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E. A. JONES

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CORNER REFLECTOR TYPE ANTENNA

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Fig. 1

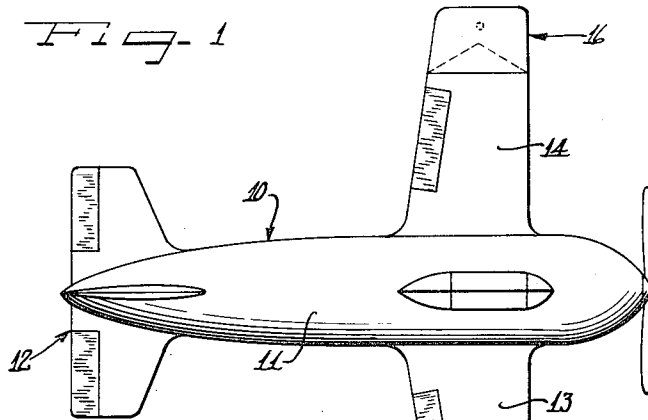


Fig. 2

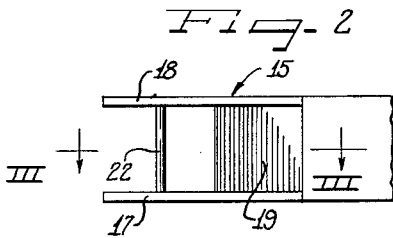


Fig. 3

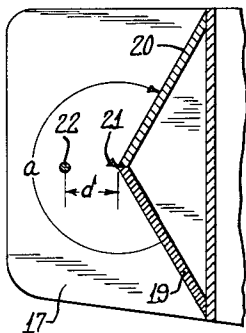
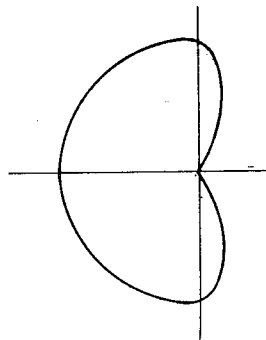


Fig. 4



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This invention relates to an antenna and more particularly to an antenna having an improved directional characteristic and peculiarly adapted for use with an airplane.

According to this invention, an antenna is provided including a pair of reflectors disposed in angularly related planes extending from a line of intersection with an antenna element generally parallel to the line and spaced therefrom and with each of the angularly related planes being at an obtuse angle relative to a plane from the line through the antenna element. The reflectors and the antenna element may be disposed between a pair of spaced generally parallel plates which may be attached to the end of an airplane wing and form continuations of the upper and lower sides thereof. The antenna may have a directional characteristic such that it will have substantial response or radiate effectively over a range of 180°. By mounting the antennas on the ends of the wings of an airplane, signals may be received or radiated in any direction. Such a system may also be used to indicate direction of travel of the airplane relative to a direct line to a transmitting station.

According to a particular feature of this invention, the planes of the reflectors may be so related to a plane from the line of intersection thereof through the antenna element and the antenna element may be so spaced from the line of intersection that a substantially uniform response to signals, or radiation of signals, over a field of a full 180° will be achieved with substantially no response in other directions, this operation being satisfactory over a wide range of operating wave lengths.

An object of this invention, accordingly, is to provide an antenna peculiarly adapted for use with an airplane.

Another object of this invention is to provide an antenna having improved directional response characteristics.

This invention contemplates other objects, features and advantages which will become more fully apparent from the following detailed description taken in conjunction with the accompanying drawings which illustrate a preferred embodiment and in which:

Figure 1 is a plan view of an airplane using a pair of antennas constructed according to this invention;

Figure 2 is a detail elevational view of one of the antennas of Figure 1;

Figure 3 is a sectional view taken substantially along lines III—III of Figure 2; and

Figure 4 is a graphical illustration of a directional response characteristic with the parts of the antenna dimensionally related in a preferred manner.

Reference numeral 10 designates an airplane having a fuselage 11, a tail assembly 12, a pair of wings 13 and 14 and a pair of antennas 15 and 16 constructed according to the principles of this invention and secured to the ends of the wings 13 and 14, respectively.

The construction of both antennas 15 and 16 is generally similar. As shown in Figure 2, the antenna 15 includes a pair of spaced generally parallel plates 17

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and 18, preferably metal, secured to the wing 13 and forming continuations of the lower and upper sides, respectively, thereof. Disposed between the plates 17 and 18 are a pair of reflectors 19 and 20. The reflectors 19 and 20 are preferably, as shown, a pair of metal plates integrally joined at a line 21. They may, however, be constructed from a plurality of rods, a screen or any structure capable of reflecting high frequency electromagnetic energy. Disposed between the plates 17 and 18 and outwardly from the line 21 is an antenna element 22, preferably a straight conductor to which connections may be made in any desired manner to excite the same or to receive high frequency energy exciting the same.

The angle between each of the reflectors 19 and 20 and the plane from the line 21 through the antenna element 22 is preferably obtuse so that the antenna will have response or radiate over a field of 180°. According to a particular feature of this invention, optimum performance is obtained by making the angle between each of the reflectors 19 and 20 and a plane from the line 21 through the reflector element 22 equal to 110° with the spacing d between the line 21 and element 22 equal to 0.3 times the wave length of operation. The total angle a in Figure 3 should hence be 220°. With these dimensions, a directional characteristic is obtained as illustrated graphically in Figure 4 with uniform response, or radiation, over 180° with substantially no response or radiation in other directions.

The above dimensions give optimum performance but it has been found that the antenna will operate satisfactorily and provide substantially uniform response or radiation over 180° with spacing d varied from 0.2 to 0.4 times the operating wave length and with the angle between each reflector and a plane from the line 21 through the element 22 varying from 100 to 120°. With operation outside these limits, response or radiation null points in one or more directions within the 180° field and excessive response or radiation in one or more directions within the 180° will occur.

The antenna may be designed for use over a wide range of wave lengths ranging from a minimum wave length to a wave length twice the minimum. For optimum operation over a range of wave lengths from a minimum of w_1 to a maximum of w_2 (w_2 not being greater than twice w_1), the optimum value for d is approximately the average of the maximum operative spacing at the minimum wave length (i. e., $0.4 w_1$) and the minimum operative spacing at the maximum wave length (i. e. $0.2 w_2$). Expressed in equation form this becomes:

$$d = \frac{0.4w_1 + 0.2w_2}{2}$$

In the special case in which w_2 equals twice w_1 ,

$$d = \frac{0.4w_1 + 0.2(2w_1)}{2} = 0.4w_1 \text{ (or } 0.2w_2)$$

It will be understood that modifications and variations may be effected without departing from the spirit and scope of the novel concepts of the present invention.

I claim as my invention:

1. An antenna assembly for an airplane having a fuselage and a pair of wings, comprising: an antenna for each wing including a pair of plates arranged to extend outwardly from the end of the wing and form continuations of the upper and lower sides thereof, a pair of reflectors disposed between said plates and disposed in planes extending inwardly from a line of intersection transverse to said plates and at substantially equal angles from a plane transverse to the fuselage, and an antenna element disposed between said plates and in said transverse plane in

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outwardly spaced parallel relation to said line of intersection.

2. An antenna assembly for an airplane having a fuselage and a pair of wings, comprising: an antenna for each wing including a pair of plates arranged to extend outwardly from the end of the wing and form continuations of the upper and lower sides thereof, a pair of reflectors disposed between said plates and disposed in planes extending inwardly from a line of intersection transverse to said plates and at angles of 100 to 120 degrees from a plane transverse to the fuselage, and an antenna element connected between said plates and in said transverse plane in outwardly spaced parallel relation to said line of intersection.

3. An antenna comprising: a pair of generally parallel spaced plates, a pair of reflectors disposed between said plates in angularly related planes extending from an intersecting line normal to said plates, and an antenna element connected between said plates parallel to said line and spaced therefrom, said planes being at obtuse angles relative to a plane from said line through said antenna element.

4. An antenna assembly for an airplane having a fuselage and a pair of wings and for operation at a wavelength W , comprising: an antenna for each wing including a pair of plates arranged to extend outwardly from the end of the wing and form continuations of the upper and lower sides thereof, a pair of reflectors disposed between said plates and disposed in planes extending inwardly from a line of intersection normal to said plates and at angles of 100 to 120 degrees from a plane transverse to the fuselage, and an antenna element parallel to said line and disposed between said plates and in said transverse plane at a point outwardly spaced from said line a distance from 0.2 to 0.4 w .

5. An antenna for an airplane having a wing, comprising: a pair of plates arranged to extend outwardly from the end of the wing and form continuations of the upper and lower sides thereof, a pair of reflectors disposed between said plates in angularly related planes extending inwardly from a line of intersection normal to said plates, and an antenna element disposed between said plates and generally parallel to and outwardly spaced from said line of intersection.

6. An antenna comprising: a pair of reflectors disposed substantially in angularly related planes extending from a line of intersection, and an antenna element generally parallel to said line and spaced therefrom, said planes being at obtuse angles relative to a plane from said line through said antenna element, said antenna having a field pattern such as to be effective over a range of approximately 180° with the principal axis of the field pattern extending from said line of intersection through said antenna element.

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7. An antenna for operation at wavelengths between w and $2w$, comprising: a pair of reflectors disposed substantially in angularly related planes extending from a line of intersection, and an antenna element generally parallel to said line and spaced approximately $0.4w$ therefrom, each of said planes being at an angle of from 100 to 120 degrees relative to a plane from said line through said antenna element, said antenna having a field pattern such as to be effective over a range of approximately 180° with the principal axis of the field pattern extending from said line of intersection through said antenna element.

8. An antenna for operation at a wavelength w , comprising: a pair of reflectors disposed substantially in angularly related planes extending from a line of intersection, and an antenna element generally parallel to said line and spaced between $0.2w$ and $0.4w$ therefrom, each of said planes being at an angle of from 100 to 120 degrees relative to a plane from said line through said antenna element, said antenna having a field pattern such as to be effective over a range of approximately 180° with the principal axis of the field pattern extending from said line of intersection through said antenna element.

9. An antenna for operation at wavelengths between a minimum wavelength of w_1 , and a maximum wavelength of w_2 , w_2 being not greater than twice w_1 , comprising: a pair of reflectors disposed substantially in angularly related planes extending from a line of intersection, and an antenna element generally parallel to said line and spaced therefrom a distance equal to:

$$\frac{0.4w_1 + 0.2w_2}{2}$$

each of said planes being at an angle of from 100 to 120 degrees relative to a plane from said line through said antenna element, said antenna having a field pattern such as to be effective over a range of approximately 180° with the principal axis of the field pattern extending from said line of intersection through said antenna element.

References Cited in the file of this patent

UNITED STATES PATENTS

2,203,807	Wolff	June 11, 1940
2,518,843	Wehner	Aug. 15, 1950
2,583,953	Kraus	Jan. 29, 1952
2,594,839	Alford	Apr. 29, 1952
2,629,051	Lindenblad	Feb. 17, 1953
2,631,237	Sichak et al.	Mar. 10, 1953
2,636,987	Dorne	Apr. 28, 1953

OTHER REFERENCES

Proceedings of the IRE, November 1940, page 518.