Oct. 31, 1950 E. O. WILLOUGHBY 2,527,609

ARRANGEMENT FOR COUPLING TO AN ELECTRIC ANTENNA

Filed June 28, 1946

Fig. 1.

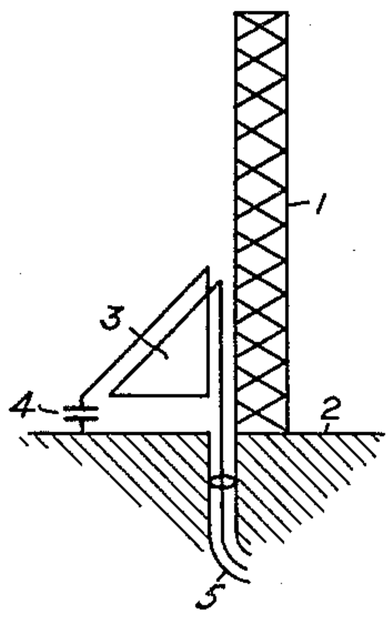


Fig. 2.

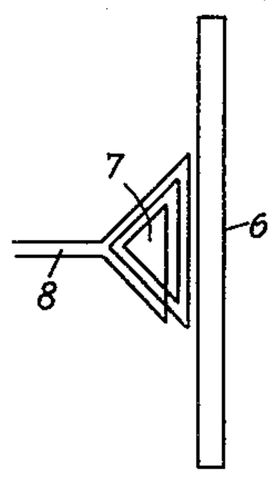


Fig. 3.

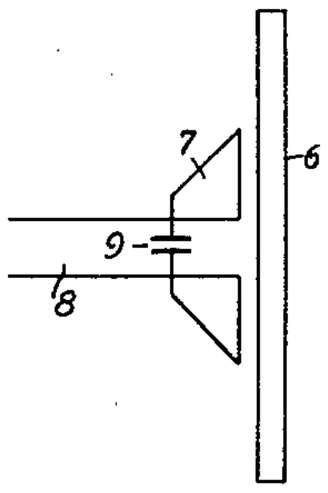
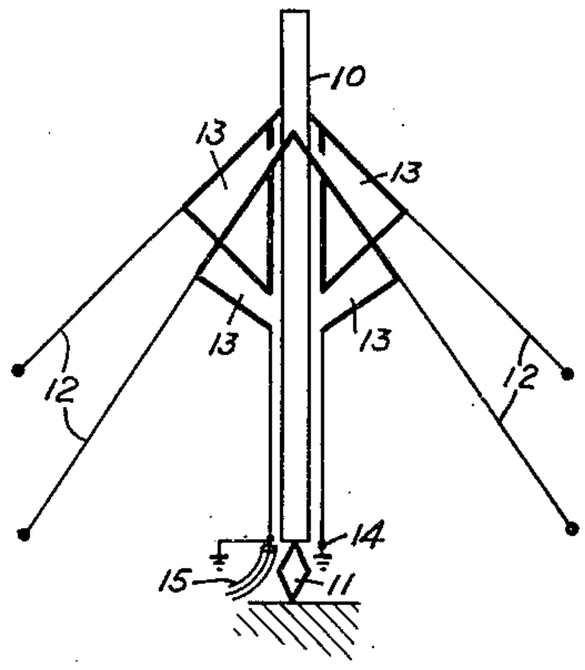


Fig. 4.



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ARRANGEMENT FOR COUPLING TO AN ELECTRIC ANTENNA

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5 Claims. (Cl. 250—33)

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The present invention relates to electric antennae, and is concerned principally with improved methods of coupling radio transmitters or receivers to antennae.

The invention provides an electric antenna system comprising an antenna, a coil inductively coupled to the antenna and adapted to resonate at the frequency at which the antenna is designed to operate, and means for connecting the coil to a radio transmitter or receiver.

The invention also provides an aircraft having a metallic wing adapted to serve as an antenna, a coil inductively coupled to the wing near the point of junction with the fuselage of the aircraft, means for tuning the coil to quarter wave resonance at the operating frequency, and a transmission line connecting the coil to a radio transmitter or receiver carried by the aircraft.

The invention will be explained with reference to the accompanying drawing in which—

Figure 1 shows an earthed base antenna with a coupling coil according to the invention.

Figures 2 and 3 show insulated or dipole antennae with coupling coils, and

Figure 4 shows an insulated mast antenna excited by a plurality of series connected coupling coils according to the invention.

Figure 1 shows an antenna **1** comprising a vertical metal mast having its lower end fixed to, and electrically connected to, ground at **2**, or to an earthed mat. The mast may be an open framework, as shown, or a metal pole, or the like. The length of the mast should be such that it is the quarter wave resonant at the mean frequency of the operating band. A flat coil of wire **3** is placed in a vertical plane, and close to the mast at the lower end. This coil should be formed from one or more turns of a wire which is a little less than a quarter wave long at the mean frequency. The coil will accordingly resonate slightly above the mean frequency, and may be tuned to quarter wave resonance by means of a condenser **4** connecting one end of the coil to earth.

A coaxial transmission line **5** connects the other end of the coil **3** to a radio transmitter or receiver (not shown).

It will be observed that the coil **3** is inductively coupled to the antenna **1** in the neighborhood of a current antinode, and very efficient operation is thereby secured.

The mutual inductance between the coil **3** and the antenna **1** provides reactance correction for the impedance of the system as seen from the terminals of the transmission line **5** which impedance can be made substantially constant over a frequency band of appreciable width, and so the transmitting or receiving efficiency over such a band is good.

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It will be noted that as the end of the coil **3** remote from the transmission line is open, the input impedance of the system will be low, and therefore will be suitable for matching to a coaxial line. If a high impedance input is desired, the remote end of the coil **3** may be directly earthed, and the condenser **4** may be connected instead between the other end of the coil and ground.

The condenser **4** may be provided in any convenient way; it could, for example, be simply a spherical knob or an anti-corona device. It is evident, also, that this condenser could be omitted altogether if the length of the wire of which the coil **3** is wound were chosen so that the coil is just quarter wave resonant at the mean operating frequency.

It will be understood that the coil **3** could be wound from wire the length of which is approximately any whole number of quarter wave lengths provided that the direction of winding is reversed at each current node on the wire, so that the magnetic lines of force which link the antennae due to all turns of the wire may be in the same direction. It will be remembered that the current in the wire changes its direction after each node is passed.

Figure 2 shows diagrammatically an arrangement according to the invention for coupling to a half wave resonant balanced antenna or dipole **6** which is insulated from ground. In this case the coil **7** is wound from wire of length approximately equal to half the mean operating wavelength, and is placed opposite the centre of the dipole **6**. The arrangement is evidently equivalent to Figure 1 together with its image in the ground. If the coil **7** is not exactly half wave resonant it may be tuned by a condenser (not shown) connected across the end of the feeding transmission line **8**, or as shown in Figure 3, the loop of wire from which the coil **7** is wound may be bisected at the end remote from the terminals, the condenser **9** being connected between the ends of the wire.

Figure 4 shows how a vertical mast antenna insulated from ground may be excited according to the invention. The mast **10** is supported from ground on an insulator **11** and is stayed by four guy wires **12** attached near the upper end. Each of these wires supports a flat coil **13** arranged opposite the centre of the mast in a vertical

plane passing through the mast, the coils being of course insulated from the guy wires in a suitable manner. The coils are all connected in series, one end of the series being earthed at 14 and the other end being connected to the central conductor of a co-axial transmission line 15 leading to a radio transmitter or receiver (not shown). The wire from which the coils 13 are wound (including the leads to the bottom of the mast) should preferably be about a whole wavelength long at the mean operating frequency (or it could be any whole number of wavelengths long), the coils being so wound in relation to the current nodes that the magnetic lines of force due to all turns of the coils link the antenna 10 in the same direction. This method of winding and connecting the coils will be called a "series aiding connection."

The antenna 10 will in this case be half wave resonant, and the arrangement is clearly an extension of the arrangements described with reference to Figures 2 and 3. A condenser (not shown) may be connected across the terminals of the transmission line 15 for the purpose of tuning the coil system to half wave resonance as previously explained. The inclination of the guy wires 12 may be suitably adjusted so that the sky wave from the upper sloping portions of the coils 13 may be unobjectionable.

What is claimed is:

1. An electric antenna system for operation at a given mean wave length comprising an antenna insulated from ground and adapted to be half wave resonant at the said mean wave length, a coupling coil adapted to be half wave resonant at the said mean wave length and inductively coupled to the said antenna, and means for connecting the coil to a radio transmitter or receiver, said coupling coil comprising one or more turns of a conducting wire of length substantially equal to one half of the mean operating wavelength, the ends of which are respectively connected to the conductors of a balanced transmission line.

2. An electric antenna system comprising a vertical antenna insulated from ground and supported by guy wires, a coil system consisting of

a plurality of coils each supported by one of said guy wires in a vertical plane adjacent to the centre of the said antenna and inductively coupled thereto, means for connecting the said coils in series aiding to a radio transmitter or receiver, the said coil system being resonant at the same frequency as the antenna.

3. A system according to claim 1 in which the terminals of the coupling coil are shunted by a condenser adapted to tune the coil to half wave resonance.

4. A system according to claim 2 in which the said coils are together formed from a conducting wire of length substantially equal to one or more whole wavelengths of the frequency at which the antenna is resonant.

5. An electric antenna system comprising an antenna, a coil inductively coupled to the antenna and adapted to resonate at the frequency at which the antenna is designed to operate, and means for connecting the coil to a radio transmitter or receiver, said coupling coil comprising turns of a conducting wire of length substantially equal to an odd member of a quarter wavelength at the operating frequency, said turns being arranged about an axis perpendicular to said antenna and clockwise or counter-clockwise in relation to the current nodes such that the magnetic lines of force from all said turns link said antenna in the same direction.

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