

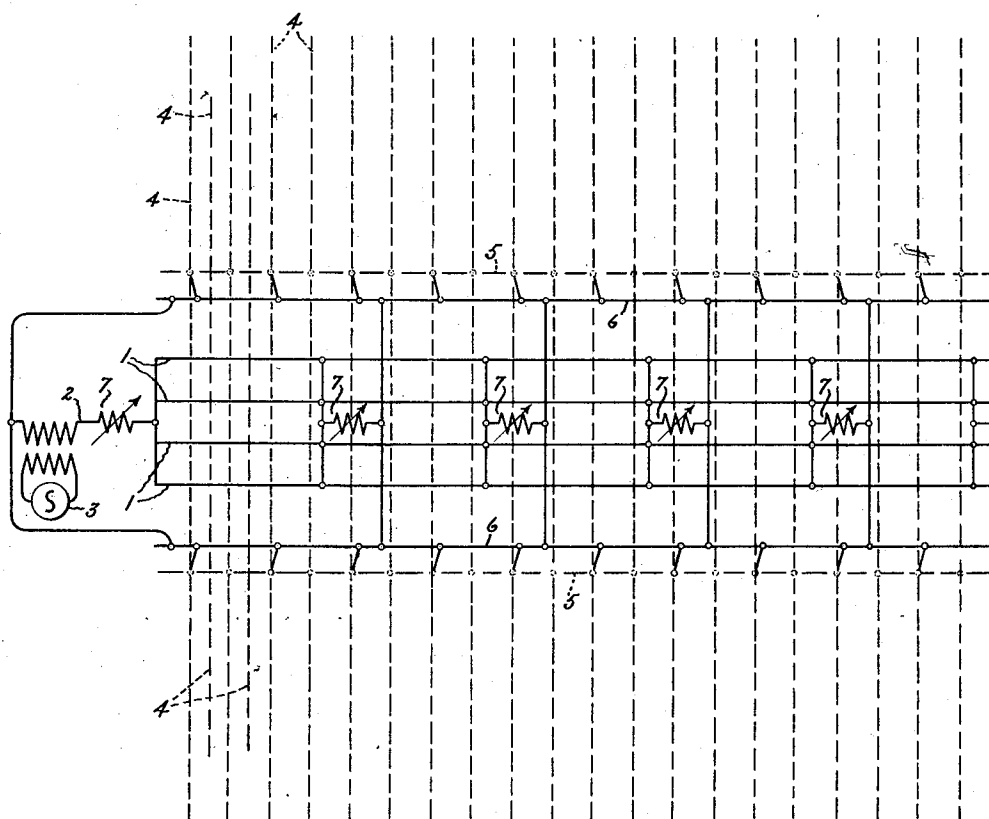
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ANTENNA

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UNITED STATES PATENT OFFICE.

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ANTENNA.

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My present invention relates to radiating antenna systems, and more particularly to a means for collecting the capacity current flowing from the aerial to ground.

5 The object of my invention is to provide a means for greatly reducing ground resistance of a radiating antenna.

10 In the construction of systems for collecting the capacity current flowing from the aerial to ground two general systems have been employed. In some cases a ground system has been constructed consisting of a network buried in the ground beneath the aerial. In other cases a capacity area or counterpoise has been employed consisting of a network beneath the antenna a short distance above the earth and insulated from the earth. A combination of these two methods has also been employed to advantage for reducing the ground resistance as described in my Patent 1,360,168, November 23, 1920.

20 In all cases, however, the area of the network has been such that a large percentage of the capacity current does not reach the ground within the area of the network and the capacity current which reaches the ground outside of the area of the network has been made to flow through the ground to the network. Because of this fact the ground resistance has been higher than desirable, particularly in cases where the soil has a fairly high resistance either at the surface or in a sub-strata beneath the surface.

30 In carrying out my invention I overcome this difficulty and greatly reduce the ground resistance by employing a buried network and extending this beyond the area covered by the aerial so far that a large proportion of the capacity current from the aerial reaches ground within the area covered by the network. Calculations show that from seventy-five to ninety per cent of the capacity current from the aerial which reaches ground outside of the area covered by the aerial reaches ground within a distance equal to from one and a half to two and one-half times the effective height of the aerial.

40 In some cases the network may therefore to advantage be extended beyond the area covered by the aerial for the distance mentioned. The distance to which the net work may be extended efficiently, however, will depend somewhat upon the nature of the soil or rather upon its resistance. The velocity of

propagation of currents collected by the earth wires depends largely upon the resistance of the earth in which the wire is buried. In all cases it will be much less than the velocity of light, being smaller the lower the resistance of the earth. The minimum effective resistance of the ground connection will be obtained when the length of the wire is approximately equal to a quarter wave length of the current in the wire, as determined by the velocity constant. As a practical matter, little can be gained by extending the wire as far as a quarter wave length because of the fact that there will be a phase difference of ninety degrees between the currents collected by the outside of the network and those collected by the portion nearest the aerial. If the network is extended beyond a quarter wave length the conductance decreases and the system becomes less efficient. As a practical matter, about three-sixteenths of a wave length is as far as the network can be extended to advantage and in some cases it will not be found necessary to extend the network more than two-sixteenth of a wave length as the greater part of the capacity current from the aerial will reach ground within this distance.

70 The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, however, both as to its organization and method of application will best be understood by reference to the following description taken in connection with the accompanying drawing in which I have indicated diagrammatically one way where by my invention may be carried into effect.

80 I have indicated in the drawing a long horizontal antenna made up of aerial conductors 1, which is supplied with energy through the ground connection 2 at one end by means of a source 3 of high frequency current. The ground system is made up of a plurality of wires 4 buried in the earth beneath the aerial and extending in a direction at right angles to the direction of the aerial conductors 1 for a distance on each side of the aerial approximately equal to from two to three-sixteenths of a wave length as determined by the velocity constant of the wire. Because of the fact that the current density in the outer ends of the wires is much less than near the center every alternate wire may be extended only a portion of the total

width of the network. All of the buried wires are connected to two or more bus conductors 5 which are also buried and these bus conductors are in turn connected to two or more other bus conductors 6 supported a short distance above the earth. The antenna is preferably of the multiple tuned type described in my Patent 1,360,167, November 23, 1920, connections between the aerial and the ground system being made from a plurality of points in the aerial through tuning coils 7. Each one of these tuning coils is connected to a plurality of points in the ground system. While for convenience in illustration I have shown only one connection from each of the down leads to each of the bus conductors 6, each down lead will preferably be connected to a great number of points distributed uniformly over the area of the network through a system of balancing coils so as to cause equal currents to flow in all of the ground connections, as described more fully in my Patent 1,360,168, November 23, 1920.

To assist one skilled in the art in successfully practicing my invention, the following example is given of an installation in which my invention has been carried into effect. The antenna which is of the type illustrated in the drawing is supported on towers about four hundred and fifty feet high and is about one hundred and fifty feet in width. The earth resistance measured about 35,000 ohms per cubic foot. For a wave length of 16,500 meters it was found that the velocity of propagation was such that a quarter wave length in a buried wire was about 1800 feet. The network was extended about 925 feet on each side of the area covered by the antenna, or a distance equal to about twice the height of the antenna. With this arrangement calculations show that about eighty-five per cent of the capacity current from the antenna which reaches ground outside of the area covered by the antenna reaches ground within the area covered by the network. The wires 4 are located about ten feet apart every alternate wire being extended only five hundred feet.

While I have illustrated my invention as applied to one particular type of antenna it is obvious that it may equally well be em-

ployed with other types of radiating antennæ and that many modifications in the manner in which the network is constructed and connected to the antenna may be made without departing from the scope of my invention as set forth in the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. A radiating antenna system comprising a long horizontal aerial, a network beneath said aerial comprising a plurality of buried wires extending in directions at right angles to the direction of the aerial for a distance on each side of the area covered by said aerial substantially equal to at least one and one-half times the effective height of the aerial, bus conductors connecting all of said wires, and connections from a plurality of points along the length of said aerial to said network, each of said connections from the aerial being made to a plurality of points in said bus conductors.

2. A radio signaling system comprising a horizontal antenna, a source of high frequency current connected to said antenna and a grounding system for said antenna comprising a plurality of buried wires extending away from said antenna for a distance equal to from two to three-sixteenths of a wave length of the current flowing in the wires, a bus conductor connecting all of said wires and connections from a plurality of points along the length of said antenna to said bus conductor.

3. A radio signaling system comprising a horizontal antenna, a source of high frequency current connected to said antenna and a grounding system for said antenna comprising a plurality of buried wires extending away from said antenna for a distance equal to from two to three-sixteenths of a wave length of the current flowing in the wires, a bus conductor connecting all of said wires and connections from a plurality of points along the length of said antenna to said bus conductor, each of said connections from the antenna being made to a plurality of points in said bus conductor.

In witness whereof, I have hereunto set my hand this 8th day of April, 1922.

ERNST F. W. ALEXANDERSON.