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SHORT WAVE ANTENNA
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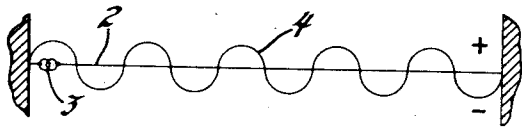


Fig. 1

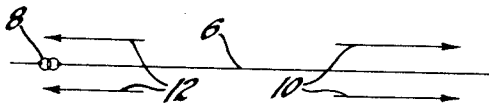


Fig. 2

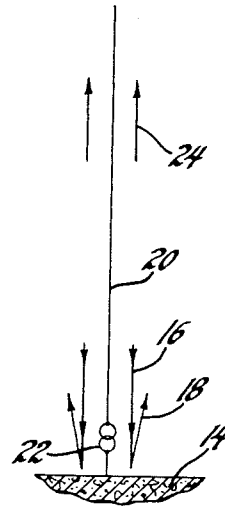


Fig. 3

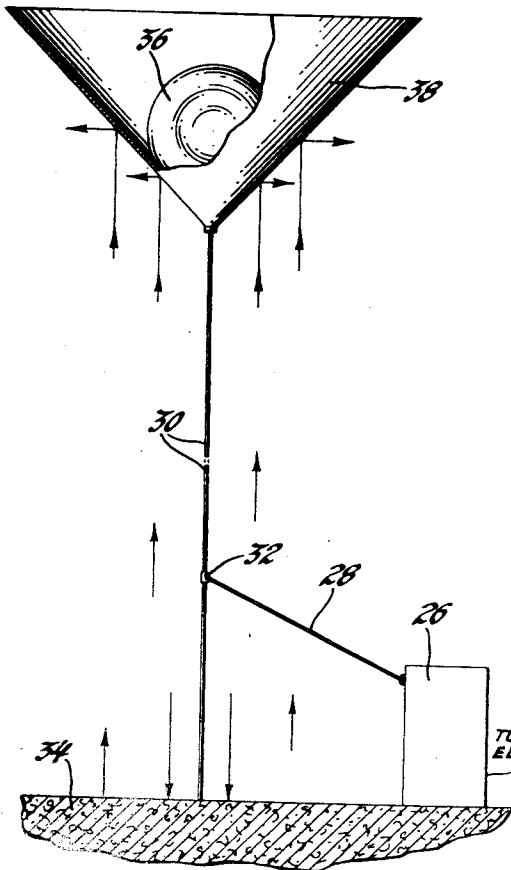


Fig. 4

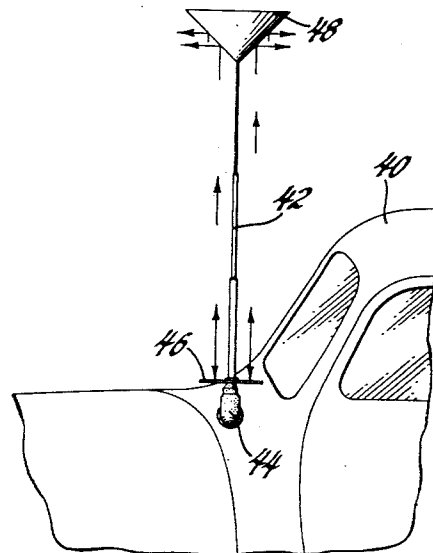


Fig. 5

TUNABLE
ELECTRICAL MEANS

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UNITED STATES PATENT OFFICE

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SHORT WAVE ANTENNA

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3 Claims. (Cl. 250—33.65)

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The present invention relates to the design of antennas for the propagation or reception of ultra high frequency electric waves. More particularly it relates to antennas having an omnidirectional pattern in a horizontal plane, for the propagation and reception of microwaves. Electric waves in the microwave or ultra high frequency spectrum generally follow only straight or line-of-sight paths. Propagation or reception of such waves is enhanced by use of elevated points for the antennas and also by the use of antennas with high horizontal directivity.

For instance, previous to the present invention, it was common practice to use a series of vertically stacked dipoles or other unit radiators all similarly phased. This whole array was then located on top of a tall building, tower, or hill. The propagation or reception of electric waves in the spectrum where a quarter wave length is greater than a practical antenna dimension is simple where omnidirectional characteristics are desired and difficult where directional characteristics are desired. In the range of frequencies where the antenna may be one-quarter wave length and still be of such size as to emit appreciable power, the problem of both omnidirectional and directional propagation and reception is greatly simplified. It is quite difficult in the propagation of microwaves with present antennas, to obtain satisfactory antenna gain with omnidirectional field patterns.

Previous to the present invention it was common practice to use a single dipole or a series of stacked dipoles or dipoles arrayed in a particular pattern so as to obtain sufficient antenna gain.

The present invention utilizes the axial propagation characteristic of an antenna which is several wave lengths long. Previous to the present invention it was thought undesirable to use continuous antennas of greater length than one-half wave length since the propagation in a plane normal to the antenna is not increased by increasing the length of the antenna, their propagation being essentially only in an axial direction. The present invention utilizes a reflector which may be of inverted conical shape to convert the directional propagation parallel to the antenna to an omnidirectional propagation in a plane normal to the antenna. Any downward radiation along the vertical wire could be reflected by a flat wire mesh reflector located in a plane normal thereto and near the lower extremity thereof.

It is, therefore, an object of the present in-

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vention to produce an antenna of several wave lengths having an omnidirectional characteristic in a plane normal to the antenna.

It is a further object of the present invention to produce an antenna of several wave lengths with maximum propagation in a normal plane intersecting a point near the top of the antenna.

It is a still further object of the present invention to produce a highly efficient antenna for microwaves.

Other objects of this invention will become apparent upon reading the specification and inspection of the drawings and will be particularly pointed out in the claims.

Referring to the figures in the drawing:

Figure 1 illustrates standing waves;

Figure 2 illustrates parallel directional propagation of an antenna in free space;

Figure 3 illustrates propagation from a vertical antenna;

Figure 4 illustrates an embodiment of the present invention for stationary transmitters and receivers;

Figure 5 illustrates a second modification of the present invention utilized on mobile transmitters and receivers.

Referring more particularly to the figures of the drawing, Figure 1 shows a conductor 2, several wave lengths long with a point source of energy 3. If such a conductor is terminated with any load impedance other than the characteristic impedance of the line system, of which the conductor is a part, a so-called standing wave results from the series of reflected waves caused by the discontinuity in impedance at the termination. This standing wave approaches a sine wave shape as a maximum. In Figure 1 this wave is shown as 4. Due to the arrangement of potentials caused by this standing wave, such a conductor as 2, if placed in free space, would propagate waves in a direction which coincides with the direction of the conductor.

Referring to Figure 2 such a conductor in free space is shown as 6 with a point source of energy 8 located at some place in its length. Such a conductor may be considered as terminated in an impedance very different from the characteristic impedance of the transmission line system which includes the conductor. Under these circumstances the directional propagation of the antenna is illustrated by the arrows 10 and 12. If such an antenna is placed over a plane conducting surface normal to the antenna such as shown in Figure 3, the wave propagated by 12 is reflected by this surface 14 as illustrated by the

arrows 16 and 18. In this illustration the antenna 20 and point source of energy 22 may be considered the equivalent of the conductor 6 and the point source of energy 8 in Figure 2. This antenna, similar to the antenna shown in Figure 2, in addition to reflecting wave 18, has the direct waves 24 propagated therefrom. Such an antenna is illustrated in Figure 3. It has directional characteristics and propagates a wave front in a direction axial to the antenna, here shown as vertical. In order to change this directional pattern, into an omnidirectional pattern normal to the antenna, a convex hyperbolic or inverted cone reflector of conducting material is attached to the top of the antenna.

Referring to Figure 4, an inverted conical reflector is used with a stationary transmitter or receiver 26. A lead-in wire 28 is attached to the proper point on the antenna 30 to obtain maximum transfer of energy between the antenna and the lead-in wire. This point of attachment, of course, will vary in accordance with the particular wave length being transmitted or received. If 26 is a transmitter or receiver which is voltage fed, the point of attachment 32 will be an uneven number of quarter wave lengths from the reflecting surface 34. If, on the other hand, the transmitter or receiver 26 is current fed, the point of attachment 32 will be an even number of quarter wave lengths from the reflecting surface 34. The antenna 30 shown in this modification of the invention is of the flexible small diameter conductor type and is supported in a vertical position by means of a gas-filled balloon or other buoyant element 36. Located between the balloon 36 and the conductor 30 is a conical or a hyperbolic surface of rotation reflector 38. Such a reflector gives good horizontal omnidirectional propagation or reception characteristics. I prefer to use an inverted conical reflector element having a vertex angle of 90° and located symmetrical with the line of center of the antenna. Such a reflector is also shown in the modification of my invention illustrated in Figure 5.

In Figure 5, 40 is an automobile or other mobile unit transporting the antenna with its associated transmitter and/or receiver. In this case the antenna 42 is of the self-supporting type and is attached to the automobile by means of insulator 44. In this modification a conducting plane 46 located normal to the antenna near its base, replaces the reflecting surface 34 shown in Figure 4. The cone has a vertex angle of 90° and is supported symmetrically at its apex by the antenna 42 so that all points on the reflecting surface present an angle of 135° with the antenna. In this modification, the vertically propagated waves are reflected at an angle of 90° so as

to be propagated in an omnidirectional pattern normal to the antenna. If this antenna is used for a receiver the received waves are reflected in a vertical direction along the antenna so as to induce a current therein.

It is to be understood also that although the invention has been described with specific reference to a particular embodiment thereof, it is not to be so limited, since changes and alterations therein may be made which are within the full intended scope of this invention as defined by the appended claims.

I claim:

1. A radio antenna for electric signals having an omnidirectional horizontal wave pattern including; a vertical conductor for said electrical signal of a length equal to several wave lengths of said electrical signal at its operating frequency, an inverted conical reflector with a downwardly directed vertex angle of substantially 90° located symmetrical with said conductor at the upper extremity thereof, and a horizontal conducting plane at the lower extremity of said conductor.

2. A radio antenna system for electrical signals having an omnidirectional horizontal wave pattern including; a vertical conductor for said electrical signal of a length equal to several wave lengths of said electrical signal at its operating frequency, an inverted conical reflector with a downwardly directed vertex angle of substantially 90° located symmetrical with said conductor at the upper extremity thereof, and electrical means connected to said antenna adjustable to resonate at said operating frequency.

3. In an antenna system as claimed in claim 2 having a horizontal conducting plane at the lower extremity of said conductor.

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