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Thornton

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[54] **HF DUAL-FEED CORNER REFLECTOR ANTENNA**

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[52] **U.S. Cl.** **343/836,** 343/914

[51] **Int. Cl.** **H01q 19/28**

[58] **Field of Search** 343/834, 835, 836, 914

[56] **References Cited**

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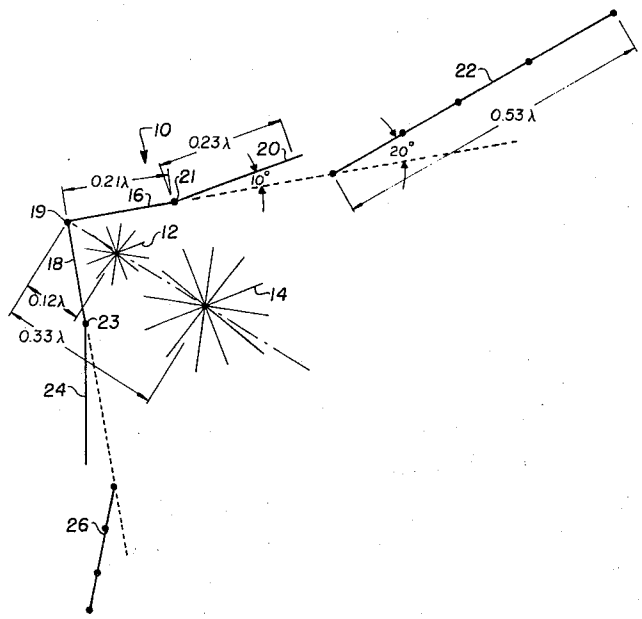
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[57] **ABSTRACT**

A high frequency, corner reflector antenna comprising two screens of vertical wires positioned at right angles to each other and two active elements located therebetween. The device is operable over a frequency bandwidth of 4:1 and can provide an azimuth pattern beamwidth of 45°. The active elements comprise moderate-Q radiators tunable over a 2:1 frequency range whereby two frequencies can be transmitted simultaneously without the use of multicouplers.

4 Claims, 7 Drawing Figures



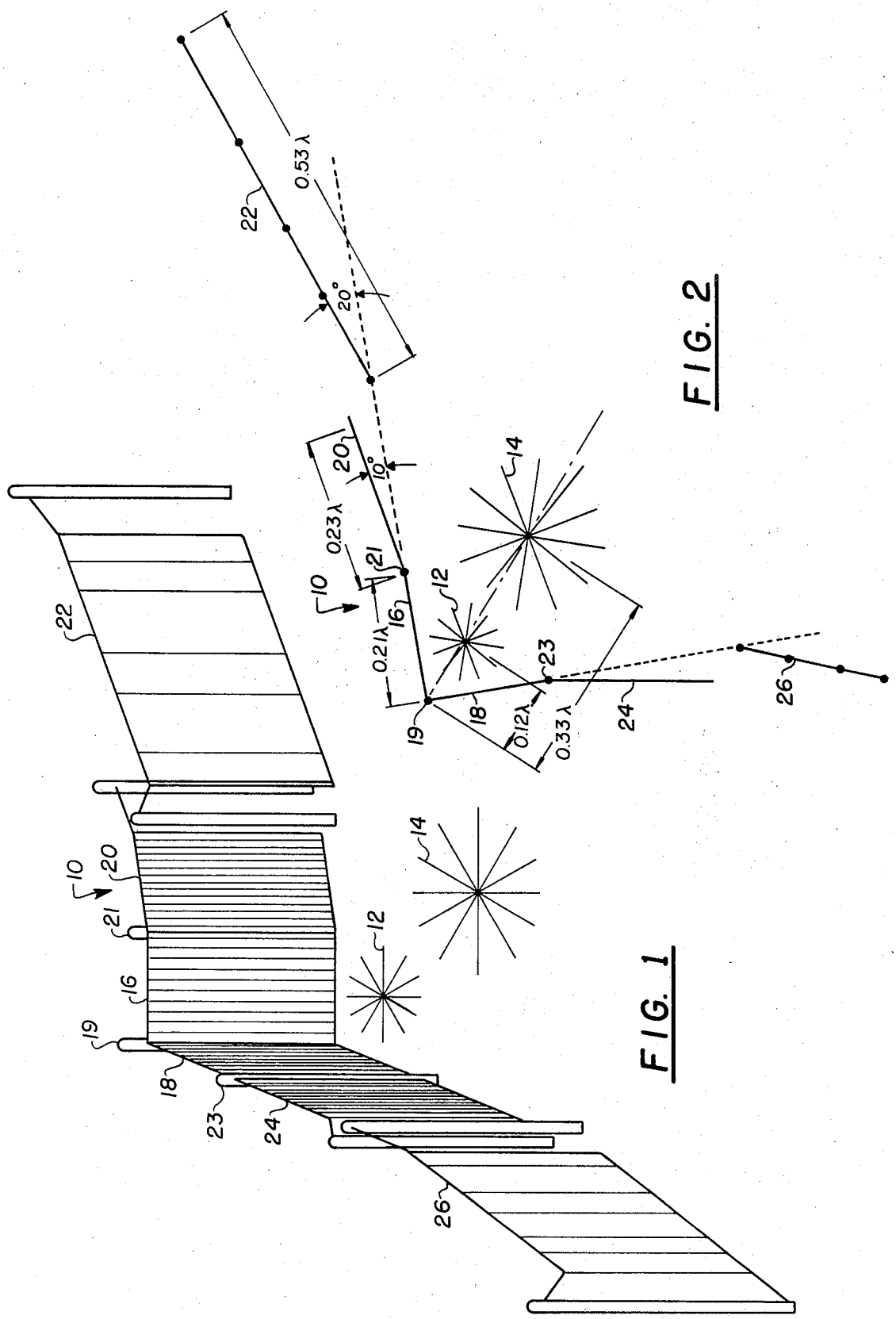

0.53λ
22
20°
20
10°
0.23λ
21
10
16
0.21λ
12
14
23
18
19
0.12λ
0.33λ
24
26

FIG. 2

22
10
20
21
16
19
18
23
24
26
12
14

FIG. 1

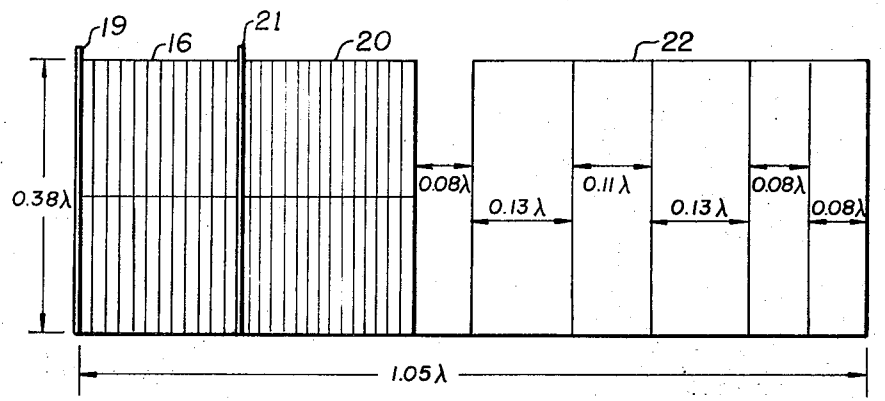


FIG. 3

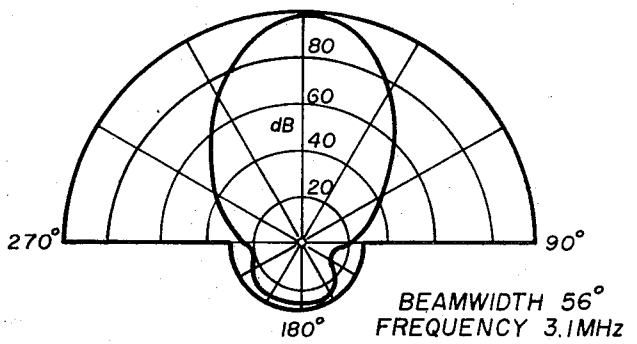


FIG. 4

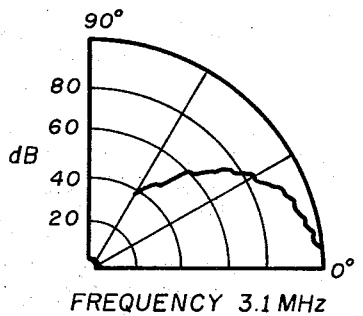


FIG. 6

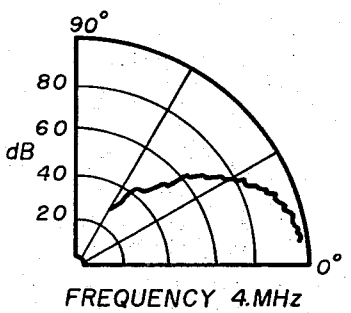


FIG. 7

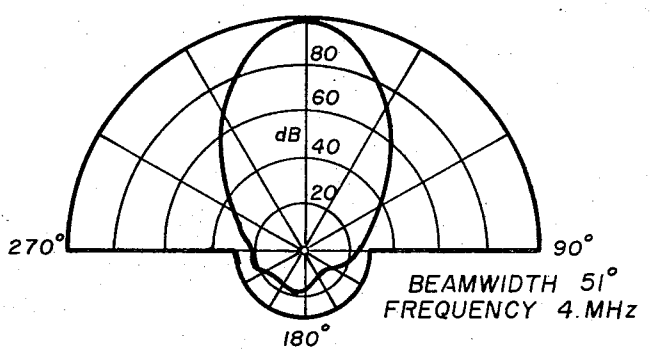


FIG. 5

HF DUAL-FEED CORNER REFLECTOR ANTENNA

BACKGROUND OF THE INVENTION

The use of corner reflector antennas to foucs and reflect electromagnetic energy is well-known. The antenna normally comprises two conductive planes intersecting at any angle up to 180°, and is usually excited by a dipole radiator or a monopole erected over a conducting plane whereby the antenna has a high-gain and moderate bandwidth. The use of more than one active element within a corner reflector to increase the bandwidth, however, is believed to be new in the art.

The antenna most commonly used for HF communications is the horizontal rhombic antenna which has a useful bandwidth limited to the ratio of 2:1 by the allowable radiation pattern variations and tolerable side lobe level. The rhombic antenna is best suited for long-distance, point-to-point circuits where low elevation-angle radiation is desirable. The dual-feed corner reflector to be disclosed is better suited for variable-length circuits where broader and more consistent vertical patterns are desirable. Furthermore, rhombic antennas designed for elevation angles inevitably have a narrow main horizontal lobe. The nominal azimuth half-power beamwidth of the dual feed corner reflector is 45° over a 4:1 frequency range, enabling a broader sector to be monitored and thereby being less sensitive to normal signal variations in the horizontal plane. Experimental studies have shown that at least two rhombic antennas would be required to cover the 4:1 bandwidth covered by a single dual-feed corner reflector antenna of the type to be described herein.

SUMMARY

HF antenna apparatus are disclosed comprising a dual-feed, corner reflector antenna. Flared, wire grids are connected to a corner reflector structure consisting of two conductive planes with intersect at 90°. A pair of moderate-Q antennas are positioned symmetrically within the 90° angle in such a manner that two frequencies can be transmitted simultaneously without use of a multicoupler.

OBJECTS

It is the primary object of the present invention to disclose HF antenna apparatus operable over a bandwidth of 4:1 and with a pattern beamwidth of 45° and capable of simultaneously transmitting two frequencies without use of multicouplers.

Other objects, advantages and novel features of the invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an isometric view of the novel antenna to be described hereinafter;

FIG. **2** is a top view of the antenna of FIG. **1**;

FIG. **3** is a side view of the right-hand side of the antenna **10** of FIGS. **1** and **2**;

FIGS. **4** and **5** represent azimuthal directivity voltage patterns achieved with the antenna of FIG. **1**; and

FIGS. **6** and **7** represent vertical-plane voltage patterns achieved as above.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The configuration shown in FIG. **1** represents a dual-feed corner reflector antenna **10** embodying the present inventive concept. The antenna has the capability of covering a 4:1 frequency bandwidth with a half-power azimuth beamwidth of 45°. Two moderate-Q antennas, **12** and **14**, are used as the active radiators, each covering a 2:1 frequency range. The arrangement shown allows simultaneous transmissions of two 40-KW peak signals without the use of multicouplers. One transmission is within the upper octave frequency range and the other is within the adjacent lower octave range. The gain obtainable on beam over perfect ground is 11 to 16 dB's relative to an isotropic radiator.

The corner reflector **10** comprises two wire screens or grids, **16** and **18**, which intersect at the apex **19** at right angles with respect to each other. The screens **20** and **24** intersect with the screens **16** and **18** at the apexes **21** and **23**, respectively, and at an angle of 10° with respect to each other. The apexes **21** and **23** are a distance of about 0.21 λ from the apex **19**.

A second pair of flared screen portions **22** and **24** are positioned at an angle of 20° with respect to the first flared pair **20** and **24**, respectively, and at a distance of about 0.24 λ from the apex **19**.

FIG. **2** is a simplified top view of the antenna of FIG. **1**. As can be seen, the active elements **12** and **14** are symmetrically located between the screens **16** and **18** at a distance of 0.12 λ and 0.33 λ, respectively, from the apex **19**. It should be appreciated from FIGS. **1** and **2** that the flare portions **22** and **26** are electrically connected to the remaining portions of the antenna and that FIG. **2** is simplified for purposes of description only.

FIG. **3** is a side view of the right-hand side portion of the antenna of FIG. **2**. As can be seen, the screens **16** and **20** (and **18** and **24**) comprise vertical wires spaced at about 0.01λ. About 96 wires are required and as shown, they are connected by horizontal wires at the top and mid-points. The flare portion **22** (and **26**) comprise six horizontal wires spaced as shown in FIG. **2** and connected at the top by horizontal wires.

The grid configuration and the spacings between the vertical wires of the flare portions **22** and **26** are different from those of the remaining portions to produce the necessary pattern-broadening effects at these frequencies. Experimental pattern measurements were made on various configurations of the antenna, from which the following observations were made. Increasing the length of the reflector narrowed the patterns, while increasing the width of the aperture had a broadening effect. Controlling the leakage of energy to the reflector's sides enables patterns at specific frequency ranges to be changed, and pattern beamwidth at specific ranges of frequencies could also be increased by increasing the width of the corner at specific distances from the apex,

It was further experimentally demonstrated that if two whip radiators were used in the corner simultaneously, pattern splitting and broadening occurred at higher frequencies. Consequently, to reduce the reradiated energy and the pattern distortion, the vertical monopoles were replaced with tunable antennas. The moderate-Q antenna which is characterized by narrow bandwidth was chosen because of its frequency selec-

tivity, low-profile, and adaptability to tuning. The combination of the two moderate-Q radiators produced the desired results, with the beamwidth being only slightly narrow at the high frequencies. Adding the 10° flare portions and modifying the grid configuration produced the necessary pattern broadening effects at the frequencies of interest.

Experimental testing also was utilized to determine the optimum number of grid elements required to approach the results obtained with solid copper sheets. The results have previously been described with respect to FIG. 3.

Consideration was also given to providing isolation between the radiators since RF energy will be coupled from one moderate-Q radiator to the other because of their proximity. When the two radiators are transmitting simultaneously there will be instants of time when voltage resulting from the coupled power will add in phase within the coaxial transmission line with the voltage of the transmitted signal. Therefore consideration must be given to the voltage rating of the coaxial cable. To reduce the coupling passive filter networks may be used to provide additional isolation without degrading the performance of each antenna. These networks may be in the form of either transmission line segments or lumped constants.

Thus it can be seen that a dual-feed corner reflector antenna has been disclosed for use as a high frequency transmitting antenna where omnidirectional azimuthal radiation is not necessary nor desirable and directive gain can be used. The antenna can be used to provide enhanced signal strength of both sky wave and ground wave for a given sector and to provide enhanced sky wave coverage for ranges as close as 180°. The antenna can also be used to direct an antenna beam along a heavily used route for ship/shore/ship communications.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. An HF antenna comprising:

a corner reflector antenna comprising two rectangular conductive planes intersecting at an angle of 90° with respect to each other;

first flared conductive planes electrically connected to the edges of said two conductive planes parallel to the intersecting edges thereof and intersecting said edges at an angle of approximately 10°;

second flared conductive planes electrically connected to the edges of said first flared planes parallel to the intersecting edges thereof and positioned to form an angle of approximately 20° therewith; and,

a pair of active elements electrically connected to said conductive planes and being symmetrically positioned within said 90° angle.

2. The antenna of claim **1** wherein said two conductive planes are 0.21λ long, said first planes are 0.23λ, said second planes are 0.53λ long, and wherein all of said planes are 0.38λ wide.

3. The antenna of claim **2** wherein said two planes and said first planes comprise 96 vertical wires spaced at 0.01λ from each other and connected to horizontal wires at the top and mid-point thereof and wherein said second flared planes comprise six vertical wires sequentially spaced at 0.13λ, 0.11λ, 0.13λ, 0.08λ, and 0.08λ from the adjacent one of said wires.

4. The antenna of claim **3** wherein said pair of active elements comprise first and second moderate-Q antennas positioned 0.12λ and 0.33λ from the intersection of said two conductive planes whereby said antenna can simultaneously transmit two frequencies over a frequency bandwidth of 4:1 and with an azimuth pattern beamwidth of 45°.

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