



12 **EUROPEAN PATENT APPLICATION**

21 Application number: **90302418.0**

51 Int. Cl.⁵: **H01Q 21/00, H01Q 21/06**

22 Date of filing: **07.03.90**

43 Date of publication of application:
11.09.91 Bulletin 91/37

84 Designated Contracting States:
AT BE CH DE DK ES FR GB GR IT LI LU NL SE

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54 **Antenna.**

57 A triplate antenna (11,13,15) wherein the ground planes (13,15) are flat metal plates screwed together at spaced locations and having arrays of apertures formed by stamping out, wherein a suspended stripline structure is formed as a printed circuit on a thin dielectric film substrate (11) and is supported between and spaced from the ground planes (13,15) and maintained flat by foam dielectric layers (17,19).

EP 0 445 453 A1

This invention relates to a flat array triplate antenna particularly, but not exclusively, for receiving T.V. transmissions from a geostationary satellite.

U.S. patent 4,486,758 discloses a triplate antenna for coupling circularly polarised radiation to a plurality of feed lines by way of a planar array of such elements each having a pair of orthogonally disposed dipoles, the dipole array being positioned between conductive sheets each having corresponding arrays of apertures. The dipole array and associated transmission strip lines are spaced from the conductive sheets by layers of dielectric material. The dipoles are formed one from each pair on one surface of a dielectric sheet and the other one of the pair on the opposite surface of the sheet. The respective strip line networks are also formed on the respective opposite surfaces of the sheet. In one embodiment of this prior art antenna a third unapertured conductive sheet is spaced from one of the apertured conductive sheets to act as a reflective surface.

The antenna is fabricated in accordance with conventional rigid printed circuit techniques, which will cause fairly high losses to be encountered.

European patent application No. 0 252 779A proposes the use of metal plates which are shaped by pressing and stamping in order to form radiating slots and to emboss spacing abutments on the plate surfaces facing the dielectric sheet carrying printed conductors and terminations. Application EP 0 252 779A states that the use of embossed spacing abutments obviates the need for expensive solid dielectric material to space the conductive sheets from the dielectric sheet carrying the printed conductors. However, we have found that embossing of metal plates to form accurate spacing abutments is a complex and costly procedure to support the stripline. In addition in order to reduce the loss we have found it is important to use a very thin dielectric layer so that the amount of solid dielectric is minimal. As a consequence however, we have discovered that the stripline is liable to distort. In particular these distortions can occur periodically over the surface at a fraction, e.g. one half or one quarter of the operating wavelength which at the wavelength we are concerned with is about one centimetre periodic distortion, and the resulting losses become significant.

It is an object of the invention to produce a cheap antenna on a mass production basis and having a low loss.

According to the invention there is provided a triplate antenna having a flat stripline feed structure supported between a pair of ground planes, said ground planes being formed by flat metal plates having a plurality of apertures aligned with each other, a plurality of fixings holding said plates at

spaced apart locations, the stripline feed structure being formed on a thin flexible dielectric substrate which is maintained flat and parallel to the plates by foam dielectric material.

Preferably the foam dielectric material comprises on each side of said substrate a respective continuous foam dielectric sheet which is soft and gently embraces both the substrate and the respective plate.

Preferably also each fixing is comprises an attachment which extends through the triplate and which has a spacer shank defining the maximum spacing between the outer surfaces of the plates at the location.

We propose to have a support structure having a plurality of shouldered pillars each of which extends through close-fitting holes in the triplate structure whereby to provide said alignment.

Conventionally said structure has a plurality of support pillars in which said fixings are secured.

According to another embodiment of the invention there is provided a flat array antenna comprising a dielectric film carrying on one surface a printed conductor pattern formed as an array of pairs of conductor terminations, the terminations of each pair being orthogonal to one another and connected together by a conductive stripline, the pairs of terminations each being connected to a common stripline feed structure, the dielectric film being spaced between two conductive surfaces each having an array of apertures corresponding to the array of termination pairs, characterised in that the conductive sheets are flat metal plates wherein the apertures are formed, and that the dielectric sheet is spaced from the metal plates by layers of dielectric foam material.

In a preferred embodiment of the invention the pairs of orthogonal terminations are disposed in an orthogonal array and the orientations of each pair of terminations are at 45° to the perpendicular axes of the array.

An embodiment of the invention will now be described with reference to the accompanying drawings, in which:-

Fig. 1 is a part sectional part schematic view of part of a flat array antenna according to the embodiment;

Fig. 2 is a perspective exploded view of the flat array antenna;

Fig. 3 is a part sectional view of the flat array antenna showing details of the assembly fixing arrangements;

Fig. 4 is a plan view of the triplate structure of the antenna; and

Fig. 5 is a detail of the plan view showing schematically the orientation of the orthogonal terminations.

The various views shown in the drawings are

not dimensionally accurate and are for illustrative purposes only.

Referring to the drawings, the antenna comprises a suspended dielectric film 11 positioned between two metal plates 13, 15 by means of foam dielectric layers 17, 19. The dielectric film 11 has formed thereon, by conventional printed circuit techniques pairs of circuit terminations or "excitation probes" 21, 23 which are orthogonally positioned with respect to one another, and this printed film forms the flat stripline feed structure.

The metal plates 13, 15 are each provided with an array of apertures 25, 27 arranged in respective orthogonal arrays. The apertures 25 and 27 are fabricated in the flat metal plate 13, 15 by simple conventional metal stamping out techniques. By way of example, Applicants have found that it is practical to stamp out an array of holes in flat aluminium sheet of thickness of only 0.5mm. Such flat sheets have sufficient rigidity when sandwiched with layers of foam dielectric material, such as expanded polyethylene, to support the suspended stripline formed on a thin polyester film.

The film 11 and the plates 13, 15 are arranged so that the apertures 25, the pairs of probes 21, 23 and the apertures 27 are aligned perpendicular to the plane of the dielectric film 11 and together provide an array of antenna elements. The probes of each pair are connected to each other by stripline sections (not shown) and all the stripline sections are connected to a common stripline feed structure (not shown) in accordance with known techniques to effect reception (or transmission) of circularly polarised radio frequency signals. Such connection techniques are known from, for example, U.S. patent No. 4,792,810.

Additionally the antenna may be provided with a third, generally unapertured metal plate 29 spaced from the metal plate 15 to act as a reflector plate.

The triplate structure and the reflector plate 37 are secured to a rigid base 30, in this embodiment made of a moulded plastics, by fixings, in this embodiment screws 31, 33 respectively engaging with blind bores in pillars 35, 37 respectively passing through fixing holes in the plates 11, 13, 15 and 29. In addition there are shouldered pillars 39 which pass through close fitting holes in all the layers of the assembled structure to provide accurate lateral alignment of the apertures 25, 27 with the probes 21, 23. Note that the holes in the metal plates through which the pillars 35 pass are clearance holes to prevent distortion of the metal plates when the screws are tightened. Furthermore the screws 31 have shouldered spacer shank portions 31a of predetermined length so that when properly tightened they exert no undue compression on the triplate structure consisting of metal plates 13, 15,

the suspended dielectric film 11 and supporting foam dielectric layers 17, 19, and determine the maximum spacing between the outer surfaces of the plates at each fixing location. The length of the shouldered portion 31a is such that when the plates 13, 15 and foam layers 17, 19 are of maximum thickness allowed by manufacturing tolerance, there is insignificant compression and distortion of the triplate structure. Likewise, when the thicknesses of 13, 15, 17 and 19 are the minimum allowable there will be insignificant slack in the holding of the triplate structure by the screws. The foam dielectric layers 17, 19 are unapertured except for the holes where the locating and securing pillars pass through. Thus the screws 31, shoulder 31a and pillars 35, together with the foamed dielectric layers 17 and 19 accurately control the spacing between the outer surfaces of the ground planes 13 and 15. The foam dielectric is soft and gently embraces the feed structure sufficient to prevent any periodic distortions near the fractional wavelength period mentioned above.

Applicants have noted that it is advantageous to have a diversity of orientations for the probe pairs 21, 23. In particular Applicants have determined that the performance of the antenna array is optimised when the alignments of the individual probes are at 45° to the axes of the columns and rows of the orthogonal array of antenna elements.

The common feed stripline structure referred to above (and not shown in the drawings) has an output termination which couples into a rectangular waveguide 41 the propagation axis of which is perpendicular to the plane of the triplate structure. Finally the triplate structure is covered by a moulded plastics radome cover 43 which is secured at its edges to the base 30.

In order to reduce leakage losses at the edges of the metal plates the edges may be formed with lips (not shown) at right angle to the plane of the plates. Likewise the reflecting plate 29 may be formed with right angled lips 45.

Claims

1. A triplate antenna having a flat stripline feed structure supported between a pair of ground planes, said ground planes being formed by flat metal plates having a plurality of apertures aligned with each other, a plurality of fixings holding said plates at spaced apart locations, the stripline feed structure being formed on a thin flexible dielectric substrate which is maintained flat and parallel to the plates by foam dielectric material.
2. An antenna as claimed in claim 1, wherein said foam dielectric material comprises on each

side of said substrate a respective continuous foam dielectric sheet which is soft and gently embraces both the substrate and the respective plate.

3. A antenna as claimed in any preceding claim wherein each fixing comprises an attachment which extends through the triplate and which has a spacer shank defining the maximum spacing between the outer surfaces of the plates at the location.

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4. An antenna as claimed in any preceding claim, comprising a support structure, having a plurality of shouldered pillars each of which extends through close-fitting holes in the triplate structure whereby to provide said alignment.

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5. An antenna as claimed in claim 4, wherein said structure has a plurality of support pillars to which said fixings are secured.

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6. A flat array antenna comprising a dielectric film carrying on one surface a printed conductor pattern formed as an array of pairs of conductor terminations, the terminations of each pair being orthogonal to one another and connected together by a conductive stripline, the pairs of terminations each being connected to a common stripline feed structure, the dielectric film being spaced between two conductive surfaces each having an array of apertures corresponding to the array of termination pairs, the conductive sheets being flat metal plates, the apertures being formed by stamping out and the dielectric film being spaced from the metal plates by layers of dielectric foam material.

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7. An antenna according to claim 6 wherein the pairs of orthogonal terminations are disposed in an orthogonal array and the orientations of each pair of terminations are at 45° to the perpendicular axis of the array.

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8. A triplate antenna substantially as claimed herein with reference to and as shown in the accompanying drawings.

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Fig.1.

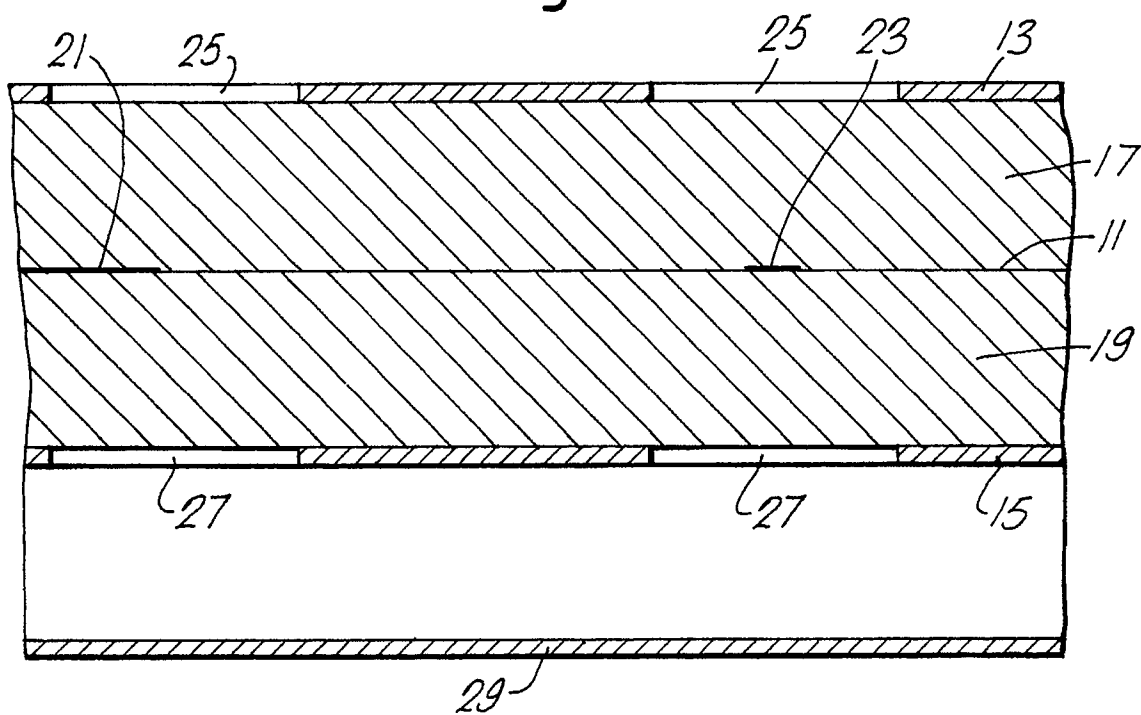


Fig.3.

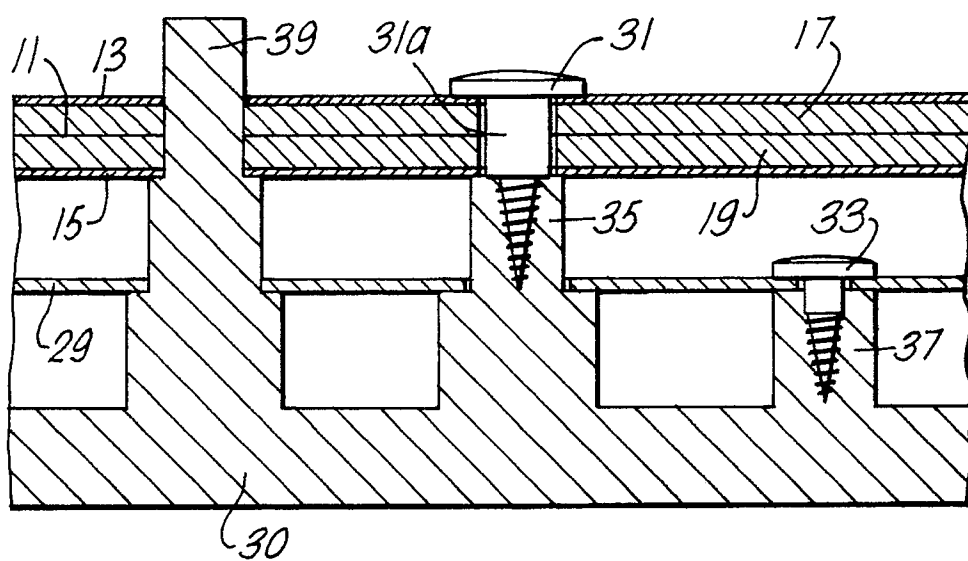


Fig.2.

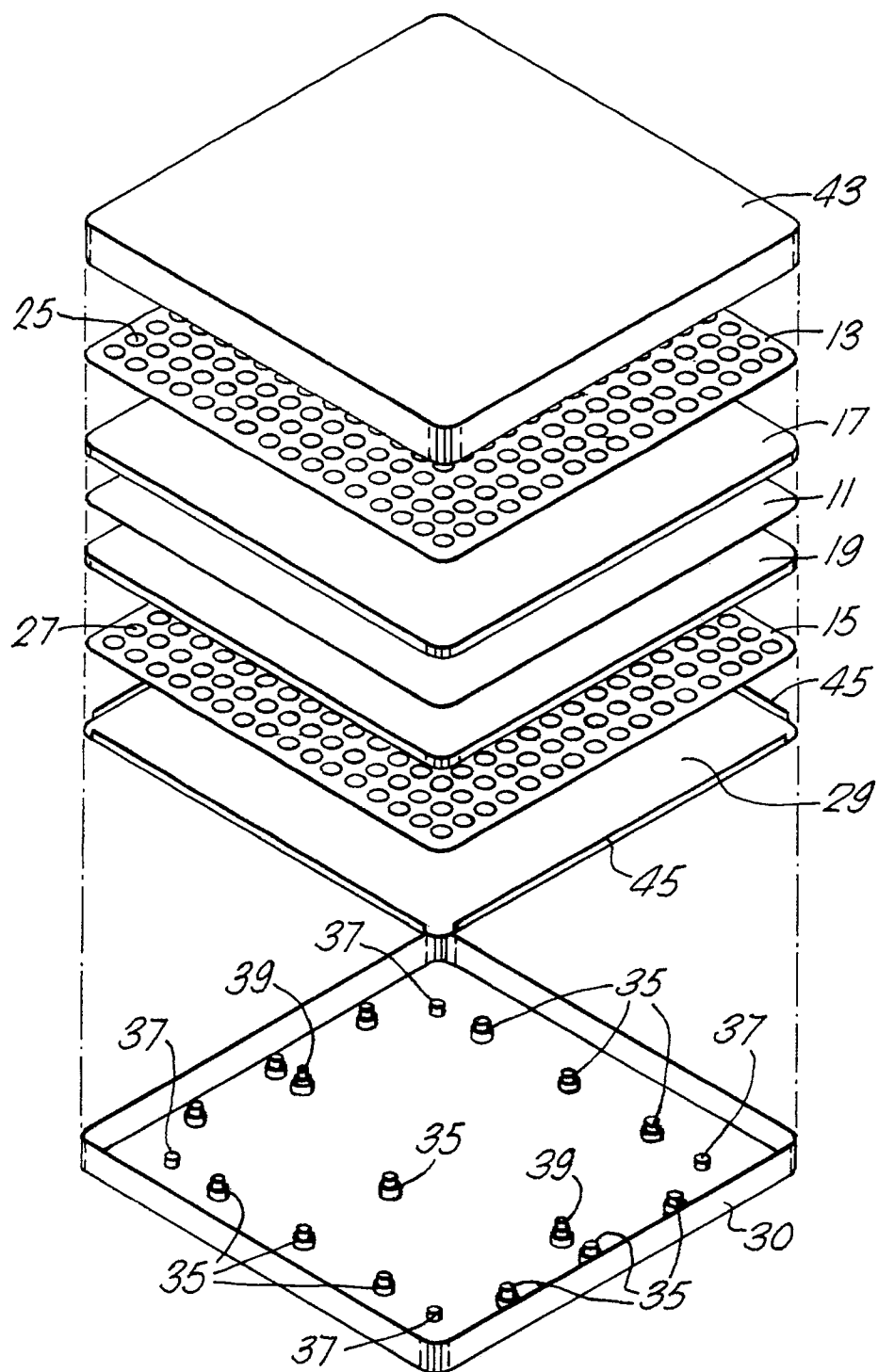
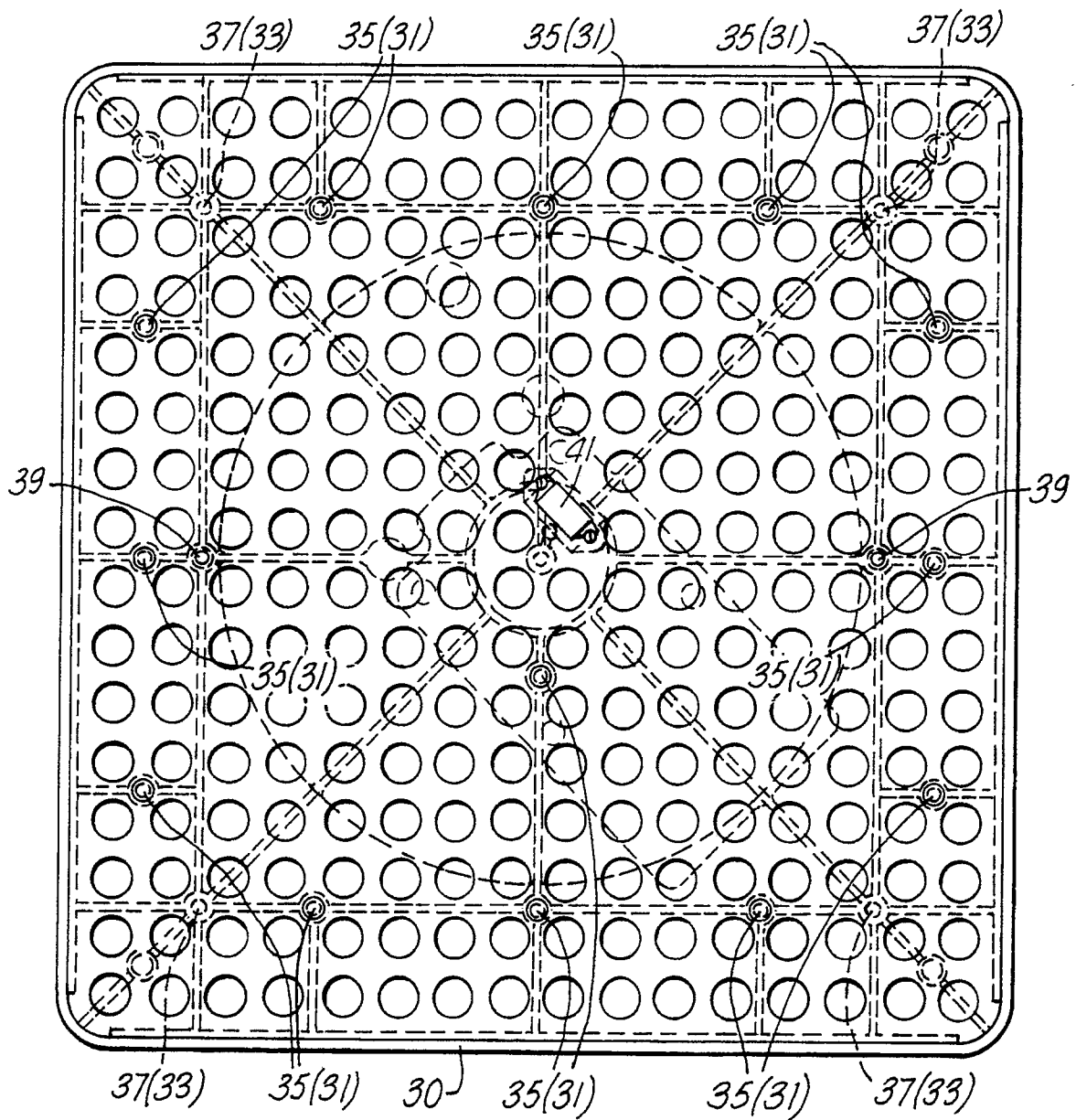
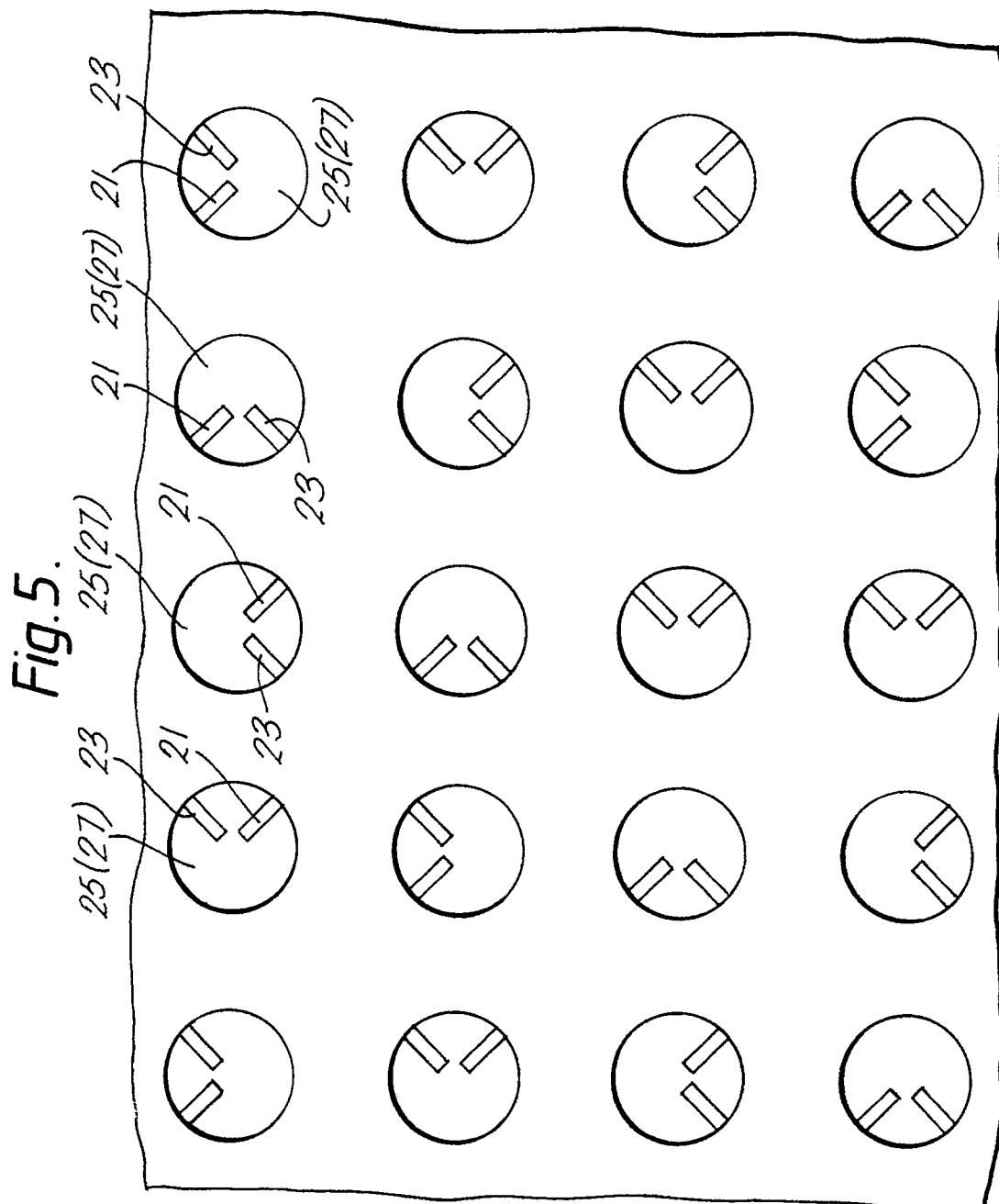


Fig.4.







European
Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 90 30 2418

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.5)
D,X,A	EP-A-0 252 779 (RAMMOS) * claims 1, 23, 24; figures 1, 9, 11, 13 * -- --	1,8,2-6	H 01 Q 21/00 H 01 Q 21/06
X,A	IEEE TRANSACTIONS ON BROADCASTING. vol. 34, no. 4, December 1988, NEW YORK US pages 457 - 464; ITO et al.: "PLANAR ANTENNAS FOR SATELLITE RECEPTION" * page 461, right-hand column; figure 10 * -- --	1,8,6	
A	EP-A-0 312 989 (SONY) * column 16, lines 20 - 30; figure 18 * -- --	1,2,6	
A	EP-A-0 317 414 (RAMMOS) * abstract; figures 10, 14 * -- --	1,3-6	
A,D	EP-A-0 064 313 (L.E.P.) * abstract; figures 1b, 3b, 4 & US-A-4486758 * -- --	1,6	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			H 01 Q
The present search report has been drawn up for all claims			
Place of search		Date of completion of search	Examiner
The Hague		09 November 90	ANGRABEIT F.F.K.
CATEGORY OF CITED DOCUMENTS			
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