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ANTENNA FOR BROAD FREQUENCY BANDS

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Fig. 1

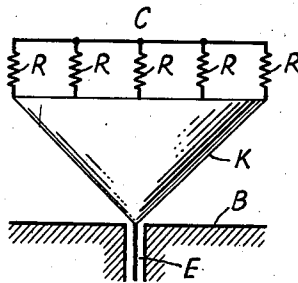


Fig. 1a

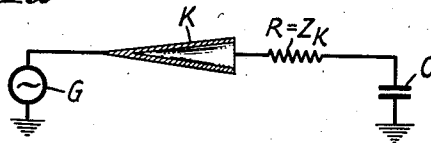


Fig. 3

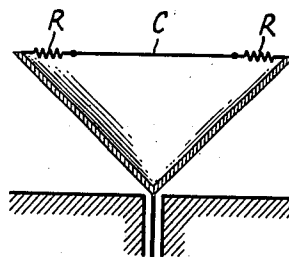
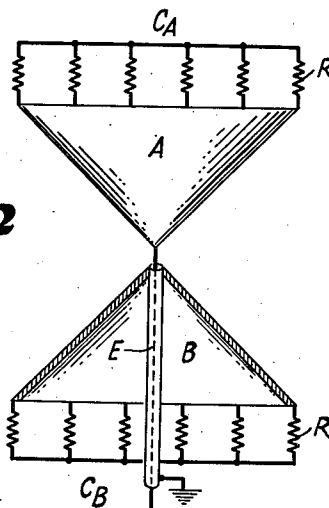


Fig. 2



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7 Claims. (Cl. 250—33)

For the transmission of television programs it is necessary to make available a type of antenna designed to transmit or pick up a broad frequency band at as uniform an amplitude as feasible over the entire band. In the majority of aerials that have been disclosed in the prior art and which are tuned to the carrier, reactances arise in the side-bands which cause a marked dependence of the amplitude upon the frequency.

To avoid the above difficulty, antenna arrangements have been suggested in the art which have only a small reactance gradient. Antennae of this kind comprise a $\lambda/4$ radiator in the form of an inverted cone, that is, a cone set on its apex. A cone of this kind not only possesses a low surge impedance and thus also a small reactance variation with the frequency, but, above all, a constant surge impedance.

According to the invention an antenna arrangement, especially an antenna arrangement designed for a broad frequency band in the form of a cone or double-cone has this outstanding feature that the broad end (base) of the cone is coupled with a space capacity through an ohmic resistance having a value equal to the constant surge impedance of the cone.

The surge impedance of a cone of infinite size whose apex is directed towards a ground plate results from theory to be

$$Z = -60 \log_e \tan \frac{\alpha}{4}$$

where α the apertural angle of the cone. For cones of finite size, having apertural angles ranging between, say, 40 and 90 degrees, measurements have resulted in the same formula; in fact, only the constant was of a slightly different value. The formula is

$$Z = -83 \log_e \tan \frac{\alpha}{4}$$

or for decadic logarithms

$$Z = -191 \log \tan \frac{\alpha}{4}$$

Whence for the various apertural angles taken as examples the surge impedances are as indicated in the following tabulation

$\alpha=40$ degrees	$Z=144$ ohms
$\alpha=60$ degrees	$Z=109$ ohms
$\alpha=80$ degrees	$Z=84$ ohms

In order to compensate the influence of the reactance of such a cone antenna completely, the obtuse end or base of the cone is connected with a space capacity, the latter, for instance, being

in the form of a flat sheet or plate. Connection is established through an ohmic resistance, the latter being of a value equal to the surge impedance of the cone.

For a more complete understanding of the invention reference will now be had to the following detailed description which is accompanied by a drawing in which Figure 1 illustrates an embodiment of the present invention employing a single vertical cone radiator; Figure 1a illustrates an equivalent circuit organization for an antenna as shown in Figure 1; Figure 2 illustrates a modification of Figure 1 employing a double cone radiator and Figure 3 illustrates another modification of Figure 1.

Referring now to Figure 1, cone K is connected to the inner conductor of an energy lead or co-axial cable E the outer conductor of which is connected with the grounding sheet B. Connected with the obtuse end or base of the cone are resistances R which unite the cone with a capacity sheet C. The paralleled resistances R have an aggregate value which is equal to the surge impedance Z of the cone aerial. As long as the reactance of the space capacity is low in contrast with the surge impedance, only traveling (non-stationary) waves will arise on the cone antenna if an arrangement as stated is used so that the reactance will not be varied in case of a change in frequency. In Figure 1a the energy feeder is represented by a generator G whose internal resistance is equal to the surge impedance of the energy feeder (or co-axial cable). The said generator is connected with the cone antenna K which has the same surge impedance as the energy feeder so that no reflections will occur. The base end of the cone antenna is connected through the surge impedance R with the space capacity C by which a capacitive connection is established to ground. It will be noticed that reflections are not produced at any place in this organization, hence, no standing waves are able to arise.

Figure 2 shows another circuit organization which comprises two cones A and B having their apices united or placed opposite each other. The feeding of the two cones is in push-pull or phase opposition, preferably by way of a co-axial energy feeder lead E arranged in the axis of the cone, though the feed could be effected just as readily by way of a two-wire line brought to the cone apex from the side. The bases of the cones are united by way of a number of resistances R, each having such a value that by being paralleled, their combined resistance is equal to

the surge impedance of the cone, with capacity surfaces C_A and C_B , respectively, or else the lower cone may be grounded directly by way of a resistance. A similar arrangement may also be carried into effect with an upright cone only. In this arrangement the base surface of the cone is grounded by way of the surge impedance, while a counterpoise is provided opposite the apex of the cone.

Figure 3 illustrates a further arrangement according to the invention in which the capacity surface C (which, instead of consisting of a plate or sheet could also consist of a hemisphere), is arranged in the very base surface of the cone rather than in superposed or in sub-jacent relation thereto, while being connected by resistances R with the periphery of the cone base surface. The various paralleled resistances R may also be replaced by a ring made of resistance material the dimensions and resistivity being chosen to suit the case. If an arrangement as shown in Figure 1 or Figure 2 is used, the said ring has the form of a cylindrical shell which connects the periphery of the base of the cone with the capacity surface, while the ring in an arrangement as in Figure 3 is a flat circular ring whose inner contour is connected with the capacity sheet, while its outer periphery is united with the circumference of the cone shell.

I claim:

1. In combination, a short wave antenna comprising two surfaces of revolution in the form of cones symmetrically located with respect to a common axis passing through their apices, said apices being adjacent one another, a high frequency apparatus connected to said apices the length and diameter of each of said surfaces of revolution being such that the impedance of said antenna is substantially pure resistance of substantially constant magnitude over a wide range of frequencies, a pair of capacity sheets located in planes perpendicular to the axis of said cones, the base edge of each of said cones being connected to one of said capacity sheets by a substantially uniformly distributed resistance, the aggregate value thereof being equal to the surge impedance of said cone.

2. In combination with a short wave antenna comprising a surface of revolution in the form of a cone, transmitting apparatus and a line connecting said transmitting apparatus to the apex

of said cone, the length and diameter of said surface being such that the impedance of said antenna is substantially a pure resistance of substantially constant magnitude over a wide range of frequencies and a capacity sheet located in a plane perpendicular to the axis of said cone, the base edge of said cone being connected to said sheet by a substantially uniformly distributed resistance, the aggregate value of said resistance being equal to the surge impedance of said cone.

3. A short wave antenna comprising a conical surface of revolution, a high frequency apparatus connected to the apex of said cone, the length and diameter of said surface of revolution being such that the impedance of said antenna is substantially a pure resistance of substantially constant magnitude over a wide range of frequencies, a capacity sheet located in the plane of the base of said cone, the base edge of said cone being connected to said sheet by a substantially uniformly distributed resistance, the value thereof being equal to the surge impedance of said cone.

4. A short wave antenna comprising a pair of conical surfaces of revolution symmetrically located with respect to a common axis passing through their apices, said apices being adjacent one another, a high frequency apparatus connected to said apices, the length and diameter of said surfaces of revolution being such that the impedance of said antenna is substantially pure resistance of substantially constant magnitude over a wide range of frequencies, a capacity sheet located in the plane of the base of each of said cones, the base edge of each of said cones being connected to the adjacent sheet by a substantially uniformly distributed resistance, the aggregate value thereof being equal to the surge impedance of said cone.

5. An antenna arrangement as claimed in claim 1, with the characteristic feature that said uniformly distributed resistance is composed of an unbroken ring of resistor material.

6. An antenna arrangement as claimed in claim 2, with the characteristic feature that said uniformly distributed resistances are each composed of an unbroken ring of resistor material.

7. An antenna arrangement as claimed in claim 2, with the characteristic feature that a counterpoise is provided at the apex of said cone.

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