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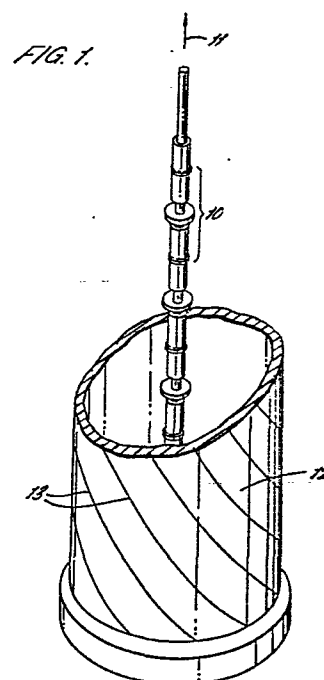
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(64) **Antenna for circularly polarised radiation.**

(57) Linear array of radiating elements (10) with common linear polarisation. A single anisotropic layer (12) is mounted around the array so as to be substantially parallel to the wave fronts of radiation emitted by the array. The orthogonal axes of the anisotropic layer are at acute angles to the linear polarisation (11) of the array and the geometry and structure of the anisotropic layer and its spacing from the array are selected so that repeated reflections between the layer and the array produce a radiated wave from the antenna which is circularly polarised. The anisotropic layer can be supported on a radome and comprise parallel spaced conductors (13) extending in one of the orthogonal axis of the layer at 45° to the linear polarisation of the array.



ANTENNA FOR CIRCULARLY
POLARISED RADIATION

The present invention relates to an antenna for circularly polarised radiation. Circular polarisation of RF radiation is known to be useful in various applications. For example, it is well known that

5 circular polarisation can be helpful in radar systems in discriminating desired targets from clutter, especially rain clutter. Additionally, when a circularly polarised signal is reflected from a substantially smooth surface, such as the sea on a relatively calm

10 day, the reflected signal becomes circularly polarised in the opposite hand. Thus, provision of an antenna system which discriminates in favour of circularly polarised signals in a particular hand can be useful in discriminating against such signals which have been

15 reflected from the sea. This feature has particular applications in position fixing systems in which the distance of a station of which the position is to be found from transponders at known fixed positions is determined by interrogating the transponders and

20 measuring the time delay of receipt at the interrogating station of response signals from the transponders. It

can be appreciated that these time delay measurements can be substantially corrupted if the transponder, or the interrogating station responds to signals reflected from sea.

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Antennas generally produce radiation which is linearly polarised on a particular axis. Circular polarisers are known for converting these linear polarised emissions to circularly polarised signals. In general, such circular polarisers are arranged as anisotropic regions, that is regions which have differing capacitativ and inductive effects on the transmitted radiation in each of two orthogonal directions transverse to the direction of transmission. The orthogonal directions of the anisotropic region can be described as the orthogonal axes of the region. In one known example of circular polariser, parallel plates are used inclined at 45° to the linear polarisation axis of the radiation from the antenna which is to be circularly polarised. The components of the linearly polarised radiation having electric vectors parallel and orthogonal to the parallel plates of the polariser are changed in phase differentially as they pass through the polariser. Careful design of the spacing and depth (in the transmission direction) of the plates can arrange for this phase change to be 90° , thereby resulting in circular

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polarisation. It can be appreciated that the parallel plate polariser described above is essentially suitable only for signals transmitted with a substantially planar wave front in a predetermined direction. The
5 system is not suitable for use in a compact arrangement on a wide beam antenna.

The prior art also includes a number of printed polarisers in which anisotropic arrangements of
10 conductors are provided on insulating supporting sheets. However, with such arrangements it has hitherto been found necessary to use at least two such anisotropic sheets or layers to minimise reflections from these layers resulting in serious mis-match at the antenna.
15 However, anisotropic layer polarisers of this kind can be shaped to correspond to the wave front of signals from the antenna and therefore used in wide beam applications.

20 There is a clear need for a more compact circular polarising arrangement providing good polarisation discrimination in a compact antenna whilst affording reasonable or good matching at the antenna without excessive voltage standing wave ratio (VSWR).

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---According to the present invention, an antenna for

circularly polarised radiation comprises a linear array of primary radiating elements having a common linear polarisation, and means to supporting a single anisotropic layer shaped to be substantially parallel to the wave fronts of radiation emitted by the array, the orthogonal axes of the anisotropic layer being at acute angles to the linear polarisation of the primary radiating elements, the geometry and structure of the anisotropic sheet and the radial spacing of the sheet from the array being selected such that repeated reflections between the sheet and the primary radiating elements produce a radiated wave from the antenna which is circularly polarised.

The above invention is based primarily on the somewhat surprising discovery that a satisfactory antenna with circular polarisation can be produced using a single anisotropic layer. By carefully designing the anisotropic layer itself and careful spacing of the anisotropic layer from the primary radiating elements, mis-matching of the antenna can be minimised and good circular polarisation achieved.

It will be appreciated that, as normal in antenna systems, the present antenna can be equally suitable for receiving radio-frequency radiation as for transmitting

and references throughout this specification to radiations and emissions from the antenna are included solely for convenience in describing the antenna and should not be construed as limiting the antenna to
5 transmission applications.

Conveniently said supporting means of the antenna comprises a radome of dielectric material carrying the anisotropic layer. The anisotropic layer may comprise
10 parallel spaced conductors extending in one of the orthogonal axes of the layer. The spaced conductors may be at 45° to the common linear polarisation of the radiating elements.

15 In one arrangement the linear array provides omnidirectional radiation in planes perpendicular to the array and said anisotropic layer forms a complete cylinder surrounding the array.

20 Examples of the present invention will now be described in greater detail with reference to the accompanying drawings in which :

Figure 1 is a partial view of an antenna for
25 circularly polarised radiation with a portion of the radome and anisotropic layer broken away for clarity and

Figure 2 is an alternative embodiment of antenna employing a different form of primary radiating element.

Referring to Figure 1, the antenna comprises an
5 array of three dipole radiators 10 stacked end to end
along a common axis 11. The detailed construction
of the dipole radiators 10 of the array is not essential
to the understanding of the present invention and nothing
more will be included herein. It can be seen that the
10 dipoles 10 of the array have a common linear polarisation
producing, in the absence of any circular polariser,
radiation with an electric vector parallel to axis 11.
Furthermore, it can be seen that the array of dipoles 10
can produce radiation in all directions in a plane
15 parallel to the axis 11. Thus, with the axis 11 vertical,
the antenna is omnidirectional in azimuth.

The array of dipoles 10 is enclosed in a cylindrical
radome of which a lower part only is shown at 12. The
20 upper part of the radome is broken away for clarity so
as to reveal the dipole array. The cylindrical radome
12 is arranged to surround the dipole array so that the
axis 11 of the array is on the axis of the cylinder of
the radome. The radome is made of a dielectric material
25 and is arranged to provide substantial weather protection
for the antenna. For example the antenna may form the

antenna of a transponder unit in a navigation or position fixing system and may therefore be located in an unattended and exposed position for example on the coastline.

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In this example of the present invention, the radome 12 also supports an anisotropic layer formed of parallel helical wires or conducting paths 13. The wires 13 are either embedded in the thickness of the dielectric material of the radome 12 or supported on the inside wall of the radome. In an alternative arrangement the wires or paths 13 may be contained between an inner and an outer layer of the radome. For example the paths may be supported on the outer cylindrical surface of a rigid plastics cylinder forming an inner layer of the radome and providing the mechanical strength of the radome. The conducting paths 13 of the anisotropic layer are then encapsulated by an outer layer of the radome which may for example be formed of a heat shrinkable plastics shrunk onto the inner layer of the radome to cover the conducting paths.

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The helical wires or conducting paths 13 are arranged with a helical pitch of 45° so that they are always at 45° to the axis 11 of the dipole array.

It will be appreciated by those experienced in this field that the components of the radiation emitted by the dipole array which are perpendicular and parallel respectively to the paths or wires 13 will be affected differently by the anisotropic layer. The component which is perpendicular to the wires or paths 13 will see the anisotropic layer as more capacitative than the component parallel to the wires, which latter will in turn see the layer as more inductive. It will be appreciated also that there will be reflections from the anisotropic layer back towards the array of dipoles and return reflections from the dipoles.

It has been discovered that careful selection of the design of the anisotropic layer and the material and thickness of the radome, together with careful spacing of the radome and anisotropic layer from the dipole array can result in producing effective circular polarisation of radiation emitted by the array with reasonable or good matching of the antenna.

The selection of the various parameters of the antenna is largely, though not entirely, an empirical process and of course these parameters will be different for different applications and, in particular, different frequencies.

In one example, an antenna as shown in Figure 1 was made to operate at a wave length of about 7 cm with a spacing between the helical wires 13 of about 1.5 cm and a radius from the anisotropic layer to the axis of the dipole array of about 4.5 cm.

Referring now to Figure 2, an alternative arrangement is shown which is essentially similar to that of Figure 1 except that the primary radiating elements are slots 14 in a wave guide 15. Again the slotted wave guide is enclosed in a substantially cylindrical radome carrying helical wires or conducting paths to form a single anisotropic layer. In other respects, the arrangement of Figure 2 may be substantially similar to that of Figure 1.

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CLAIMS:

1. An antenna for circularly polarised radiation comprising a linear array of primary radiating elements
5 having a common linear polarisation, and means supporting a single anisotropic layer shaped to be substantially parallel to the wave fronts of radiation emitted by the array, the orthogonal axes of the anisotropic layer being at acute angles to the linear polarisation of the primary
10 radiating elements, the geometry and structure of the anisotropic sheet and the radial spacing of the sheet from the array being selected such that repeated reflections between the sheet and the primary radiating elements produce a radiated wave from the antenna, which
15 is circularly polarised.

2. An antenna as claimed in Claim 1 wherein said supporting means comprises a radome of dielectric material carrying the anisotropic layer.
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3. An antenna as claimed in either of Claims 1 or 2, wherein the anisotropic layer comprises parallel spaced conductors extending in one of the orthogonal axes of the layer.
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4. An antenna as claimed in Claim 3,

wherein said spaced conductors are at 45° to the common linear polarisation of the radiating elements.

5. An antenna as claimed in any
- 5 preceding claim wherein said linear array provides omnidirectional radiation in planes perpendicular to the array and said anisotropic layer forms a complete cylinder surrounding the array.

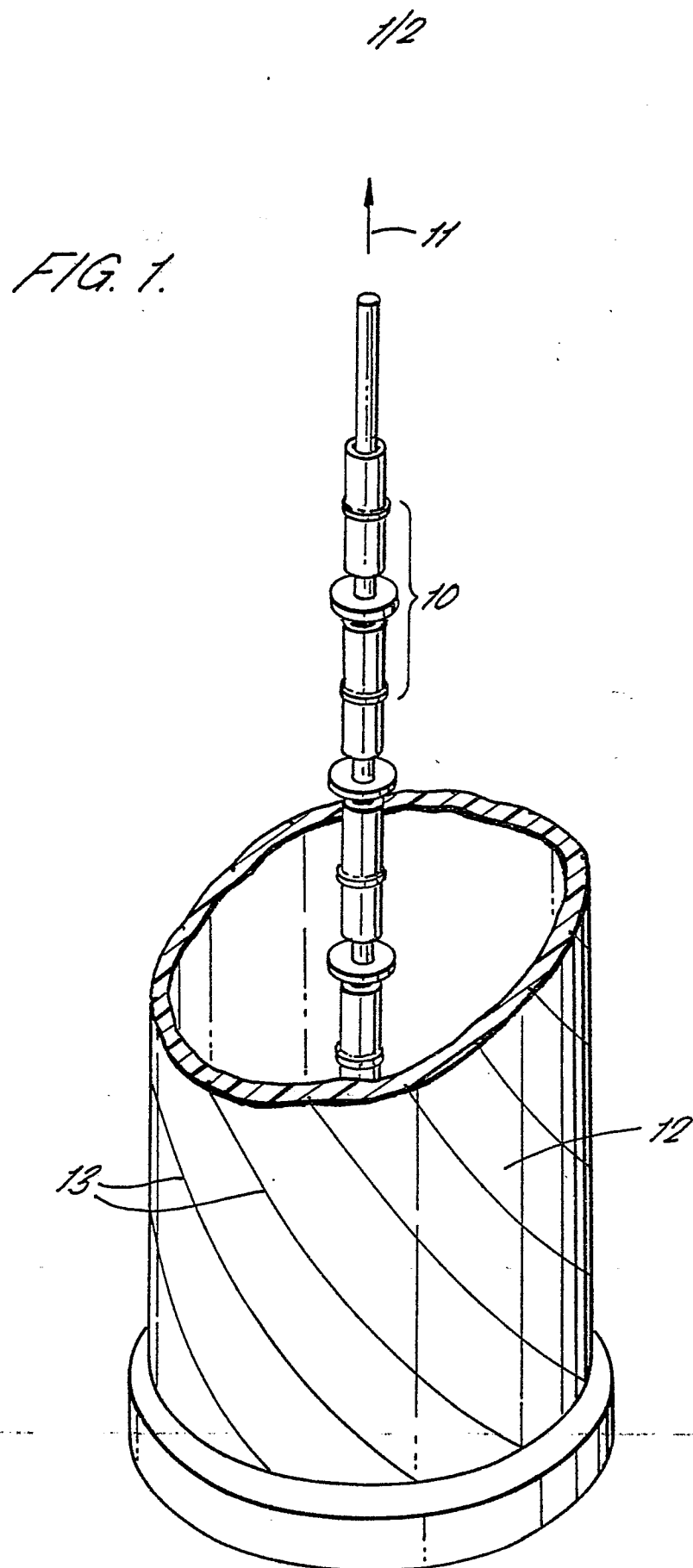
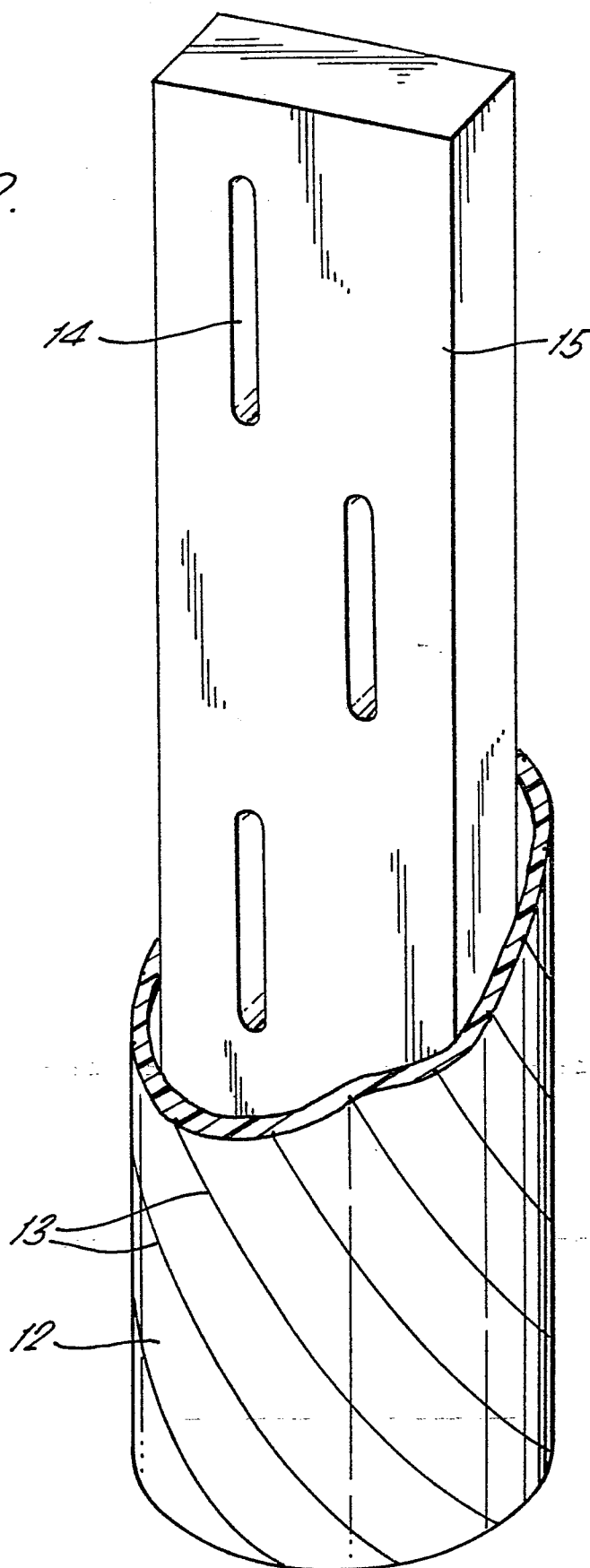


FIG. 2.





European Patent
Office

EUROPEAN SEARCH REPORT

0156549
Application number

EP 85 30 1518

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. 4)																				
A	GB-A-1 240 529 (BRITISH AIRCRAFT) * The whole document *	1-4	H 01 Q 15/24 H 01 Q 1/42																				
A	GB-A-1 165 444 (C.F. THOMSON HOUSTON HOTCHKISS BRANDT) * The whole document *	1-3,5																					
A	US-A-2 800 657 (F.M. WEIL et al.) -----																						
			TECHNICAL FIELDS SEARCHED (Int. Cl. 4)																				
			H 01 Q																				
The present search report has been drawn up for all claims																							
Place of search THE HAGUE		Date of completion of the search 17-06-1985	Examiner CHAIX DE LAVARENE C.																				
CATEGORY OF CITED DOCUMENTS <table border="0"> <tr> <td>X</td> <td>particularly relevant if taken alone</td> <td>T</td> <td>theory or principle underlying the invention</td> </tr> <tr> <td>Y</td> <td>particularly relevant if combined with another document of the same category</td> <td>E</td> <td>earlier patent document but published on, or after the filing date</td> </tr> <tr> <td>A</td> <td>technological background</td> <td>D</td> <td>document cited in the application</td> </tr> <tr> <td>O</td> <td>non-written disclosure</td> <td>L</td> <td>document cited for other reasons</td> </tr> <tr> <td>P</td> <td>intermediate document</td> <td>&</td> <td>member of the same patent family, corresponding document</td> </tr> </table>				X	particularly relevant if taken alone	T	theory or principle underlying the invention	Y	particularly relevant if combined with another document of the same category	E	earlier patent document but published on, or after the filing date	A	technological background	D	document cited in the application	O	non-written disclosure	L	document cited for other reasons	P	intermediate document	&	member of the same patent family, corresponding document
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