Dec. 2, 1924. 1,517,570

J. O. MAUBORGNE ET AL.

SYSTEM OF RADIO COMMUNICATION

Original Filed Feb. 17, 1921

Fig. 2.

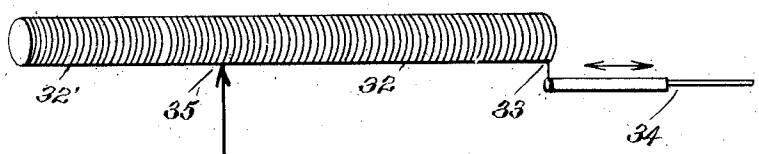


Fig. 3.

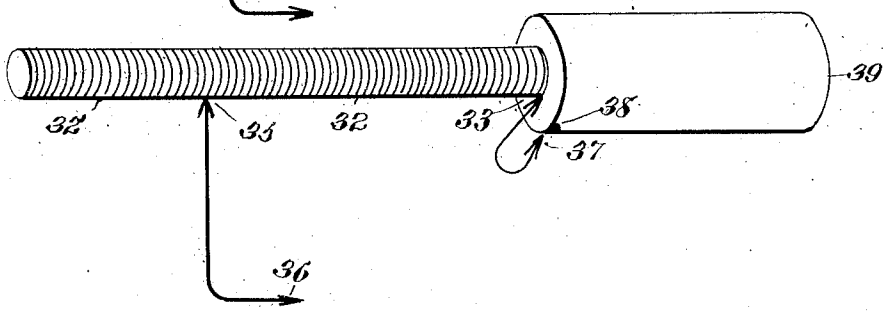


Fig. 4.

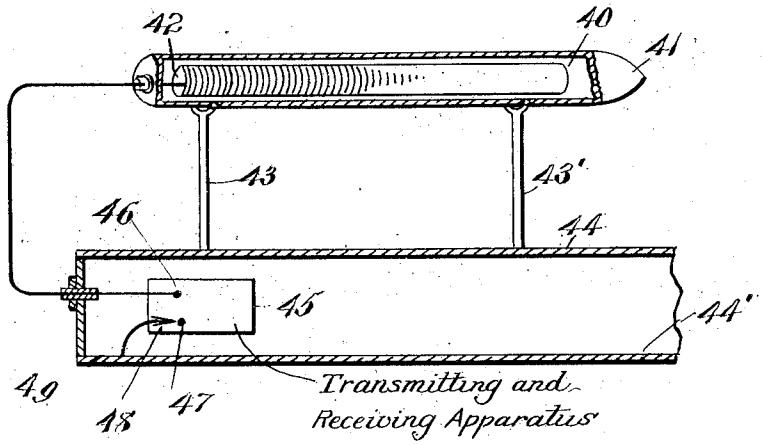
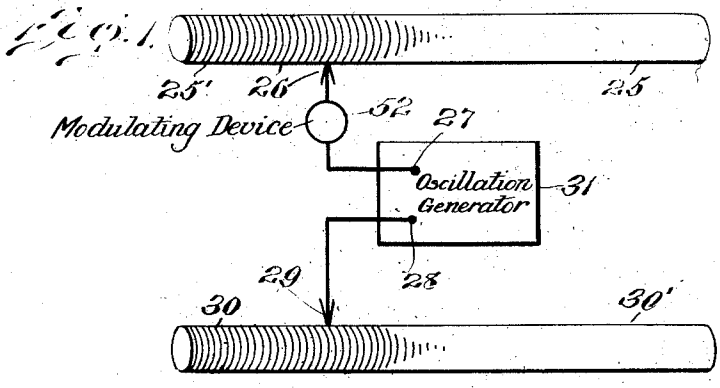


Fig. 1.



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UNITED STATES PATENT OFFICE.

JOSEPH O. MAUBORGNE, OF CHICAGO, ILLINOIS, AND GUY HILL, OF WASHINGTON, DISTRICT OF COLUMBIA.

SYSTEM OF RADIOCOMMUNICATION.

Original application filed February 17, 1921, Serial No. 445,880. Divided and this application filed February 3, 1923. Serial No. 616,747.

To all whom it may concern:

Be it known that JOSEPH O. MAUBORGNE and GUY HILL, citizens of the United States, residing respectively at Chicago and Washington, in the county of Cook and State of Illinois and District of Columbia, have invented certain new and useful Improvements in Systems of Radiocommunication, of which the following is a specification.

This invention relates to improvements in radio transmitters and is a divisional case from application, Serial No. 445,880, filed Feb. 17, 1921, relating to system of radio communication. The method herewith proposed involves the use of an open antenna circuit in the form of a wave coil provided with a single or double sliding or variable electrostatic, direct, or electro-magnetic connection, to which is attached a lead or leads to a suitable tuned transmitting or receiving set of apparatus, which, in turn, is connected either to a direct ground, a capacity ground, or a counter capacity in any of the well-known forms, or in the form of another wave coil.

The resonance wave coil, which we shall designate hereinafter simply as wave coil, is preferably in the form of a long helix, uniformly wound with wire, in single or multiple layers, the electrical constants of which coil, that is inductance, capacity and resistance, are all of a distributed character and of such magnitude as to insure a wave development along the coil for the frequencies of the signals desired to receive or transmit. However, the coil may not necessarily be of uniform section throughout its length, as for example an airplane strut may be used for the core upon which the coil is wound. The wave coil is wound with a comparatively large number of turns per unit length, the object being to secure in a relatively short coil, the equivalent condition of a long antenna in the matter of its natural electrical period.

We have found that this form of antenna, when taken in conjunction with its sliding contact and the lead through said sliding contact to either the receiving or transmitting set of apparatus, constitutes an antenna system, operating at a fundamental period or periods which, so far as the antenna itself is concerned, depend principally upon the position of the slider on the coil and the electrical constants of the coil itself between the point of contact with the slider and either end of the coil.

This may be made clearer by the following statements:

When either the transmitting set or the receiving set is connected to the middle point on the coil, the connection may be any of the well-known forms, such as direct or electrostatic; both halves of the coil having exactly the same electrical characteristics, they will respond to the impressed electro-motive force and oscillate with the same frequency. If, however, the connection of the transmitter or the receiver is shifted on either side of the central point of the coil, the two parts of the coil will each have different electrical characteristics, and therefore respond to different wave lengths, corresponding to the natural periods of the said two parts of the coil. By adjusting the tuned set to either one of the two parts of the coil, the energy may be either transmitted or received on either part of the coil, that is to say, only that part of the coil is effective in either transmitting or receiving which is in resonance with the set to which it is tuned.

The principle of operation and the method of using our invention can better be understood by reference to the accompanying diagrammatic figures which show practical embodiments of the invention and form part of this specification. In all of the figures herewith, the same symbols and nomenclature are used to designate the same apparatus and therefore reference to the various common symbols will not be repeated except in cases where it is necessary to make clear the difference between the various figures.

Figure 1 is an arrangement illustrating the use of the invention for transmitting purposes in which one terminal of the tuned transmitter is connected to a wave coil and the other terminal of the transmitter is connected to another wave coil functioning as a counterpoise.

Figure 2 shows a method for varying the actual wavelength of the coil by connecting a short length of wire to one end of the coil.

Figure 3 shows a metal tube utilized as a means for varying the wavelength of the coil.

Figure 4 shows a method of utilizing a submersible wave coil as an antenna for guided torpedo and submarine boat work.

Figure 1 is an embodiment of our invention illustrating the use of a wave coil antenna for transmitting purposes. In this figure 31 designates an oscillation generator associated with the necessary modulating equipment for telegraphy or telephony; one terminal 27 of said oscillation generator being connected to a point 26 on the wave coil 25—25′; the other terminal 28 being connected at the point 29 to a wave coil 30—30′. The upper coil 25—25′ is connected to the high potential point of the oscillation generator and constitutes the radiating antenna system. The lower coil 30—30′ functions as a counterpoise antenna. For best operation the contact 29 should be suitably adjusted on coil 30—31, depending upon the wavelength being transmitted from coil 25—25′. The transmitting set may be adjusted so that the frequency of the oscillation generated may be in resonance with either that part of the coil indicated by 26—25 or the part 26—25′. When slider 26 is in the center of the coil then the transmitting set should be tuned to the wavelength corresponding to half of the coil and in this case each half of the coil will radiate the same wavelength. Where the slider is not in the center of the coil, and the apparatus is tuned to the longer section or the shorter section of the coil, only that section of the coil radiates energy which is in resonance with the oscillations generated by the oscillator 31. Sometimes it is desirable to put the modulating device in the lead 26—27 as indicated in this figure by 52 instead of having it as part of the oscillation equipment 31.

Figure 2 represents a modification in the form of our wave coil antenna in which a short length of wire or a small metal tube 34, is connected at a point 33 to one end of the wave coil 32—32′. 36—34 represents the lead connection through the transmitter or receiving apparatus to the wave coil 32—32′; contact is made on any point 35. It was found that by the addition of a short length of wire, or small tubes indicated here by 34, a considerable change in the natural period of the coil is effected, thus increasing the wavelength range of the coil, and offers at the same time a simple means for tuning this wave coil as an antenna by varying the length of wire or tube 34. In practice it is preferable to substitute for the short length of wire 34, a telescopic metal tube, as indicated in the figure, the length of which being varied changes the tuning of the wave coil 32—32′ without varying the position of slider 35. This method of tuning becomes very desirable where only a few taps are brought out from the winding of the wave coil as in the case of some comparatively large wave coils for transmitting purposes. It is evident that if slider 35 is at the center of coil 32—32′ it might be desirable to have a wire or telescopic tube attached to each end of the coil.

Figure 3 differs from Figure 2 only in the method employed in increasing the range of wavelengths of the coil by bringing near the coil a mass of metal which may be in the form of a tube as indicated here by 39, or it may be of any other shape. This metal mass may be placed in electro-static relation to the coil either near its end or by sliding over it or may be connected at point 38 by the lead 37—33 to the nearer end of the coil 33. When the metal mass is placed in electro-static relation to the coil without any direct connection to it, then it might be preferable sometimes to ground the said metal mass.

In Figure 4 is shown an embodiment of our invention wherein the wave coil 40 of a certain desired period is so constructed and protected by water-proof construction as to be capable of being used as an antenna when immersed in water. 41 designates the water-proof casing. A lead from any desired point on the coil is brought out through the water-proof casing 42 and from there to the antenna binding post 46 of the transmitting and receiving apparatus 45. The ground terminal 47 of the transmitting or receiving set may be connected if desired to any suitable ground 49 by means of lead 48. This ground may be in the case of a submarine torpedo or submarine boat, the shell of such boat or torpedo which is indicated here by 44—44′, the said coil being attached at the supports 43—43′, or their equivalent in some convenient position on said submarine boat or submarine torpedo.

In all instances in the specification and in the accompanying figures where the word "earth connection" or "ground" has been used, it is to be understood that any form of earth connection ordinarily employed, is included, such as, for instance, a direct connection to earth, a connection to a wave chute consisting of bare wires on the earth or buried in the earth, or a connection to insulated wires placed on or above the earth which may or may not form a counterpoise.

If this wave coil antenna is used on an airplane it is understood that the word "ground" refers to those metal parts of the plane to which the ground lead of the receiver or transmitter may be connected. While the wave coil has been described in the above specification "as consisting of a long helix of wire uniformly wound in single or multiple layers, the electrical constants of which coil, inductance, capacity and resistance, are all of a distributed character and of such proportions as to insure a wave

development along the coil for the frequency of the signals desired to receive or transmit", nevertheless the form of the coil and the uniformity of its winding may be considerably deviated from without departing from the spirit and scope of our invention. For example, this wave coil may consist of a number of turns of wire wound on a strut or struts or other convenient parts of an airplane or it may be wound about any body if suitably insulated from it, such as around a portion of the fuselage of an airplane, the body of a tank, the shell of a torpedo, etc.

Furthermore, while in the figures the form of the wave coil has been diagrammatically shown as being comparatively small in size, it is to be understood that the drawings and specifications do not place any limitations upon the size and form of such a coil. If high power stations require antennae in limited space, this form of coil antenna will be of particular advantage, and the coils may reach considerable magnitude.

Having described our invention, we claim:

1. In an antenna system for radio communication comprising a wave coil antenna having an elongation of variable length at one end thereof, the method of varying the capacity of said coil and consequent wave distribution thereon consisting in varying the length of said elongation.

2. In an antenna system for radio communication comprising a wave coil in the form of an open circuit having a metallic conductor of variable electrical length attached to one end thereof, the method of varying the capacity of said coil and consequent wave distribution thereon consisting in varying the length of said metallic conductor.

3. In an antenna system for radio communication comprising a wave coil having a distributed inductance and capacity and having a metallic conductor of variable electrical length attached to one end thereof, the method of varying the capacity of said coil and consequent wave distribution thereon consisting in varying the length of said metallic conductor.

4. In an antenna system for radio communication comprising a wave coil in the form of an open circuit having a distributed inductance and capacity and having a metallic conductor of variable electrical length attached to one end thereof, the method of varying the capacity of said coil and consequent wave distribution thereon consisting in varying the length of said metallic conductor.

5. In an antenna system for radio communication comprising suitable detecting means, a wave coil in the form of an open circuit and having a metallic conductor of variable length attached to one end thereof, the method of bringing the antenna system in resonance with the frequency desired consisting in selecting a point on said coil, connecting said point and said detecting means through a single lead, and varying the adjustable capacity at the end of each said coil.

6. In an antenna system for radio communication comprising a wave coil antenna comprising a wave coil in the form of an open circuit, means for varying the capacity of said coil, and consequent wave distribution thereon, said means comprising a metallic conductor of variable electrical length associated electrically with one end of said coil.

7. A system for radio signalling comprising a wave coil antenna, a conductor of variable dimensions connected to one end of said antenna, said conductor being free at its other end, and a source of oscillatory currents, one terminal of which is connected to a point on said antenna.

8. A system for radio signalling comprising a wave coil antenna in the form of an open circuit, a conductor of variable dimensions connected to one end of said antenna, said conductor being free at its other end, and a source of oscillatory currents, one terminal of which is connected to a point on said antenna.

9. A system for radio signalling comprising a wave coil antenna having a distributed inductance and capacity, a conductor of variable dimensions connected to one end of said antenna, said conductor being free at its other end, and a source of oscillatory currents, one terminal of which is connected to a point on said antenna.

10. A system for radio signalling comprising a wave coil antenna in the form of an open circuit having a distributed inductance and capacity, a conductor of variable dimensions connected to one end of said antenna, said conductor being free at its other end, and a source of oscillatory currents, one terminal of which is connected to a point on said antenna.

11. A system for radio signalling comprising a pair of wave coils each being in the form of an open circuit, a conductor of variable dimensions electrically associated with one end of each of said wave coils, the other end of each of said conductors being free, and a source of oscillatory currents arranged between said coils, and having a terminal connected to a selected point on each of said coils.

12. A wave coil antenna system consisting of a wave coil, of fixed distributed inductance and capacity, having attached to one end thereof a metallic extension of variable electrical length so that the combined inductance and capacity of the combination can be varied by a variation of said extension.

13. In a system for radio communication comprising a wave coil antenna in the form of an open circuit and having a distributed

inductance and capacity, the method of varying said capacity which consists in bringing into electrical association therewith a variable capacity, and varying said variable capacity.

14. In a system for radio communication comprising a wave coil antenna in the form of an open circuit and being in itself of a fixed distributed inductance and capacity, a metallic conductor of adjustable dimensions adapted to act as a variable capacity, the method of varying the normally fixed capacity which consists in bringing said variable capacity into electrical association therewith, and varying said variable capacity.

15. In a system for radio communication comprising an undergrounded resonance wave coil antenna in the form of an open circuit and being in itself of a fixed distributed inductance and capacity, an undergrounded metallic conductor of adjustable dimensions adapted to be used as a variable capacity, the method of varying said normally fixed capacity which consists in bringing said variable capacity into electrical association therewith, and varying said variable capacity.

In testimony whereof we affix our signatures.

JOSEPH O. MAUBORGNE.
GUY HILL.