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ANTENNA FOR RADIATING ELLIPTICALLY POLARIZED ELECTROMAGNETIC WAVES

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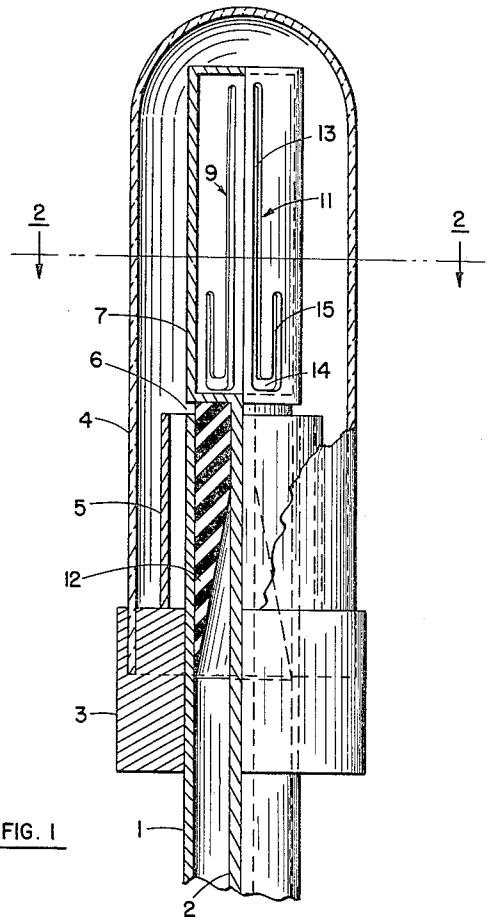


FIG. 1

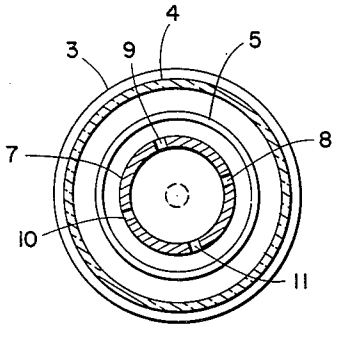


FIG. 2

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ANTENNA FOR RADIATING ELLIPTICALLY POLARIZED ELECTROMAGNETIC WAVES

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5 Claims. (Cl. 343—729)

This invention relates to airborne antennae, and particularly to an airborne beacon antenna adapted to propagate elliptically polarized electromagnetic waves over a substantially toroidal pattern with a minimum axial ratio of ellipticity.

To propagate an elliptically polarized electromagnetic wave it is necessary to launch an electromagnetic wave which is plane polarized in one direction simultaneously with a wave, plane polarized in a direction normal to the polarization of the first wave. Various devices exist for launching such waves with the proper direction such, for example, as the dipole for propagating electromagnetic waves with polarization parallel to the axis of an antenna and the slot for propagating electromagnetic waves of polarization normal to the axis of an antenna. One such scheme is disclosed in patent application Serial No. 264,481 filed January 2, 1952, in the names of Robert Krausz and Donald Margerum, for "Airborne Beacon Antenna." If the two waves are launched from two different points in space, there is a good probability that the ellipticity of the resultant wave will not be uniform throughout the propagation pattern, i. e., the axial ratio of ellipticity (the ratio of the major to the minor axis of the ellipse) may be of an acceptably low value only within certain small solid angles subtended from the antenna. This invention contemplates means for radiating elliptically polarized electromagnetic waves of substantially constant axial ratio of ellipticity over substantially all of a toroidal propagational radiation pattern. This invention further contemplates the superposition of an array of especially designed slots, and a dipole to achieve the simultaneous radiation of the two plane polarized waves.

It is therefore an object of this invention to provide a beacon antenna adapted to propagate elliptically polarized electromagnetic waves.

It is another object of this invention to provide a beacon antenna for propagating elliptically polarized electromagnetic waves of substantially constant axial ratio.

It is another object of this invention to provide a beacon antenna of relatively uniform propagational characteristics.

Other objects of invention will become apparent from the following description taken in connection with the accompanying drawings, in which:

Fig. 1 is an elevational view of the invention, partly in section, and

Fig. 2 is a sectional view of the device shown in Fig. 1 taken at 2—2 in Fig. 1.

Referring to Fig. 1, a coaxial wave guide, including an outer conductor 1 of generally cylindrical shape and an inner conductor 2, is surrounded by a fitting 3 which carries an envelope 4 of glass or some other low dielectric constant material. Fitting 3 also carries skirt member 5 of hollow cylindrical shape, which abuts against fitting 3 and is open at the upper end. Outer conductor 1 terminates at circumferential slot 6, while inner conductor 2 is connected to dipole 7 which is constructed of conducting

material such as a metal, and which carries four slots 8, 9, 10, and 11, each shaped like the letter J. Dielectric collar 12 separates conductors 1 and 2, and is of generally hollow cylindrical shape, with a cut-out in its lower end shaped like the frustum of a hollow cone. Each of the J-shaped slots includes a vertical portion 13, a horizontal portion 14, and a tip portion 15.

In operation, electromagnetic energy is furnished by the coaxial wave guide and is end-fed to the dipole by means of conductor 2. A portion of the energy is therefore radiated with polarization parallel to the principal axis of the antenna, as shown in Fig. 1. However, due to the presence of slots 8, 9, 10, and 11 a portion of the energy is also radiated with polarization normal to the principal axis of the antenna. Skirt member 5 acts as a choke to prevent the flow of currents on the outside of the conductor below slot 6. Currents flow on the outer surface of dipole 7 and excite slots 8, 9, 10, and 11 which then radiate electromagnetic waves with polarization normal to the axis of the wave guide. Excitation of the slots occurs at horizontal portion 14 of the slots. The effective center of radiation for the waves radiated by the dipole is very near this point, so that by proper choice of slot width and length the resultant wave is elliptically polarized. Dipole 7 is constructed to be approximately one-half the length of the electromagnetic waves being propagated, and portion 13 of the slots is of very nearly the same length. Portion 15 of the slots is made to be somewhat less than one-fourth the wave length of the energy being propagated.

The resultant radiation pattern is of toridal shape, and the resultant waves are elliptically polarized with an axial ratio of less than 2:1 substantially throughout the pattern. Envelope 4 is provided to protect the elements of the invention and to minimize drag when the invention is utilized on a high-speed aircraft.

Although the invention has been described and illustrated in detail, it is to be clearly understood that the same is by way of illustration and example only and is not to be taken by way of limitation, the spirit and scope of this invention being limited only by the terms of the appended claims.

I claim:

1. A microwave radiator comprising a section of coaxial wave guide, means for feeding microwave energy to said guide, means for radiating a portion of said energy out of said guide with electric field orientation in the plane of the longitudinal axis of said guide, including a dipole at the end of said guide and a means for radiating out of said guide a portion of said energy with electric field orientation in a plane normal to the axis of said guide and in phase quadrature with said parallel polarized energy, including a plurality of diametrally opposed slots in said dipole, said slots being cut in the surface of said dipole with orientation parallel to the axis of said dipole.

2. An airborne beacon antenna comprising a section of coaxial wave guide, a dipole end-fed from said wave guide, a plurality of symmetrically disposed J-shaped slots cut in said dipole with the legs of said J parallel to the longitudinal axis of said dipole and with the horizontal portion of the said letter J near the inboard end of said dipole whereby said dipole radiates electromagnetic waves with polarization in the plane of the said axis of symmetry of said wave guide, and said slots radiate electromagnetic waves with polarization in a plane normal to said axis to thereby propagate elliptically polarized electromagnetic waves in a substantially toroidal pattern.

3. The device as recited in claim 2 and further comprising a hollow cylindrical conducting choke attached to said guide near said dipole to prevent circulating currents on the outside of said guide.

4. In a microwave antenna having a radiating element radiating plane polarized microwave radiation, means for producing an electric field with polarization normal to that produced by said element, comprising a J-shaped slot in said element oriented with its axis in the plane of said radiation of said radiating element.

5. In a microwave antenna having a cylindrical dipole, radiator means for producing an electric field with polarization normal to the axis of said dipole radiator, comprising a J-shaped slot in said dipole radiator oriented with its axis parallel to the axis of said dipole radiator.

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