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(71) Applicant: RADIO DESARROLLO, S.A. (RADESA)
Avda. de America, 55
Madrid(ES)

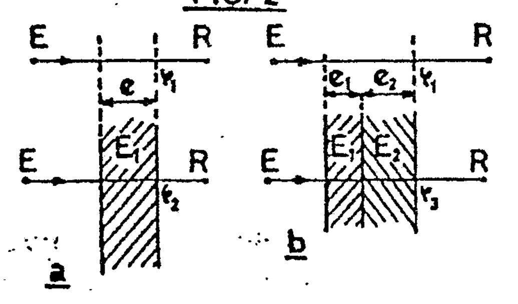
(72) Inventor: Gomez Moli, Maria Elena
Calle Caribe, 2-4 G
ES-28027 Madrid(ES)

(74) Representative: Jorio, Paolo et al,
c/o Ingg. Carlo e Mario Torta Via Viotti 9
I-10121 Torino(IT)

(54) **A passive process for the variation of the phases in the fresnel zones.**

(57) The process consists in that electric bodies, transparent to the electromagnetic waves, are introduced into the paths thereof, so as to cover different Fresnel zones and thereby producing phase variations of the waves passing separately through each zone.

FIG. 2



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A PASSIVE PROCESS FOR THE VARIATION OF THE PHASES IN THE FRESNEL ZONES

This invention relates to a passive process for the variation of the phases of the Fresnel zones.

When an electromagnetic connection is established between an emitting antenna E and a receiving antenna R, according to the study accomplished by Fresnle, it is possible to establish the so-called "Fresnel zones" in a plane intersecting the line ER connecting both the antennas along the path of the waves. Assuming O is a point of the line ER and through it a plane P is traced intersecting the same, this will cut the Fresnel ellipsoids according to a series of ellipses arranged so that each will contain all the preceding; the surface of the first ellipse is called the first Fresnel zone, the crown included betweeen the first and the second ellipses is the second Fresnel zone, and so forth. When the plane P is perpendicular to the line ER, which is called axis of the beam, the ellipses will convert in concentric circumferences having their centre in 0 and radiuses given by the Fresnel formula, whose zones will then be: the first zone a circle with radius r_1, the second a circular crown with radiuses r_1, and r_2, etc. Some of these zones have been represented in Figure 1.

It is known from long time that when an electromagnetic wave travels through a dielectric material, its propagation speed depends from the parameters of the medium, so that if in the path of a beam a dielectric plate having a given thickness is interposed, the time required for the beam to traverse the plate depends from the parameters of the material forming said plate and from its thickness; or said in other words, the phase of the wave in the outlet surface has changed in comparison with the phase it presented in the same point before the introduction of the plate. It will be possible to obtain different phase variations inserting plates of different materials, or plates with different thicknesses, or a proper combination of materials and thicknesses. This is shown in figure 2a. The inserted plate can be formed with different superimposed plates from different materials, as illustrated in figure 2b, some of which (or all of them) can be the air, which is also a dielectric material.

All the points of a wave falling into the same Fresnel zone contribute to the formation of the received field intensity with amounts variable according to its phase but all the same sign, so that the first contributes positively, the second negatively, and generally the zones of odd space contribute positively, while the zones of even space contribute negatively. Inverting the phases of all the points of the wave passing through a Fresnel zone, the sign of its contribution will be inverted, so that if it acted negatively, i.e. reducing the field value, inverting the sign the field will increase in the receiving point. Carrying out the inversion of the phases of various Fresnel zones of the same nature, the field obtained will be substantially increased. Varying the phases of the waves passing through a Fresnel zone in proper amounts for each point, or in various zones, it is possible to obtain a substantial reduction of the received field. In similar manner further advantageous results are possible. The process according to the present invention consits in the insertion of plates of dielectric materials having proper permittivity and suitable thickness to obtain the required phase variation in the points of each Fresnel zone, attaining one of the above-mentioned results. The inserted plates should cover completely or in part each of the Fresnel zones, and their thicknesses should be apt to produce the proper phase variation. In figure 3 the arrangement of two crowns of dielectric material corresponding to two circular Fresnel zones is shown, and in figure 4 the arrangement of two further polygonal crowns for their corresponding Fresnel zones is illustrated, both without any limiting character in the form or in the number of the inserted dielectric bodies.

Further, said results are obtained inserting dielectric bodies in different Fresnel zones of both nature as shown without any limiting character in figure 5, in which the first four zones are represented covered by the respective dielectric bodies; in this example the same material but with different thickness in the zones of different nature has been employed, as will be appreciated in the cross-section A-A in said figure. In the same manner it is possible to operate using polygonal crowns or parts of the former and of the latter.

Further, the process can be applied repetidly in different points O_1,, O_2 in the path of the beam, as represented in figure 6, obtaining thereby a very important amplifying effect.

The process of the present invention consists in the insertion of dielectric bodies having the true or approximate corresponding shapes of the respective Fresnel zones formed in the selected point of the path of the beam, or of parts of the same, and the proper thicknesses in order that at the outlet faces the phases of the waves have udergone the required variations in each of the Fresnel zones, or in part of the same, as has been explained in this description and illustrated in figures 1 to 6.

The passive process for the variation of the phases of the Fresnel zone in one of its embodiments produces as a direct consequence a substantial increase of the field value in the receiving point, that means a corresponding increase of the density of the electromagnetic intensity received in said point. This increase in the direction ER demonstrates that in different directions the energy will be reduced and as a consequence less detrimental interferences from a radio channel upon other contiguous or upon itself (attenuation of the signal due to reflection, effects produced by beams according to multiple paths, etc.) are produced.

The group of crowns of dielectric materials (one or more) arranged in the Fresnel zones of a certain plane, is kept jointed by known mechanical means and is secured to its supporting base through posts, masts or any other supporting means conventionally used to keep objects at a level and in an orientation required. Figure 7 is a schematic representation of one of said supporting means, without any limitative character, and given as a simple illustrative example.

By properly chosing the pahse variations obtained with the present process in all the Fresnel zones, so that at the outlet face the exiting waves of all the Fresnel zones result in the same phase, the maximum energy gain is obtained in the receiver. In one of the embodiments of the present process, a substantial increase in the gain is obtained inverting the phases of the waves passing through different even Fresnel zones, so that their contributions to the field formation change the sign, being negative, and so they cooperate now with the odd zones to increase the value of the received field. As the phase variations depart from the inversion, the effects in the gain along ER become smaller. According to another embodiment of this process dielectric bodies with different thicknesses are inserted in various Fresnel zones, which, properly selected, nullify or drastically reduce an interfering signal arriving in a known direction.

The same group of crowns resulting from the application of the described process can be used for various radioelectric channels E_1R_1, E_2R_2, etc. simultaneously when their axes cross in the centre of the group of crowns. As a non limiting example of an embodiment of the described process, in this particular case, is the production of a multiple antenna with a high gain, formed by a single group of dielectric crown and various coil antennas properly arranged in relation with the crowns, that can be used for the reception of the signals simultaneously from various television satellites.

The passive process for the variation of the phases of the Fresnel zones is further a process by means of which the phases of every Fresnel zone are separately changed, and by selecting properly said variations it is possible to obtain the required purpose. It substantially consists in the introduction of dielectric bodies, transparent to the electromagnetic waves, which cover each Fresnel zone and having thicknesses suitable to obtain in every point the required phase change. Even if the size of these bodies is non exactly matched with the covered zones, for instance using polygonal crowns, the effect attained with the present process will be almost the same as that with crowns having the same size as the corresponding Fresnel zones.

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CLAIMS

1. A passive process for the variation of the phases in the Fresnel zones, characterized in that dielectric bodies transparent to the electromagnetic waves are inserted in the path of the latter and different Fresnel zones are covered, in order to obtain variations in the phases of the waves traversing separately each zone.

2. A passive process for the variation of the phases in the Fresnel zone as claimed in claim 1, characterized in that the dielectric bodies have the same shape and size as the covered Fresnel zone, or part of the same.

3. A passive process for the variation of the phases in the Fresnel zone as claimed in claims 1 and 2, characterized in that the dielectric bodies are plates having selected thicknesses for every zone, being allowed also a variation inside every zone.

4. A passive process for the variation of the phases in the Fresnel zone as claimed in claims 1 and 3, characterized in that the dielectric bodies have a polygonal contour and approximately cover the respective Fresnel zone.

5. A passive process for the variation of the phases in the Fresnel zone as claimed in claim 3, characterized in that the plates are formed by superimposed plates of dielectric material with the proper thickness, including air, which is also a dielectric.

6. A passive process for the variation of the phases in the Fresnel zone as claimed in claims 1, 2, 3, 4 and 5, characterized in that it applies to any number of Fresnel zones in the same plane, forming in this way a

so-called group of crowns.

7. A passive process for the variation of the phases in the Fresnel zone as claimed in claim 6, characterized in that it applies to the Fresnel zones of different planes, forming as many groups of crowns.

8. A passive process for the variation of the phases in the Fresnel zones as claimed in claim 6, characterized in that the same group of crowns applies simultaneously to different radioelettric channels when their axes cross at the common centre of the group of crowns.

9. A passive process for the variation of the phases in the Fresnel zones as claimed in anyone of the preceding claims, characterized in that the dielectric bodies applie to different zones of even order, producing the inversion of their phases.

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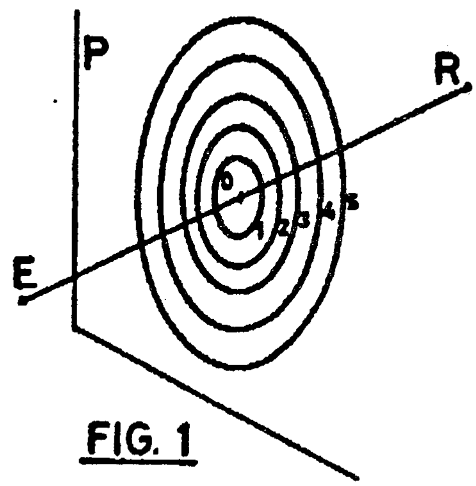
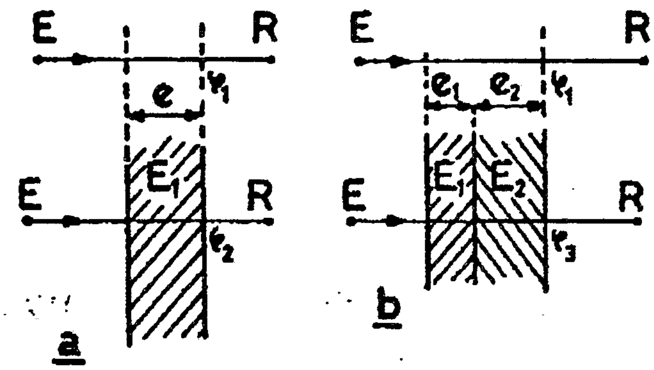


FIG. 1

FIG. 2



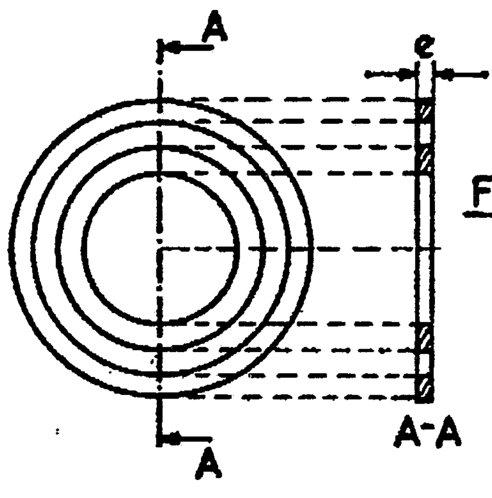


FIG. 3

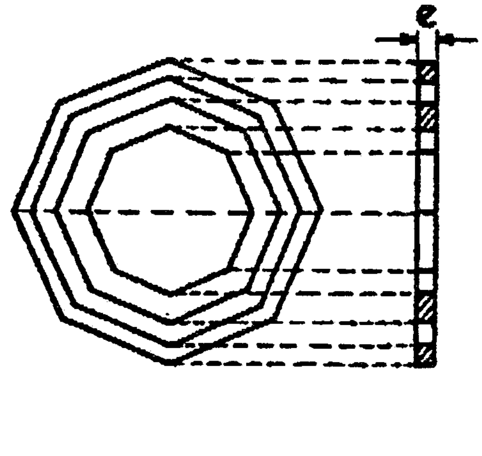


FIG. 4

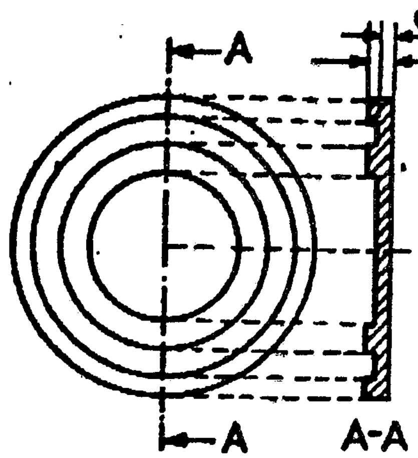
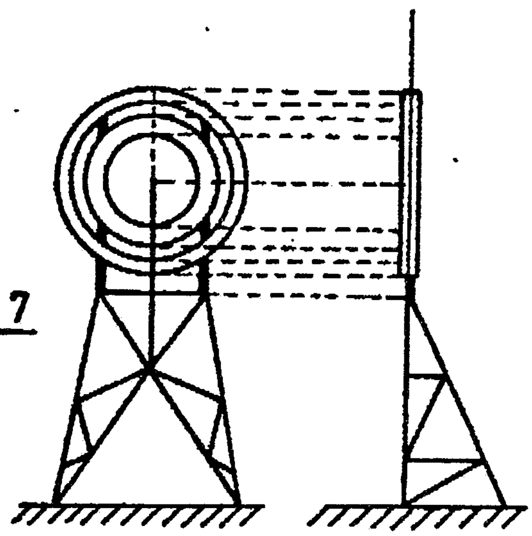


FIG. 5

FIG. 7



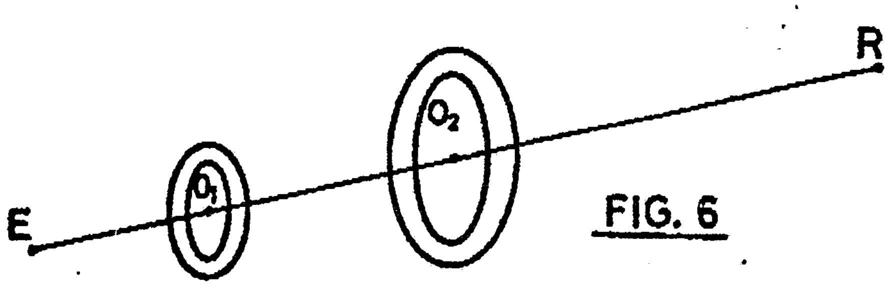


FIG. 6