Jan. 20, 1942. J. D. KRAUS 2,270,314

CORNER REFLECTOR ANTENNA

Filed Jan. 31, 1940

FIG. 1.

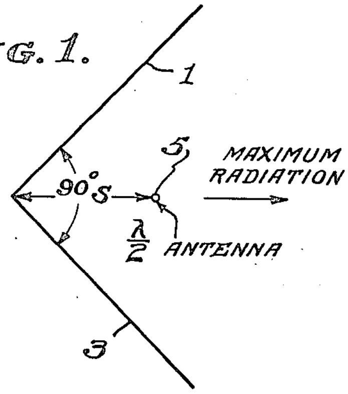


FIG. 2.

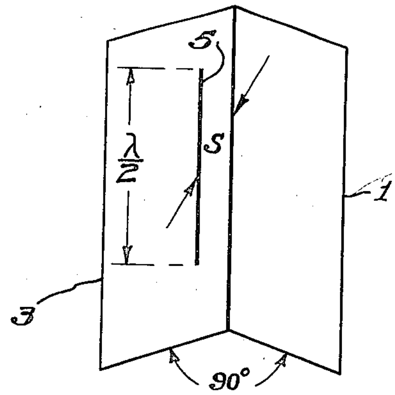


FIG. 3.

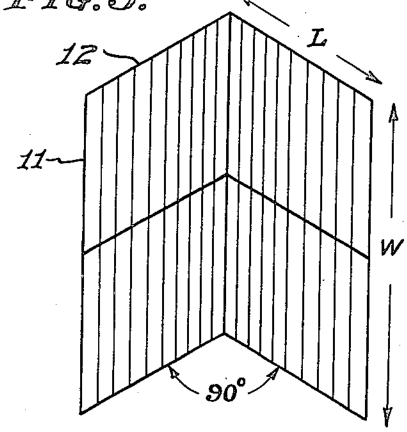


FIG. 4.

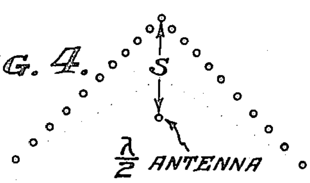


FIG. 5.

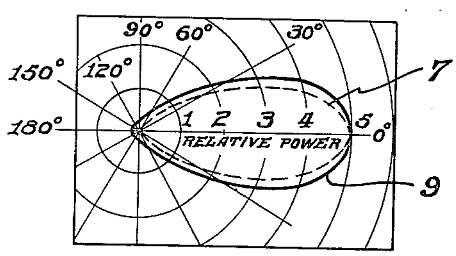
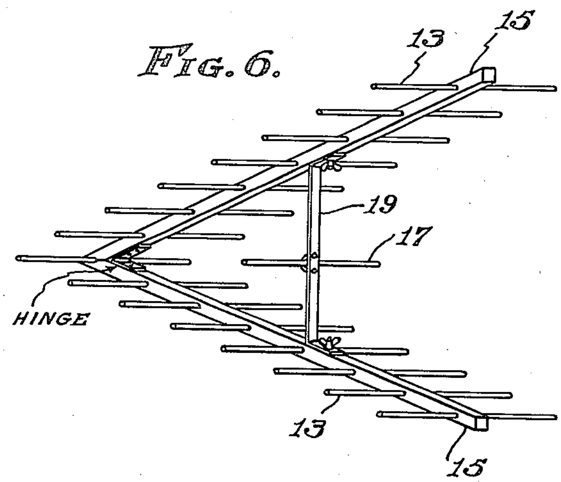


FIG. 6.



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2,270,314

UNITED STATES PATENT OFFICE

2,270,314

CORNER REFLECTOR ANTENNA

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Application January 31, 1940, Serial No. 316,625

6 Claims. (Cl. 250—11)

This invention relates to antennas and especially to an antenna which is placed near the corner of a pair of intersecting wave reflecting surfaces.

The use of reflecting surfaces to direct the waves from or to an antenna is old. In general these surfaces have been of parabolic form with the antenna located at or near the focus. The surfaces have been constructed of solid conductive sheets, metal screening, or a plurality of parallel conductors. In U. S. Patent 1,745,342, Yagi discloses an antenna which includes a plurality of rod reflectors and directors. The reflectors are arranged to form either a curved surface or two intersecting flat surfaces; the directors are in line with the direction of maximum radiation; and the antenna is located in the plane forming the opening of the reflecting surface. Another example of the prior art is found in U. S. Patent No. 741,622 which issued October 20, 1903, to S. G. Brown.

While the prior art devices produce directive radiation patterns, it has been discovered that sharply defined patterns may be obtained by locating an antenna adjacent the corner of a pair of intersecting reflecting surfaces and preferably in the plane bisecting the angle between the surfaces. The term corner reflector antenna has been used to describe such an antenna array. The corner reflector antenna exhibits a sharply defined beam. The beam width can be varied by changing the angle between the reflecting surfaces, the beam becoming sharper as the angle is decreased. Corner angles of about 90° or less are both practical and desirable. Since the reflecting surfaces are planes, the array may be made cheaply and may be arranged for folding to make transportation easy.

One of the objects of the invention is to provide means for radiating a sharply defined directive radio field. Another object is to provide an efficient, compact, directive antenna array. Another object is to provide a foldable reflector and antenna array. An additional object is to provide an adjustable corner reflector antenna array.

The invention will be described by referring to the accompanying drawing in which Figures 1 and 2 are plan and perspective views, respectively, of a corner reflector antenna; Figures 3 and 4 are perspective and plan views, respectively, of a modified corner reflector; Figure 5 is a graph illustrating the field pattern of a 90° corner reflector antenna; and Figure 6 is a perspective view of a foldable corner reflector antenna array.

Referring to Figs. 1 and 2, a pair of wave reflecting surfaces **1**, **3**, of conductive sheets are arranged to intersect at an angle of 90°. An antenna **5**, which may be a half wave dipole, is located in the plane bisecting the angle. The antenna can be connected or coupled to the transmitter or receiver by any of the methods well-known to the art, such as for example, by two parallel, twisted or concentric conductors. The distance S from the point of intersection to the antenna **5** is not critical, but may be between 0.1 and 0.5 of the operating wave length. Assuming infinite sheets of perfectly conducting material intersecting at 90° and a spacing S of 0.15 wave length, the calculated field pattern is shown by the broken line curve **7** of Fig. 5. The measured curve **9** is obtained by the modified array of Figs. 3 and 4.

Since perfect conductors of infinite extent can not be obtained in practice, an efficient and inexpensive compromise may be provided as shown in Figs. 3 and 4. A plurality of vertical conductors **11** are arranged on a wooden frame. The conductors may be connected together by cross-connecting wires, **12**, as shown, or these may be omitted. By way of example, the conductors adjacent to the corner were spaced 3 inches and the conductors more remote from the corner 6 inches for an operating wave length corresponding to a frequency of 56 to 60 megacycles per second. The lengths of the reflecting sides, L, were 6 feet and the width, W, 10 feet 6 inches. The distance S equalled 32 inches. The opening for 90° was approximately 8 feet 6 inches. The directive pattern for this array is represented by the curve **9** of Figure 5. It should be understood that diminishing the distance S will increase the directivity at a somewhat diminished gain. At S equal to 0.3λ a measured gain of 7.5 db. was obtained over a single half wave antenna.

By way of example the following table gives the dimensions for a square corner antenna reflector operated at 56 to 60 mc., for various values of S which may be used.

"S" in wave-lengths	"S" in feet	Side length, L in feet
0.15	2′ 7″	4′ to 6′
0.20	3′ 5″	5′ to 8′
0.25	4′ 3″	6′ to 10′
0.30	5′ 1″	7′ to 12′

Side width, W=10′ 6″.

If the angle of the intersecting reflecting surfaces is diminished, the directivity and gain will be increased. Angles of the order of 60° or less are within practical limits. The gain for a 60° angle is approximately 12 db. over a half wave antenna; a 45° angle shows even greater gain. As the angle is diminished the spacing S is increased, otherwise the radiation resistance of the antenna becomes unduly low. The length of the sides may also be increased. The directive pattern may be varied by moving the antenna toward one of the wave reflecting members.

A modified antenna is shown in Fig. 6. In this arrangement the reflecting surfaces are a plurality of rods 13 which are supported on hinged members 15. The length of each rod is preferably one-half or more of the operating wavelength. The hinged members may be conductive or non-conductive. The spacing between rods is not critical, but, for example, spacings of the order of 0.1 to 0.2 of the operating wavelength can be used. The antenna 17 is arranged on a support 19 which may be clamped on the hinged member 15 to maintain the desired angle. This arrangement may be folded readily to make the array easy to transport and easy to erect. Any of the foregoing arrays may be used for receiving or transmitting either vertically or horizontally polarized radio waves.

Thus the invention has been described as a corner reflector antenna in which plane reflecting surfaces are arranged to intersect at an angle of the order of 90° or less. An antenna is arranged in the plane bisecting the angle of intersection and at a distance of not less than 0.1 of the operating wavelength from the intersection. The reflecting surfaces or members may be formed by sheets, screens, or rod like reflectors. The device may be readily folded and transported. The gain over a half-wave antenna with the same power input may be from 7 to 12 or more decibels; the directivity may be increased by decreasing the angle or the antenna spacing. By way of example, the square corner reflector having an aperture of one-half the wave length is equal in gain and directivity to a parabolic reflector having twice the aperture and a focus to vertex spacing of about one-quarter wave-length.

I claim as my invention:

1. A corner reflector antenna including a pair of plane wave reflecting members arranged to intersect at an angle, said members having a length and width of the order of six-tenths of an operating wave length, means for adjusting said angle to a predetermined value of not more than 90°, and an antenna located between said members and at a distance from said intersection substantially less than the distance from said intersection to the opening of said members.

2. A foldable antenna array including a plurality of conductors, a pair of mounting members hinged at one end and each carrying in a row some of said plurality of conductors arranged in parallel to each other, an antenna, and a supporting member securing said mounting members in spaced relation and carrying said antenna between said two rows of conductors.

3. A foldable antenna array including a plurality of conductors having a length of not less than half the operating wave length of said array, a pair of mounting members hinged to each other at one end and carrying said conductors arranged in parallel to each other to form two intersecting planes of wave reflecting members, an antenna, and a supporting member carrying said antenna and securing said members in spaced relation at points intermediate their ends.

4. A foldable antenna array including a plurality of conductors, a pair of mounting members hinged at one end to form an angle of not more than 90° and each carrying in a row some of said plurality of conductors arranged in parallel to each other, an antenna, and a supporting member securing said mounting members in spaced relation and carrying said antenna between said two rows of conductors.

5. A foldable antenna array including a plurality of conductors having a length of not less than half the operating wave length of said array, a pair of mounting members hinged to each other at one end and carrying said conductors arranged in parallel to each other to form two planes of wave reflecting members intersecting at an angle of not more than 90°, an antenna, and a supporting member carrying said antenna and securing said members in spaced relation at points intermediate their ends.

6. A corner reflector antenna including in combination a pair of reflectors intersecting at an angle of 90 degrees or less, said reflectors each including a plurality of parallel conductors of substantially the same length, means for supporting said conductors at substantially their centers and substantially in planes, an antenna, and a third supporting means for supporting said antenna parallel to said planes and substantially midway between them at a point of not less than .1 or more than .5 of the operating wave length from said intersection.

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