Sept. 18, 1951 J. E. PAUCH 2,568,560

SLOTTED PRISMATIC ANTENNA

Filed Dec. 27, 1946 2 Sheets-Sheet 1

Fig. 1.

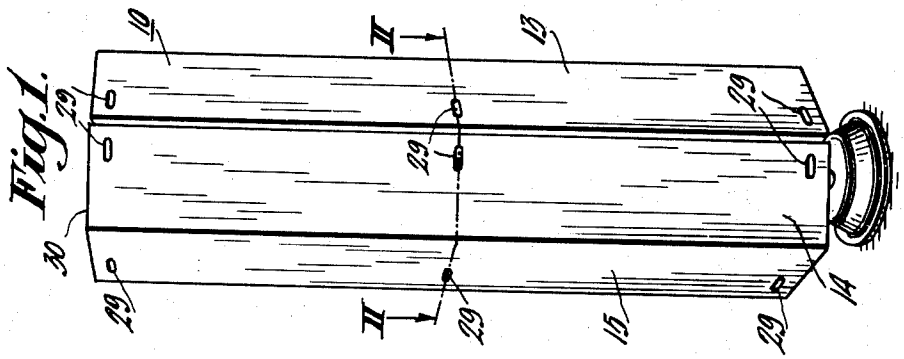
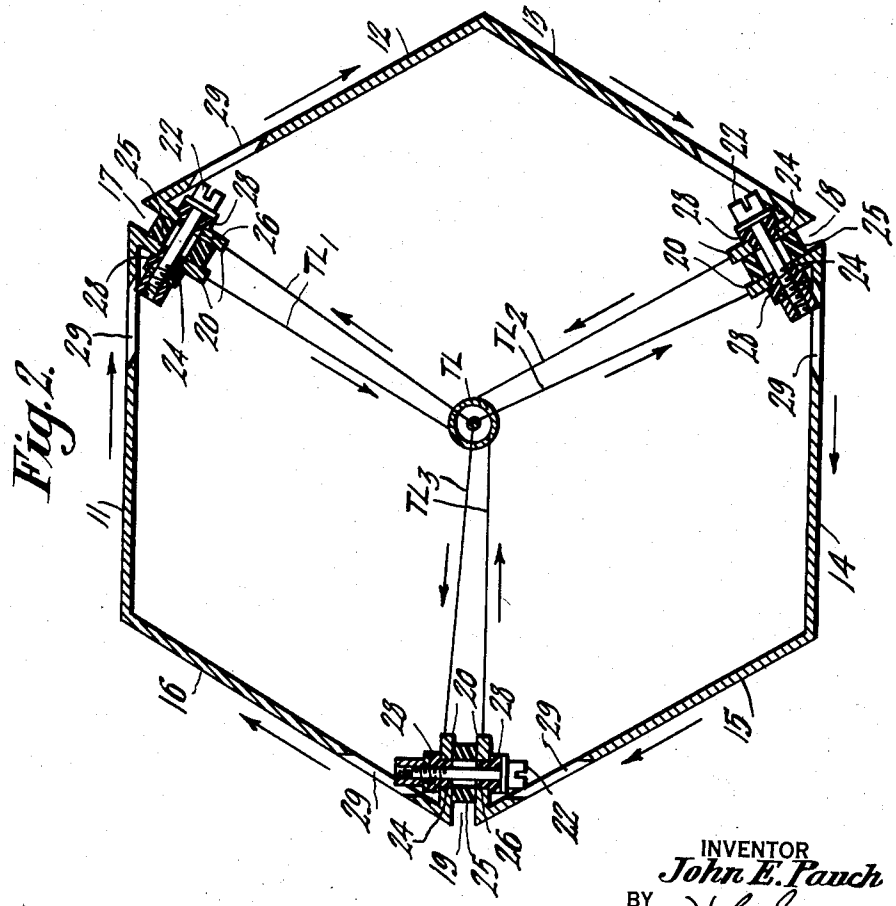


Fig. 2.



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Fig. 3.

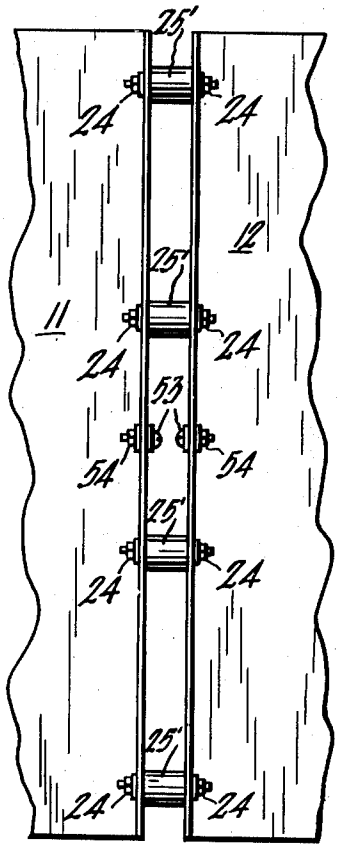


Fig. 4.

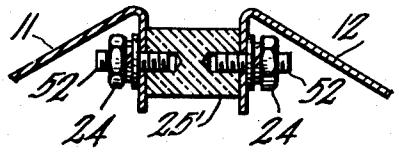
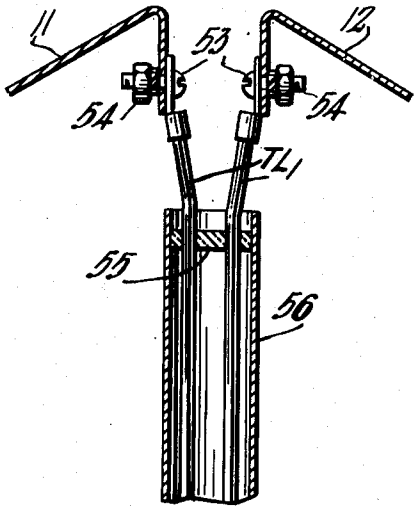


Fig. 5.



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UNITED STATES PATENT OFFICE

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SLOTTED PRISMATIC ANTENNA

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2 Claims. (Cl. 250—33)

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The present invention relates to antennas and more particularly to ultra high frequency antennas.

An object of the present invention is to provide an antenna element having broad band characteristics.

Another object of the present invention is to provide an antenna capable of radiating substantially pure horizontally polarized waves.

Another object of the present invention is to radiate high frequency energy with highly uniform field intensity in all directions in the horizontal plane.

Still another object of the present invention is the provision of a simple low cost, broad band antenna suitable for use in broadcast transmission.

The foregoing objects and others which may appear from the following detailed description are attained by providing a radiator element in the form of a hollow sheet metal prism of triangular, square or other polygonal cross section or in the form of a hollow sheet metal cylinder. The prism or cylinder is provided with two or more equally spaced longitudinal slots about its circumference. The antenna thus formed is fed with single phase radio frequency energy across the slots with all of the slots connected in parallel in such a way that all the currents around the exterior of the antenna are in the same direction.

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 elevation an embodiment of the present invention, while

Figure 2 illustrates a cross sectional view of the antenna taken along line 2,2 of Figure 1, and

Figures 3, 4 and 5 are fragmentary views showing modifications of details of the antenna.

The antenna of the present invention consists of a hollow sheet metal body 10 of generally prismatic or cylindrical form. The embodiment shown in the drawing is hexagonal in cross section but a circular or other polygonal cross section may be used if desired. The antenna of the present embodiment is composed of a plurality of flat planar surfaces 11, 12, 13, 14, 15 and 16 arranged in a hexagonal formation. Preferably adjacent faces such as 12—13, 14—15 and 16—11 are continuous leaving slots 17, 18 and 19 at alternate corners of the hexagon. The metallic sheets, where they are adjacent to slots 17, 18 and 19, are preferably provided with in-

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turned flanges 20 to provide means for clamping the structure together and also to provide for ready connection of the transmission line across the slots. The flanges 20 are maintained in parallel insulated relationship one with the other by means of clamping bolts 22 passing through suitable apertures 24 and 26 through the flanges 20. An insulating spacer 25 maintains the spacing between the flanges 20. The bolts 22 may be insulated from flanges 20 by shouldered insulating washers 28. As shown more clearly in Figure 1 three or more such clamping means may be provided along each of the longitudinal slots 17, 18 and 19. For embodiments where the overall length of the antenna is of the order of a half wavelength or more it is necessary that the insulated construction described be provided at the center clamping point only, the spacers at the ends of the radiator being constructed of conducting material. The voltage across the slots at the ends of the radiator is, for such lengths, so low that there is no necessity for providing insulation at the ends. Furthermore, an all-metal clamping structure at each end increases the mechanical rigidity of the structure. If desired, the upper end of the antenna may be closed in by a hexagonal conductive plate 30 whereby the structure is strengthened and foreign matter kept out of the interior of the structure. Similar closing means may be also provided at the bottom to which the desired supporting structure may be attached. In order to allow convenient access to holes 24 and 26 through which the clamping bolt 22 passes for assembly and for inspection, access holes 29 may be provided in the flat faces of the antenna.

The antenna as so far described is ordinarily mounted vertical with a transmission line TL passing up into the interior from the base. At substantially the midpoint of the antenna the transmission line TL is connected in parallel relationship to slots 17, 18 and 19 by short sections of two-wire transmission line TL_1, TL_2 and TL_3. As indicated by the arrows in Figure 2 the connection is in such sense that the exterior currents flow in the same direction around the antenna. While I have shown the transmission lines as being connected to the midpoint of the antenna, other points along the individual slots may be utilized if desired. In some cases the slots may be fed at one end thereof.

The dimensioning of the antenna is not critical since the diameter may be chosen anywhere between the limits of $\frac{1}{10}$ wavelength and $\frac{1}{4}$ wavelength at the midband operating frequency. The

length of the antenna is not critical but may be as short as $\frac{1}{10}$ wavelength or as long as one or more wavelengths. The ends of the slots 17, 18 and 19 should preferably not be short circuited unless the overall length of the antenna is of the order of a half wavelength or more with the feed point at substantially the center of the radiator.

The antenna arranged and energized as described above has an essentially uniform unidirectional current circulating circumferentially about the exterior. The resulting field produced is to a high degree free from vertical polarization components and has a high degree of uniformity about the vertical axis. There is no radiation along the axis of the radiator.

The input impedance characteristics of the radiator are such that it may be readily adapted to operate over a wide frequency range without readjustment of the antenna system. The broad band characteristics of the antenna are determined somewhat by the length of the cylinder, the longer the antenna the greater the bandwidth. The uniformity of the field in the horizontal plane depends upon the number of the longitudinal slots and on the diameter of the antenna. Apparently the optimum number of slots is three and a more uniform radiation pattern is obtained with the smaller diameters. The input impedance of the antenna is dependent upon the number of longitudinal slots, the diameter of the antenna, the capacity between the flanges 20 and, to some extent, upon the length of the cylinder. Ordinarily the width of the slots 17, 18 and 19 and/or the width of the flanges 20 is adjusted to make the radiator resonant at midpoint frequency. Increasing the slot width or decreasing the widths of flanges 20 increases the resonant frequency. The cross sectional shape of the antenna has practically no effect on its characteristics as long as the departure from a generally circular formation is not too great.

Tests on an embodiment of the antenna described above approximately 60 inches in length and 18 inches across corners indicated that a satisfactorily circular radiation pattern and a substantially constant input impedance was obtained over a frequency range of from 112 to 118 megacycles.

In Figures 3 and 4 I have shown fragmentary views of modifications of the form of the invention described above. Figure 4 shows in section a solid insulator 25' having studs 52 screwed into tapped holes in each end of the insulator. This construction may be used instead of the insulator 25, insulating washers 26 and clamping bolt 22 of Figure 2. Thus the studs 52 and nuts 24 need not be insulated from the flanges 20. This arrangement may, in many cases be simple, less expensive and more rigid than the arrangement of Figure 2.

Figure 3 shows in elevation, from the interior of the antenna an arrangement of a number of insulators 25' along one of the slots which has been actually used. As shown here and in Figure 5 the conductors of transmission line TL_1 are connected to flanges 20 by bolts 53 and clamping nuts 54. Though in this figure they are shown at substantially the midpoint of slot 17, if desired connection may be made near one end or the other, if the ends are insulated as indicated in Figure 3.

Also if desired, the conductors of the two wire transmission lines, as indicated with respect to line TL_1 in Figure 5, may be located within a shielding tube 56, maintained in alignment about the conductors by insulating spacers such as that shown at 55.

While I 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 without departing from the spirit and scope of the invention.

What is claimed is:

1. A high frequency antenna including a plurality of elements of flat conductive material arranged to form a substantially closed prismatic member, the over-all length of said member being substantially a half wavelength at the midband operating frequency, and the dimensions of said member transverse to the longitudinal axis thereof being between one-tenth and one-quarter wavelength at the midband operating frequency, said elements having rectilinear edges spaced to form a number of slots in said member, there being parallel inturned flanges along said rectilinear edges, and means to couple a two-conductor transmission line directly to said antenna, one of said conductors being connected to corresponding slots at said rectilinear edges of all of said slots and the other conductor being directly connected to the remaining edges to cause the instantaneous currents to flow in the same direction about the perimeter of said member.

2. A high frequency antenna including a plurality of sheets of flat conductive sheet material having rectilinear edges, said sheets being bent to form inturned flanges along said rectilinear edges and being arranged to form a substantially closed prismatic member, the overall length of said member being substantially a half wavelength at the midband operating frequency, and the dimensions of said member transverse to the longitudinal axis thereof being between one-tenth and one-quarter wavelength at the midband operating frequency, some of said rectilinear edges being spaced to form three longitudinal slots in said prismatic member, and means to couple a two-conductor transmission line directly to said antenna, one of said conductors being connected to corresponding rectilinear edges of all of said slots and the other conductor being directly connected to the remaining edges to cause the instantaneous currents to flow in the same direction about the perimeter of said member.

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