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A. ALFORD

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FIG. 1

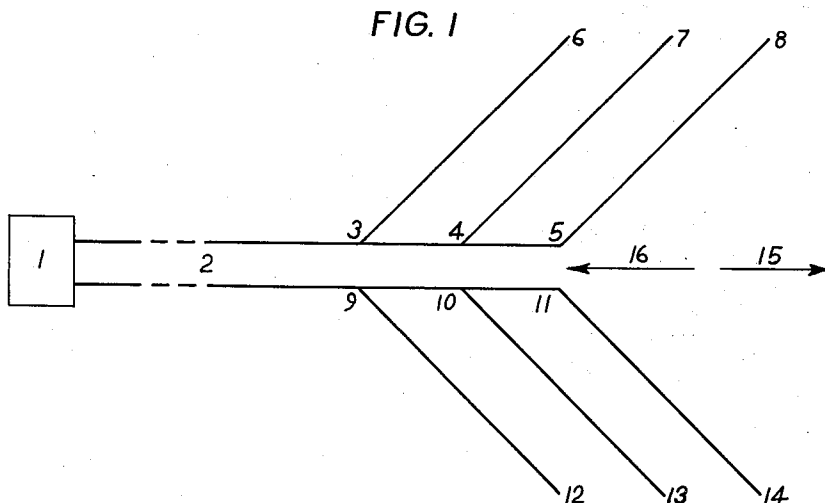
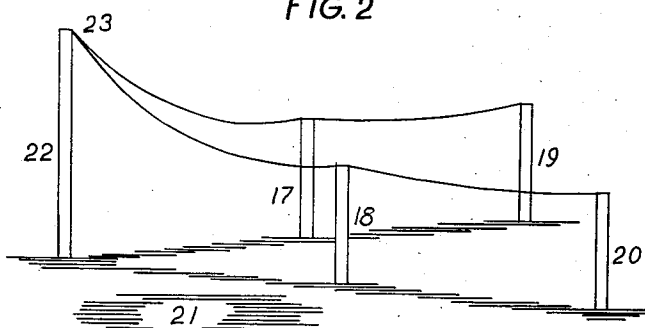


FIG. 2



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This invention relates to antenna systems, and more particularly to a unidirectional antenna which may be used for the reception or transmission of short wave radio messages.

It is the object of the present invention to construct a unidirectional transmitting or receiving antenna without the use of the customary reflectors, impedance matching device or terminations.

With this object in view an open-ended antenna wire, preferably connected with a transmission line, is supported at or near its open end in proximity to the ground, whereby the attenuation of currents traversing the antenna wire will be so great near the open end that the reflection of waves towards the other portions of the antenna wire and the transmission line will be substantially completely prevented. A system built up of such antenna wires will radiate in one direction only.

My invention may be best understood by referring to the following description in conjunction with the accompanying drawing in which—

Fig. 1 shows a plan view of the antenna system, and

Fig. 2 is a perspective of one of the pairs of sagging radiators of Fig. 1.

Referring to Fig. 1, 1 is a source of modulated radio frequency energy which is fed by any well-known coupling means to the transmission line 2. The latter is of the usual construction, its sole function being to transfer efficiently the energy it receives from the source 1 to the system of open-ended radiators 3—6, 4—7, 5—8, 9—12, 10—13, and 11—14. These radiators are connected in pairs at successive points along the transmission line, each pair in plan view forming a V as, for example, the pair 5—8 and 11—14. The sides of the V's formed by the other pairs are substantially parallel to the radiators 5—8 and 11—14.

Ordinarily, such an arrangement of radiators radiates principally in the two directions shown by the arrows 15 and 16 which are in the vertical plane bisecting the angle formed by the radiators and is, therefore, said to be bilaterally directive. It is desirable, however, to achieve unilateral directivity, e. g., no radiation in direction 16 and substantially all of the radiation in direction 15. The practice generally followed in the art has been to terminate the outer ends in an impedance which will absorb all that remains of the outward flowing energy which reaches the outer ends so that none is reflected back towards the transmission line. Since no energy is re-

flected, the radiation in direction 16 is reduced to zero. This requires an impedance capable of dissipating the energy at the same rate as it receives energy from the radiator. In a practical installation, where the impedance is usually called upon to dissipate large amounts of energy, such an impedance is of expensive construction. Another proposed arrangement, designed to accomplish the same purpose, is to make the radiators so long that practically all of the energy will be radiated on the outward journey. When one considers that a V with sides 16 wavelengths long provides a front-to-back ratio of less than 5 decibels, it is apparent that enormously long radiators will be required before the desired result may be accomplished to a reasonable extent.

I have found, on the other hand, that by making the outer ends of the radiators trail very close to the ground, I can realize substantially unilateral directivity with open-ended radiators of moderate length. Thus, for example, in Fig. 2, is shown the side elevation of a typical radiator of my invention, i. e., one side of a V. In Fig. 2, the ground surface 21 is shown level merely for convenience in delineation, only the relative distance from the ground of the various portions of the conductor being important in a practical installation. The pole 22 supports the transmission line end of the wire 23—17, the end 23 being preferably about one-quarter wavelength above the ground 21. It is understood that when a pole is said to support a wire that the customary construction using insulators is implied. The outer end of the wire 23—17 is supported by the very short pole 18 (five to ten feet high) allowing sufficient sag as shown so that a considerable portion of the wire runs close to the ground. If required, the wire may be continued to another similarly short pole 20 where the end 19 is supported. The portion of the wire 17—19 runs close to the ground, i. e., about 5 feet above the ground.

The antenna of my invention will not work equally well over all types of ground. For example, over a relatively perfect conducting ground, such as sea water or salt marshes, I have found that satisfactory results are difficult to obtain. Likewise, over a relatively insulating ground, the results would doubtless be unsatisfactory. Over intermediate or partially conducting ground, such as would be encountered in a large percentage of installations, I have found that the attenuation per unit length in the portion of the radiators very close to the ground is enormously greater than in the remaining por-

tion further removed from the ground. In this invention, I utilize this high attenuation to reduce the outward travelling energy on the radiators to a negligible quantity so that substantially none is left to be reflected. Furthermore, this is achieved with the radiating conductors extended only a moderate distance a few feet above the ground.

In practicing this invention it is preferable to test the ground conditions in advance by installing an inexpensive test line such as portion 17—19 running about 5 feet above the ground. It is a relatively simple matter to measure the attenuation per unit length of the test line. This test provides information which enables one to estimate the attenuation of that portion of each radiator of the proposed antenna which will run close to the ground. This attenuation should be made as large as practicable but need not be excessively great. It has been determined by experiment that an attenuation of ten to fifteen decibels is already sufficiently great to be useful. Over suitable ground this may be attained with moderate lengths of wire. Furthermore, the construction of the portion near the ground is relatively inexpensive and may be extended to occupy any additional available space. Should the space available for the outer portion of the radiators be restricted, it is not necessary to extend the outer portions in the same direction as the higher or radiating portion. The resulting antenna system is substantially aperiodic so that the length is not critical with respect to wavelength. In determining the proper angle for the V's, only the length from 23 to the bottom of the sag need be considered as active and due allowance must be made for the slope of this active portion in order to secure the proper angle of elevation for the beam.

Where more than three pairs of radiators are employed it will be worth while to provide impedance matching between the transmission line and the successive pairs of radiators in the manner well understood by one skilled in the art. In certain cases satisfactory results may be obtained with one or two pairs of sagging radiators without any impedance matching devices in the transmission line.

What I claim is:

1. An antenna system comprising a line, and antenna wires connected therewith, and each wire for a considerable portion of its length from the free end being positioned close to the ground so as to have an attenuation per unit length greater than that of the remainder thereof.

2. An antenna system comprising a transmission line, and antenna wires connected therewith and forming a V, and each wire for a considerable portion of its length from the free end being positioned close to the ground so as to have an attenuation per unit length greater than that of the remainder thereof.

3. An antenna system comprising a transmission line, and antenna wires connected therewith

and forming a plurality of parallel V's, and each wire for a considerable portion of its length from the free end being positioned close to the ground so as to have an attenuation per unit length greater than that of the remainder thereof.

4. An antenna system comprising a transmission line, means for supporting said line at a certain elevation, two antenna wires with one end connected to the line at said certain elevation, and means for supporting the other ends at a substantially lower elevation than the other portions, the length of said other portions being a substantial percentage of the total length of the antenna wires and being positioned a few feet above the ground so as to make the antenna substantially uni-laterally directive.

5. An antenna system comprising a transmission line, means for supporting said line at a certain elevation, two antenna wires forming a V and with one end connected to the line at said certain elevation, and means for so supporting the other ends that for a considerable portion of the length therefrom such antenna wires are at a substantially lower elevation, whereby said portions of the wires have substantially higher attenuation per unit length than the portions nearest the line.

6. An antenna system comprising a line, means for supporting said line at a certain elevation, an antenna wire with one end connected to the line at an elevation a substantial part of a wavelength above ground, and means for supporting a substantial length of the free portion of the wire at a substantially lower elevation with said substantial length running close to ground so as to increase the attenuation of waves traversing said antenna wire thereby to reduce substantially the reflection of said waves over the antenna wire towards said line.

7. An antenna system comprising a line, a pair of radiators connected therewith at an elevation above the ground of the order of magnitude of a quarter wavelength, and means for supporting the outer ends of said radiators with a substantial portion of the length thereof from the outer ends near the ground so that the attenuation offered by said substantial portions of the radiators in proximity to the ground to the waves traveling therethrough will substantially completely prevent the reflection of waves over the radiators towards the transmission line.

8. An antenna system according to claim 7, and in which a plurality of pairs of said radiators are connected with the transmission line substantially parallel with one another.

9. An electrically long antenna comprising a wire, one part of which is supported at a distance above ground equal to a substantial part of a wavelength and another part of which is supported very close to ground, said second part being of such length that the antenna is substantially uni-laterally directive.

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