

July 30, 1957

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2,801,413

DIRECTIVE DIELECTRIC ANTENNAS

Filed March 30, 1949

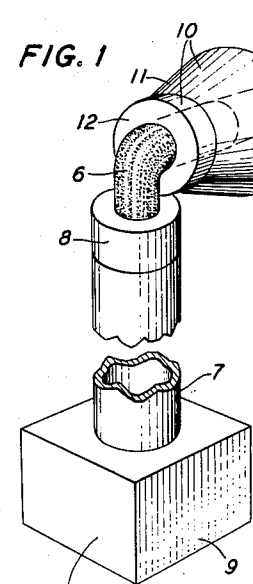


FIG. 1

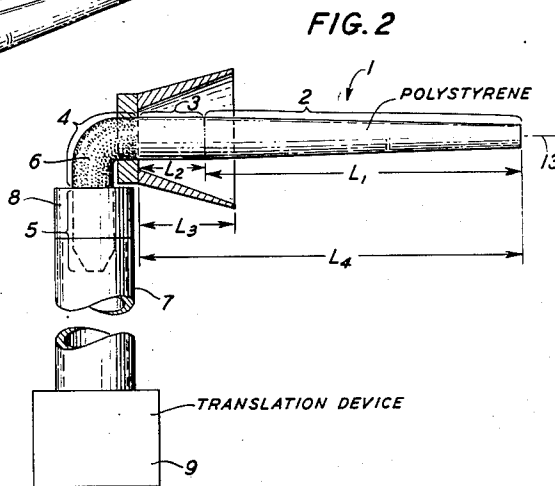


FIG. 2

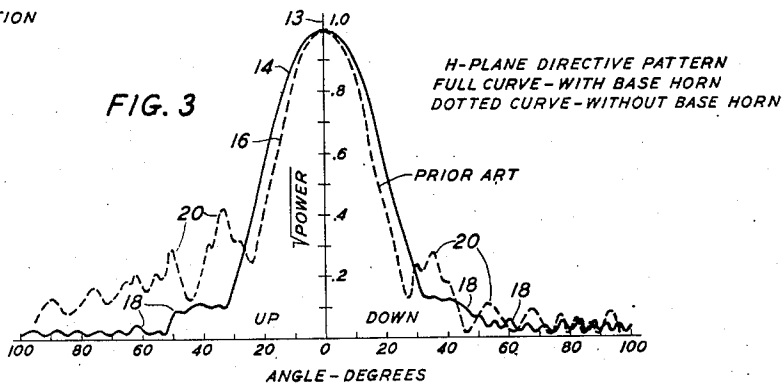


FIG. 3

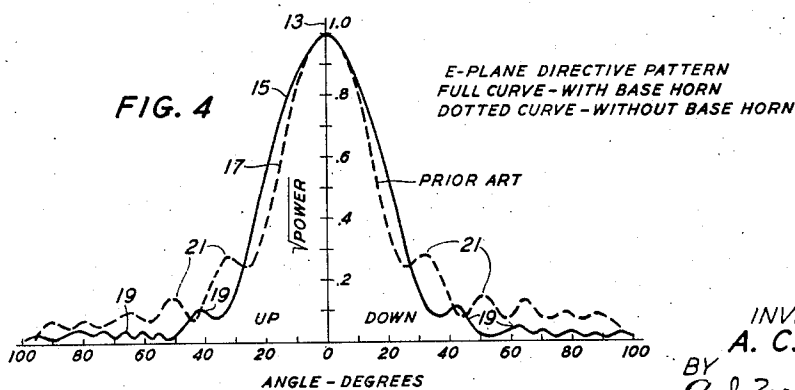


FIG. 4

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Application March 30, 1949, Serial No. 84,280

2 Claims. (Cl. 343—785)

This invention relates to antenna systems and particularly to directive antennas of the dielectric type.

As is known, and as is disclosed in Patent 2,425,336 granted on August 12, 1947 to G. E. Mueller, an end-on tapered polystyrene rod antenna, hereinafter denoted a "polyrod," has been suggested for obtaining highly directive radio action. In practice it has been found that, while the directivity gain and the major lobe of the directive characteristic are in general fairly satisfactory, the minor lobes of the characteristic are often relatively large and, accordingly, it appears desirable to obtain an antenna of this type having a more satisfactory directive characteristic.

It is one object of this invention to improve the directive characteristic of an end-on linear antenna.

It is another object of this invention to decrease the intensities of the minor lobes in the directive characteristic of an end-on dielectric antenna.

It is a further object of this invention to increase the directivity gain of an end-on linear polystyrene antenna.

In accordance with the preferred embodiment of the invention the large end or base portion of a circular tapered polyrod, such as disclosed in the above-mentioned Mueller patent, is equipped with a small conical metallic horn. The polyrod extends through the throat and mouth of the horn and the longitudinal axes of the polyrod and horn are coincident. An annular metallic member is provided for connecting the periphery of the horn throat to the periphery of the polyrod. In an embodiment actually constructed, the ratio of the axial polyrod length to the axial horn length is approximately four, and the flare angle of the horn is approximately twenty degrees. The conical horn encloses the untapered section, and a part of the tapered section, of the polyrod. In operation, the horn functions to render the minor lobes of the directive characteristic negligible and to increase the directivity gain of the polyrod.

The invention will be more fully understood from a perusal of the following specification taken in conjunction with the drawing on which like reference characters denote elements of similar function and on which:

Fig. 1 is a perspective view of one embodiment of the invention;

Fig. 2 is a sectional side view of the embodiment of Fig. 1;

Fig. 3 illustrates the H-plane directive patterns of the embodiment of Fig. 1 and a polyrod not equipped with a horn; and

Fig. 4 illustrates the E-plane directive patterns of the embodiment of Fig. 1 and the prior art polyrod not associated with a horn.

Referring to Figs. 1 and 2 there is shown a linear polystyrene antenna element 1, or polyrod, of the type disclosed in the above-mentioned Mueller patent. The polyrod 1 has a circular transverse cross-section, a tapered longitudinal radiating section 2 having a length

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L_1 , a uniform or non-tapered radiating section 3 having a length L_2 , a bent section or elbow 4 and a combined clamping and matching section 5. If desired, the elbow 4 may be omitted and the polyrod section 3 may be directly connected to the matching section 5. The ratio of the length L_2 of the tapered section to the length L_1 of the uniform section is approximately five. A metallic coating 6 is applied to the surface of the elbow 4 for preventing radiation. The matching section 5 extends into the end of an air-filled metallic wave guide 7 and is supported therein by means of a metallic polyrod holder 8. The other end of the guide 7 is connected to a translation device 9 such as a radio transmitter or receiver.

A conical horn 10 comprising a metallic flared member 11 having a flare angle of approximately twenty degrees and a metallic annular throat member 12 having a circular aperture, is mounted on the polyrod in a manner such that the axis 13 of the polyrod and the axis of the horn are coincident. More particularly, the axial length L_3 of the horn is greater than the length L_2 of the uniform section 3 of the polyrod; and the annular member 12 is attached to one end of the uniform polyrod section 3 so that the flared horn member 11 surrounds the uniform section 3, and a portion of the tapered section 2, of the polyrod. The ratio of the length L_4 of the polyrod proper, comprising the radiating sections 2 and 3, to the axial length L_3 of the horn 10 is approximately four.

By way of example, in one embodiment actually constructed and tested, the axial lengths L_1 , L_2 and L_3 of the tapered polyrod section 2, the uniform polyrod section 3 and the horn 10 are respectively 5, 1 and 1.5 inches corresponding to 3.96, 0.79 and 1.19 wavelengths, the design wavelength being approximately 3.2 centimeters. Also, in the actual embodiment just described, the inside mouth diameter and the inside throat diameter of the horn 10 are respectively 2.0 and 0.885 inches corresponding to 1.59 and 0.70 wavelengths; and the maximum and minimum diameters of the polyrod are respectively 0.666 and 0.375 inch corresponding to 0.53 and 0.30 wavelengths.

In operation, assuming the translation device 9 is a transmitter, waves are supplied by device 9 to the guide 7 and thence to the polyrod 1. The waves are radiated from the surfaces of sections 2 and 3 of the polyrod, the radiation being end-on, that is, the maximum directive effect is along the axis 13, as explained in the Mueller patent. The wavelets emanating from the side of the polyrod and impinging upon the flared horn member 11 are for the most part redirected towards the horn mouth and in the general direction of the axis 13. As a result, the minor lobes are rendered negligible and the directive gain of the polyrod is enhanced.

Referring to Figs. 3 and 4, the full line curve 14, Fig. 3, illustrates the measured H-plane pattern and the full line curve 15, Fig. 4, illustrates the measured E-plane pattern of an embodiment constructed in accordance with the invention and having the dimensions given above. For purpose of comparison the measured H-plane pattern 16 and the measured E-plane pattern 17 of a polyrod not equipped with a horn are illustrated in Figs. 3 and 4. As shown in Figs. 3 and 4, the H-plane minor lobes 18 and the E-plane minor lobes 19 for the polyrod-horn of the invention are relatively small and insignificant as compared to the H-plane minor lobes 20 and the E-plane minor lobes 21 of the prior art polyrod. The measured directive gain for the polyrod-horn combination was 15.0 decibels as compared to

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a measured gain of 14.5 decibels for the prior art poly-rod.

While the invention has been explained in connection with the preferred embodiment it should be understood that it is not to be limited to the embodiment described inasmuch as other apparatus may be employed in successfully practicing the invention.

What is claimed is:

1. A directive antenna comprising an end-on tapered dielectric antenna element and a conical metallic horn, said horn being shorter than said dielectric element, and having a throat or small aperture surrounding and connected to the larger end of said element, the flared end of said horn extending in the same direction as the tapered end of said element, the ratio of the axial length of said element to the axial length of said horn being approximately four, and the flare angle of said horn being approximately twenty degrees.

2. In combination, a directive antenna comprising a polystyrene antenna rod having a tapered section and a uniform or non-tapered base section, a conical metallic horn comprising a flared member and an apertured annular base or throat member, the flare angle of said

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horn being twenty degrees substantially, the ratio of the axial length of said rod to the axial length of said horn being four, substantially, the axes of said rod and horn being coincident, the flared end of said conical horn being directed in the same direction as the tapered end of said rod, the diameter of the throat aperture of said horn being larger than the diameter of the uniform section of said rod, said annular member connecting the periphery of the horn throat aperture to the periphery of the uniform section, and a translation device connected to said antenna rod.

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