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VARIABLE PATTERN RADAR AERIAL

2,913,723

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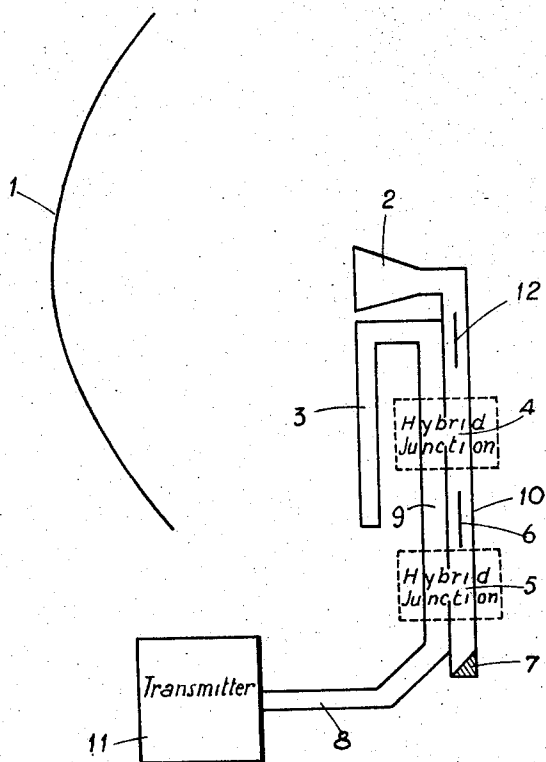


FIG. 1

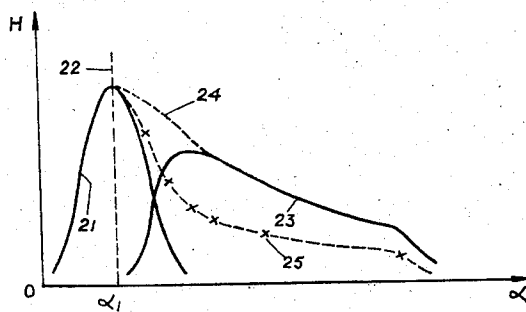


FIG. 2

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VARIABLE PATTERN RADAR AERIAL

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7 Claims. (Cl. 343—777)

The present invention relates to radar aerials. More particularly, it has for its object a variable pattern radar aerial.

In search radar installations the whole of the area which is to be scanned by the radar is usually divided into partial areas, or coverages, of different elevations. Most frequently, a low elevation beam scans a "low coverage" area in order to detect distant targets, whereas a higher elevation beam scans a "high coverage" area, thus searching for nearer targets. Two distinct aerials, having different radiation patterns, are generally required to this effect, since to use a single aerial for achieving a total coverage could only be at the expense of the maximum radiation range of the radar unit, the radiation pattern having in this case a wider opening.

It is therefore an object of the invention to provide an aerial which, even though used alone, is capable of ensuring the total coverage without reducing the action radius or radiation range of the radar.

The aerial according to the invention comprises a paraboloid reflector, and two primary radiation sources, such as a horn and a linear source, for instance, a slotted waveguide. The type of coverage provided depends on the distribution of the energy, supplied from a single transmitter, between the horn and the linear source. This distribution is controlled by means of an adjustable phase-shifter located between two conventional 3 db hybrid junctions connecting to each other two wave guides feeding the two sources from the transmitter.

The invention will be best understood from the following description taken in connection with the appended drawing wherein,

Fig. 1 diagrammatically shows an arrangement according to the invention;

Fig. 2 shows the radiation patterns obtained by means of the arrangement in Fig. 1.

In the embodiment illustrated in Fig. 1, a transmitter 11, feeds through a wave guide 8, a wave guide portion 9 which terminates in a slotted wave-guide exciter 3. A wave guide portion 10 has a common wall with wave guide portion 9 and feeds a horn exciter 2.

Two 3 db hybrid junctions, 4 and 5, are formed in this common wall and a variable phase shifter 6, of any suitable type, is positioned between these junctions, for instance in the wave guide 10.

Horn 2 and slotted wave guide 3 are located in the focal zone of a reflector paraboloid 1 which they illuminate. Wave guide 10 is terminated, at the end opposite horn 2, by a matched load 7. A variable phase shifter 12, of any conventional type, is preferably disposed in one of the wave guides, between junction 4 and the corresponding radiator.

The system according to the invention operates as follows:

The high frequency energy supplied by transmitter 11 is fed through wave guide 8 to wave guide 9.

It will be readily appreciated that, when phase-shifter 6 is set in such a way as not to interfere with energy

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distribution, the energy supplied by transmitter 11 is, through the action of the two 3 db hybrid junctions 5 and 4, entirely fed to horn 2. The aerial displays in this case a conventional radiation pattern 21, as illustrated in Fig. 2 where field intensities are plotted as a function of the angles of elevation. This provides a low coverage. The axis of symmetry 22 of this pattern, corresponding, to an angle of elevation α_1 .

It will also be seen that, when phase-shifter 6 is set to cause a phase shift of 180° to occur in the energy transmitted, the whole of the energy is fed to linear source 3, owing to the well known properties of 3 db hybrid junctions. The radiation pattern 23, corresponding to a high coverage, is then obtained.

For an intermediate position of phase-shifter 6, the energy is equally distributed between sources 2 and 3. Under these conditions, and with the primary radiating sources 2 and 3 put in phase, if need be, by means of phase shifter 12, the radiation pattern of the aerial as a whole is obtained by performing the vectorial summing of patterns 21 and 23 which results in pattern 24. Of course the field intensity scale is not the same in Fig. 2 for patterns 22 and 23 on the one hand, and pattern 24 on the other, since the energy is distributed in a much larger volume of space in the case of pattern 24.

Other radiation patterns could be obtained with different settings of phase shifter 6. If, for instance, the setting of the phase shifter 6 is such that the output of horn 2 is fourfold of that supplied to the linear exciter 3, the shape of a pattern will evidently be obtained by adding the ordinates of curves 21 to the half-ordinates of curve 23, resulting in a pattern substantially corresponding to the curve 25.

It will thus be appreciated that by suitably adjusting phase-shifter 6 the radiation pattern of the aerial may be varied with substantial suppleness. It is possible, in particular, to obtain a radiation pattern insuring the passage from high, or low coverage, to total coverage being obtained instantaneously, by simple control of phase-shifter 6 and without its being necessary to stop the operation of the transmitter.

The invention is, of course, in no way limited to the embodiment described and illustrated, which has been given only by way of example.

What I claim is:

1. A variable pattern radar antenna comprising: a reflector; a first and a second exciter having different coverage patterns and positioned for illuminating said reflector; wave guides respectively coupled to said exciters for feeding energy thereto; two 3 decibel hybrid junctions between said wave guides; and phase shifting means between said two junctions.

2. A variable pattern radar antenna comprising: a reflector; a first and a second exciter and positioned for illuminating said reflector; respective waveguiding means coupled to said exciters; two 3 decibel hybrid junctions between said respective waveguiding means; and phase shifting means between said two junctions.

3. A variable pattern radar antenna comprising: a reflector; a first and a second exciter having different coverage patterns and positioned for illuminating said reflector; a waveguide coupled to said first exciter for feeding energy thereto; a waveguide having two ends coupled respectively to said second exciter and to a matched load; two 3 decibel hybrid junctions between said waveguides; and variable phase shifting means between said two junctions.

4. A variable pattern antenna comprising: a reflector; a first and a second exciter having different coverage patterns and positioned for illuminating said reflector; waveguides respectively coupled to said exciters for feeding energy thereto; two 3 decibel hybrid junctions be-

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tween said waveguides; and phase shifting means between said two junctions in the waveguide coupled to said second exciter.

5. A variable pattern radar antenna comprising: a reflector; a first and a second exciter having different coverage patterns and positioned for illuminating said reflector; waveguides respectively coupled to said exciters for feeding energy thereto; two 3 decibel hybrid junctions between said waveguides; phase shifting means between said two junctions; and further phase shifting means, in one of said waveguides, between the exciter connected thereto and the 3 decibel hybrid junction nearest thereto.

6. A variable pattern radar antenna comprising: a reflector; a first and a second exciter having different coverage patterns and positioned for illuminating said reflector; a waveguide coupled to said first exciter for feeding energy thereto; a waveguide having two ends coupled respectively to said second exciter and to a matched load; two 3 decibel hybrid junctions between said waveguides; variable phase shifting means between said two junctions in said second waveguide; and further variable phase shifting means in one of said waveguides between the exciter connected thereto and the 3 decibel hybrid junction which is nearest thereto.

7. A variable pattern radar antenna comprising: a reflector; a horn exciter and a slotted waveguide exciter positioned for illuminating said reflector; a waveguide

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coupled to said horn for feeding energy thereto; a waveguide having two ends coupled respectively to said slotted waveguide exciter and to a matched load; two 3 decibel hybrid junctions between said waveguides; variable phase shifting means between said two junctions in said second waveguide; and further variable phase shifting means in one of said waveguides between the exciter connected thereto and the 3 decibel hybrid junction nearest thereto.

References Cited in the file of this patent

UNITED STATES PATENTS

2,112,282	Fritz	Mar. 29, 1938
2,430,568	Hershberger	Nov. 11, 1947
2,530,079	Riblet	Nov. 14, 1950
2,556,094	Lindenblad	June 5, 1951
2,688,744	Sunstein	Sept. 7, 1954
2,728,050	Van de Lindt	Dec. 20, 1955
2,751,586	Riblet	June 19, 1956
2,805,415	Berkowitz	Sept. 3, 1957

FOREIGN PATENTS

599,600	Great Britain	Mar. 16, 1948
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OTHER REFERENCES

Principles and Practice of Radar, Penrose and Boulding, 1949, Van Nostrand Co. Inc.