiating patch is either one of a first radiating patch situated immediately adjacent the first panel and a second radiating patch which is mounted adjacent the first patch so that the first patch is interposed between the second patch and the panel; the first radiating patch being capacitatively coupled to the feed/reception means, the second patch being electromagnetically coupled to the first patch.

5. An antenna according to any of claims 1 to 4, wherein the patch and the parasitic element are defined by metal areas formed on mutually opposite surfaces of a patch panel.

6. An antenna according to claim 5 when appended to claim 2, wherein the patch panel is mounted on the support panel in spaced parallel relationship therewith.

7. An antenna according to claim 5 or 6, wherein the metal area defining the parasitic element is in the shape of an elongated strip.

8. An antenna according to claim 7, wherein the elongated strip is a curved strip.

9. An antenna according to claim 8, wherein the parasitic element is a part-circular metal strip, subtending an angle of about 270° symmetrically disposed with relation to the radiating patch.

10. An antenna according to any of claims 5 to 10, wherein a metal area defining the patch is capacitively coupled, by uncoated areas, to two metal coated areas aligned along orthogonal axes for handling the orthogonally polarised radio signals, the two metal coated areas forming part of the feed/reception means.

11. An antenna according to any of the preceding claims, wherein the radiating patch and the parasitic element form a patch assembly and the antenna has a plurality of such patch assemblies.

12. An antenna according to claim 11, wherein the feed/reception means take the form of a feed/reception network having conductive tracks formed by conductive metal areas deposited on the support panel.

13. An antenna according to claim 12 and comprising an array of four separated radiating and receiving patch assemblies, which are capable of handling two independent and orthogonally polarised signals simultaneously, there being two input ports for each patch assembly and the ports that correspond to the two polarisations being capacitively coupled to the corresponding tracks of the feed/reception network.

14. An antenna according to any of the preceding claims, in which the parasitic element is interposed between the radiating patch and the panel.

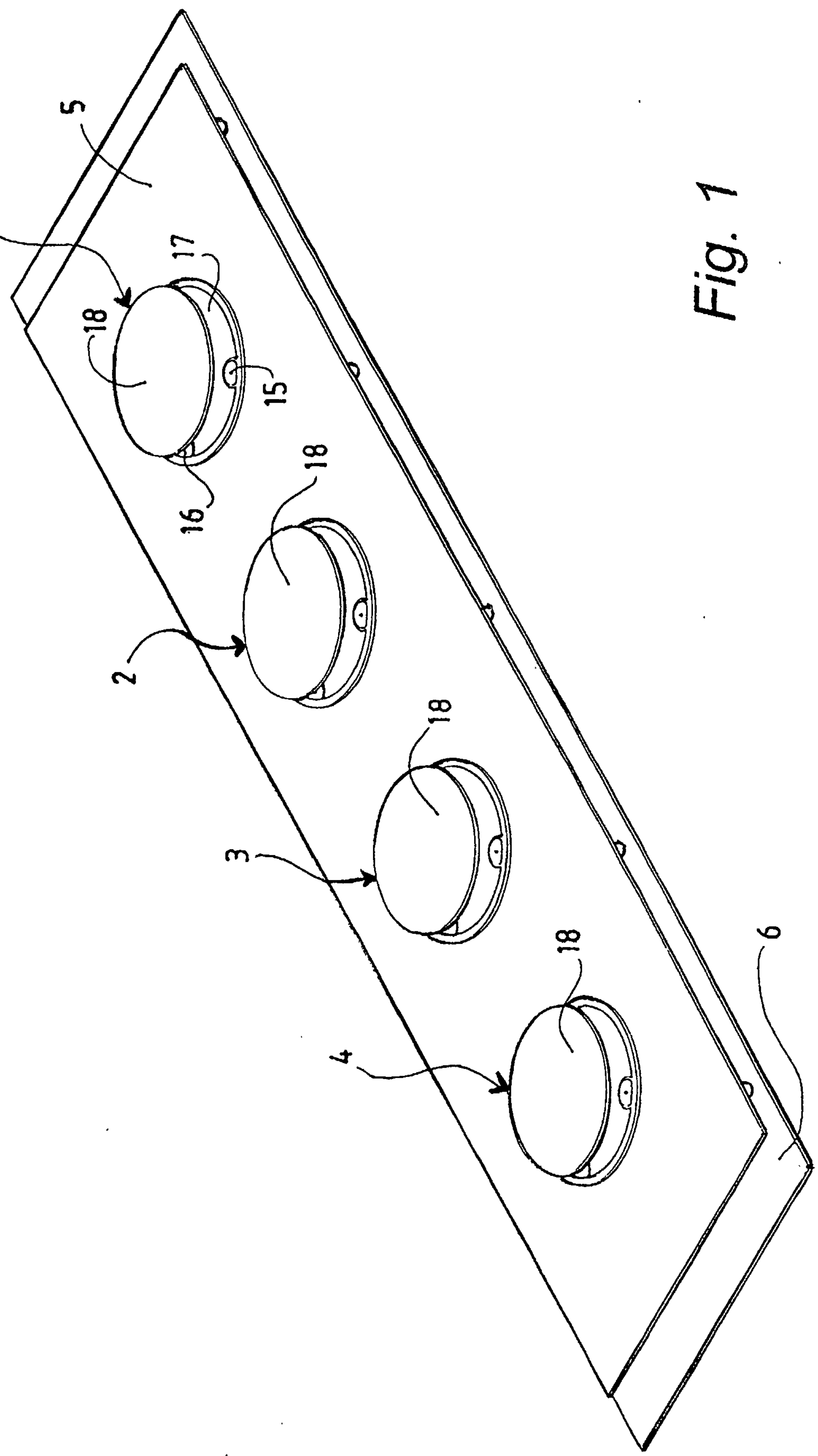

Fig. 1

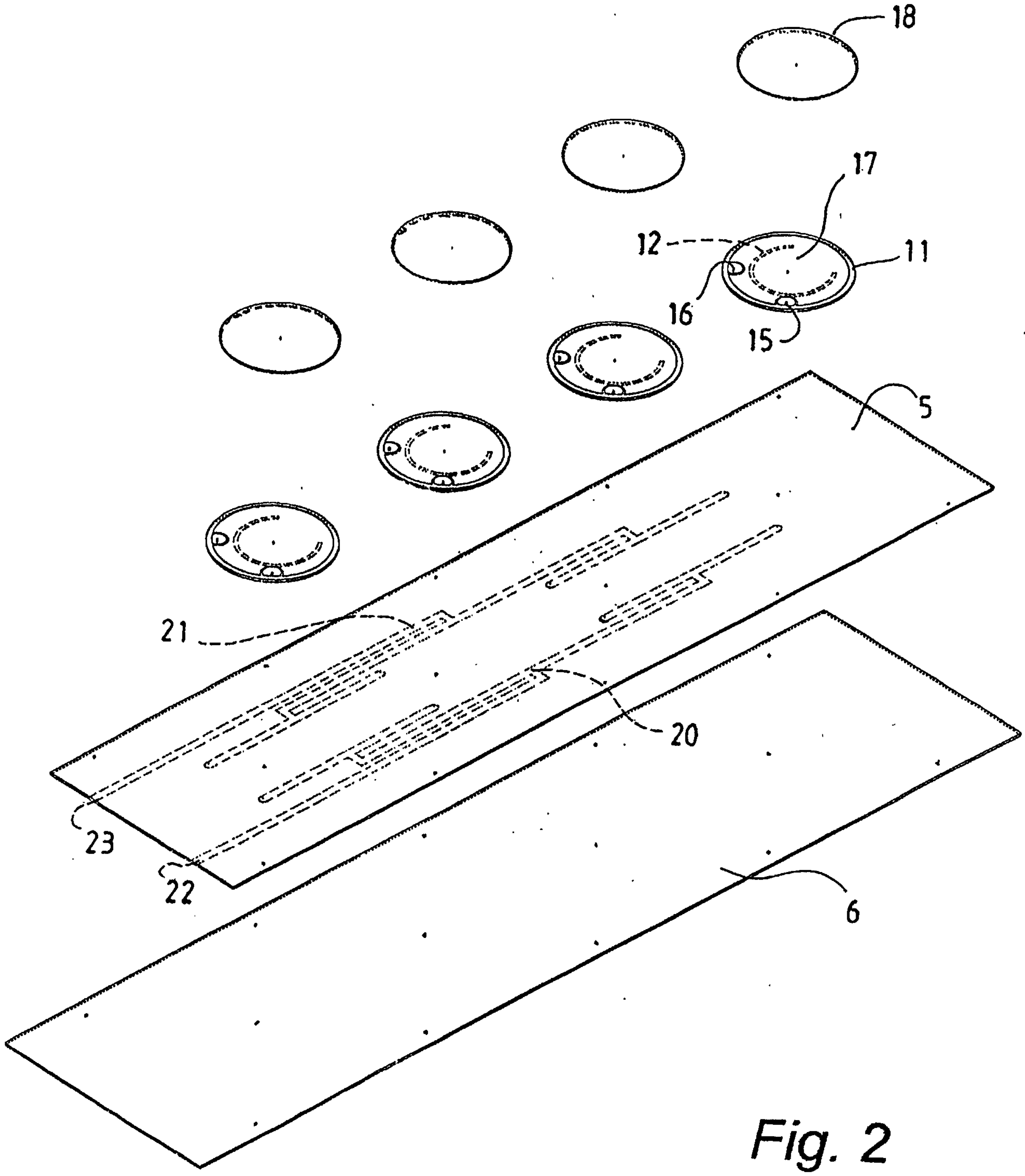

Fig. 2

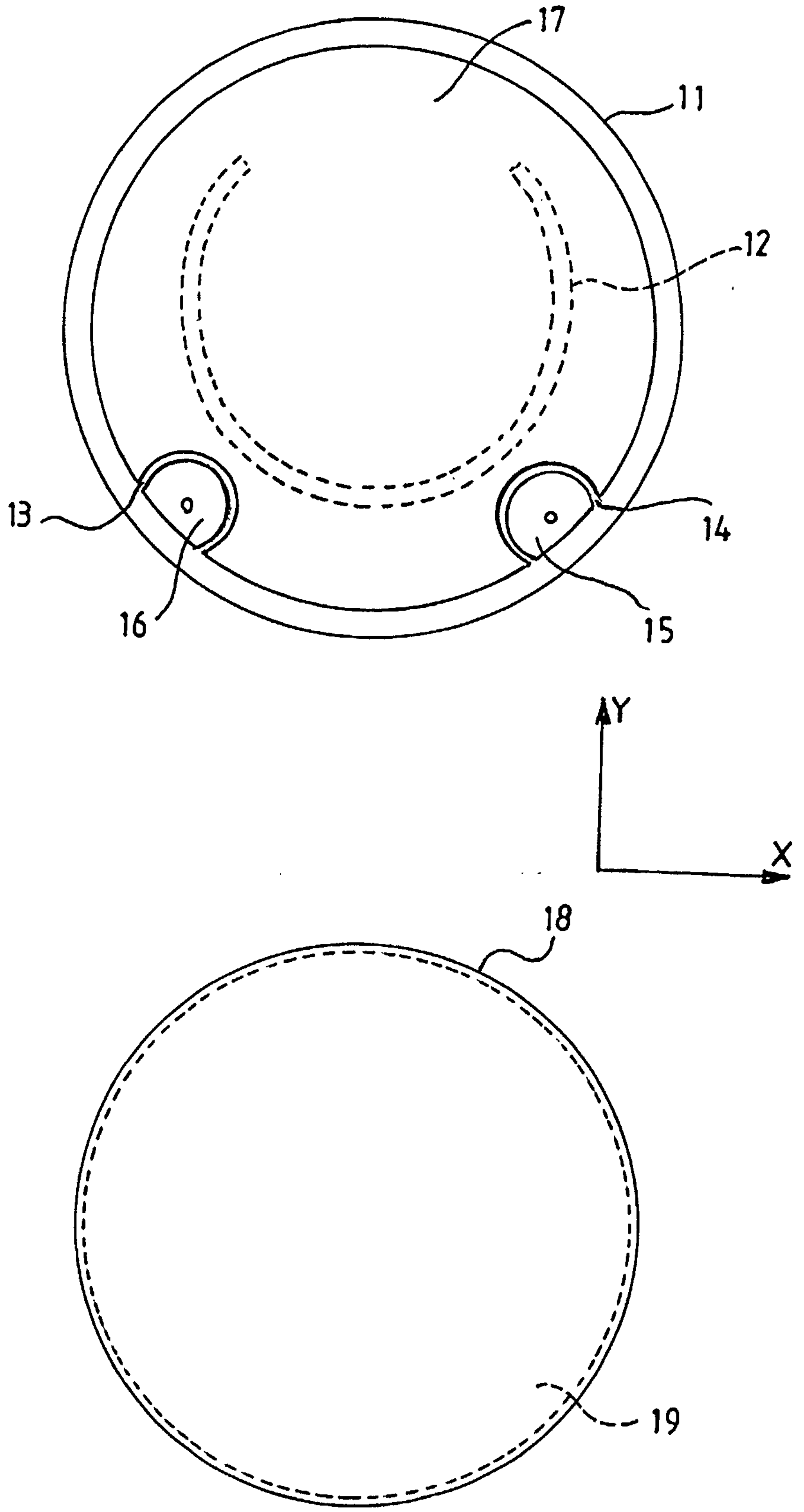

Fig. 3

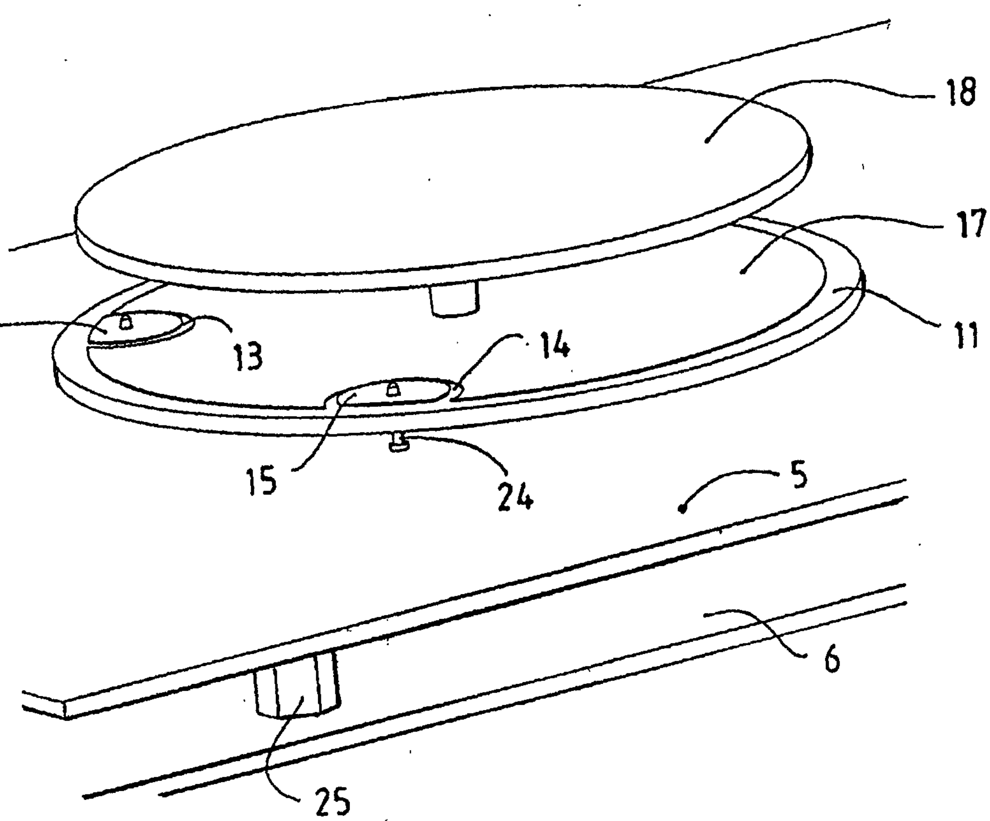

Fig. 4

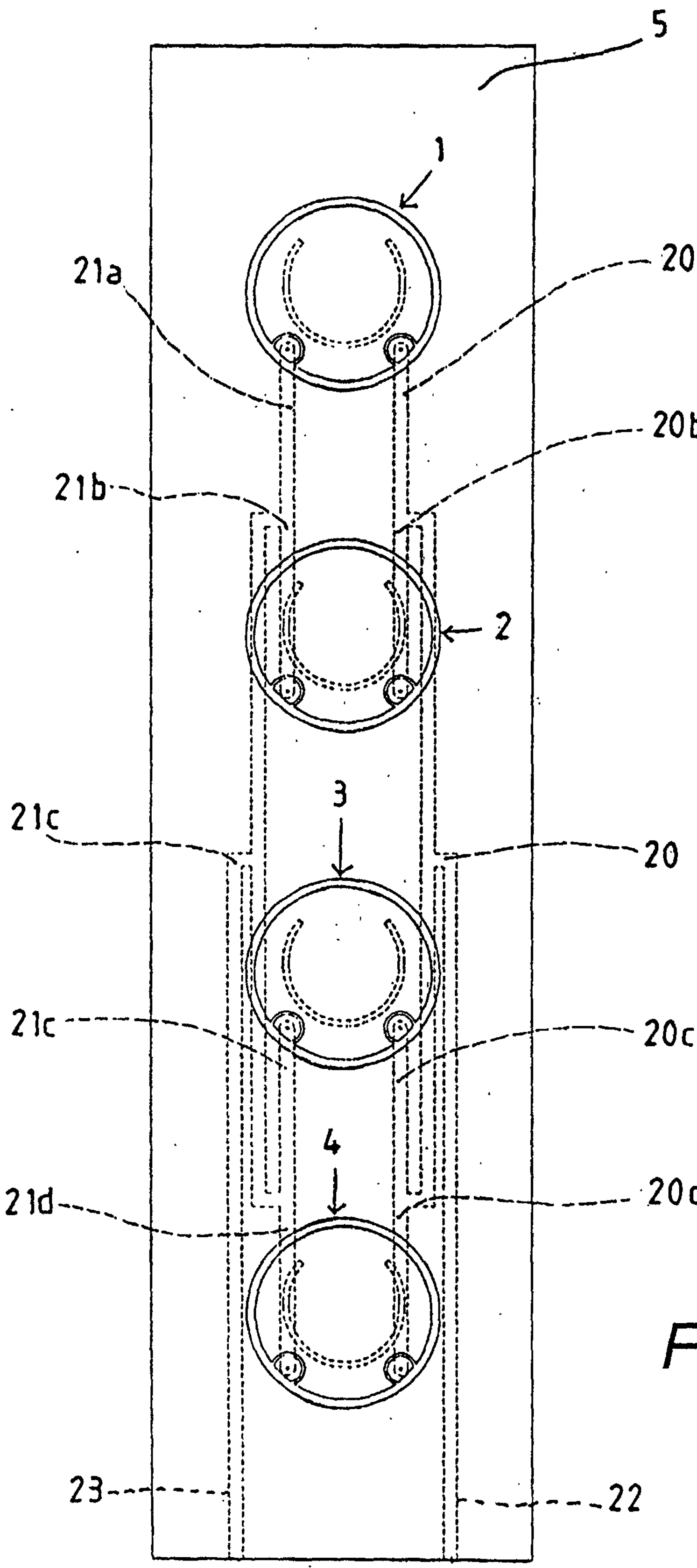

Fig. 5

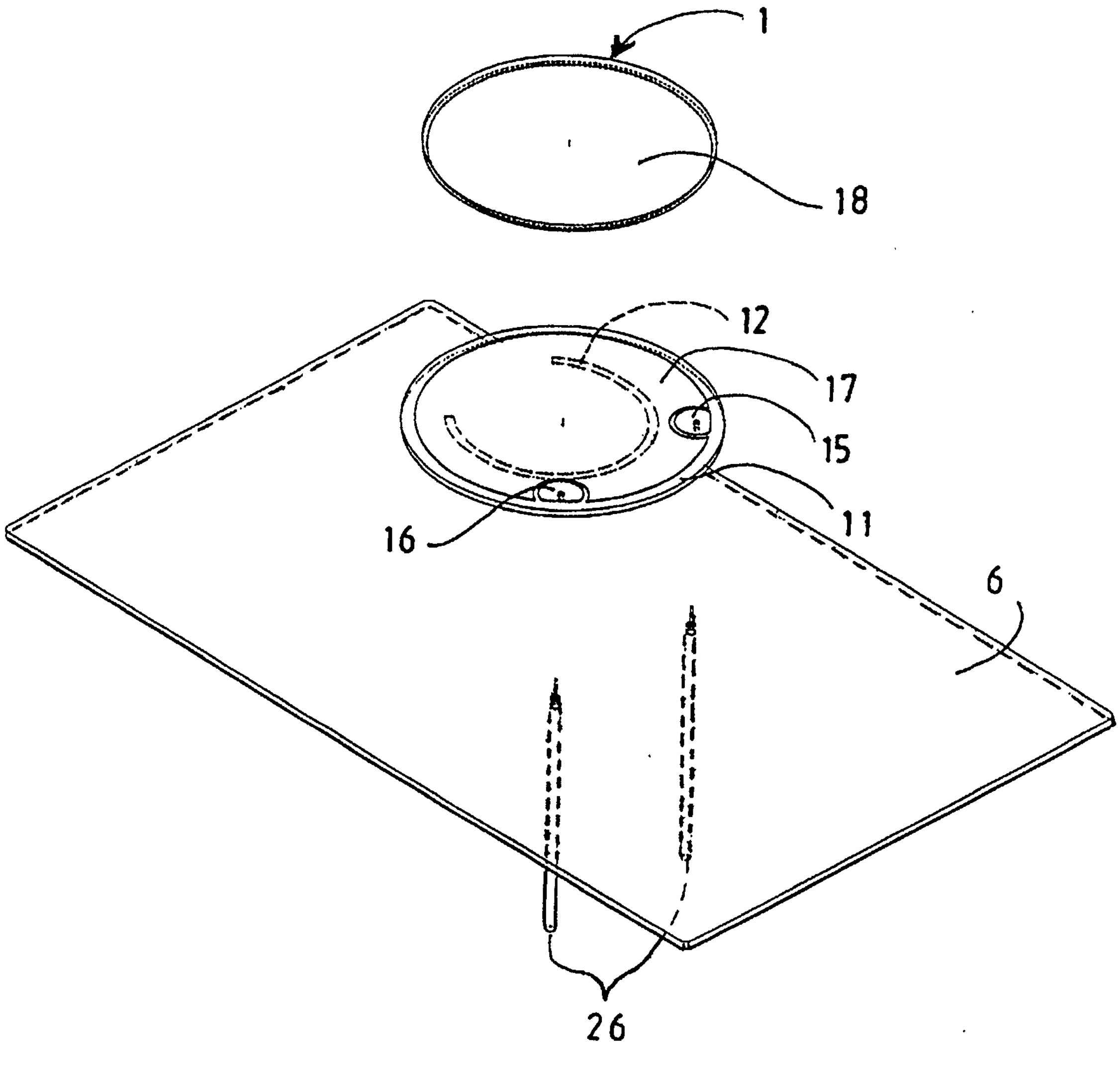

Fig. 6