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W. VAN B. ROBERTS

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Fig. 1

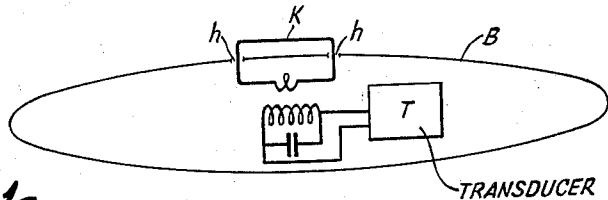


Fig. 1a

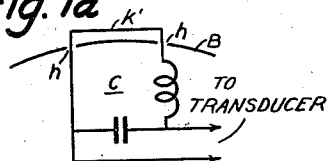


Fig. 2

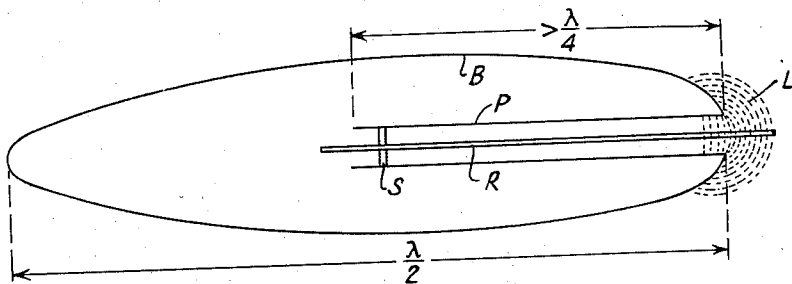
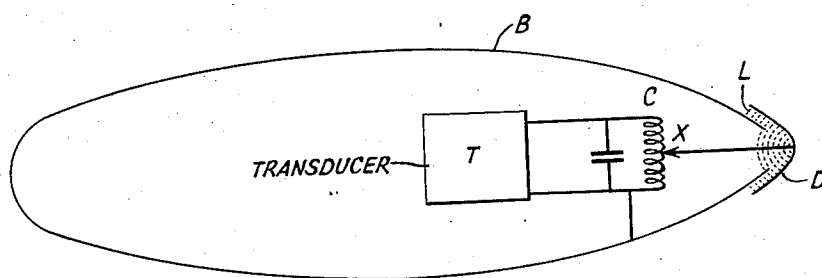


Fig. 3



INVENTOR
WALTER VAN B. ROBERTS
BY *H. B. Grover*
ATTORNEY

UNITED STATES PATENT OFFICE

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ANTENNA

Walter van B. Roberts, Princeton, N. J., assignor
to Radio Corporation of America, a corporation
of Delaware

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The present invention relates to an arrangement for using the outer surface of an aircraft or other ungrounded conductively cased vehicle as an antenna.

It has been customary, both for receiving and transmitting, to provide aircraft with a conventional type of antenna, such as, a loop antenna, an open wire antenna trailing behind the plane or strung fixedly on supports projecting from the plane, or a self-supporting rod antenna.

An object of the present invention is to utilize the relatively great dimensions of the plane itself as the antenna either for transmitting or receiving and thus do away with the necessity for any projecting structure of any considerable dimensions.

Another object of the present invention is to provide a means for coupling a resonant system entirely contained within a body which also is a resonant system to the containing resonant system.

The present invention may be applied not only to airplanes but, also, to dirigibles or any kind of aircraft made largely of metal so as to form an electrically resonant system. It may be applied even to metal bodied motor vehicles insulated from the ground by rubber tires.

The invention will be more fully understood by reference to a full detailed description which is accompanied by a drawing in which Figure 1 illustrates schematically an embodiment of the invention, Figure 1a illustrates a modification of Figure 1, and Figures 2 and 3, further modifications thereof.

In Figure 1, B indicates an elongated conducting body insulated from earth such as, for example, the fuselage of a metal covered airplane. Structural details of the plane such as wings, motors, landing gear, etc., which are not pertinent to the present invention have not been shown. Such a body constitutes a dipole with a relatively large radiation resistance but relatively small reactance for frequencies other than its natural frequency. This is because of the large ratio of maximum diameter to its length as compared with the usual wire or tubing dipole. As a result of the small ratio of length to cross section, the body B considered as a resonant system is very broadly resonant and will respond to a relatively large range of frequencies. Let us suppose, therefore, that horizontally polarized radio waves impinge upon horizontal body B with a frequency of the order of the natural frequency of the body. As a result, oscillating current flows along the surface of B, which current pro-

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duces a magnetic field around the body and an electric field along the body. The produced magnetic field is greatest at the middle of the body, and the electrostatic field is greatest at the ends.

Inside the enclosed body is another resonant circuit C tuned to the desired frequency. Due to the shielding action of B, no voltage can be picked up by the interior tuned circuit by any connection that can be made within B at any position therewithin.

The interior resonant system may be coupled to the exterior resonant system, as shown in Figure 1, by providing a magnetic link circuit K, which is magnetically coupled to the interior tuned circuit C. It is passed through a pair of holes *h, h* in B so that the conductor wire of the link encloses some of the magnetic flux surrounding B. Holes *h, h* are preferably located along a line of current flowing on the outside of B. The amount of coupling increases with the distance between the holes and with the separation between the external part of the link circuit K and the surface of B. It will be appreciated that in place of an independent link circuit a portion of the interior resonant circuit C may be brought out through the aforesaid holes *h, h*, as shown in Figure 1a, at K', so as to provide direct mutual inductance between the interior and exterior systems.

If the present system is to be used for receiving signals, transducer T may comprise radio receiving equipment, while if it is to be used for transmitting, the transducer may comprise a generator of intelligence bearing high frequency energy coupled to the tuned circuit C.

Figure 2 shows a modified form of the invention wherein coupling between the interior and exterior systems is electrostatic in nature. In Figure 2, B is, as before, assumed to be of a length the order of one-half the wavelength of the operating frequency. Re-entrantly connected to one end of B, where the electrostatic field is the greatest, is a metal pipe P of somewhat greater length than a quarter of the operating wavelength. Within the pipe is a conductive rod R connected to the pipe by a sliding piston S. The rod is also slidable in the piston. When the right end of the rod is entirely inside the pipe, the concentric line formed by R and P will be resonant and entirely decoupled from the dipole formed by the outer surface of B. However, if S and R be moved to the right so that the rod R projects slightly beyond the end of the pipe, electrostatic lines of force will be set up as shown at L between the end of the rod and the end of the outer sur-

face of B. These lines of force interact with the lines of force emanating from the ends of B due to oscillations on the outside of B and hence constitute a capacity coupling between the two systems. The coupling may also be considered from a different point of view as follows: Since the current in the rod is not zero at the point where the rod leaves the pipe, there must be an equal and opposite current flowing from the end of the pipe into the end of dipole body B. This current may be small but a small current fed in at one end of a dipole will excite a relatively large amount of current in the middle of the dipole, thus obtaining the desired coupling. By means of relative adjustment between R and S, the interior system may be sharply tuned to a desired frequency while by sliding S (together with R as a unit) inside P, the coupling between the interior and exterior systems may be adjusted. The interior system may be fed with energy from an oscillator or amplifier in the usual fashion for transmission purposes while for reception, the receiving set will obtain voltage from the interior system.

Since the coupling between the interior and exterior systems has been demonstrated to be due to the capacity between a high voltage point of the interior system and a high voltage point of the exterior system, the interior system need not be of the concentric line type but may be a tuned circuit C as shown in Figure 3. Furthermore, if desired, the projecting rod shown in Figure 2 may be replaced by a small streamlined cap D fitting over the end of the body B and insulated therefrom. In this case, the coupling between the systems may be adjusted by moving the tap X indicated on the tuned circuit C.

It should be noted that the system is applicable to automobiles or other land vehicles having metal bodies for the reception of wavelengths approximating twice the length of the vehicle. In the case of cars of ordinary dimensions, this wavelength range includes the range at present assigned to frequency modulation broadcasting.

While I have shown and particularly described several embodiments of my invention, it is to be distinctly understood that my invention is not limited thereto but that modifications within the scope of my invention may be made.

I claim:

1. In combination, a pair of resonant systems, the first of said systems having appreciable radiation resistance, the second of said systems being enclosed within said first system, and means for coupling said systems, said means comprising a member coupled with said second system and having a portion extending to the exterior of said first system, said member having associated therewith an electromagnetic field of the same nature as the electromagnetic field at the exterior of said first system at the position where said member extends, said extending portion being at a position where the exterior field is a maximum.

2. In combination, a pair of resonant systems, the first of said systems having appreciable radiation resistance, the second of said systems being enclosed within said first system, and means for coupling said systems, said means comprising a member coupled with said second system and having a portion extending to the exterior of said first system, said member having associated therewith an electromagnetic field of the same nature as the electromagnetic field at the exterior of said first system at the position where said member extends, said extending portion being at a posi-

tion where the exterior field is a maximum, said second system being tuned to the resonance frequency of said first system.

3. In a radiant energy system, a vehicle having an electrically conductive surface forming a hollow resonant body whose length is of the order of a half wavelength at the operating frequency of said system, a resonant circuit within said body and means for coupling said circuit to the exterior of said body, including a member coupled with said circuit and extending to the exterior of said body, said member having associated therewith an electromagnetic field of the same nature as the electromagnetic field at the exterior of said body at its point of extension.

4. In a radiant energy system, a vehicle having an electrically conductive surface forming a hollow resonant body whose length is of the order of a half wavelength at the operating frequency of said system, a resonant circuit within said body and means for coupling said circuit to the exterior of said body, including a member coupled with said circuit and extending to the exterior of said body at a point of maximum magnetic field, said member being arranged to encircle a portion of said magnetic field.

5. In a radiant energy system, a vehicle having an electrically conductive surface forming a hollow resonant body whose length is of the order of a half wavelength at the operating frequency of said system, a resonant circuit within said body and means for coupling said circuit to the exterior of said body, including a member coupled with said circuit and extending to the exterior of said body at a point of maximum electric field.

6. In a radiant energy system, a vehicle having an electrically conductive exterior forming a hollow resonant body, said vehicle having a length of the order of a half wavelength at the operating frequency of said system, a resonant circuit within said body and means for coupling said circuit to the exterior of said body, including a conductor linked to said circuit and passing through apertures in said body arranged along the length thereof and spaced from said body to encircle some of the magnetic field surrounding said body.

7. In a radiant energy system, an aircraft comprising a hollow electrically conductive surface forming a hollow resonant body whose length is of the order of a half wavelength at the operating frequency of said system, a resonant circuit within said body and means for coupling said circuit to the exterior of said body, including a conductor linked to said circuit and passing through apertures in said body arranged along the length thereof at opposite sides of the region of maximum field surrounding said body and spaced from said body to encircle some of said magnetic field.

8. In a radiant energy system, a vehicle having an electrically conductive surface forming a hollow resonant body whose length is of the order of a half wavelength at the operating frequency of said system, a resonant circuit within said body and means for coupling said circuit to the exterior of said body, including a member coupled with said circuit and extending at one end of said body.

9. In a radiant energy system, a hollow electrically conductive body having a length of the order of a half wavelength at the operating frequency of said system, a resonant circuit within said body and means for coupling said circuit to the exterior of said body, including a conductive cap at one end of said body and connected to

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said circuit, said cap being insulated from said body and spaced therefrom a small distance.

10. In a radiant energy system, a vehicle having an electrically conductive exterior forming a hollow resonant body having a length of the order of a half wavelength at the operating frequency of said system, a resonant circuit within said

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body and means for coupling said circuit to the exterior of said body, including a member coupled with said circuit and extending from said body at a position where the electromagnetic field is a maximum.

WALTER VAN B. ROBERTS.