

Jan. 14, 1958

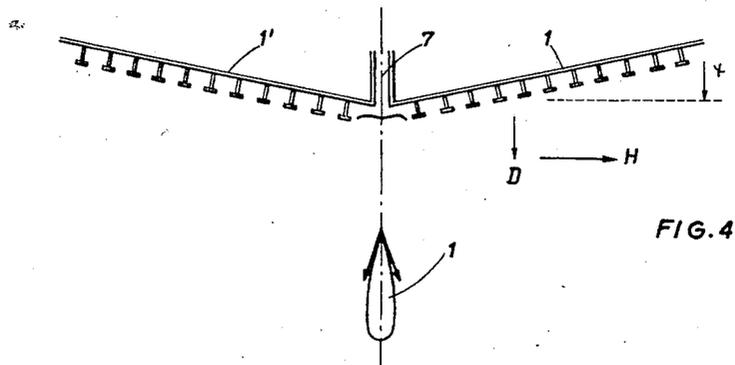
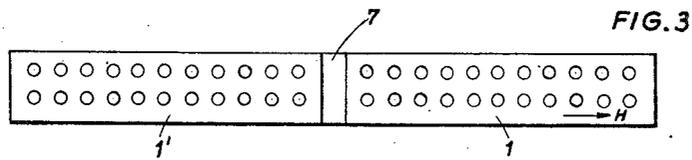
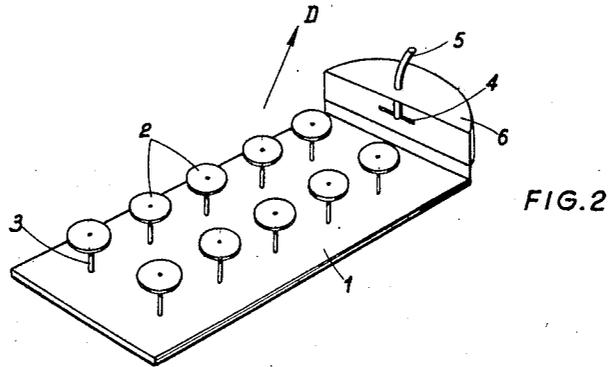
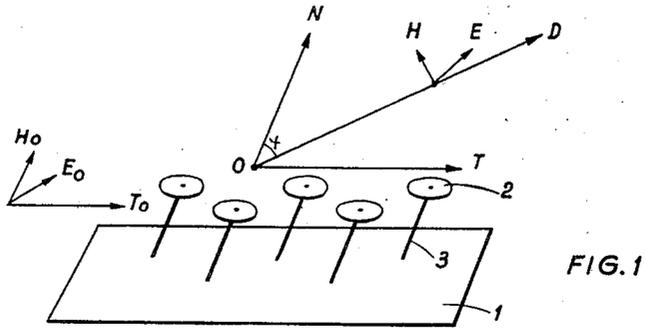
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2,820,221

DIRECTIONAL AERIALS

Filed Sept. 13, 1955

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

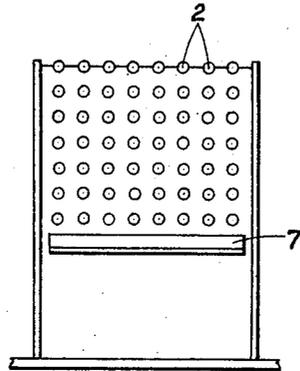


FIG. 5

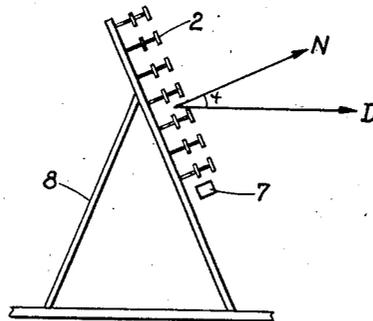


FIG. 6

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DIRECTIONAL AERIALS

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6 Claims. (Cl. 343-753)

The present invention relates to directional antennas for ultra short waves.

The applicant has proved by theory, confirmed by experiment, that the direction of maximum radiation of a wave, propagated between a plane solid metal plate and an array of coplanar discs parallel thereto, is located in a plane normal to the plane of the array and parallel to the direction of propagation of the applied waves between the plate and the array. In the same way, a plane wave propagated in the direction of maximum radiation and incident upon the array of discs, will generate a wave which will be propagated between the array and the plate in a direction parallel to the array and in the direction opposite to that of the applied wave previously mentioned.

A directional antenna in accordance with the invention comprises a solid metal plate and one or more arrays of coplanar metal discs, all the dimensions of which are equal or substantially equal, located in planes parallel to the solid plates, on the same side thereof, and whose centers form a regular square mesh. These discs are centrally supported on the plate by metal rods extending perpendicular thereto.

The invention will be more clearly understood from the ensuing description with reference to the appended drawings, which illustrate some non restrictive embodiments of the invention, and in which:

Figure 1 shows schematically a perspective view of an array of discs according to the invention;

Figure 2 shows a perspective view of an embodiment of the aerial according to the invention;

Figures 3 and 4 shows, in front elevation and in plan respectively a preferred embodiment of the invention;

Figures 5 and 6 show, side elevation and in front elevation respectively, another embodiment of the invention more particularly adapted to metric waves.

In all these figures, like references designate like elements.

In Fig. 1, a solid plate 1 supports circular discs 2, all located in a plane parallel to plate 1, through the medium of metal rods 3. These discs form an array, the centers of which define a square mesh. If a wave is propagated horizontally between discs 2 and plate 1 in the direction T_0 , parallel to the latter, with its magnetic field H_0 normal to said plate, the aerial radiates a diffracted wave in free space, and this wave has a maximum radiation direction OD located in the plane NOT formed by ON normal to plane 1 and the straight line OT parallel to the direction T_0 . The wave thus radiated is polarized normally to said plane NOT; conversely, a plane wave polarized normally to the plane NOT and propagating in the direction DO of said plane will give rise to a diffracting wave, propagated in a direction parallel to the plane of the discs between plate 1 and discs 2. It has been found that the direction OD is such that this diffracted wave is in phase with the incident wave in front of each disc. The angle

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of incidence formed by the favored direction OD with ON is given by the formula:

$$\sin \psi = n \frac{\lambda}{2p} - \frac{\lambda}{\lambda_1}$$

where λ is the wave length in free space; λ_1 the wave length of the wave propagated between the discs and plate 1, which, for a given frequency, is smaller than λ ; $2p$ is the distance between the centers of two consecutive discs; n is a whole number. The main lobe is obtained for $n=1$, the second lobe corresponds to $n=2$, and so on.

In practice, it is generally desired to obtain a field pattern having only the main lobe, which implies the condition $n=1$, hence $\lambda > 2p$, and as

$$\frac{\lambda}{\lambda_1}$$

is generally approximately equal to 1,1, an approximate formula giving the angle ψ , valid for a variety of disc arrays, will be:

$$\sin \psi = \frac{\lambda}{2p} - 1, 1$$

which implies that:

$$0.4\lambda < 2p < \lambda$$

In Figure 2, the aerial is constituted by a solid metal plate 1 and coplanar metal discs 2 carried by rods 3. This aerial is excited by a dipole 4 fed by a coaxial 5; this dipole is located between the plane of plate 1 and the plane of discs 2 at the focus of a parabolic cylinder 6 completed by two metal plane sections, normal to the cylinder axis. Rods 3 being normal to the electric field of the applied wave, do not take part in the radiation. It is possible to vary the density of the energy radiated from the array by varying the diameter of the discs.

Figures 3 and 4 represent a V-shaped aerial constituted by two solid plates 1 and 1' which support discs 2 and together form an angle $\pi - 2\psi$.

The wave is applied by a wave-guide located in the plane of symmetry of the aerial. The radiation diagram is shown at L. In the example given all the discs have the same diameter.

Figures 5 and 6 represent an aerial similar to that of Figure 2, but comprising two parallel disc arrays. This aerial is secured to a support 8 and is so mounted that the direction of maximum radiation D is horizontal. The system is fed at 7, for instance through a wave-guide provided with suitable radial slits.

It has been found that in all these aerials, the directivity increases, in direct proportion to their lengths, in the direction of propagation within the array. The aerial shown in Figures 3 and 4 will be highly directive in the horizontal plane and will radiate much less in the vertical plane. The aerial shown in Figures 5 and 6 will be practically omni-directional.

Very long aerials of these types are very easily built, since they comprise only plane elements; they are particularly suitable for highly directive systems, such as, for instance, their use in connection with radio-astronomy.

I claim:

1. Directive aerial for ultra short waves comprising: at least one solid plane metal plate, said plate having edges; at least one array of coplanar metal discs parallel to said plate, the respective centers of said discs of one array forming a square mesh; thin metal rods carried by said plate and perpendicular thereto, each supporting one disc of each array by its center and means positioned at one of the edges of said plate, for feeding wave energy between said plate and said array of coplanar metal discs to excite the aerial.

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2. Directive aerial for ultra short waves comprising: at least one solid plane metal plate having first and second sides and on said first side a plurality of arrays of coplanar metallic discs parallel thereto, thin metal rods carried by said plate and perpendicular thereto for carrying said discs at their respective centers; the respective centers of each array forming a square mesh and means, positioned at one of the edges of said plate, for exciting the aerial between said plate and at least one plane of said coplanar metallic discs.

3. Directive aerial for an ultra short wave having a wavelength λ comprising: at least one solid plane metal plate; at least one array of coplanar metal discs parallel thereto, the respective centers of said discs of one array forming a square mesh; thin metal rods carried by said plate and perpendicular thereto, each supporting one disc of each array by its center, the distance between the respective centers of two neighbouring discs being comprised between λ and 0.4λ and means, positioned at one of the edges of said plate, for exciting the aerial between said plate and at least one of said coplanar metal discs.

4. Directive aerial as claimed in claim 3, in which all the discs have the same diameter.

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5. Directive aerial for ultra short waves, comprising first and second solid plane metal plates, symmetrical to each other about a plane; first and second pluralities of arrays of coplanar metal discs respectively parallel to said first and second plates and symmetrical to each other about the same plane, the respective centers of said discs of said arrays forming respectively square meshes; thin metal rods carried by said plates and perpendicular thereto for carrying respectively each of said discs at its respective center; and guiding means located in the symmetry plane for guiding a wave propagating between said first and said second plates and said first and said second pluralities of arrays.

6. Directive aerial for ultra short waves comprising a plane metal plate, an array of coplanar metal discs parallel to said plate, a thin metal rod perpendicular to said plate supporting each disc of said array at its respective center in a pattern defining a square mesh, and wave guide means positioned at an edge of said plate to guide a wave propagating between and parallel to said plate and array.

No references cited.