April 28, 1942. DE WITT R. GODDARD 2,281,429

ANTENNA

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Fig. 1

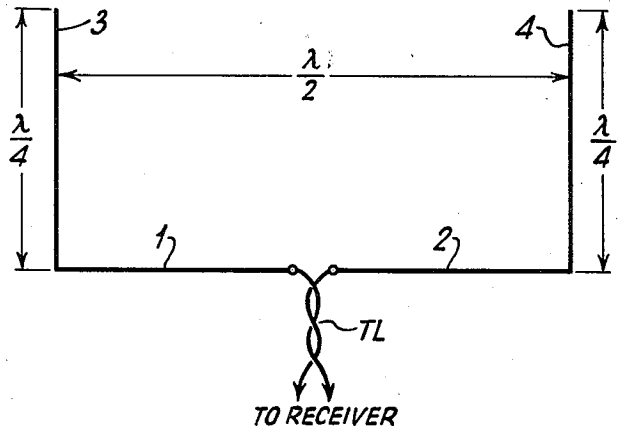
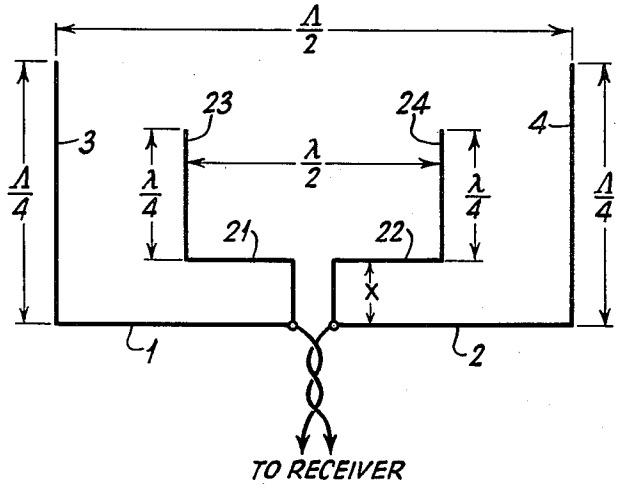


Fig. 2



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13 Claims. (Cl. 250—33)

The present invention relates to short wave antennas and, more particularly, to antennas for receiving horizontally polarized waves over a wide band of frequencies.

An object of the present invention is to enable the reception of horizontally polarized signals over a wide band of frequencies such as is at present used in television.

Another object of the invention is to provide an antenna suitable for receiving horizontally polarized signals over a wide band of frequencies.

Still another object of the invention is to provide an antenna having a low degree of directivity in the horizontal plane.

Still another object of my invention is to provide an antenna having an omni-directional horizontal directivity diagram.

The foregoing objects, and others which may appear from the following description, are accomplished by providing an antenna comprising a pair of half wave conductors bent at right angles at the midpoint of each of said conductors. The resultant L shaped conductors are arranged in a horizontal plane with one arm of each conductor connected to one side of a transmission line. The portions of the two conductors which are connected to the transmission line are preferably arranged along a common axis in the horizontal plane.

As a modification, I may provide two such antennas of different dimensions and connected in parallel to the same transmission line. Both antennas in this modification may lie in the same horizontal plane. In this modification the dimensions of one of said pairs of conductors is determined by the maximum frequency to be received and the other by the minimum frequency to be received. Between these two limits the antenna responds substantially uniformly to signals received from any point on the horizon.

Reference will now be made, for a more complete understanding of the invention, to the following detailed description which is accompanied by a drawing in which Figure 1 illustrates one form of my antenna and Figure 2 illustrates a modification thereof.

The form of my invention shown in Figure 2 may possibly be the preferred form where a wide range of frequencies is to be covered with a substantially uniform response.

Referring, now, to Figure 1, reference numerals 1 and 3 indicate a single element of my antenna and which comprises a conductor having a length equal to one half the length of the operating wave and bent at right angles at the center. Reference numerals 2 and 4 indicate a similar L shaped conductor with the portion 2 in coaxial alignment with portion 1 of the first mentioned conductor. The two conductors lie in a common horizontal plane and the adjacent ends of conductor portions 1 and 2 are connected to a transmission line TL and through the transmission line to the receiver. As is well known, a horizontal dipole antenna similar in appearance to portions 1 and 2 only of Figure 1 has a figure 8 directive pattern in the horizontal plane. Since conductor portions 3 and 4 are spaced in the horizontal plane substantially a half of the length of the operating wave length the potentials picked up by conductor portions 3 and 4 are substantially a half a wave out of phase with each other for waves arriving along a line perpendicular to their axes. Since conductors 1 and 2 are each a quarter of the length of the operating wave in length, the resultant received energy arriving from conductor portions 3 and 4 at the transmission line will be in phase opposition. The reception pattern from these two conductor portions added to the figure 8 reception pattern resulting from conductors 1 and 2 will result in a substantially circular pattern. It should also be noted that due to the length of conductor portions 1 and 2 the energy received or transmitted from conductors 3 and 4 is in a phase quadrature relationship with respect to that received or transmitted from conductors 1 and 2. In transmission, therefore, a horizontally polarized field rotating at carrier frequency is generated. An antenna of this type is especially of value in connection with ultra short wave broadcast systems where it is desirable to use an antenna which is omni-directional in its response so that signals from all directions may be received with equal intensity. Furthermore, an antenna responsive to a horizontally polarized wave is desirable since it results in an improved signal-to-noise ratio. In an embodiment of this antenna in which the conductor portions 3 and 4 were each approximately 7/10 of a meter long and the distance between the conductors 3 and 4 was approximately 1.4 meters a substantially omni-directional response was obtained for frequencies between 60 and 100 megacycles.

Another embodiment of the same antenna having conductor portions 3 and 4 of 1.58 meters in length and the distance between the conductors 3.24 meters a substantially omni-directional response was obtained for frequencies of 45 megacycles upwardly toward 60 megacycles.

In each of these physical embodiments of my

invention the conductor sections were constructed of half inch copper tubing and so arranged as to be as near self-supporting as possible.

In order to further increase the usable frequency band width a modification as shown in Figure 2 may be used. This modification comprises two U shaped antennas, each substantially as heretofore described. One of the antennas is designed to be particularly responsive to the longer wave length which may be designated by the symbol Λ and has a spacing between the conductor portions 3 and 4 of $\Lambda/2$. As in the previously described embodiment, the length of each of the conductor portions 3 and 4 was $\Lambda/4$. The second antenna is designed to be particularly responsive to the shorter wavelength which may be designated by γ and is composed of conductors 23 and 24 spaced apart a distance of $\gamma/2$ and each conductor having a length of $\gamma/4$. Conductor portions 21 and 22 obviously have a length of $\gamma/4$ also. The adjacent inner ends of the pairs of conductors are connected to a common transmission line TL. The distance x between the large U antenna and the small U antenna is made as small as conveniently possible, preferably on the order of 3 inches.

An antenna constructed according to Figure 2 was found to have a substantially uniform omnidirectional response from 45 megacycles to 100 megacycles using the same dimensions as for the two U separate antennas, as heretofore given.

While I have particularly shown and described several modifications of my invention and given certain definite dimensions, it is to be particularly understood that my invention is not to be limited thereto but that modifications may be made within the scope of the invention.

I claim:

1. A short wave antenna comprising a pair of L shaped radiating conductors disposed in a common horizontal plane with an arm of each of said conductors extending toward each other along a common axis and their ends adjacent, and a transmission line connected to said conductors, each of said conductors having a length equal to half the length of the operating wave, the parallel arms of said conductors being so spaced that the energy radiated thereby is additive along a line perpendicular to said arms.

2. A short wave antenna comprising a pair of L shaped radiating conductors disposed in a common horizontal plane with an arm of each of said conductors extending toward each other along a common axis and their ends adjacent, and a transmision line connected to said conductors at their adjacent ends, each of said conductors having a length equal to a half the length of the operating wave, the parallel arms of said conductors being so spaced that the energy radiated thereby is additive along a line perpendicular to said arms.

3. A short wave antenna comprising a pair of complementary L shaped radiating conductors disposed in a common horizontal plane with an arm of each of said conductors extending inwardly toward each other along a common axis and a transmission line connected to said conductors, each of said conductors having a length equal to a half the length of the operating wave.

4. A short wave antenna comprising a pair of complementary L shaped radiating conductors disposed in a common horizontal plane with an arm of each of said conductors extending inwardly toward each other along a common axis, the other arms of said conductors being parallel and a transmission line connected to said conductors at the adjacent ends of said first mentioned arms, each of said conductors having a length equal to half the length of the operating wave.

5. A broad band antenna system comprising a pair of antennas each including a complementary pair of radiating conductors disposed in a common horizontal plane, each of said conductors being bent at right angles near its midpoint to form a pair of arms, an arm of each of the conductors of each pair lying along a common axis with their ends adjacent, said antennas having their coaxial arm portions parallel and a single transmission line connected to said antennas in parallel whereby said conductors are so energized that substantially uniform response is obtained for all directions in a horizontal plane, each of the conductors of one of said antennas having a length equal to a half of the length of the lowest frequency wave to be transmitted and the conductors of the other of one of said antennas having a length equal to a half of the length of the highest frequency wave to be transmitted.

6. A broad band antenna system comprising a pair of antennas, each including a pair of radiators disposed in a common horizontal plane, each of said radiators being bent at right angles at its midpoint to form a pair of arms, an arm of each of the conductors of each pair lying along a common axis with their ends adjacent, said antennas having their corresponding arm portions parallel and a single transmission line connected to said antennas in parallel whereby said radiators are so energized that substantially uniform response is obtained for all directions in a horizontal plane, each of the radiators of one of said antennas having a length less than a half of the length of the mean operating wave and the radiators of the other of said antennas having a length greater than a half the length of the mean operating wave.

7. A broad band antenna system comprising a pair of U shaped antennas of different sizes connected together at their bases and disposed in a common horizontal plane and a transmission line connected thereto, the spacing between the parallel sides of each of said antennas being such that radiation from said sides has a maximum along a line perpendicular to said sides, said radiation being additive to that from the base portion of each of said antennas whereby an omni-directional characteristic is obtained over a wide range of frequencies.

8. A broad band antenna system comprising a pair of U shaped antennas of different sizes connected together at their bases and disposed in a common horizontal plane and a transmission line connected thereto, one of said antennas being disposed within the other, the spacing between the parallel sides of each of said antennas being such that radiation from said sides has a maximum along a line perpendicular to said sides, said radiation being additive to that from the base portion of each of said antennas whereby an omnidirectional characteristic is obtained over a wide range of frequencies.

9. A broad band antenna system comprising a pair of U shaped antennas of different sizes connected together at their bases and disposed in a common horizontal plane and a transmission line connected thereto, one of said antennas being disposed within the other and having its open end facing in the same direction, the spacing between the parallel sides of each of said antennas being

such that radiation from said sides has a maximum along a line perpendicular to said sides, said radiation being additive to that from the base portion of each of said antennas whereby an omni-directional characteristic is obtained over a wide range of frequencies.

10. A broad band antenna system comprising a pair of U shaped antennas of different sizes connected together at their bases and disposed in a common horizontal plane and a transmission line connected thereto, one of said antennas being disposed within the other and having its open end facing in the same direction, one of said antennas having an overall conductor length greater than the length of the operating wave and the other a length less than the length of the operating wave, the spacing between the parallel sides of each of said antennas being such that their energy phase relationship is additive with respect to a remote point whereby an omni-directional characteristic is obtained over a wide range of frequencies.

11. A short wave antenna comprising a pair of L shaped radiating conductors disposed in a common horizontal plane with an arm of each of said conductors extending toward each other along a common axis with their ends adjacent, and a transmission line connected to said conductors at their adjacent ends, the other arms of said conductors extending in the same direction in said plane, each of said conductors having a length equal to half the length of the operating wave.

12. A short wave antenna comprising a U shaped antenna disposed in a horizontal plane and a transmission line connected to said antenna at its midpoint, the spacing between the parallel sides of said antenna being such that radiation from said sides has a maximum along a line perpendicular thereto, said radiation being additive to that from the base of said U whereby an omni-directional characteristic is obtained.

13. An antenna including in combination a pair of complementary radiator elements, said elements each having a bend intermediate its ends to form parallel portions of one quarter wavelength and inwardly extending portions, the free ends of said parallel portions pointing in the same horizontal direction, and a transmission line connected to complementary points on said inwardly extending portions, the spacing between said parallel portions being such that the radiation therefrom combines with that from said inwardly extending portions to produce a substantially uniform radiation in the horizontal plane.

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