

Feb. 19, 1963

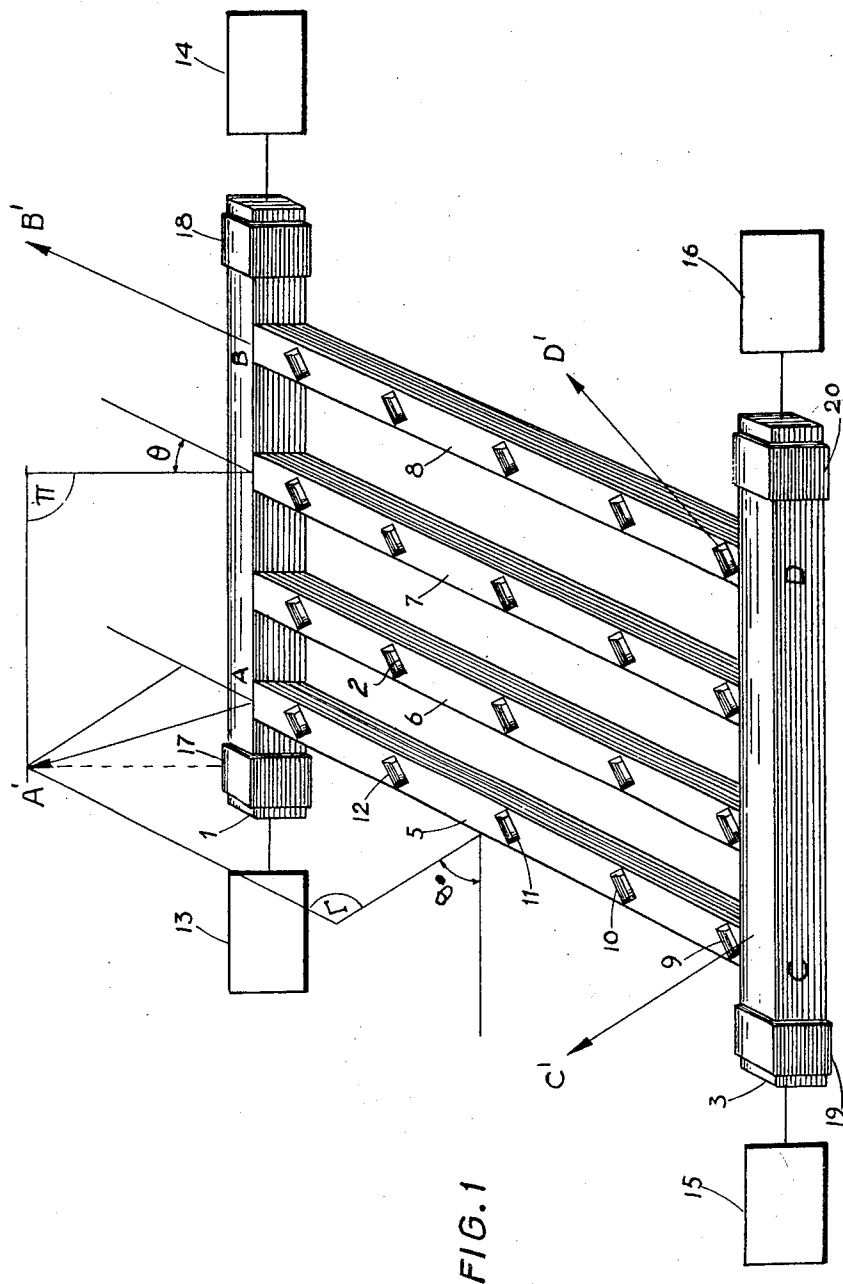
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3,078,463

PARALLEL PLATE WAVEGUIDE WITH SLOTTED ARRAY AND MULTIPLE FEEDS

Filed Nov. 6, 1959

2 Sheets-Sheet 1



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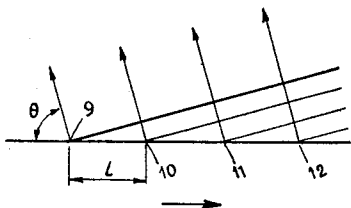


FIG. 2

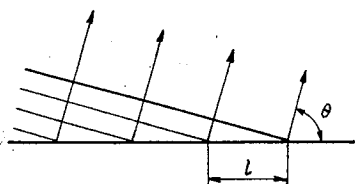


FIG. 3

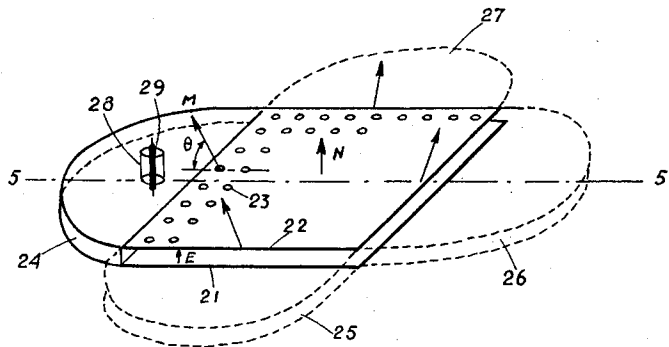


FIG. 4

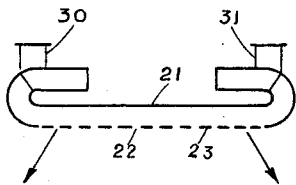


FIG. 5

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PARALLEL PLATE WAVEGUIDE WITH SLOTTED ARRAY AND MULTIPLE FEEDS

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3 Claims. (Cl. 343-771)

The present invention relates to multi-beam aerials, i.e. aerials capable of radiating a plurality of beams.

Under certain conditions, for example in certain types of radar systems, it may be necessary to radiate simultaneously a plurality, for example four, different beams and it is an object of this invention to provide a relatively simple structure having a plurality of directional beam patterns.

A system according to the invention comprises a plurality of radiating sources positioned along two sets of lines, the lines being parallel in each set and the lines of one set intersecting those of the other. The radiating sources are located at the intersection points and thus define a lattice having rows and columns. The meshes of the lattice are generally square. The radiating sources are spaced by a distance different from the operating wavelength along the rows and the columns. Means are provided for feeding energy to the sources at each of the exterior rows and/or columns of radiating sources.

In one embodiment of the invention, the radiating system includes a plurality of parallel slotted wave-guides spaced apart substantially by the same distance which separates the slots provided in these guides. The latter are coupled by their ends to two further wave-guides and four sources of radiating energy are respectively coupled to ends of the latter. Four beams inclined to the radiating system at the same angle and respectively directed in four different directions are thus obtained.

In another and generally preferred embodiment, the radiating system is formed by two parallel metal plates, one of the plates being solid and the other having holes forming a lattice, the radiating system receiving the energy along the four edges thereof. The final result is the same as above.

The invention will be best understood from the following description and appended drawing, wherein:

FIG. 1 illustrates a radiating system according to the invention;

FIGS. 2 and 3 are explanatory diagrams;

FIG. 4 illustrates another embodiment of a radiating system according to the invention; and

FIG. 5 is a partial sectional view of the system illustrated in FIG. 4.

According to the embodiment illustrated in FIG. 1, a main wave-guide 1 is coupled to four slotted guides 5, 6, 7 and 8, which at their opposite ends are coupled to another main wave-guide 3. The slotted wave-guides are disposed in parallel relationship and are equally spaced from one another. They are, for example, perpendicular to the main wave-guides 1 and 3. Each slotted guide has equally spaced slots, some of which 9, 10, 11 and 12 are shown in the drawing. The distribution of the slots is the same in all the guides, which results in these slots forming parallel rows and columns, the rows being parallel to the main guides 1 and 3 and the columns perpendicular thereto. The cross-section of the slotted guides is the same as that of the main guides and the distance separating two adjacent slots, such as for instance 10 and 11, is equal to the distance l separating two adjacent slots of two adjacent guides, such as slots 12 and 2. According to the invention this distance l differs from the length λ_g of the guide of the operating wave length λ . For example λ_g is greater than l . Four sources of radiating

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energy 13, 14, 15 and 16 are respectively coupled to the four ends of the two main guides 1 and 3. Directional ferrite attenuators, also known as isolators, 17, 18, 19 and 20 may be placed in the main guides, in the immediate vicinity of supply sources 13 to 16 respectively, with a view towards protecting each source against any possible interference from the other sources.

The device operates as follows:

Considering FIG. 2, which illustrates, very diagrammatically, one of the slotted wave-guides with its slots 9, 10, 11, 12 . . . , and assuming that the direction of propagation of energy in the guide is from left to right, the direction of radiation is inclined to the left and the angle θ it makes with the guide is, as is well known:

$$\lambda/\lambda_g \cdot l + l \cos \theta = \lambda$$

If the slotted guide is now fed from its other end, as shown in FIG. 3, the radiation direction is inclined to the right by the same angle θ .

The axis of the beam obtained upon feeding the radiating system of FIG. 1 from generator 13 is accordingly AA', defined by the intersection of a plane π forming an angle θ with the slotted guides and of a plane Γ , forming the same angle θ with the main guide 1, since the distance between two adjacent slots of a slotted guide is the same as that between two adjacent slots respectively pertaining to two adjacent slotted guides.

The same applies to each one of generators 14, 15 and 16, thus defining three further directions of radiation BB', CC', and DD'.

A system with four directional radiating patterns is thus provided, each beam being inclined at the desired angle.

In the embodiment of FIG. 4 the aerial comprises two parallel plane plates 21 and 22. Holes 23 are punched in plate 22. They are arranged in rows and columns defining a lattice with, for example, square meshes, the side of a mesh being different from λ_g . Plates 21 and 22 are associated with parabolic or "pill-box" reflectors 24, 25, 26 and 27, respectively positioned along the edges thereof. Each pill-box is provided with a supply horn 28 having a directional ferrite attenuator or isolator 29 for protecting each supply source against the energy from the three others. This isolator is inserted in the feeder connecting the supply horn to the transmitter feeding this horn. The energy respectively provided by pill-boxes 25 to 28 is radiated along patterns which are respectively inclined at an angle θ to the horizontal surface of plate 22, as shown in FIG. 4.

FIG. 5 shows, very diagrammatically, the same system as in FIG. 4. However, to avoid excessive space consumption the pill-boxes are folded back along the edges of plates 21 and 22.

It is of course to be understood that the invention is not limited to the embodiments described and illustrated which are given only by way of example. It will be in particular appreciated that other elementary sources than those shown could be used.

What is claimed is:

1. A system for radiating ultra-high frequency waves comprising: a first solid conductive plate having four edges; a second conductive plate having edges and provided with holes located along two sets of intersecting lines spaced apart by a distance different from the operating wave length and respectively forming rows and columns parallel to said edges and having intersections, two of said rows being exterior rows and two of said columns being exterior columns, said holes being positioned at said intersections; and four feeding means, comprising directional attenuators, directly coupled respectively along the four edges of said plates.

2. A system for radiating ultra-high frequency waves

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comprising a first solid conductive plate having four edges, a second conductive plate having edges and provided with holes located along two sets of lines intersecting at right angles, spaced apart by a distance different from the operating wave length and respectively forming rows and columns parallel to said edges and having intersections, two of said rows being exterior rows and two of said columns being exterior columns, said holes being positioned at said intersections; and four feeding means, comprising directional attenuators, directly coupled respectively along the four edges of said plates.

3. A system for radiating ultra-high frequency waves comprising a plate assembly having four edges and including a first rectangular solid conductive plate and a second rectangular plate provided with holes located along two sets of lines intersecting at right angles, spaced apart by a distance different from the operating wave length and

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respectively forming rows and columns having intersections, two of said rows being exterior rows and two of said columns being exterior columns, said holes being positioned at said intersections of said rows and columns, and four feeding means, each comprising a directional attenuator and a reflector having the same cross section as said plate assembly, directly coupled thereto at the respective edges thereof.

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