

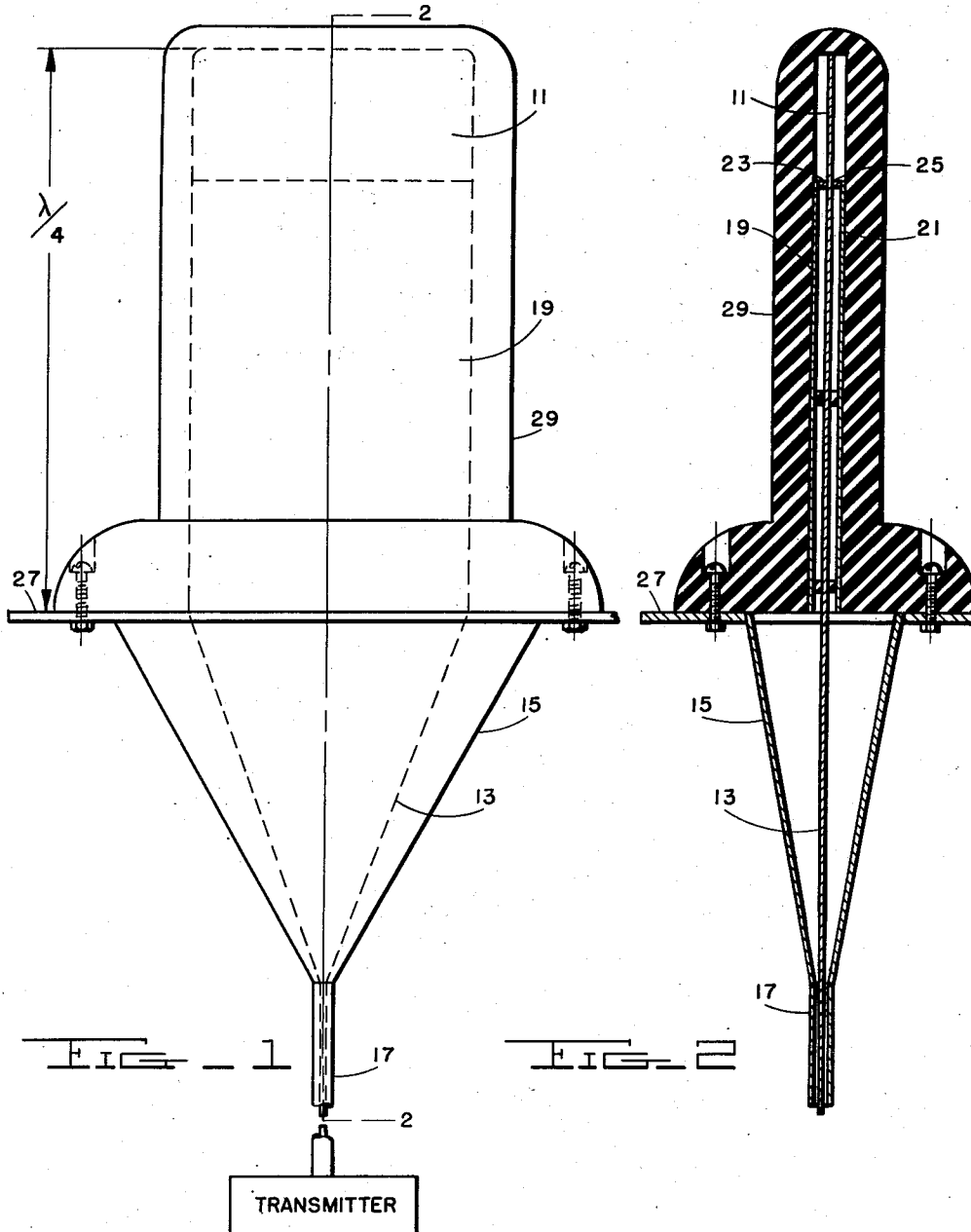
Sept. 25, 1951

J. T. BOLLJAHN

2,568,710

WIDE-BAND ANTENNA

Filed Nov. 13, 1945



Inventor
JOHN T. BOLLJAHN

By *Ralph L. Chappell*

Attorney

UNITED STATES PATENT OFFICE

2,568,710

WIDE-BAND ANTENNA

John T. Bolljahn, Washington, D. C.

Application November 13, 1945, Serial No. 628,339

10 Claims. (Cl. 250—33)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

1

This invention relates to antennas and, more particularly, to wide-band antennas.

An object of the invention is to provide an antenna capable of efficient operation over a wide band of frequencies.

Another object of the invention is to provide a wide-band antenna suitable for mounting on the exterior surface of a high-speed aircraft.

A further object of the invention is to provide a wide-band antenna which has a low resistance to the flow of air at high velocity.

The radiating element of an antenna in accordance with the invention comprises a thin sheet of conductive material, which projects through an opening in an extended conductive surface. Means, which may comprise a pair of tapered conductors, are provided for coupling the radiating element to a transmission line. The other end of the line may be connected to a wave signal translator, such as a radio receiver or transmitter. Inductive stubs conductively attached to the radiating element are provided for neutralizing the normal reactance of the radiating element, thereby providing a substantially non-reactive termination at the antenna end of the transmission line.

Other objects, features and advantages of the invention will be apparent from consideration of the following description and the accompanying drawing, in which

Fig. 1 is an elevation view of an exemplary embodiment of the invention, and

Fig. 2 is a sectional view of the embodiment shown in Fig. 1, taken in the plane 2—2.

Referring now to the drawing, the radiating element of an antenna according to the invention may comprise a thin conductive sheet 11. Means comprising tapered conductors 13, 15 are provided for effecting a gradual dimensional transition between the radiating element 11 and a coaxial transmission line 17. A pair of inductive stubs comprising conductive sheets 19, 21 are positioned on each side of the radiating element 11 and are conductively connected thereto between the ends thereof by the shorting bars 23, 25.

The outer tapered conductor 15 is connected at the wide end thereof to an extended conductive surface 27. The inner tapered conductor 13 may be a continuation of the radiating sheet element 11 projecting below the conductive surface 27, the width of the sheet being tapered down to the diameter of the inner conductor of the line 17 at the junction therebetween. If, as is shown, the thickness of the radiating element 11 is substantially the same as the diameter of the inner conductor of the line 17, the thickness of conductor 13 need not be tapered.

The conductive surface 27 may comprise, for example, the metallic outer surface of an air-

2

plane fuselage. When mounted on an airplane the antenna has a minimum wind drag when the plane of the sheet 11 is parallel to the direction of air flow. It has been found that minimum wind drag of the antenna is obtained on high speed aircraft when the ratio of width to thickness of the antenna is as large as is practicable. Consequently, the invention provides an antenna which is well adapted for use on high speed aircraft.

The antenna structure projecting above the conductive surface 27 may be enclosed in a dielectric housing 29 of appropriate dimensions to protect and strengthen the structure.

The height of the radiating element 11 above the conductive surface 27 is preferably of the order of one-quarter wavelength near the center of the frequency band over which wide-band operation is desired. The width of element 11 may be of the order of one-eighth wavelength.

The tapered conductors effect a smooth dimensional transition between the line 17 and the antenna. When the antenna has the dimensions mentioned above, the impedance of the antenna provides a satisfactory termination for a 50-ohm transmission line. Consequently, if line 17 has a characteristic impedance of 50 ohms, the tapered conductor sections 13, 15 are designed to maintain a 50 ohm characteristic impedance throughout their length between the line 17 and the radiating element 11. However, the tapered conductors may constitute an impedance transformer if the desired line impedance is not matched satisfactorily by the antenna impedance.

While a radiating element 11 has been shown comprising a rectangular sheet, it will be apparent that sheet elements having other than rectangular shapes may be used without departing from the scope of the invention. For example, diamond-shaped, triangular, elliptical or other plane figures may define the edges of radiating element 11.

The inductive stubs 19, 21 are provided to neutralize the reactive component of the antenna impedance. The stubs 19, 21 together with element 11 effectively constitute sections of transmission line having plane conductors, which are short-circuited at one end by shorting bars 23, 25. In accordance with known transmission line theory, the length of the stubs and their separation from element 11 may be computed so as to cause the stubs to present an inductive reactance of substantially equal magnitude to the capacitive reactance of the radiating element 11, over a wide band of frequencies. Thus, means are provided for maintaining a substantially non-reactive termination of the line 17 by the antenna over a wide frequency band.

It will be understood that the invention is not

limited by the embodiment herein illustrated and described and that the scope of the invention is to be determined by reference to the appended claims.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

What is claimed is:

1. An antenna comprising a conductive sheet having a length of substantially one-quarter of the operating wave-length and a width which is a fraction less than unity of the operating wave-length, a transmission line, and means for coupling the line to the conductive sheet comprising a tapered flat divergent conductor section interposed between the line and the conductive sheet.

2. An antenna comprising a conductive sheet having a length of substantially one-quarter of the operating wave-length, and a width which is a fraction less than unity of the operating wave-length, a transmission line, and means for coupling the line to the conductive sheet comprising a tapered flat divergent conductor section interposed between the line and the conductive sheet, and a dielectric housing enclosing the conductive sheet.

3. In combination, an antenna comprising a conductive sheet having a length of substantially one-quarter of the operating wavelength, and a width which is a fraction less than unity of the operating wavelength, means defining an extended ground plane conductive supporting surface for the antenna, a transmission line, and tapered flat divergent conductor means for coupling the line to the antenna.

4. In combination an antenna comprising a conductive sheet having a length of substantially one-quarter of the operating wavelength, a finite thickness, and a width which is substantially one-eighth of the operating wavelength, a coaxial transmission line, having an inner conductor with a diameter equal to the thickness of the conductive sheet, means defining an extended ground plane conductive supporting surface for the antenna, and a tapered flat divergent section of the transmission line for effecting a gradual transition between the widths of the conductive sheet and the cross-sectional dimensions of the line.

5. In combination an antenna comprising a conductive sheet having a length of substantially one-quarter of the operating wavelength and a width which is substantially one-eighth of the operating wavelength, means defining an extended ground plane conductive supporting surface for the antenna, a pair of conductive elements positioned parallel to the conductive sheet on opposite sides thereof and connected to the sheet intermediate the ends thereof, a coaxial transmission line, and tapered conductor means coupling the line to the conductive sheet.

6. An antenna comprising a conductive sheet having a length of substantially one-quarter of the operating wavelength and a width which is substantially one-eighth of said wavelength, and a pair of inductive transmission line elements shorter than the conductive sheet positioned parallel to the sheet and conductively connected to the sheet at one end of each element.

7. In combination, an antenna comprising a conductive sheet having a length of substantially one-quarter of the operating wavelength and a width which is substantially one-eighth of said wavelength, a pair of conductive elements shorter than the conductive sheet positioned parallel to the sheet and conductively connected to the sheet at one end of each element, a transmission line, and tapered conductor means for coupling the line to the antenna.

8. An antenna comprising a conductive sheet having a length of substantially one-quarter of the operating wavelength and a width which is substantially one-eighth of said wavelength, a pair of conductive elements shorter than the conductive sheet positioned parallel to the sheet and conductively connected to the sheet at one end of each element, a transmission line, and tapered conductor means for coupling the line to the antenna, and means defining an extended ground plane conductive supporting surface for the antenna, the antenna and the line extending in opposite directions from the conductive surface.

9. An antenna comprising, a conductive sheet having a length of substantially one-quarter of the operating wavelength, and a width which is substantially one-eighth of the operating wavelength, means defining an extended ground plane conductive supporting surface for the antenna, a transmission line, a tapered planar conductive member coupling one conductor of the transmission line with the conductive sheet, and a pair of divergent tapered flat planar conductive members disposed on opposing sides of the planar conductive member connecting a second conductor of the transmission line with the aforementioned means.

10. An antenna comprising, a conductive sheet having a length of substantially one-quarter of the operating wavelength, a finite thickness, and a width which is substantially one-eighth of the operating wavelength, means defining an extended ground plane conductive supporting surface for the antenna, a transmission line having at least a first conductor equal in thickness to the thickness of the conductive sheet and a second conductor, a tapered planar conductive member coupling the first conductor of the transmission line to the conductive sheet, and a pair of divergent tapered flat planar conductive members disposed on opposing sides of the planar conductive member connecting a second conductor of the transmission line with the aforementioned means.

JOHN T. BOLLJAHN.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,807,386	Clarke	May 26, 1931
1,960,006	Hagen	May 22, 1934
2,080,577	Ponte	May 13, 1937
2,184,729	Bailey	Dec. 26, 1939
2,239,724	Lindenblad	Apr. 29, 1941
2,251,708	Hefe	Aug. 5, 1941
2,284,434	Lindenblad	May 26, 1942
2,433,698	Hurst	Dec. 30, 1947
2,463,547	Meier	Mar. 8, 1949