July 17, 1956 L. J. EYGES 2,755,467

BROADBAND LINEAR ARRAY

Filed May 15, 1946

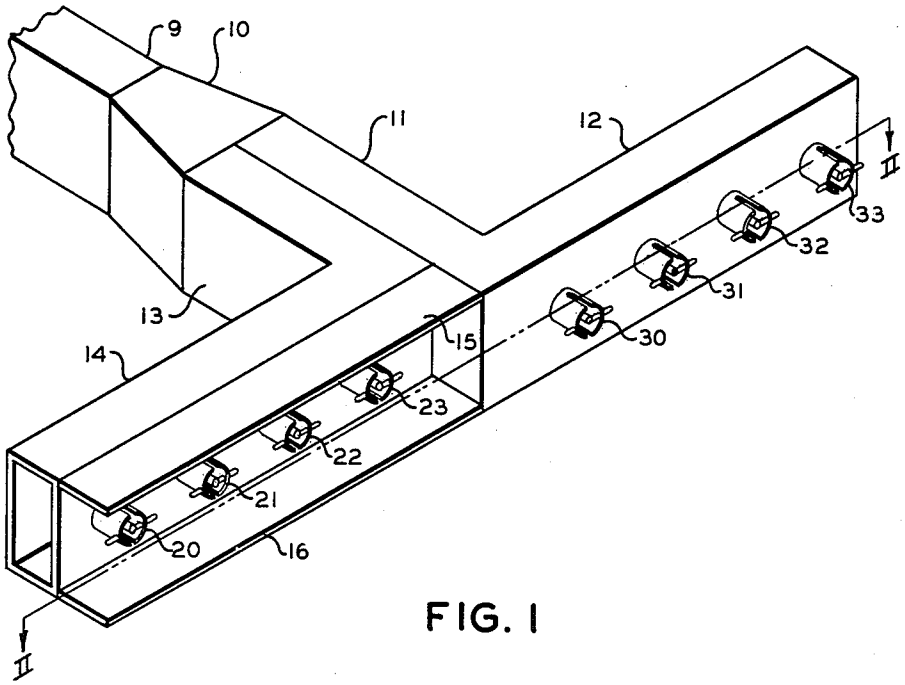


FIG. 1

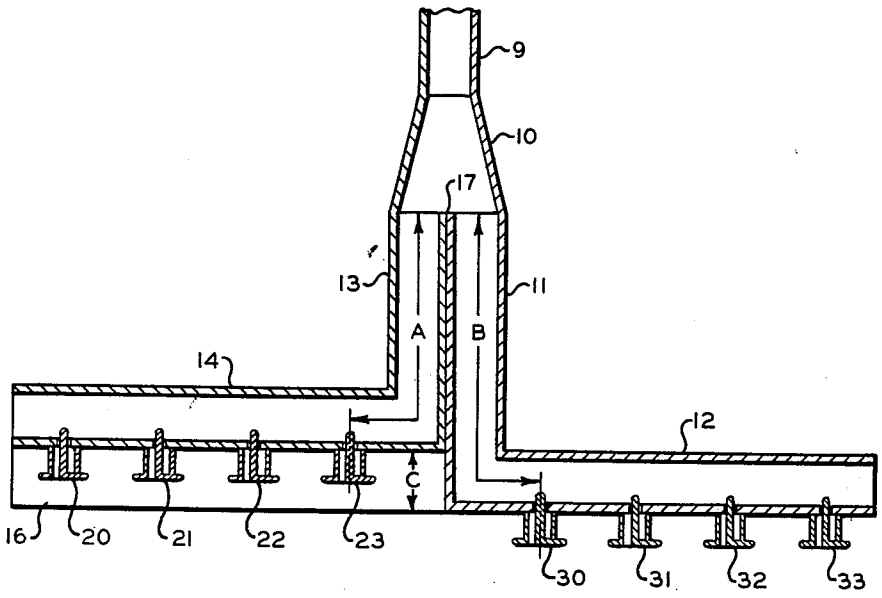


FIG. 2

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United States Patent Office 2,755,467 Patented July 17, 1956

2,755,467

BROADBAND LINEAR ARRAY

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Application May 15, 1946, Serial No. 669,781

5 Claims. (Cl. 343—844)

This invention relates to an antenna, and more particularly to a broadband linear array of dipole radiators.

Linear arrays of radiating elements are frequently employed when a radiation pattern having a high ratio of beam widths in its two major planes is required. The adjustment of linear arrays to effect the correct impedance match to the associated transmission line is a difficult and tedious procedure. An array having reasonably uniform impedance characteristics over a wide frequency band is relatively complex and difficult to construct.

It is, therefore, an object of this invention to provide a linear array antenna having reasonably uniform impedance characteristics over a broad frequency band.

It is another object of this invention to provide an antenna which is easily matched in impedance to its associated transmission line.

These and other objects will be more apparent upon consideration of the following description, together with the accompanying drawings, in which:

Fig. 1 is a perspective view of an embodiment of the present invention; and

Fig. 2 is a sectional view along line II—II of the apparatus of Fig. 1.

Fig. 1 shows a linear array antenna comprising two electrically identical sections positioned end-to-end and fed by separate wave guide transmission lines, which are coupled to a power divider. The electrical lengths of the transmission lines are such that reflections of electromagnetic energy from one section cancel those from the other section at the power divider.

As shown, a wave guide transmission line **9** having a rectangular cross section is coupled to a power divider **10**, comprising a section of tapered wave guide.

Wave guide transmission lines **11** and **13**, disposed side by side, are coupled together to power divider **10** with the adjacent wide walls of lines **11** and **13** forming a septum **17**, shown in Fig. 2.

The antenna comprises two electrically identical array sections of dipole radiating elements **20, 21, 22, 23** and **30, 31, 32, 33**, arranged upon and energized by wave guide transmission lines **14** and **12** respectively. The dipole elements shown are of the conventional type, with excitation provided by electric probes extending within the wave guides in the well-known manner.

As shown in Fig. 2, the two array sections are disposed end-to-end, with their longitudinal axes substantially parallel and displaced by a distance C. The distance A from the edge of septum **17** to the excitation probe of dipole **23** is electrically one-quarter wave length less than the distance B from the edge of septum **17** to the probe of dipole **30**. Thus, it can be seen that the sum of the electromagnetic energy reflections produced within one section when wave guide **9** is energized will substantially cancel the effects of those produced in the other section, since the electrical path lengths are such that the reflected waves will arrive at the power divider 180° out of phase.

A necessary condition for the production by an array of a satisfactory radiation pattern is the uniformity of the phase front of the electromagnetic field existing near the radiating elements. To fulfill this requirement, distance C, the axial displacement of the two array sections, is made equal to an electrical one-quarter wave length. Because of the difference between the wave length of the energy propagated in free space and that propagated within the wave guides, conductive strips **15** and **16** are positioned parallel to the narrow walls of wave guide **14**, forming extensions thereof, and causing the physical distance C to be the same as one-quarter wavelength of the energy propagated within wave guide **13**.

Since certain changes may be made in the above described apparatus, and different embodiments of the invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense, and therefore that the invention is to be limited only by the spirit of the appended claims.

What is claimed is:

1. An antenna comprising, in combination, a first rectangular wave guide, a power divider connected to said wave guide and having the shape of a horn flaring from said first wave guide, second and third wave guides connected to the flared end of said power divider, a fourth wave guide extending outwardly from said second wave guide, a fifth wave guide extending outwardly from said third wave guide, and a series of radiators disposed in spaced relationship along said fourth and fifth wave guides, said second wave guide being shorter than said third wave guide by an amount equal to a quarter of a wave length at the frequency of operation of said antenna, said fourth and fifth wave guides extending outwardly in diametrically opposed directions and said radiators comprising dipoles communicating with and energized from said fourth and fifth wave guides.

2. An antenna comprising a first rectangular wave guide, a horn flaring outwardly from one end of said wave guide, a pair of wave guides attached to the flared end of said horn, said last-mentioned wave guides being disposed in the back-to-back relationship with their contacting walls bisecting said flared end and forming a septum, one wave guide of said pair being longer than the other by an amount equal to a quarter wave length at the frequency of operation of said antenna, a radiating wave guide extending perpendicularly away from each of said pairs of wave guides, said radiating wave guides extending in diametrically opposite directions, and a series of dipoles spaced along said radiating wave guides and communicating with the interiors of said radiating wave guides.

3. Apparatus as in claim 2 wherein the dipoles spaced along the radiating wave guide extending from the shorter wave guide of said pair are shielded in two parallel planes by conductive strips substantially similar to and continuous with the walls of said last-mentioned radiating wave guide.

4. An antenna assembly comprising, in combination, a first section of rectangular wave guide, a tapered horn connected to one end of said section, first and second L-shaped rectangular wave guide members having their vertical arms attached to the mouth of said horn, the vertical arms of said members being disposed in a back-to-back relationship along the symmetrical axis of said horn so that the horizontal arms of said members extend in opposite directions, said vertical arms differing in length by a quarter wave length of the frequency of the electromagnetic energy being propagated therein, first and second groups of dipole radiators mounted along corresponding walls of the horizontal arms of said first and second members, respectively, with corresponding dipoles

of said groups being symmetrically displaced with respect to said axis.

5. In an antenna assembly as defined in claim 4 a pair of parallel conductive plates forming extensions of the walls of the horizontal arm of the L-shaped member having the shorter length, said plates extending in the direction of energy radiation and having a width such that the electromagnetic energy radiated by said first and second groups of dipoles are substantially in phase at a plane passing through the group of dipoles mounted on the L-shaped member having the longer vertical arm.

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