April 5, 1960 LE ROY MOFFETT ET AL 2,932,026

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Fig. 1.

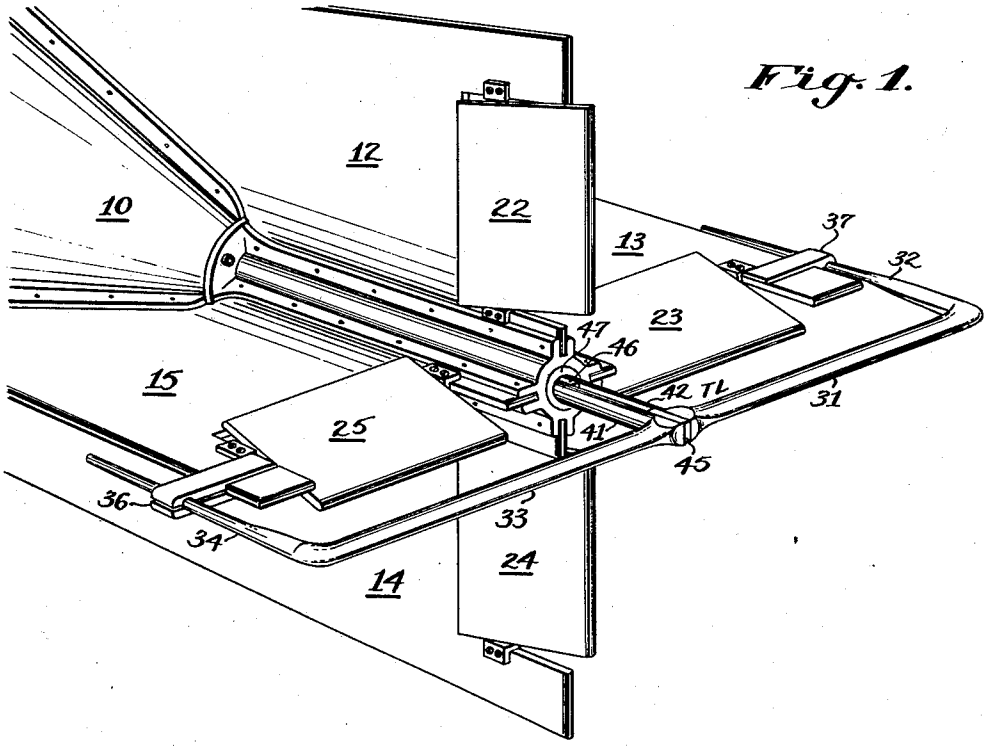


Fig. 2.

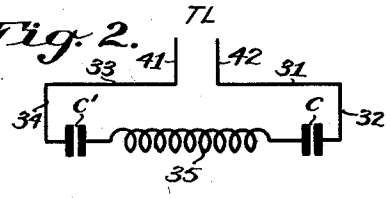
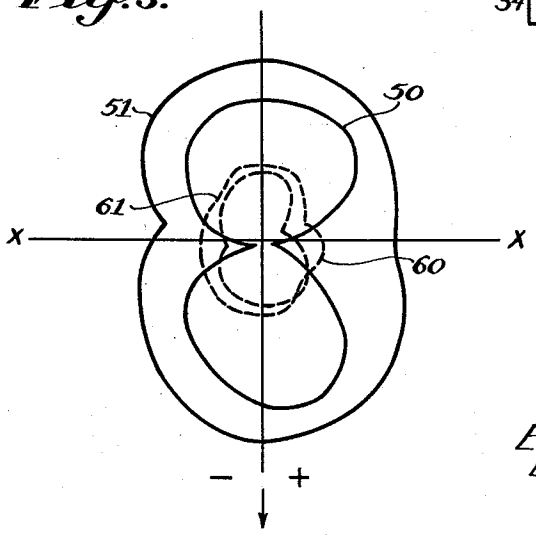


Fig. 3.



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8 Claims. (Cl. 343—708)

The present invention relates to short wave antennas and, more particularly, to such antennas adapted for use on aerodynamic vehicles.

An object of the present invention is the provision of an antenna adapted to be structurally associated with an aerodynamic vehicle.

A further object of the present invention is the provision of an antenna as aforesaid which induces the cooperation of control surfaces of said body in radiating radiant energy signals from said body.

Another object of the present invention is the provision of means for moderately increasing the feed point impedance of a half wave dipole antenna so that it may be directly connected to a low impedance two-wire transmission line without the interposition of impedance matching networks.

Still a further object of the present invention is the provision of an antenna structurally associated with the rear end of an aerodynamic vehicle to give a substantial radiation in a rearward direction from said vehicle.

Another object of the present invention is the provision of an antenna structurally associated with control surfaces of an aerodynamic body and which is simple and rigid in construction.

Still a further object of the present invention is the provision of an antenna as aforesaid which does not unduly destroy the aerodynamic properties of the vehicle with which it is associated.

The foregoing objects and others which may appear from the following detailed description are attained by providing a full half wave dipole antenna on the rear end of an aerodynamic vehicle with the ends of the dipole folded forward and capacitively coupled to the metal structure of the vehicle whereby each half of the dipole acts somewhat as a top loaded antenna and in which a current maximum is produced at the center feed point.

The resultant radiated field pattern of such an antenna structure is similar to that of a half wave dipole except that the sides, in which there is normally a minimum of radiation, are somewhat filled out.

The present invention will be more fully understood by reference to the following detailed description which is accompanied by a drawing in which:

Figure 1 illustrates in perspective view an embodiment of the present invention while;

Figure 2 is a simplified diagram of the present antenna, illustrating its manner of operation;

Figure 3 is a family of curves illustrating the radiation pattern obtained by the use of the antenna of Figure 1.

Referring now to Figure 1, reference numeral 10 indicates generally a portion of an aerodynamic vehicle such as a bomb having a pair of flight stabilizing fins 13, 15 and 12, 14 arranged at right angles to each other at the rear end of the bomb.

Since the particular vehicle shown in Figure 1 was designed to be guided in its travel, one pair of fins 13, 15, shown here in the horizontal position, was provided with control flaps 23, 25. Similarly the other pair of

fins 12, 14, shown vertically in Figure 1, was provided with control flaps 22, 24. The control mechanism which actuates flaps 22, 23, 24, 25 is not shown nor described since it forms no part of the present invention.

In order to radiate signals from the radiant energy devices carried by the vehicle 10, an antenna is provided. As shown in Figure 1 the antenna consists of an end to end arrangement of a pair of rods 31, 33 lying generally parallel to the rear edge of fins 13, 15 and closely adjacent thereto. The rods 31, 33 are bent at right angles near their remote ends to lie parallel to the outer edges of fins 13, 15. The bent portions are denoted by reference numerals 32, 34. Portions 32, 34 are maintained in position relative to the remote edges of fins 13, 15 by insulators 36 and 37.

The radiant energy devices within the vehicle 10 are coupled to the antenna by a transmission line TL passing out the rear end of the vehicle 10. The transmission line TL is a fairly low impedance two conductor transmission line and includes a pair of substantially semicircular rods 41, 42 arranged with their flat faces parallel to one another to form a substantially cylindrical structure. Rods 41, 42 are maintained in their relationship, one with the other, by insulating blocks 45 and 46 between their parallel faces and are maintained in coaxial arrangement with respect to the passageway in the body of vehicle 10 through which they pass by insulating rings such as ring 47.

Rods 31 and 33 are preferably streamlined in cross section in order to reduce to the minimum possible value the disturbance in the air stream flowing over fins 13 and 15 and control surfaces 23, 25.

In Figure 2 the electrical configuration of the antenna of Figure 1 is shown in a somewhat more diagrammatic form where it will be seen that the bent portions 32 and 34 of radiator rods 31 and 33 by their capacity to the edges of fins 13, 15 effectively end load the radiator rods 31, 33. The effective capacities are identified in Figure 2 by reference characters C and C'. The electrical effect of fins 13 and 15 between the bent portions 32 and 34 is illustrated by inductance 35 of Figure 2.

Due to the extremely close spacing between the dipole composed of rods 31, 33 and the rear edge of fins 13, 15 the current flowing in the two parallel paths will be in the same direction in space although in opposite direction in the antenna section due to phase reversal at the ends. The arrangement is almost identical in its radiation characteristic with that of a single wire half wave dipole antenna, and the mutual impedance between the two conductive paths is almost equal to the impedance of one wire. Therefore, the two parallel conductive paths of the antenna system are very closely coupled by their mutual impedances as well as by the capacitive coupling at the ends due to the effective capacities C and C'. This capacity coupling is a critical adjustment since the adjustment of the phase and amplitude of current flowing in the vehicle is important in order to secure optimum conditions for maximum radiation of the RF energy.

Since the transmission line TL is in effect connected in series with only one conductive path of the system which does not carry the total current, a radiation resistance is obtained which is somewhat greater than the radiation resistance of a single wire dipole without the use of any special impedance matching circuit between the antenna and the transmission line. Thus, the antenna may be directly connected to the end of a transmission line TL having a characteristic impedance of the order of 92 ohms. Alternatively, as in an embodiment actually constructed and tested the transmission line 41, 42 may be a quarter wave impedance matching device used to match impedances between the antenna at its center feed point and the further transmission line to the

transducer equipment within the vehicle. Consequently, an antenna system is obtained having a flat impedance versus frequency characteristic over a substantial band width. Furthermore, all portions of the antenna system are closely associated with the vehicle itself and are not likely to be damaged in transportation before the vehicle is launched in its intended mission.

Due to the streamlined formation of the major portion of the antenna system disturbances in the air flow around the vehicle are reduced to a minimum.

The arrangement shown in Figure 1 has a radiation characteristic which is very close to that of a single wire half dipole antenna. This is indicated in Figure 3 where curve 50 illustrates the radiation pattern in the plane of the antenna conductors and normal to the axis of the vehicle of a conventional half wave dipole while curve 51 illustrates the radiation pattern in the same plane of the antenna of Figure 1. It will be seen that the patterns are very closely similar except for a slight filling out of the pattern along axis X—X in the case of the folded dipole. Similarly, dotted line curve 60 illustrates the vertical radiation pattern of a dipole antenna while curve 61 illustrates the vertical radiation pattern of the antenna of Figure 1.

While we have illustrated a particular embodiment of the present invention, it should be clearly understood that it is not limited thereto since many modifications may be made in the several elements employed and in their arrangement and it is therefore contemplated by the appended claims to cover any such modifications as fall within the spirit and scope of the invention.

What is claimed is:

1. An antenna including a pair of oppositely extending conductors, means for coupling a transmission line to their adjacent ends, a conductive member closely adjacent said conductors and lying in the plane of said conductors, said member being shorter than the overall length of said conductors and said conductors being bent to lie parallel and close to the ends of said conductive member.

2. An antenna including a pair of oppositely extending conductors having an overall length substantially equal to one half of the operating wavelength, means for coupling a transmission line to their adjacent ends, a conductive member closely adjacent said conductor and lying in the plane of said conductors, said member being shorter than one half of the operating wavelength and said conductors being bent to lie along the ends of said conductive member.

3. An aerodynamic device including a guiding fin structure, said fin structure being conductive, a pair of oppositely extending conductive rods lying closely adjacent to an edge of said fin structure, the remote portions of said rods being bent to lie along the ends of said fin structure, and means for coupling wave transducer equipment to the adjacent ends of said conductive rods.

4. In combination with a vehicle having an elongated conductive wall member extending from said vehicle, said wall member being substantially shorter in length than one half the operating wavelength of a radiant energy device carried by said vehicle, a half wave dipole lying along one edge of said wall and closely adjacent thereto, the ends of said dipole being bent to lie parallel to the ends of said wall and means for coupling said radiant energy device to the center of said dipole.

5. An aerodynamic device carrying a guiding fin structure at its rear end, said fin structure being conductive, a pair of oppositely extending conductive rods lying closely adjacent to the rear edge of said fin structure, the remote portions of said rods being bent to lie along transverse edges of said fin structure, and means for coupling wave transducer equipment to the adjacent ends of said conductive rods.

6. In combination with a vehicle having an elongated conductive wall member extending from said vehicle, said wall member being substantially shorter in length than one half the operating wavelength of a radiant energy device carried by said vehicle, a half wave dipole lying along one edge of said wall and closely adjacent thereto, the ends of said dipole being bent to lie parallel to the ends of said wall, a pair of substantially semi-circular rods, one connected to each one of said dipoles and said rods being arranged with their flat sides parallel and closely adjacent, said rods passing into the interior of said vehicle and connected to said radiant energy device.

7. An aerodynamic device carrying a guiding fin structure at its rear end, said fin structure being conductive, said fin structure having a width substantially less than a half of the operating wavelength of radiant energy carried by said device, a pair of oppositely extending conductive rods lying closely adjacent to the rear edge of said fin structure, the remote portions of said rods being arranged closely adjacent edges of said fin structure normal to said rear edge thereof, and means for coupling said radiant energy means to the adjacent ends of said conductive rods.

8. In combination with a vehicle having an elongated conductive wall member extending from said vehicle, said wall member being substantially shorter in length than one half the operating wavelength of radiant energy device carried by said vehicle, a pair of conductive rods arranged in an end to end relationship and lying along one edge of said wall and closely adjacent thereto, the remote ends of said rods being bent to lie parallel to the ends of said wall, and means for coupling said radiant energy device to the adjacent ends of said rods.

References Cited in the file of this patent

UNITED STATES PATENTS

1,571,507	Brandt	Feb. 2, 1926
1,705,474	Hammond	Mar. 19, 1929
2,048,726	Bohn	July 28, 1936
2,287,220	Alford	June 23, 1942
2,290,800	Brown	July 21, 1942
2,293,136	Hampshire	Aug. 18, 1942
2,413,621	Hammond	Dec. 31, 1946
2,414,266	Lindenblad	Jan. 14, 1947
2,434,893	Alford	Jan. 27, 1948

FOREIGN PATENTS

268,940	Germany	Feb. 5, 1913