May 28, 1929. R. C. GALLETTI 1,714,864

PROPAGATION OF WIRELESS WAVES

Filed July 12, 1926

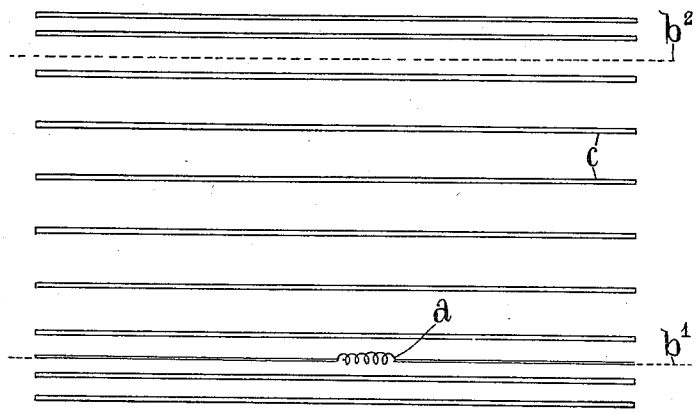


Fig. 1.

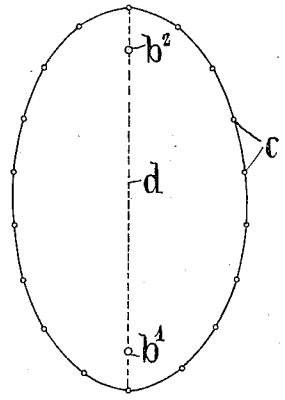


Fig. 2.

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UNITED STATES PATENT OFFICE.

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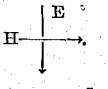
PROPAGATION OF WIRELESS WAVES.

Application filed July 12, 1926, Serial No. 122,001, and in Great Britain August 19, 1925.

This invention relates to an improved arrangement for the uni-directional transmission and reception of electromagnetic waves by means of a reflector which is constituted by a plurality of wires and the focus of which contains a radiating aerial. It has hitherto been proposed to arrange the reflecting wires along a portion of a body of elliptical cross-section, the waves radiated being directed along a beam the base of which is constituted by the concave open side of the elliptical body.

The invention essentially differs from the prior arrangement in this that the reflecting wires completely surround the radiating aerial by being arranged not only along a portion but all around the whole surface of the body of elliptical cross-section, whereby the formation of a beam of the character above described is entirely prevented, since the waves emanating from the focal aerial do not find any opening on the elliptical surface but are reflected round and round inside the barrel and through the focal lines until they lapse into a stationary wave confined to the axial plane of the barrel; this action is all the more powerful if the major axis of the elliptical cross-section of the barrel be equal to a multiple of the half wave length $\frac{\lambda}{2}$ so that the return of the stationary wave onto the focal aerial may take place in unison with the renewed emanation of this aerial.

In the simplest case of $\frac{\lambda}{2}$ = length of aerial = length of barrel = major axis of elliptical cross-section of barrel, it is easy to represent the instantaneous electric field of the said stationary wave by marking on a sheet of paper, representing the axial plane, (+) and (−) signs in the four corners of a square whose side is $\frac{\lambda}{2}$ such that wave inversion takes place on each side; then it is obvious that lines of electric force connect the opposite signs along each side of the square, while the lines of magnetic force are perpendicular to the sheet of paper, so that we must recognize equal faculty of radiation towards each side of the square, except that the barrel apexes, above and below, reflect back, so that radiation remains free only through the open ends of the barrel, say right and left.

Referring to Figures 1 and 2 of the accompanying drawings which illustrate, by way of example and diagrammatically, an arrangement according to the present invention in elevation and end view respectively, an open Hertz oscillator a or equivalent generator of wireless waves is situated in one focal line b_1 of an elliptical barrel formed by staves of straight wires c parallel to one another and having the same periodicity as the oscillator, the sum of the vector radii of the ellipse, viz the major axis d thereof, being made equal to half the wave length generated, that is to say $\frac{\lambda}{2}$ or a multiple thereof. Under these conditions an image is produced in the second focal line b_2. By making the ellipse fairly elongated the field produced between the oscillator arranged in the focal line b_1 and the image produced in the focal line b_2 is practically a cross 

The magnetic lines do not close around the oscillator but are reflected at the elliptical surface. Each ray travelling through the foci and reflected within the ellipse finally lapses on to the major axis where all the rays continue to pulsate up and down along the major axis until their energy is radiated through the ends of the barrel, thus constituting a phantom aerial.

In the arrangement hereinbefore described the electromagnet waves are propagated along a beam in the longitudinal direction of the barrel, the energy being more concentrated along the plane containing the focal lines, the highest concentration being along a ray forming a continuation of the focal line b_1.

The elliptical arrangement of staves may be used horizontally, vertically, or at any desired angle and a second radiating oscillator may be placed in the focal line b_2 and be so energized that its phase is 180° in relation to the first oscillator.

The natural frequency of the staves of straight wires is made to correspond to half the wave lengths propagated in the air, viz equal to $\frac{\lambda}{2}$ or a multiple thereof.

According to a modification all the staves or wires surrounding the radiating oscillator

or oscillators placed in the focal line or lines are arranged along the surface of an imaginary conical body the cross-sections of which are at right angles to the axis of the cone the oscillator or oscillators lying in the focal line or lines of the said conical body as determined by the said elliptical cross-sections.

All the wires may be earthed at one end preferably through a metal sheet.

In the latter arrangement, as well as in the conical arrangement above referred to, the transmission is effected in one direction only, viz in the direction facing the open end, and both these modifications are preferably used when the beam of electromagnetic waves is directed vertically upwards.

When the arrangement is earthed the major axis of the ellipse is $\frac{\lambda}{2}$ or a multiple thereof, while the natural frequency of the individual wires is made to correspond to $\frac{\lambda}{4}$ or a multiple thereof.

With a view to obtaining propagation solely in the direction facing only one of the two ends of the system of wires, a reflector, preferably in the form of a plane reflecting surface, is arranged practically at right angles to the system of wires at the other end thereof, at the distance of approximately $\frac{\lambda}{4}$ from the latter end, whereby the waves are reflected back towards the end facing away from the reflector and propagated with practically double intensity.

The staves may be kept apart in any convenient manner and the other details for carrying the invention into effect may be modified in various respects without in any way departing from the spirit of the invention.

When the method hereinbefore described is applied to the reception of electromagnetic waves, the receiving wire is placed in the focal line of the closed reflector of elliptical cross-section constituted by the plurality of reflecting wires, the whole of the reflector being directed with one of its open ends towards the direction from which the waves are received.

What I claim is:—

1. Means for concentrating electromagnetic waves along a ray or beam, comprising in combination a radiating oscillator and a plurality of wires completely surrounding the said radiating oscillator along the whole elliptical surface of an imaginary body of elliptical cross section, the said radiating oscillator lying in a focal line of the said elliptical surface.

2. Means for concentrating electromagnetic waves along a ray or beam, comprising in combination a radiating oscillator and a plurality of wires completely surrounding the said radiating oscillator along the whole elliptical surface of an imaginary body of elliptical cross section, the said radiating oscillator lying in a focal line of the said elliptical surface and the said wires being parallel to one another and to the focal line containing the radiating oscillator.

3. Means for concentrating electromagnetic waves along a ray or beam comprising in combination two radiating oscillators and a plurality of wires completely surrounding the said radiating oscillators along the whole elliptical surface of an imaginary body of elliptical cross section, the said radiating oscillators lying in the two focal lines of the said elliptical surface respectively.

4. Means for concentrating electromagnetic waves having a wave length λ along a ray or beam comprising in combination a radiating oscillator and a plurality of wires completely surrounding the said radiating oscillator along the whole elliptical surface of an imaginary body of elliptical cross section, the said radiating oscillator lying in a focal line of the said elliptical surface and the major axis of the ellipse being made equal to half the wave length $\frac{\lambda}{2}$ or a multiple thereof.

5. Means for concentrating electromagnetic waves having a wave length λ along a ray or beam, comprising in combination a radiating oscillator and a plurality of wires completely surrounding the said radiating oscillator along the whole elliptical surface of an imaginary body of elliptical cross section, the said radiating oscillator lying in a focal line of the said elliptical surface and the natural frequency of the individual wires arranged along the surface of the imaginary body of elliptical cross section being made to correspond to half the wave length $\frac{\lambda}{2}$ or a multiple thereof.

6. Means for concentrating electromagnetic waves along a ray or beam comprising in combination a radiating oscillator and a plurality of wires completely surrounding the said radiating oscillator along the whole elliptical surface of an imaginary body of elliptical cross section, the said radiating oscillator lying in a focal line of the said elliptical surface and all the wires arranged along the surface of the imaginary body being earthed.

7. Means as claimed in claim 6 in combination with a metal sheet through which the earthing is effected.

8. Means for concentrating electromagnetic waves having a wave length λ along a ray or beam comprising in combination a radiating oscillator and a plurality of wires completely surrounding the said radiating oscillator along the whole elliptical surface of an imaginary body of elliptical cross section, the said radiating oscillator lying in a focal line

of the said elliptical surface, all the wires arranged along the surface of the imaginary being earthed and the major axis of the ellipse being made equal to half the wave length $\frac{\lambda}{2}$ or a multiple thereof.

9. Means as claimed in claim 6 and in which the natural frequency of the individual wires is made to correspond to $\frac{\lambda}{4}$ or a multiple thereof.

10. Means as claimed in claim 1 in combination with a reflecting surface arranged at right angles to the longitudinal direction of the wires at one end of the said wires as and for the purpose set forth.

11. Means for receiving electromagnetic waves along a ray or beam comprising in combination a receiving oscillatory circuit and a plurality of wires completely surrounding the said receiving oscillatory circuit along the whole elliptical surface of an imaginary body of elliptical cross section, the said receiving oscillatory circuit lying in a focal line of the said elliptical surface.

In testimony whereof I have signed my name to this specification.

ROBERTO CLEMENS GALLETTI.