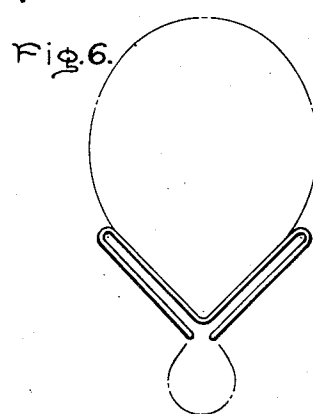
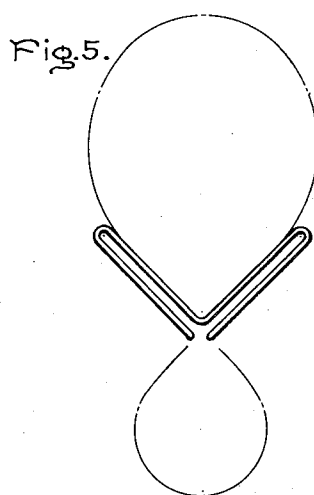
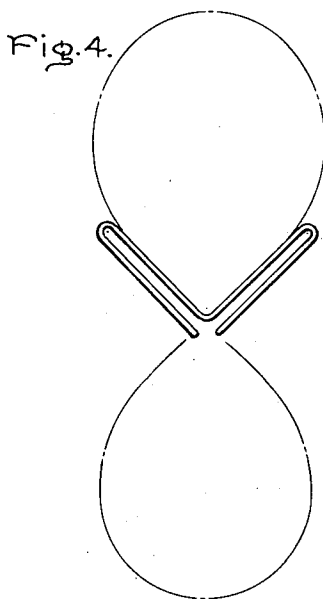
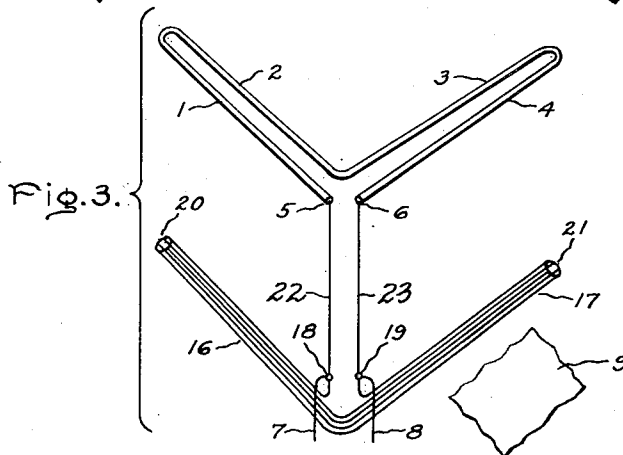
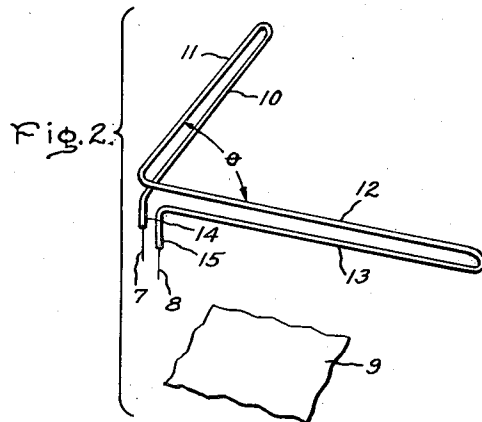
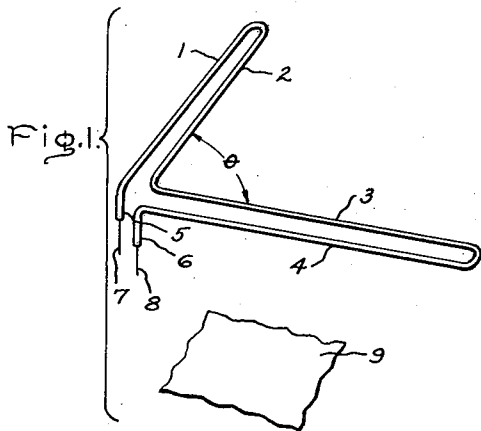


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RECEIVING ANTENNA
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UNITED STATES PATENT OFFICE

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RECEIVING ANTENNA

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2 Claims. (Cl. 250—33.65)

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My invention relates to antennas and, in particular, to antennas for the reception of high frequency waves occurring over a broad band of frequencies, such as the television frequency bands. It is an object of my invention to provide a new and improved high frequency receiving antenna which affords improved operating characteristics over a plurality of high frequency bands displaced in frequency by a substantial frequency difference.

Television signals are broadcast at present in two high frequency bands, one of which covers the range from 54 to 88 megacycles and the other of which is displaced from the first band by a substantial frequency difference and covers the range from 174 to 216 megacycles. It is desirable to provide television receivers which are adapted to receive signals occurring in either of these bands. The strength of signals which are obtained on these bands, however, is controlled in the first instance by the antenna which intercepts the high frequency signals and translates them to the television receiver. It has been customary to use for this purpose a straight folded half-wave dipole, each arm of the dipole measured from the center to either end having a length equal to one-quarter wavelength at a frequency of approximately 65 megacycles. It has been found that such an antenna provides satisfactory reception of all signals occurring in the lower frequency band of the two bands in which the television signals occur. However, in the higher frequency band, i. e., in the band from 174 to 216 megacycles, this type of antenna operates as a three-halves wavelength antenna having three current maxima along the antenna, two of the current waves being in phase, while the third one is 180° out of phase with respect to the other two. As a result, it has been found that such an antenna provides a voltage at its output terminals which is only approximately one-third that which is provided by an antenna of this type having a maximum possible efficiency. Accordingly, it is an object of my invention to provide a new and improved television receiving antenna which provides a large voltage at its output terminals for received signals varying over a wide range of frequency.

In accordance with one embodiment of my invention, a folded dipole type of antenna is formed as a V type antenna having a vertex angle such that a maximum voltage is provided at its output terminals. In another of its forms, my invention provides a folded dipole formed as a V antenna which is provided with a driven reflector also of the V type.

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The features of my invention which I believe to be novel are set forth with particularity in the appended claims. My invention itself, however, both as to its organization and method of operation, together with further objects and advantages thereof, may best be understood by referring now to the following description taken in connection with the accompanying drawing in which Fig. 1 is a schematic perspective view of the antenna of my invention; Fig. 2 is a schematic perspective view of a modification of the antenna of Fig. 1; Fig. 3 is a schematic perspective view of another embodiment of my invention including a driven type reflector; and Figs. 4-6 are diagrams illustrating certain characteristics of my antenna structure.

Referring to the drawing, in Fig. 1 there is shown a folded dipole type of antenna comprising four coplanar conductors 1-4, conductors 1, 2 and 3, 4, respectively, being connected at their outer extremities. Conductors 2, 3 are connected at their adjacent ends, while conductors 1 and 4 are provided at their adjacent ends with output terminals 5, 6 to which are connected the conductors 7, 8 of a transmission line. The conductors 1-4 are illustrated as being arranged in a horizontal plane parallel with a ground plane illustrated as the plane 9. The conductors may be supported by any conventional type of supporting means, such as a mast (not shown). The pairs of conductors 1, 2 and 3, 4 are arranged, respectively, at an angle to each other to form a V type of antenna, conductors 2 and 3 being joined at the vertex of the V and the output terminals 5, 6 being provided at the vertex of the angle formed by conductors 3, 4. Preferably, the pairs of conductors 1, 2 and 3, 4 are spaced apart in the plane by a relatively small distance. Likewise, the length of each of the conductors 1-4 is made approximately equal to a quarter wavelength of a high frequency wave having a frequency of 65 megacycles.

I have found that in an antenna so constructed, the voltage available at the output terminals 5, 6 varies with the vertex angle θ of the V at the higher frequency band to be covered, namely, the range from 174 to 216 megacycles. In a straight folded dipole type of antenna in which each arm has a length equal to a quarter wavelength at the frequency of 65 megacycles, at the higher frequency band there occur three current maxima along the antenna, two of which are in phase and one of which is 180° out of phase. In contrast, in an antenna constructed as illustrated in Fig. 1, while the wave of current on the

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antenna still has three maxima, the space phases are such that there is no complete cancellation of one of the two in-phase portions of the current wave by the out-of-phase portion of the current wave. The relation of the relative responses, i. e., the voltage at the output terminal with the vertex angle of the V, may best be shown by the following table:

Angle of V (degrees)	Relative Response
180	0.333
160	0.410
140	0.543
120	0.645
108	0.666
100	0.659
80	0.603
40	0.336
20	0.173
0	0.000

In the above table, the relative response is given as the decimal part of the voltage available at the output terminals 5, 6 when a wave having a frequency of 65 megacycles is received. From the above tabulation of the response characteristic versus vertex angle of the V, it is readily seen that a substantially uniform performance is obtained when the vertex angle lies within the range of 100° to 120°, the maximum response being obtainable at a vertex angle of 108°.

In the construction of Fig. 2, there is shown a folded dipole type of antenna in which the arms of the dipole are arranged to form a V type of antenna and also in which the conductors which form the respective arms are arranged in vertical planes. Thus, in this construction, the conductors 10, 11 which form one arm of the V antenna are arranged in a first vertical plane, whereas the conductors 12, 13 which form the other arm of the V antenna are arranged in a second vertical plane which is displaced from the first vertical plane by the angle θ . The conductors 10, 11 and 12, 13, respectively, are conductively connected at their outer extremities. Conductors 11 and 12 are connected at their adjacent extremities, while conductors 10, 13 are provided with output terminals 14, 15 at their adjacent terminals. The pairs of conductors 10, 13 and 11, 12 are arranged in parallel horizontal planes which, preferably, are parallel with the ground plane 9. The conventional type of output transmission lines 7, 8 may be attached to the output terminals 14, 15. I have found that the construction illustrated in Fig. 2 gives added rigidity in a vertical plane to aid in preventing sagging of the respective conductors.

On the other hand, the response characteristic of this antenna is substantially identical with that illustrated in Fig. 1 and follows almost exactly that given in the tabulation of relative response versus vertex angle set forth above. Here again, it is readily apparent that the output voltage available at the terminals 14, 15 in the high frequency television band is substantially twice as great as that which is available at the output terminals of a straight type of folded dipole of the same dimensions in this higher frequency television band.

In the embodiment of my invention illustrated in Fig. 3, there is shown a television receiving antenna which provides unidirectional characteristics over a relatively wide frequency band. This structure comprises a folded dipole antenna of the V type, the component conductors of which may be arranged in the configurations of either

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Fig. 1 or Fig. 2 and which are illustrated as conductors 1—4 arranged similarly to those illustrated in Fig. 1. Arranged parallel with the respective arms of the V antenna are the arms 16, 17 of a composite reflector structure. Each of the arms 16, 17 comprises a plurality of parallel conductors, the exact number of which is arranged to give a desired output impedance value at the terminals 18, 19. All but one of the component conductors of the arms 16, 17 are continuous between their outer extremities 20, 21. The one of the component conductors which is not continuous is open at its center point to provide the terminals 18, 19. Preferably, the component conductors are conductively connected at the outer extremities 20, 21, as by soldering to a supporting ring or in any other desirable manner.

For operating as a receiving antenna for television signals, the conductors 1—4 and the component conductors of the arms 16, 17 each have a length equal to a quarter wavelength at one of the frequencies within the lower band of television signal frequency, for example 65 megacycles. The distance, therefore, between the extremities 20, 21 through one of the continuous conductors of the arms 16, 17 is then equal to a half wavelength at this frequency. Likewise, the spacing between the V antenna and the driven reflecting element is made equal to a quarter wavelength at this same frequency. The output terminals 5, 6 of the folded V doublet are connected to the terminals 18, 19 of the reflector by a quarter wavelength of the transmission line comprising conductors 22, 23. The output voltage of the antenna is obtained by means of a transmission line 7, 8 connected to terminals 18, 19.

In an antenna, of the type illustrated, it is customary to connect the output terminals of the antenna to a transmission line which has a characteristic impedance of 300 ohms. Accordingly, the antennas of Figs. 1 and 2 are both constructed to have an impedance at their output terminals of this value. In constructing the antenna of Fig. 3, however, due to the mutual impedance of the reflector elements 16, 17, the antenna structure 1—4 has a radiation resistance of approximately 403 ohms. Consequently, I have found that, when the arms 16, 17 comprise five conductors, a driven reflector may be obtained which has a resistance of approximately 1000 ohms. A parallel combination of this resistance with the resistance of the antenna elements gives an effective resistance of 300 ohms at the terminals 18, 19 for matching with the transmission line 7, 8.

An important advantage of my improved construction is that it provides a receiving antenna particularly useful for the reception of television signals which has a broad band characteristic and which provides improved reception in both bands of frequencies set aside for television signals. The antenna structures are relatively simple in nature and easily constructed. The structures of Figs. 1 and 2 provide bidirectivity in the lower frequency band and substantially unidirectivity in the upper frequency band, whereas the structure of Fig. 3 has a unidirectional characteristic frequency in both bands which makes it particularly suitable for receiving signals coming from a particular direction on either band. Diagrams illustrating the characteristic of the antennas of Figs. 1 and 2 are shown in Figs. 4—6. Fig. 4 shows the reception characteristic of these antennas at the low television frequencies, that

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is, at about 50 megacycles; Fig. 5 illustrates the characteristic of these antennas at an intermediate frequency of about 90 megacycles; and Fig. 6 illustrates the characteristic of the antennas at the highest band television frequencies of approximately 200 megacycles. Thus, Fig. 4 illustrates that structures of the antennas of Figs. 1 and 2 are bidirectional at the lower television frequencies. That reception from one direction is reduced somewhat at a slightly higher frequency is illustrated by the characteristic shown in Fig. 5. At the highest television frequencies, the characteristic shown in Fig. 6 indicates the relative unidirectivity of the structure. It is apparent that the antennas of Figs. 1 and 2 require no reflector in this high frequency band to provide a good unidirectivity characteristic.

While I have shown particular embodiments of my invention, it will of course be understood that I do not wish to be limited thereto since various modifications may be made, and I contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. An antenna for operation over a relatively low frequency band and a relatively high frequency band, said high frequency band being approximately three times the frequency of said low frequency band comprising two parallel pairs of angularly disposed closely spaced conductors, said conductors being connected together at their outer extremities, one of the conductors of each of said pairs being conductively connected at their adjacent ends, a reflector comprising two groups of parallel conductors, the conductors of each of said groups being parallel respectively with conductors of one of said pairs of conductors, one conductor of each of said groups having the inner end thereof connected to the adjacent end of the corresponding other conductor of each of said pairs of conductors, corresponding ones of the remaining conductors of said groups being conductively connected at their adjacent ends, all of the conductors of said groups being connected together at their outer ends, the spacing between each of said groups of conductors and a corresponding one of said pairs of conductors being equal to substantially a quarter wavelength at a particular frequency within said low frequency band, the conductors of said groups and of said pairs of conductors all having a length substantially equal to said spacing, the angle between said pairs of conductors and the

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angle between said groups of conductors each being substantially 108° whereby substantially maximum response is obtained over said high frequency band, and a transmission line connected to the adjacent ends of said one conductors of said groups.

2. An antenna for bi-directional operation over a first frequency band and substantially unidirectional operation over a second frequency band the mean frequency of said second band being approximately three times as high as the mean frequency of said first frequency band, comprising, two parallel pairs of angularly disposed conductors, a first conductor of each of said pairs being connected together at the adjacent end thereof, the conductors of both of said pairs being closely spaced and being connected together at their outer ends, a reflector comprising two angularly disposed conductors arranged parallel and substantially coplanar with the conductors of said pairs, adjacent terminals of said two conductors being connected respectively to the adjacent terminals of the other conductors of said pairs, each of said two conductors being parallel respectively with one of said pairs of conductors and being spaced therefrom by a distance substantially equal to a quarter wavelength at the mean frequency of said first frequency band, said two conductors and said pairs of conductors all having a length substantially equal to a quarter wavelength at the mean frequency of said first frequency band, and the angle between said pairs of conductors being substantially equal to 120° , thereby to provide substantially maximum unidirectional response at the mean frequency of said second frequency band.

ROBERT B. DOME.

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