Oct. 7, 1941. P. S. CARTER 2,258,406

WIDE BAND ANTENNA

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Fig. 1

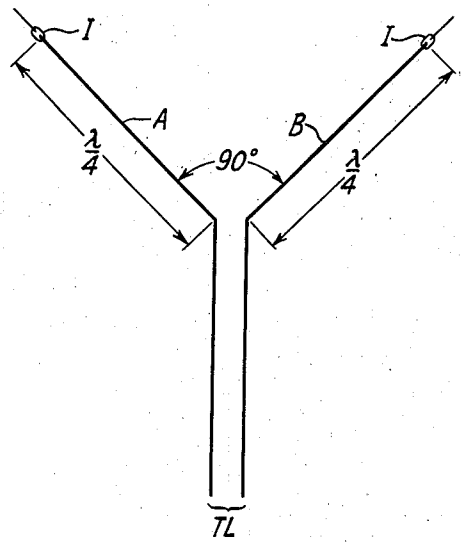


Fig. 3

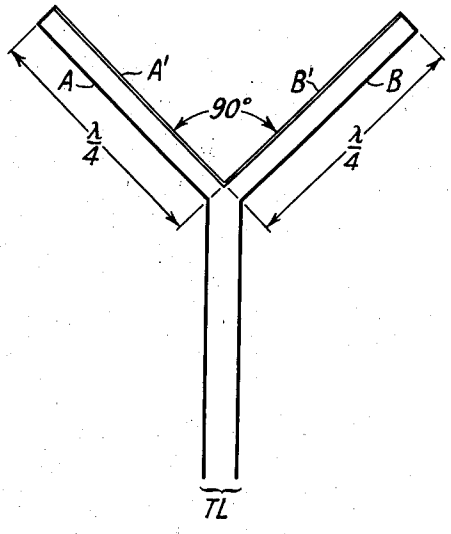


Fig. 2

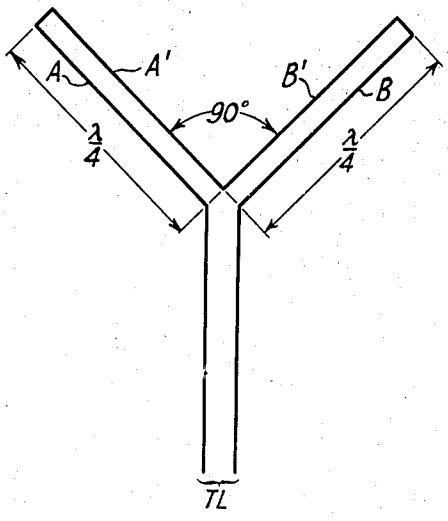
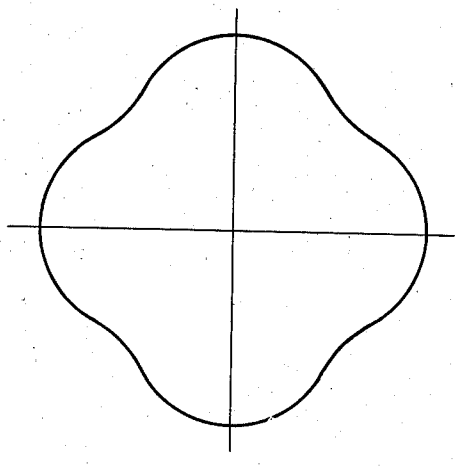


Fig. 4



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WIDE BAND ANTENNA

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Fig. 5

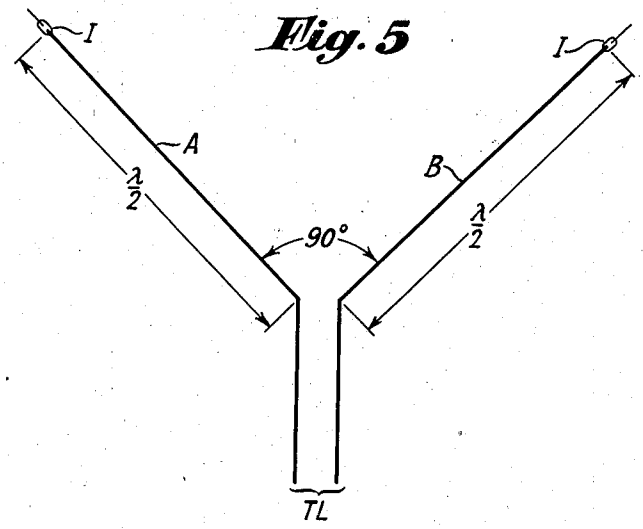


Fig. 6

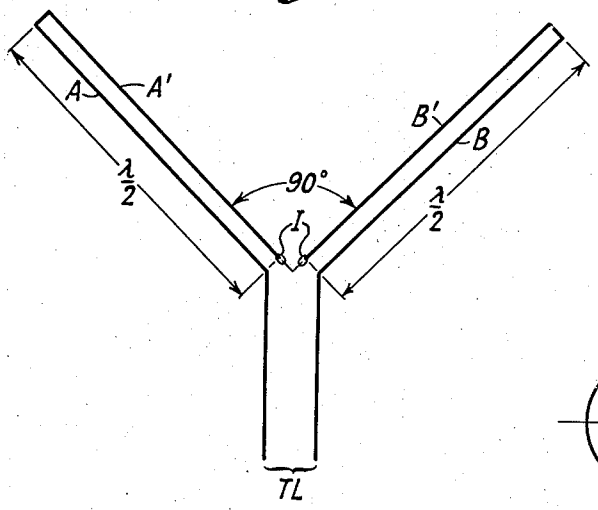
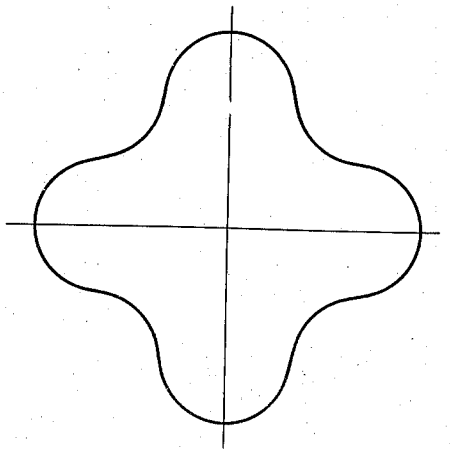


Fig. 7



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2,258,406

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2,258,406

WIDE BAND ANTENNA

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Application April 16, 1938, Serial No. 202,460

5 Claims. (Cl. 250—33)

The present invention relates to antennas and, more particularly, to antennas for use with wide band television reception and transmission.

The primary object of the present invention is to provide an efficient television antenna for transmission or reception of horizontally polarized waves which may be easily and simply erected.

Another object is to provide a television antenna for transmission or reception of horizontally polarized waves which is substantially non-directional.

Still another object of the present invention is to provide a simple broad band antenna which may be directly connected to a transmission line.

The most common type of antenna used for transmission and reception of horizontally polarized waves is a horizontal half wave dipole. The radiation pattern for this type of antenna is a figure of 8 in the horizontal plane, the radiation being zero in directions corresponding to the axis of the antenna. This type of antenna requires the use of an auxiliary circuit when its impedance is matched to a transmission line.

The present invention overcomes the above mentioned objectionable radiation and frequency band characteristics while still maintaining the simplicity of the commonly used half wave dipole.

Briefly, my invention consists of an antenna comprising two conductor arms forming an angle of 90 degrees with each other, having a transmission line connected to their apex, and supported at their non-adjacent ends by means of insulators connected to any suitable supports. The conductors may be either a quarter or a half wave in length and they may each be a single wire or each comprise a plurality of parallel wires connected in series. If a plurality of wires are used the wires are very closely spaced, perhaps a one-hundredth of a wave length apart. The radiation pattern of such an antenna in the plane of the conductors does not appreciably depart from a circle, in the case of an antenna having quarter wave length arms the minimum field strength being about 71 percent of that of the maximum so that for practical purposes it should be useful for reception in any direction. In the case of an antenna having half wave length arms the minimum is somewhat smaller. On the other hand, the impedance of such an antenna is somewhat higher reducing difficulties in matching the antenna to a transmission line.

A better understanding of the invention is to be had by referring to the following detailed description which is accompanied by drawings wherein Figures 1, 2, 3, 5 and 6 illustrate various embodiments of the present invention while Figures 4 and 7 illustrate approximate radiation patterns of my antenna.

Referring, now, to Figure 1, my antenna comprises, as shown in this figure, two conductors A and B, lying in a substantially horizontal plane, each a quarter of a wave in length and forming an angle of 90 degrees with each other. At their apex a transmission line TL is connected. The non-adjacent ends of conductors A and B are supported by means of insulators I which are connected to any convenient supporting structure (not shown). If it is desired to connect the antenna to a two wire transmission line having a somewhat higher impedance than that usable with the embodiment shown in Figure 1, the modification shown in Figure 2 may be used. By the scheme shown in this figure the impedance of the antenna may be transformed to a value four times that of a simple two-wired V. In this modification conductors A, A' and B, B' are very closely spaced from one another, perhaps a distance of one one-hundredth of a wave length and are electrically connected at their ends. The currents flowing in the two conductors will be in the same direction in space, although in opposite directions within the antenna circuit due to phase reversal at the ends. Consequently, the arrangement will be almost identical in its radiation characteristic with that of the single wire antenna shown in Figure 1. However, as previously pointed out, the resistance will be four times that of the simple two wire V.

In the modification shown in Figure 2 it has been assumed that the conductors are of the same diameter. This does not have to be the case, however, and if desired the conductors may have different diameters, particularly in cases where it is desired to depart from an even transformation ratio. By making the diameters of the two wires A, A', B, B' unequal, as shown in Figure 3, almost any desired transformation ratio may be obtained.

When conductors of different diameters are employed in the antenna system it will be found that the conductor of larger diameter will carry the larger current. The difference in the amount of current carried by the conductors of different diameters results in a different transformation ratio from the case where the conductors are of the same diameter. The reason the larger diameter conductor carries a greater current than the smaller diameter conductor in the antenna system is due to the fact that the larger diameter conductor has less series reactance for unit of length than the smaller diameter conductor. Obviously, if desired, conductors A and B may be made larger in diameter than conductors A', B'. The effect of this change is to make the transformation ratio less than that of a similar antenna system where the conductors are of the same diameter.

Figure 4 illustrates approximately the radia-

tion pattern obtained with the embodiments of my invention shown in Figures 1, 2 and 3 wherein the arms are each a quarter wave in length.

Figure 5 illustrates a further modification of my invention wherein the conductors A and B are each a half wave in length. Otherwise, this figure is exactly the same as in Figure 1.

With the antenna constructed in this manner there is more variation in field strength with direction than with the first type but this modification has a higher radiation resistance which is an advantage in matching the antenna to the usual type of transmission line.

As shown in Figure 6, it is also possible to obtain different input impedances with the antenna having half wave length arms by adding a second pair of conductors A', B' to the system. These conductors are arranged in the same way as described for Figure 2. However, in this embodiment the conductors A', B' must not be connected in the center, for if this were done the currents in the two conductors would be equal and opposite and the radiation resistance of the system would be negligibly small.

Figure 7 shows the approximate radiation pattern obtained using the antennas shown in Figures 5 and 6.

While I have illustrated and described my particular arrangements for carrying the invention into effect, my invention is by no means limited to the particular arrangements shown and described and modifications may be made without departing from the scope and spirit of the invention.

I claim:

1. In an antenna system comprising a pair of separated conductors forming an angle of 90 degrees with each other and means for energizing said conductors in an opposing phase relationship comprising a transmission line directly connected to the adjacent ends of said pair of conductors, means for matching the impedance of said antenna to said transmission line over a wide band of frequencies comprising a second pair of conductors of the same length as said first pair arranged parallel to said first pair of conductors and closely spaced therefrom, said second pair of conductors being connected to said first pair at points removed from said adjacent ends, whereby there is minimized the existence of reflected waves on said transmission line which might disturb the radiation characteristics of said antenna conductors.

2. In an antenna system comprising a pair of separated conductors having a length equal to a multiple, including unity, of a quarter of the length of the operating wave and forming a horizontal angle of 90 degrees with each other, and a transmission line directly connected to the adjacent ends of said pair of conductors for energizing said conductors in phase opposition, means for matching the impedance of said antenna to said transmission line over a wide band of frequencies comprising a second pair of conductors arranged parallel to said first pair of conductors and closely spaced therefrom, said second pair of conductors being connected to said first pair at points removed from said adjacent ends, whereby there is minimized the existence of reflected waves on said transmission line which might disturb the radiation characteristics of said antenna conductors.

3. In an antenna system comprising a pair of separated conductors having a length equal to a quarter of the length of the operating wave and forming an angle of 90 degrees with each other and a transmission line directly connected to the adjacent ends of said pair of conductors for energizing said conductors in phase opposition, means for multiplying the impedance of said antenna to a value equal to that of said transmission line over a wide band of frequencies comprising a second pair of conductors of the same length as said first pair arranged parallel to said first pair of conductors and closely spaced therefrom, the adjacent ends of said second pair of conductors being connected together, said second pair of conductors being connected to said first pair at points removed from said adjacent ends and said second pair of conductors having a different diameter than said first pair whereby said impedance multiplication is an odd value, whereby there is minimized the existence of reflected waves on said transmission line which might disturb the radiation characteristics of said antenna conductors.

4. In an antenna system comprising a pair of separated conductors having a length equal to a quarter of the length of the operating wave and forming a horizontal angle of 90 degrees with each other and a transmission line directly connected to the adjacent ends of said pair of conductors for energizing said conductors in phase opposition, means for multiplying the impedance of said antenna to a value equal to that of said transmission line whereby reflection of energy into said transmission line is prevented comprising a second pair of conductors of the same length as said first pair arranged parallel to said first pair of conductors and spaced therefrom a distance of the order of 1/100 of the operating wave length, the adjacent ends of said second pair of conductors being connected together, said second pair of conductors being connected to said first pair at points removed from said adjacent ends and said second pair of conductors being of the same diameter as said first pair of conductors.

5. In an antenna system comprising a pair of separated conductors having a length equal to half the length of the operating wave and forming a horizontal angle of 90 degrees with each other, and a transmission line directly connected to the adjacent ends of said pair of conductors for energizing said conductors in phase opposition, means for matching the impedance of said antenna to the impedance of said transmission line over a wide band of frequencies whereby reflection is preverted comprising a second pair of conductors of the same length as said first pair arranged parallel to said first pair of conductors and closely spaced therefrom, said second pair of conductors being connected to said first pair at points removed from said adjacent ends, said second pair of conductors having a different diameter than said first pair whereby the impedance change due to said second pair is an odd multiple, whereby there is minimized the existence of reflected waves on said transmission line which might disturb the radiation characteristics of said antenna conductors.

PHILIP S. CARTER.