

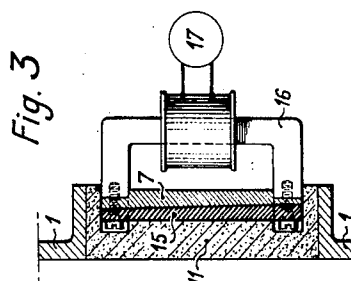
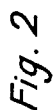
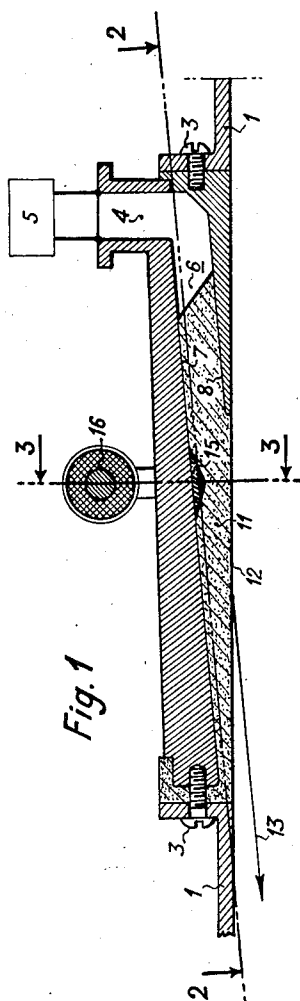
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LOBE-SCANNING MICROWAVE ANTENNA

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LOBE-SCANNING MICROWAVE ANTENNA

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3 Claims. (Cl. 343—783)

The present invention relates to an antenna which enables the direction of a microwave beam to be varied at the rate of a low-frequency signal.

The object of the invention is to provide a lobe-scanning microwave antenna having a plane radiating surface which may be inserted into the wing of an airplane as a portion of said wing.

The antenna comprises a radiating device and a scanning device for varying the direction of the beam, these two devices being in the form of thin layers of dielectric materials spread on a metallic surface.

The principle employed is the following:

The radiating member makes use of the propagation of microwaves along metallic plates coated with a layer of a dielectric substance. The same metallic plate bears, immediately in front of the radiating layer, a thin layer of a second dielectric substance having a very high refractive index and varying with a magnetic field. It is to be borne in mind that the refractive index of a dielectric substance is equal to $\sqrt{\epsilon\mu}$ where ϵ is the dielectric constant and μ the permeability. Dielectric substances, the permeability of which varies in the presence of a magnetic field, such as high-frequency ferrites, which are sintered mixed oxides of iron and other metals, e. g. manganese, nickel and zinc, are known in the art. The general cross-sectional shape of the said thin layer of the second dielectric substance is that of an isosceles triangle which has a small base and a great height and which, if required, may be truncated on the apex side, thus giving it the shape of an elongated trapezium. The surface waves are propagated parallel to the base of the triangle and are deflected, as by means of a prism.

A magnetic field is created in the direction of the altitude of the triangle and the variations of the intensity of this field vary the angle of deflection by the prism.

The invention will be better understood on reading the following detailed description with the aid of the accompanying drawings, of which

Fig. 1 is a section of the antenna on the line 1—1 of Fig. 2;

Fig. 2 is a section of the antenna on the line 2—2 of Fig. 1; and

Fig. 3 represents a cross section of the antenna at the line 3—3 of Fig. 1 and a front view of an electromagnet producing the lobe scanning magnetic field.

The antenna is supposed to have been placed beneath the wing of an airplane, the plate 1 of which constitutes the intrados. A recess 2 is made in this plate for placing the antenna therein, and the latter is fixed to the wing by screws 3.

A feeder 4, which is represented in the form of a rectangular guide, connects a microwave transmitter-receiver unit 5 to the antenna. This feeder is extended by a sectoral horn 6 which has two parallel faces 7 and 8 and two divergent faces 9 and 10. The mouth of said horn is located in a plane which makes a small angle, of a few degrees, with its axis. It results from the obliquity of the mouth plane of the horn that, among the two parallel

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faces, one 8 has an extension sharply shorter than the other one 7.

A sheet 11 of dielectric substance covers the metallic face 7. It is in contact with the atmosphere by means of a surface 12 which is the mouth plane of the horn and its thickness with reference to the face 8 of the face 7 decreases from the edge of face 8 to the edge of face 7 of the horn. On the other side, it enters the horn 6.

Owing to the decreasing thickness of the dielectric sheet 11, the direction of the beam transmitted by the horn is parallel to the plate 7. In fact, the field of the wave radiated becomes weaker as one moves from the right to the left on the surface 12 (Fig. 1) and the direction of propagation in the free space tends simultaneously to make, with the direction of the face 7, an angle which approaches zero.

The part of the dielectric sheet 11 which enters the horn is bounded, on the inner side of the horn, by an hyperbola 14, one of the foci F of which is at the tip of the horn. The object of this arrangement is to convert into a plane wave the cylindrical wave which would be propagated in the sectorial horn in the absence of the sheet.

A plate 15 of ferrite, which is the essential member of the antenna of the invention and which constitutes the lobe scanning device, is arranged in the horn 6 against the face 7. In the section shown in Fig. 2, it has the general shape of an elongated trapezium, the altitude of which is perpendicular to the axis of symmetry of the horn. A magnetic field is induced in the plate 15 parallel to its height by means of the electromagnet 16 which is energized by the source of current 17.

The plane waves transmitted by the horn 6 are deflected by the plate 15, the direction 13 of the transmitted wave remaining in the plane of Fig. 2 and the angle of deflection varying with the magnetic field, that is to say with the current from the source 17. If the current is a sinusoidal current, the direction 13 of the beam varies sinusoidally between the two positions 13' and 13'' corresponding to the maximum and the minimum of the said sinusoidal current. If the current has a shape of a rectangular wave, the maximum and the minimum being the same as aforesaid, the direction 13 of the beam passes sharply from the position 13' to the position 13''.

What I claim is:

1. A microwave lobe-scanning antenna comprising in combination a sectoral horn, having flared and parallel metallic faces, the plane of opening which is oblique with respect to the parallel faces whereby the horn has long and short parallel faces, a first dielectric substance sheet filling the space between the plane of opening and the long parallel metallic face of the horn, said sheet constituting a layer of decreasing thickness spread on said metallic face, a second dielectric substance sheet, embedded in the first dielectric substance sheet, having a great refractive index which varies with a magnetic field applied thereto, and means to generate and apply to said second sheet a variable magnetic field.

2. A microwave lobe scanning antenna comprising in combination a sectoral horn having an axis and flared and parallel metallic faces with respect to said axis, the plane of opening which is oblique with respect to the parallel faces whereby the horn has long and short parallel faces, a first dielectric substance sheet filling the space between the plane of opening and the long parallel metallic face of the horn, said sheet constituting a layer of decreasing thickness spread on said metallic face, a second dielectric substance sheet, embedded in the first dielectric substance sheet, having a great refractive index which varies with a magnetic field applied thereto and conforming, in cross-section, to the shape of an isosceles trapezium the angle of which, that is formed by the non parallel sides, is small and the height of which is perpendicular to the axis of

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the horn, and means to generate and apply parallel to said height a variable magnetic field.

3. A microwave lobe scanning antenna comprising in combination a sectorial horn having flared and parallel faces, the plane of opening which is oblique with respect to the parallel faces whereby the horn has long and short parallel faces, a first dielectric substance sheet filling the space between the plane of opening and the long parallel metallic face of the horn, penetrating into the interior of the horn and terminating in the latter by a surface which has the shape of an hyperbolic cylinder to convert the cylindrical wave, which would be propagated in the horn

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in the absence of said first dielectric substance, into a plane wave, a second dielectric substance sheet, embedded in the first dielectric substance sheet, having a great refractive index which varies with a magnetic field applied thereto, and means to generate and apply to said second sheet a variable magnetic field.

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