

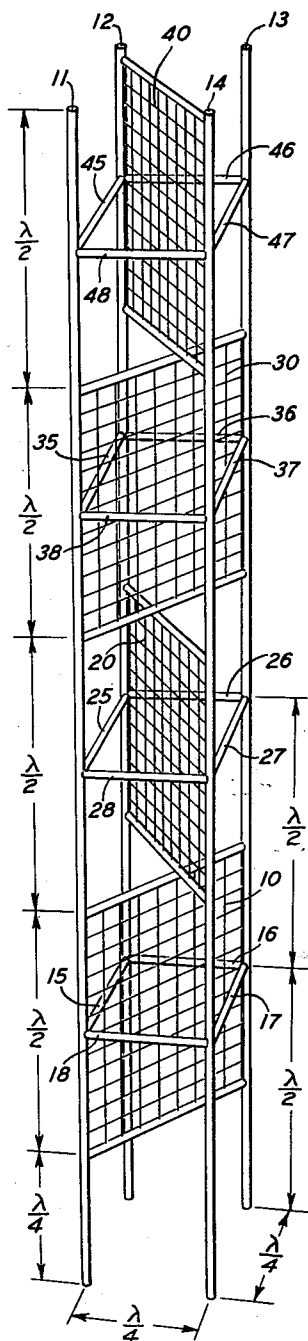
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HIGH GAIN ANTENNA

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HIGH GAIN ANTENNA

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This invention relates to antennas and, more particularly, to high-gain antennas of compact construction and especially suitable for mobile radio systems.

An object of this invention is to radiate a vertically polarized field having a uniform pattern in the horizontal direction.

A further object is to obtain a gain in radiation over that furnished by a vertical half-wave dipole.

A feature of this invention resides in an antenna framework that is rigid and self-supporting.

A further feature of this invention lies in an antenna framework that serves as a transmission line to feed the radiating portion of the antenna.

Another feature of this invention resides in an antenna framework that in itself constitutes the radiating portion of the antenna.

Other and further objects and features of this invention will appear more fully and clearly from the following description of an illustrative embodiment thereof taken in connection with the appended drawing in which the single figure shows an embodiment of the invention, in perspective.

Referring to the drawing, the antenna therein depicted comprises four parallel conductors, such as rods or tubes 11, 12, 13, 14, arranged in a rectangular array. These rods or tubes are intended to be vertically mounted on a suitable base, not shown. A plurality of sets of lateral braces 15, 16, 17, 18; 25, 26, 27, 28; 35, 36, 37, 38; and 45, 46, 47, 48 tie the rods or tubes 11, 12, 13, 14 into a tower-like structure. These braces may also be of rod or tube construction. The structure is diagonally braced by panels 10, 20, 30, 40. These panels may be solid sheets of metal, but preferably include mesh or open-work structure such as wire to reduce wind resistance. The structural elements may be of steel, aluminum, copper or other conductive material having sufficient strength.

The rods or tubes 11, 12, 13, 14 comprise a four-wire transmission line braced as shown at half-wave intervals by the braces 15, 16, 17, 18; 25, 26, 27, 28; etc. which are located at the low potential points of the antenna. If, as is shown in the drawing, the length of these braces is made a quarter-wave length for the frequency to be transmitted, it is unnecessary to insulate the braces from the rods or tubes comprising the transmission line. On the other hand, insulated braces may be used if structural restrictions prevent the use of quarter-wave length braces.

The panels 10, 20, 30, 40, besides providing diagonal bracing, serve as means for short circuiting alternate half-wave sections of diagonally opposite pairs of transmission line conductors, i. e., 11, 13 and 12, 14.

The bottom quarter-wave section of the transmission line is not short circuited and constitutes a balanced quarter-wave matching section grounded at its base. The antenna is fed at the point along this section where the antenna impedance matches that of the transmitter, reflected back through the feed line. No insulation is required, because this quarter-wave section, grounded at its base, presents a high impedance to a feed point located near the top of the section.

The ability of the antenna of this invention to radiate large amounts of power is attributable in part at least to the fact that an unbalanced transmission line develops longitudinal currents in proportion to its unbalance. Consider first a transmission pair that is unbalanced. Longitudinal currents equal in magnitude and of the same phase will be developed in the two conductors that

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constitute the pair. The magnitude of the equal currents flowing along the two conductors in parallel is a measure of the unbalance existing between the conductors and the external world. A pair of conductors purposely unbalanced along the length of the circuit may be unbalanced to such an extent that the current flow in the longitudinal circuit will appreciably exceed that in the metallic circuit. By unbalancing the pair in selected zones along its length, the longitudinal current may be phased so that the power radiated from an elementary length of the circuit will reinforce that from any other elementary length in any plane surface perpendicular to the pair of conductors. If such an unbalanced pair is supported in a vertical plane, it will constitute a vertically polarized antenna capable of producing a uniform field in the horizontal plane.

The structure of the antenna illustrated involves application of these principles of unbalance to a four-wire transmission line. Leaving the base quarter-wave section balanced, the panel 10 interconnecting rods or tubes 11 and 13 unbalances a half-wave section in one way. In the next half-wave section, the panel 20 short circuits the parallel conductors, comprising rods or tubes 12 and 14, to unbalance this section oppositely to the before-noted section. This alternately opposite unbalance of sections may be carried as far as is feasible or necessary, for example, by panels 30 and 40. In the illustrated antenna, four short circuiting panels are used, but more or fewer sections may be employed.

The gain over a half-wave dipole that can be achieved by such a four-wire transmission line antenna is a function of the over-all height of the antenna and of the degree of unbalance that can be obtained in the transmission line that constitutes the antenna. An antenna consisting of two half-wave radiating sections may be expected to have a gain in the horizontal direction of one to two decibels over a half-wave dipole. If the number of radiating sections is doubled, a gain increase of about three decibels is realizable. This antenna is designed to operate over a flat conducting ground plane which should extend outward in all directions from the base of the antenna to a distance at least as great as the over-all height of the antenna.

Although a specific embodiment of this invention has been shown and described, it will be understood that it is but illustrative and that various modifications may be made therein without departing from the spirit and scope of this invention.

What is claimed is:

1. An antenna comprising four vertical parallel conductors, bracing means including spaced groups of four elements, each of said elements of equal length and interconnecting said conductors, and a plurality of conductive panels connected between diagonally opposite pairs of said conductors, adjacent panels being in planes normal to each other.

2. An antenna as in claim 1 in which the four vertical conductors comprise both a transmission line and radiating elements.

3. An antenna as in claim 1 in which each group of bracing means is located at a point along the antenna that is at a low potential point for the wave length corresponding to the frequency of operation.

4. An antenna as in claim 1 in which each of the four elements of each bracing group has a length a quarter of the wave length that corresponds to the frequency of operation.

5. An antenna as in claim 1 in which the four vertical conductors each has a length that is the same multiple of quarter-wave lengths corresponding to the operational frequency and include a balanced quarter-wave length base section, and superposed half-wave length sections each unbalanced by a diagonally connected panel.

6. An antenna, adapted for operation at a given frequency, comprising a vertically directed, four-conductor transmission line having unbalanced half-wave sections provided by conductive means connected alternately between diagonally opposite conductors of said line and a balanced quarter-wave base section.

7. A self-supporting antenna having a length that is a multiple of quarter-wave lengths at the operating fre-

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quency, and comprising four vertical, parallel conductors of equal length, a plurality of sets of quarter-wave length lateral braces at half wave length intervals along said conductors, and a plurality of half-wave length panels along said conductors, said panels comprising conductive means connected alternately between diagonally opposite conductors of said parallel conductors, said braces interconnecting said vertical conductors.

8. A self-supporting antenna as in claim 7 in which one each of the sets of braces is at the median line vertically of one of said panels.

9. A self-supporting antenna as in claim 7 in which the lowermost set of braces is one-half wave length above the bottom of the vertical conductors, and the lowermost panel has its lower end one-quarter wave length above said bottom.

10. An antenna for radiating a vertically polarized field with a uniform pattern in the horizontal plane at a given wave length, that comprises a transmission line including a plurality of parallel, vertical conductors, arranged symmetrically with respect to a common vertical axis, a pair each of said conductors lying in a plane

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through said axis, said transmission line having a balanced quarter-wave length base section comprising the lower portions of said conductors, and a plurality of superposed half-wave length radiating sections, each comprising a portion of the two conductors of one of said pairs and an unbalancing conductive connection between the two conductor portions.

11. An antenna for radiating a vertically polarized field with a uniform pattern in the horizontal plane, at a given wave length, that comprises four parallel vertical conductors, conductive connections between diagonally opposite half-wave length portions of said conductors, the conductive connections of vertically adjacent half-wave length portions being on different diagonals.

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