Dec. 1, 1953 M. P. MIDDLEMARK 2,661,423

MULTIDIRECTIONAL ANTENNA WITH INCLUDED REFLECTOR

Filed April 27, 1953 2 Sheets-Sheet 1

Fig. 1.

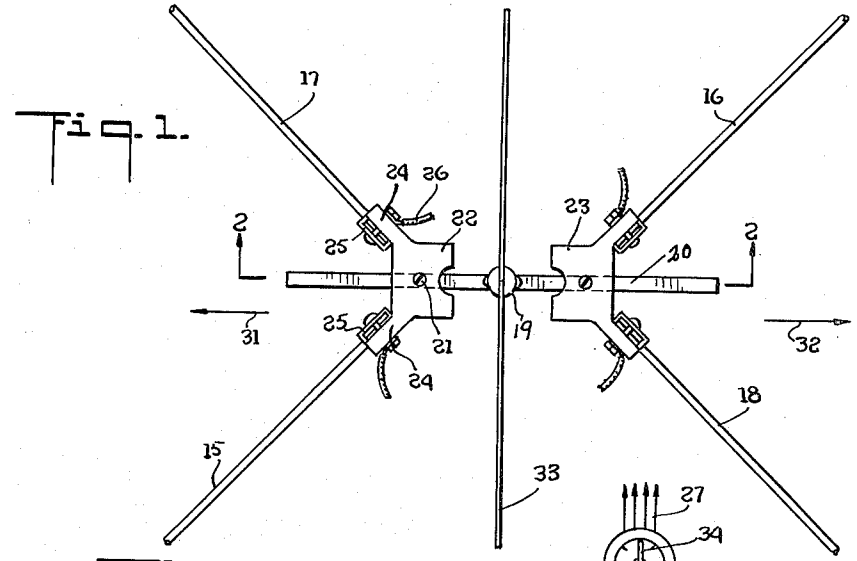


Fig. 2.

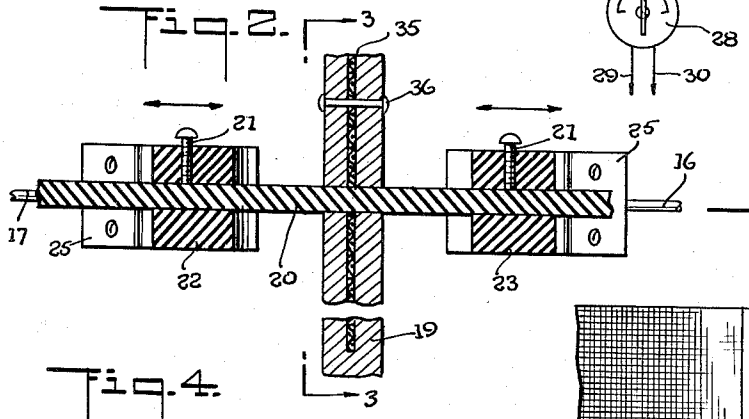


Fig. 3.

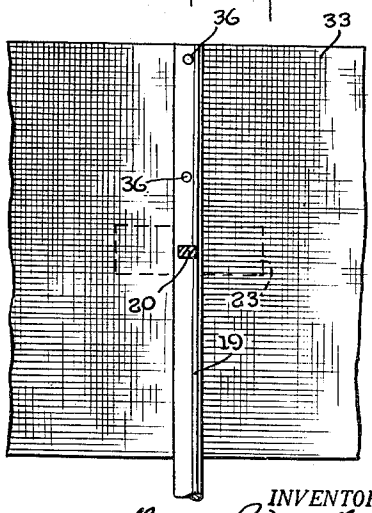
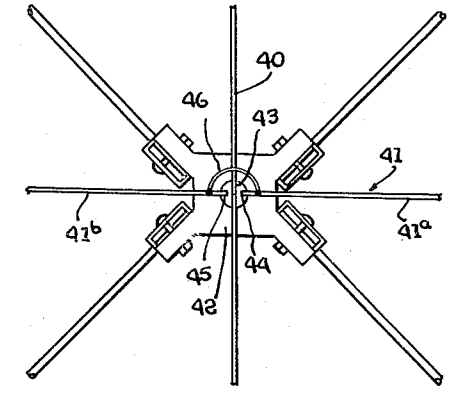


Fig. 4.



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MULTIDIRECTIONAL ANTENNA WITH INCLUDED REFLECTOR

Filed April 27, 1953 2 Sheets-Sheet 2

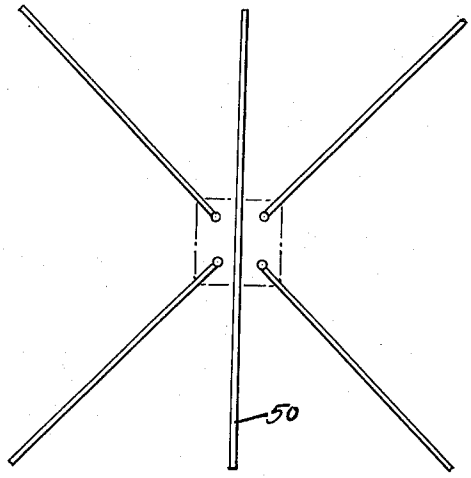


Fig. 5.

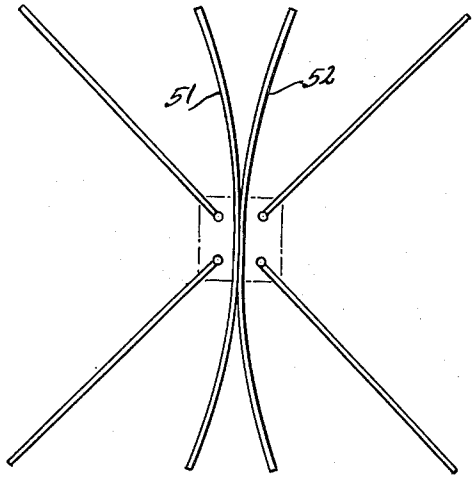


Fig. 6.

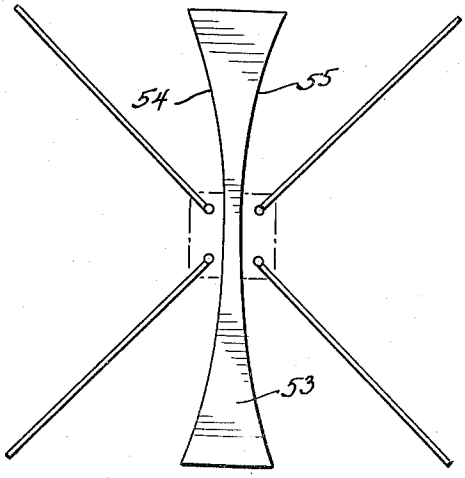


Fig. 7.

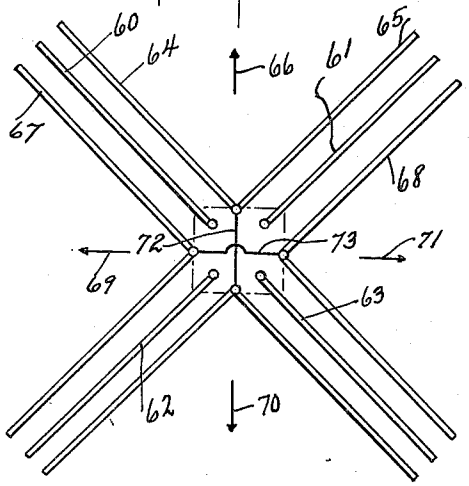


Fig. 8.

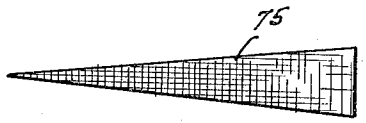


Fig. 9.

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MULTIDIRECTIONAL ANTENNA WITH INCLUDED REFLECTOR

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Application April 27, 1953, Serial No. 351,199

18 Claims. (Cl. 250—33.65)

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This invention relates to high frequency antenna arrays such as may be used in television systems or the like.

The invention is particularly concerned with a simplified form of parasitic device such as a reflector which is employed with an antenna array capable of multidirectional service without requiring physical rotation. Thus, the antenna system of the instant invention employs a direction selector switch such as was described and illustrated in my prior Patent 2,625,655. Reference is also made to my Patents 2,585,670 and 2,609,503 which disclosed crossed dipoles in combination with a selector switch for selecting various effective directions of reception and to my co-pending application Serial Number 241,959 filed August 15, 1951.

In accordance with the instant invention, I employ a sheet serving as a parasitic which serves two opposite directions. This is accomplished by interposing the sheet between two oppositely directed dipole rod pairs so that the one sheet serves both such pairs. Means are also disclosed for varying the polar characteristics of the system by adjusting the distance between either or both dipole pairs and the parasitic sheet.

In another embodiment of the invention, I disclose a pair of parasitic sheets which are crossed and jointly serve in many directions so that a direction which is selected by operation of the selector switch is automatically provided with a parasitic device. In a still further embodiment of the invention I provide crossed parasitic elements which serve both as reflectors and directors in any selected direction.

The invention will be further understood from the following description and drawings in which:

Figure 1 is a top plan view of one form of the invention herein;

Figure 2 is an enlarged cross-sectional view as taken along the line 2—2 of Figure 1;

Figure 3 is an elevational view as taken along the line 3—3 of Figure 2;

Figure 4 is a top view illustrating a modification of the antenna system shown in Figure 1.

Figures 5, 6 and 7 are modified embodiments of the antenna system disclosed in Figures 1 to 3; and

Figure 8 is a schematic view of a further modification wherein the parasitic members are arranged to serve both as directors and reflectors in any selected direction.

Figure 9 is a plan view of a modified form of dipole rod.

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Referring now to Figures 1 to 3, the fed or primary elements of the antenna array comprise the dipole rods 15 and 16 forming one dipole and the rods 17 and 18 forming another dipole which is crossed relative to the first dipole so as to be generally in the form of an X. As set forth in my prior patents above mentioned, the selection of various pairs of dipole rods produces variations in directivity as will be referred to hereinafter.

The array is provided with a mast 19 which supports the entire structure. In order to support the antenna elements themselves, a cross beam 20, illustrated as extending through an opening in mast 19 is employed. Connected to the beam 20 as by set screws 21 are a pair of insulating brackets 22 and 23. Each bracket is provided with a pair of wings 24 which are designed to support one of the dipole rods in more or less conventional manner or as set forth in my prior patents. Thus, each wing is provided with a semi-circular groove which receives a dipole rod, and a clamp 25 tightens the dipole rod in the groove.

A wire 26 extends from each clamp so as to effect electrical contact with the corresponding dipole rod. These four wires are connected to the input wires 27 of the direction selector switch 28. The function of selector switch 28 is to select any pair of dipole rods so as to constitute the fed or primary elements of the array and connect them to the input terminals of a television receiver by the output wires 29 and 30. The switch may assume the exact form disclosed in my Patent No. 2,625,655 or in my other patents. However, it will generally be unnecessary to provide a shorting member for the non-selected elements to produce a reflector thereof since the instant system provides its own parasitic as will be shown hereinafter.

Specifically I will discuss hereinafter the selection of dipole rods 15 and 17 for connection to the television receiver so as to produce directivity in the direction of arrow 31, and the alternative selection of dipole rods 16 and 18 to produce directivity in the direction of arrow 32. When these directions are selected, the reflector or parasitic screen 33 serves the function of increasing directivity and gain.

Screen or sheet 33 is planar and rectangular. It is vertically disposed and extends perpendicularly to cross beam 20 effectively dividing the X form of the dipoles into two V formations with the apices of the respective V's facing each other and the mouths thereof oppositely directed. The vertical sheet 33 thus bisects an imaginary

line connecting said apices. In addition, the sheet 33 is symmetrically disposed with respect to the four dipole rods which diverge therefrom. Of course, the cross beam 20 may also be considered a further axis of symmetry from which the dipole rods diverge. It will further be noted that the cross beam 20 is coincident with a common angle bisector for both V formations and that the screen 33 extends perpendicularly thereto on both sides of said common angle bisector equally. Let us assume that switch arm 34 is manually set to select dipole rods 15 and 17 and connect them to wires 29 and 30 for directivity pursuant to arrow 31. Sheet 33 provides a parasitic screen for this direction. On the other hand, should rods 16 and 18 be thus selected, the same sheet 33 performs the same function for the opposite direction. Thus, the advantages of a parasitic are provided for both directions by a single sheet and without requiring any physical movement thereof.

Sheet 33 is illustrated as being of a metallic mesh material for both lightness and minimum wind resistance but it may be of solid sheet form or spaced wire form. In the form shown it is set in a central longitudinal slot 35 of mast 19 and is secured thereto by fasteners 36. Cross beam 20, being square in cross section helps to prevent vertical tilting of the sheet.

Means are provided to vary the effective distances between the pairs of dipole rods and the sheet 33 for the purpose above mentioned. Thus, the set screws 21 permit the transverse adjustment of the brackets on the beam 20. In other words, the optimum spacing may be set for any frequency or band of frequencies.

In Figure 4, I show the use of crossed, perpendicularly related sheets 40 and 41 for providing parasitic or reflector service for a variety of directions. The bracket 42 is of one piece construction and has four wings or grooved portions for receiving the respective dipole rods. The mast 43 is of insulating material such as Bakelite although it is obvious that only the sheet supporting portion thereof need be of insulating material or provided with suitable insulation against one or both of the sheets 40 and 41. A longitudinal slot receives sheet 40 as in the previous embodiment but, in order to insulate sheet 41 therefrom, sheet 41 is interrupted along its vertical, center line, being formed of two halves i. e. 41*a* and 41*b* which are set in longitudinal, peripheral slots 44 and 45 respectively where they may be retained either frictionally or by any suitable clamping means. In order to connect the halves together a jumper wire 46 is provided and this may be threaded through one of the openings of mesh screen 40.

When the direction selector switch 28 is employed with the arrangement of Figure 4, it will be evident that a reflector or parasitic sheet will be provided for or at least four and probably most if not all of the directions which may be selected. It will be observed that vertical halves of each sheet radiate from a center which is common to the dipole rods and that such halves bisect every angle formed by adjacent dipole rods.

Referring to Figure 5, this shows the arrangement of Figure 1 in substantially schematic form save that the sheet 33 is replaced by a linear rod 50 which serves as a parasitic element. It will be understood that not only the dipole rods but the parasitic rod 50 may assume any forms conventional in the art such as, for example, folded dipoles or rods, or V or fan-shaped members.

In order to better serve the functions of reflection or the like, I have also devised concavo-convex parasitic members 51 and 52, the concavities of which face the respective apices of the V-shaped antenna elements which provide the desired directivity. The elements 51 and 52 are, therefore, substantially parabolic in respect to the fed elements of the antenna which they serve. It will be understood that elements 51 and 52 may be of either rod or sheet form.

In Figure 7 is shown a unitary structure employing the principles of Figure 6. Thus, parasitic element 53 is concave on both sides thereof so as to similarly serve as a parabolic parasitic or reflector as do the elements of Figure 6. Parasitic element 53 may be of planar form wherein the opposite sides 54 and 55 function like the rods 51 and 52 or it may be a solid member extending in sheet form such as in the embodiment of Figure 1.

Figure 8 disclosed a novel form of parasitic arrangement serving the antenna elements 60, 61, 62 and 63, any two of which will be selected by the directional selector switch for application to the input terminals of the television receiver. The device of Figure 8 resembles that of Figure 4 save that the parasitic elements take the form of V's instead of straight rods. Thus, rods 64 and 65 are in V form and serve as a parasitic director element for the fed antenna elements 60 and 61 when directivity in the direction of arrow 66 is selected. It will be noted that the same time parasitic rods 67 and 68 serve jointly as a reflector for this same direction. It will be observed, therefore, that selecting antenna elements to achieve directivity in the remaining directions i. e. arrows 69, 70 and 71 provides both directors and reflectors for the selected direction and with the very compact and simple antenna array shown. Each V-shaped parasitic device such as that comprising the connected rods 64 and 65 are connected to an opposite parasitic pair by either of the wires 72 or 73, these wires being shown as insulated from each other although some advantages are gained by connecting them. In reference to the above statement that Figure 8 substitutes V formations for the rods or sheets of Figure 4, it may be observed that a structure somewhat similar in function to Figure 8, may be achieved by adding V elements to the ends of sheets 40 and 41 in Figure 4. The apex of each V will be disposed at the outer ends of the parasitic elements whether in sheet or rod form and in the same horizontal plane as the primary elements and the arms of the V will extend outwardly in the above plane and parallel to two adjacent primary elements. The length of each arm will be approximately equal to that of the primary elements although it may vary downwardly to about one-half of such length. In Figure 9, the member 75 is of elongated triangular, planar form and may be employed as a dipole rod in any of the above embodiments.

What is claimed is:

1. An antenna system comprising a plurality of substantially horizontal antenna elements diverging from a common axis of symmetry, means to select different combinations of said antenna elements for connection to the input terminals of a television receiver so as to vary the directivity of reception, and a planar sheet disposed vertically among and centrally of said antenna elements and in substantial coincidence with said axis of symmetry, a pair of said antenna elements being disposed on one side of said sheet so as to provide directivity in one direction and another pair of

said antenna elements being disposed on the other side of said sheet so as to provide directivity in an opposite direction and whereby said sheet serves equally as a parasitic element for both of said pairs.

2. An antenna system comprising a pair of crossed dipoles, each of said dipoles comprising two dipole rods so that said pair of crossed dipoles comprises four dipole rods, a first bracket, a pair of adjacent dipole rods being secured and supported by said first bracket, said pair of dipole rods forming a V, a second bracket, the remaining two dipole rods being secured to and supported by said second bracket and forming a V having its apex adjacent the apex of the first-named V-shaped pair of dipole rods, and an elongated member of metallic material disposed between said apices and bisecting a common angle bisector of both of said V's.

3. An antenna system according to claim 2 and including a cross beam, each of said brackets being mounted on said cross beam and being transversely adjustable thereon, said elongated member being secured to said cross beam whereby adjustment of said brackets varies the distance between each apex and the elongated member.

4. An antenna system according to claim 3 and wherein said elongated member is a sheet of metallic mesh material and each of said brackets is slidable on said cross beam, and a set screw for tightening each bracket on said cross beam.

5. An antenna system comprising a pair of crossed dipoles, each of said dipoles comprising two dipole rods so that said pair of crossed dipoles comprises four dipole rods, opposite pairs of dipole rods being in the form of a V-shaped member and being disposed back-to-back with the apices facing each other and having a common angle bisector, means to select pairs of dipole rods for connection to the input terminals of a television receiver so as to selectively vary the direction of reception accordingly, and a reflector member disposed wholly between said V-shaped members and extending perpendicularly to said common angle bisector equally on both sides thereof so that one of said V-shaped members is on one side of said reflector member and the other V-shaped member is on the other side thereof whereby said reflector member serves equally as a parasitic element for both of said V-shaped members.

6. An antenna system comprising a pair of crossed dipoles, each of said dipoles comprising two dipole rods so that said pair of crossed dipoles comprises four dipole rods, opposite pairs of dipole rods being in the form of a V-shaped member and being disposed back-to-back with the apices facing each other and having a common angle bisector, means to select pairs of dipole rods for connection to the input terminals of a television receiver so as to selectively vary the direction of reception accordingly, and a parasitic member disposed between said V-shaped members and extending perpendicularly to said common angle bisector so that one of said V-shaped members is on one side of said parasitic member and the other V-shaped member is on the other side thereof whereby said parasitic member serves equally as a parasitic element for both of said V-shaped members.

7. An antenna system according to claim 6 and wherein said parasitic member is an elongated rod which extends equally on both sides of said common angle bisector.

8. An antenna system comprising a pair of horizontal, crossed dipoles, each of said dipoles comprising two dipole rods so that said pair of crossed dipoles comprises four dipole rods, opposite pairs of dipole rods being in the form of a V-shaped member and being disposed back-to-back with the apices facing each other and having a common angle bisector, means to select pairs of dipole rods for connection to the input terminals of a television receiver so as to selectively vary the direction of reception accordingly, and a parasitic member disposed between said V-shaped members and in substantially the same horizontal plane therewith, and extending perpendicularly to said common angle bisector on both sides thereof so that one of said V-shaped members is on one side of said parasitic member and the other V-shaped member is on the other side thereof whereby said parasitic member serves both of said V-shaped members equally.

9. An antenna system comprising a plurality of substantially horizontal antenna elements diverging from a common axis of symmetry, means to select different combinations of said antenna elements for connection to the input terminals of a television receiver so as to vary the directivity of reception, and an elongated rod disposed centrally of said antenna elements and in substantially the same horizontal plane therewith, a pair of said antenna elements being disposed on one side of said rod so as to provide directivity in one direction and another pair of said antenna elements being disposed on the other side of said rod so as to provide directivity in an opposite direction and whereby said rod serves equally as a parasitic element for both of said pairs.

10. An antenna system comprising a pair of crossed dipoles, each of said dipoles comprising two dipole rods so that said pair of said dipoles comprises four dipole rods, one pair of adjacent dipole rods forming a V and the remaining pair of dipole rods also forming a V and having its apex adjacent to the apex of said one pair of said dipole rods and an elongated parasitic member disposed between said apices and bisecting a common angle bisector of both of said V's.

11. An antenna system comprising a plurality of substantially horizontal antenna elements diverging from a common axis of symmetry, means to select different combinations of said antenna elements for connection to the input terminals of a television receiver so as to vary the directivity of reception, and a pair of crossed sheets disposed centrally of said antenna elements, said sheets being vertically disposed and having a vertical section thereof bisecting the angle between every two adjacent dipole rods of said crossed dipoles.

12. An antenna system comprising a pair of crossed dipoles, each of said dipoles comprising two dipole rods so that said pair of crossed dipoles comprises four dipole rods, opposite pairs of dipole rods being in the form of a V-shaped member and being disposed back-to-back with the apices facing each other and having a common angle bisector, and a parasitic member disposed between said V-shaped members and having a horizontal axis of symmetry which bisects said common angle bisector so that one of said V-shaped members is on one side of said parasitic member and the other V-shaped member is on the other side thereof whereby said parasitic member serves equally as a parasitic element for both of said V-shaped members.

13. An antenna system comprising a pair of

crossed dipoles, each of said dipoles comprising two dipole rods so that said pair of crossed dipoles comprises four dipole rods, opposite pairs of dipole rods being in the form of a V-shaped member and being disposed back-to-back with the apices facing each other and having a common angle bisector, means to select pairs of dipole rods for connection to the input terminals of a television receiver so as to selectively vary the direction of reception accordingly, and a parasitic member disposed between said V-shaped members and having a horizontal axis of symmetry which bisects said common angle bisector so that one of said V-shaped members is on one side of said parasitic member and the other V-shaped member is on the other side thereof whereby said parasitic member serves equally as a parasitic element for both of said V-shaped members, said parasitic member comprising a pair of concavo-convex elements with their convex sides back-to-back and their concave sides respectively facing the V-shaped members.

14. An antenna system comprising a pair of crossed dipoles, each of said dipoles comprising two dipole rods so that said pair of crossed dipoles comprises four dipole rods, opposite pairs of dipole rods being in the form of a V-shaped member and being disposed back-to-back with the apices facing each other and having a common angle bisector, means to select pairs of dipole rods for connection to the input terminals of a television receiver so as to selectively vary the direction of reception accordingly, and a parasitic member disposed between said V-shaped members and having a horizontal axis of symmetry which bisects said common angle bisector so that one of said V-shaped members is on one side of said parasitic member and the other V-shaped member is on the other side thereof whereby said parasitic member serves equally as a parasitic element for both of said V-shaped members, said parasitic members having concave opposite sides each of which face the respective V-shaped members whereby said parasitic member serves both of said V-shaped members equally.

15. An antenna system comprising a pair of crossed dipoles, each of said dipoles comprising two dipole rods so that said pair of crossed dipoles comprises four dipole rods, opposite pairs of dipole rods being in the form of a V-shaped member and being disposed back-to-back with the apices facing each other and having a common angle bisector, and a parasitic member disposed between said V-shaped members and having a horizontal axis of symmetry which bisects said common angle bisector so that one of said V-shaped members is on one side of said parasitic member and the other V-shaped member is on the other side thereof whereby said parasitic member serves equally as a parasitic element for both of said V-shaped members, said parasitic member comprising two V-shaped elements with their apices facing each other and their mouths outwardly directed.

16. An antenna system according to claim 15 and wherein the apices of said V-shaped elements are electrically connected together.

17. An antenna system comprising a pair of crossed dipoles, each of said dipoles comprising two dipole rods so that said pair of crossed dipoles comprises four dipole rods, opposite pairs of dipole rods being in the form of a V-shaped member and being disposed back-to-back with the apices facing each other and having a common angle bisector, means to select pairs of dipole rods for connection to the input terminals of a television receiver so as to selectively vary the direction of reception accordingly, a first parasitic member disposed between opposite V-shaped members and having a horizontal axis of symmetry which bisects a common angle bisector of both of said opposite V-shaped members, said first parasitic member comprising two opposite V-shaped parasitic elements, and a second parasitic member disposed between two other opposite V-shaped members and having a horizontal axis of symmetry which is perpendicular to the horizontal axis of symmetry of said first parasitic member, said second parasitic member similarly comprising two, opposite, V-shaped parasitic elements.

18. An antenna system according to claim 17 and wherein the V-shaped parasitic elements of each parasitic member are electrically connected together.

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References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,424,365	Loftin et al.	Aug. 1, 1922
1,918,180	Carter	July 11, 1933
1,952,326	Ludenia	Mar. 27, 1934
2,040,079	Carter	May 12, 1936
2,205,560	Herzog	June 25, 1940
2,434,893	Alford	Jan. 27, 1948
2,552,816	Root	May 15, 1951
2,602,892	Koch	July 8, 1952
2,617,935	Best	Nov. 11, 1952
2,631,236	Root	Mar. 10, 1953

FOREIGN PATENTS

Number	Country	Date
818,131	France	June 7, 1937