Nov. 25, 1930. H. CHIREIX 1,783,072

ANTENNA SYSTEM

Filed Sept. 8, 1925

Fig. 1

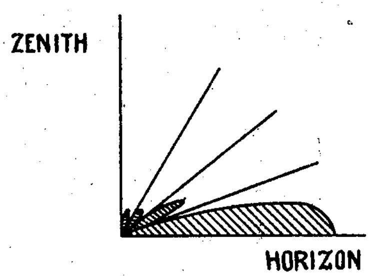


Fig. 2

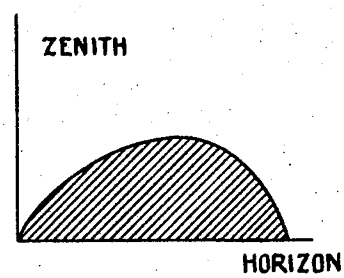


Fig. 3

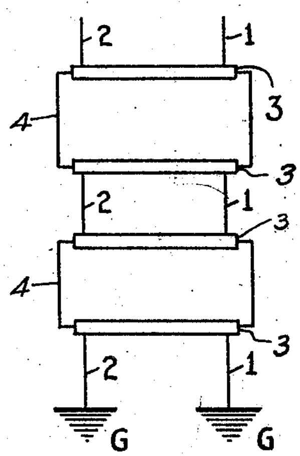
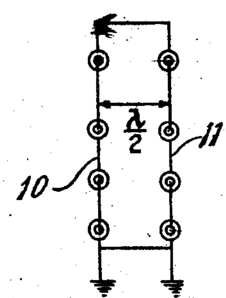


Fig. 4



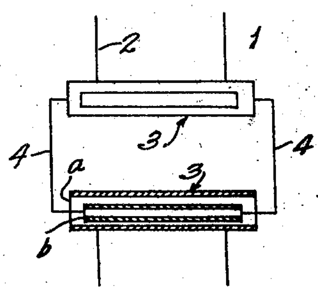


Fig. 5.

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ANTENNA SYSTEM

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The present invention concerns easily constructed antenna arrangements and has for its principal object the provision of such an arrangement which for a given power and frequency of energizing current will produce a greatly increased effect at a distance compared with what has heretofore been attained with an ordinary antenna.

Another object of the invention is to provide an antenna arrangement in which substantially all the transmitted power will be effective in a predetermined plane.

Still another object of the invention is to provide an antenna arrangement in which substantially all the transmitted power will be effective in a horizontal plane whereby zenithal deflection will be avoided and direct waves from the antenna rather than reflected waves will cause operating of receiving devices within range.

Still another object of the invention is to provide an antenna having a natural wave length less than its physical length.

Still another object of the invention is to provide an antenna having condensers connected in series with it at different points along its length whereby its natural wave length will be substantially shortened.

It is well known that by the aid of projectors, "screens", or alinements of antennæ, it is possible to obtain for directional transmission to a given distance a large reduction of the energy or power employed; but it is then necessary that the receiving station be located in the direction of the "beam" sent out, and the construction of the antenna system is rather complicated.

It is also figured that if one excites a vertical antenna with a high harmonic, a beam is sent out which is not directed horizontally but which produces a maximum effect in a direction which is markedly bent upward with reference to the horizon. This may be no inconvenience to speak of in the case of long-distance transmission on account of the reflections on the Heaviside layer, and in fact is often desired, but serious inconvenience may arise whenever the waves are sent over small distances.

The system forming the subject-matter of the present invention on the contrary, gives either a directional or non-directional transmission in the plane of the horizon, maximum in value along the horizon; in other words, entirely analogous to the action of an ordinary antenna, but with this difference; that the power used for this purpose, to realize a given distance-action, is greatly diminished. This action is realized by preventing the beam of energy from expanding in zenith. An analogous case from optics is where a luminous source is placed between two horizontal plane mirrors.

The invention is practiced simply by "charging" the vertical antenna by means of condensers arranged in series. Such an arrangement tends to reduce the self-inductance per unit of length of the antenna without its capacity being affected.

It is figured that the phase displacement of the current along an infinite line constituted in this manner is very much less than that corresponding to a non-charged line; in other words, the length of the line necessary to produce a complete wave of current is greatly increased, or from still a different aspect, the velocity of flow of energy along the radiator, i. e., in a vertical direction, is made greater than the velocity of light.

It follows therefrom that if one builds a vertical antenna of this kind, the frequency of the current corresponding to the quarter wave oscillation may be greatly increased; or, putting it in a different manner, it is possible with a current of a given frequency to excite at its fundamental wave a by far higher aerial, if, according to the present invention, it is charged with condensers. The distance at which these must be placed is calculated in the same way as the intervals at which Pupin coils must be disposed in pupinized lines.

The invention is illustrated by way of example in the accompanying drawing in which

Figs. 1 and 2 are comparative curves showing the energy dispersal from an antenna conforming to the invention and from an ordinary antenna respectively,

Fig. 3 shows a non-directional antenna conforming to the invention,

Fig. 4 shows a directional antenna conforming to the invention,

Figure 5 is a view in detail of a method of connecting the condensers, one such condenser being shown in section.

Referring first to the curves in Figs. 1 and 2 in which the shaded areas represent the dispersal of energy it will be noted that in Fig. 1 which represents conditions surrounding an antenna conforming to this invention there is substantially no radiation outside of the horizontal plane or region in space, while in Fig. 2, representing conditions surrounding an ordinary aerial, there is a very appreciable radiation outside of the horizontal plane. This necessarily implies a better utilization of the energy in the present case.

Fig. 3 shows by way of example one embodiment of the invention. The antenna is of the two-wire kind, the wires being represented by the reference numerals 1 and 2 which are interrupted at intervals by cylindrical condensers, represented at 3, each condenser consisting of two concentric tubes *a* and *b*. The two parallel wires 1 and 2 are each fastened to one end of the tube *a* which constitutes the outer armature of the series condensers. The other armature *b* of such condensers is located inside tube *a* and insulated therefrom by a suitable dielectric. The inner armatures of each two next condensers are connected together by means of wires 4 in the same manner as the outer armatures by means of wires 1 and 2. Such disposition has the advantage of easily securing a good mechanical strength, together with the necessary insulation between sections 2 and 4 and 1 and 4. It should be understood however that the condensers can be realized and built in a great many other ways.

A modification of the invention consists in constituting a closed circuit with the capacity shortened conductors shown in Fig. 3, and in inducing in the frame thus formed currents of a frequency corresponding to the resonance or tuned condition of the system.

No phase displacement nor stationary waves should then be present although the length of the conductor used by far exceeds the length of the wave corresponding to the frequency of the current; the currents in the up and down leads, in particular are of opposite sense at any and every instant. The transmission is then directed in the horizontal plane as that of a frame.

Such a modification is schematically indicated in Figure 4 in which the frame sides 10 and 11 each represent a capacity shortened upright radiator. These may each be arranged as suggested in Figure 3. Referring to Fig. 4, it may be desirable to shift the vertical conductors with relation to one another by about one-half wave-length in which case the effects due to the two conductors become most efficiently added in the plane of the frame.

It has already been proposed to use frames comprising condensers distributed along them, but it has never been suggested to give them a surface corresponding to several wave-lengths; as to the rest, the diagram found for the vertical plane is not that of a frame in the customary sense, but a diagram of the type shown in Fig. 1. This antenna then is directional, in a horizontal plane, like any frame antenna, and is also directional in a vertical plane in that radiation is depressed and kept from propagating towards the zenith.

Having described my invention, I claim:

1. An antenna arrangement comprising an essentially upright antenna and means for uniformly reducing the self-inductance per unit length thereof without affecting its capacity.

2. An antenna arrangement comprising an upright antenna conductor with substantially uniformly spaced condensers in series with it distributed along its length.

3. An antenna arrangement comprising a plurality of spaced upright antenna conductors with condensers in series with and substantially uniformly spaced along the length of said conductors.

4. An antenna for radiating directionally and in only a substantially horizontal region in space comprising a plurality of upright radiators spaced a fraction of a wave length apart and energized in dephased relation to secure directional radiation, each of said upright radiators being electrically shortened by spaced series condensers to suppress radiation towards the zenith.

5. The method of suppressing radiation towards the zenith which consists in transmitting the radiation energy in a vertical direction at a speed greater than that of light.

6. The method of securing directional transmission in only a substantially horizontal region in space which consists in radiating simultaneously from a plurality of spaced radiators in dephased relation, and at each radiator transmitting the radiation energy in a vertical direction at a speed greater than that of light.

7. The method of radiating electromagnetic energy in order to produce substantial horizontal propagation of the radiated energy which includes transmitting energy vertically and linearly at a velocity greater than that of light.

8. The method of radiating electromagnetic energy in order to produce substantial horizontal propagation of the radiated energy which includes transmitting radiant energy in a vertical plane linearly at a speed greater than that of light.

9. An antenna for radiating directionally and in only a substantially horizontal region in space comprising a plurality of upright radiators spaced a fraction of a wave length apart and energized in a predetermined phase relation to secure directional radiation, each of said upright radiators being electrically shortened by spaced series condensers to suppress radiation towards the zenith.

HENRI CHIREIX.