Dec. 30, 1952 O. McD. WOODWARD, JR 2,624,001

TELEVISION ANTENNA

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FIG. 1

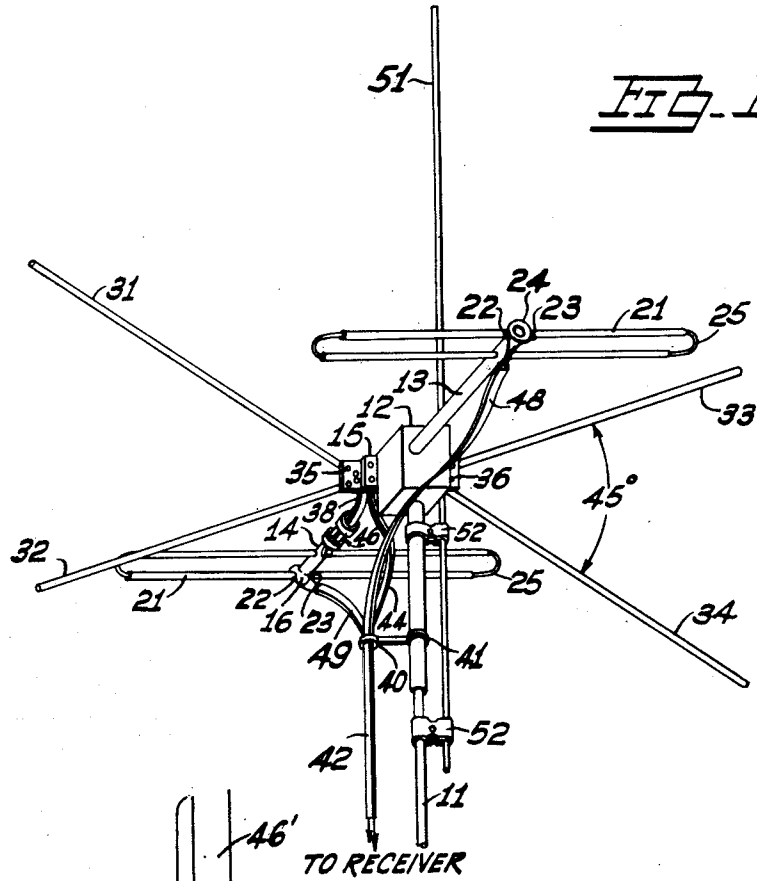
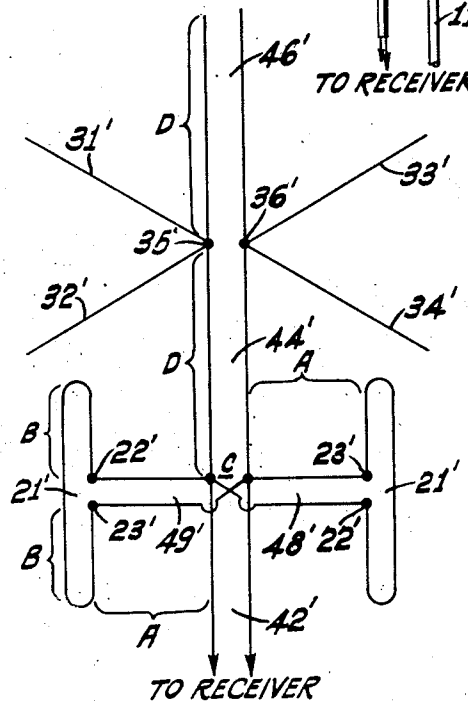


FIG. 2



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TELEVISION ANTENNA

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The invention relates to antenna systems and particularly to receiving antenna system operable over all twelve of the presently assigned television channels.

The presently assigned television channels are spread over two bands, the lower band comprising channels 2–6 lying between 54 and 88 mc./s., and the higher band comprising channels 7–13 lying between 174 and 216 mc./s. It has been found that really satisfactory reception over both bands with known antenna systems is accomplished only by employing two separate receiving antennas and complementary transmission lines. Alternately, the antenna for the higher band is connected to the transmission line for the lower band antenna for fairly satisfactory reception in some installations, though the efficiency of the system is lowered to some considerable extent because of interaction.

It is an object of the invention to provide a simple antenna system operable over a wide frequency range.

A more specific object of the invention is to provide an antenna system comprising a lower band antenna and a higher band antenna to be coupled to a receiver by a feed system and providing uniform, highly efficient results over all twelve of the presently assigned television frequency channels.

It is another object of the invention to provide an antenna system for home installations that is mechanically strong but light in weight and pleasing in appearance.

It is a further object of the invention to provide an antenna system affording optimum results over the entire band of twelve channels without any adjustment after installation is completed.

It is still another object of the invention to provide an antenna array having a bi-directional characteristic over all twelve channels.

These and other objects of the invention which will appear as the specification progresses are achieved by means of a pair of antennas arranged to prevent interaction between each other and adapted to be coupled to a receiver by means of a feed system which effectively isolates the antennas from each other and nullify the effect of one when receiving on the other.

The invention will be described with reference to the accompanying drawing forming a part of the specification and in which:

Fig. 1 is an illustration of an antenna system according to the invention; and

Fig. 2 is a schematic diagram of the electrical connections of the antenna system shown in Fig. 1.

Referring to Fig. 1 there is shown a support 11 on which is mounted a block member 12 having rod members 13 and 14 affixed thereto normally to the axis of support 11 and a further insulating mounting member 15 affixed to one side

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of block member 12. The members thus far described need not be formed exactly as shown in the figure but may be constructed in any manner suggested to one working in the art as the configurations of these members are not important to the invention. At the outer ends of members 13 and 14, folded dipole elements 21 are arranged. Further details of construction and operation of these folded dipole elements may be had by reference to U. S. Patent 2,283,914 issued May 26, 1942, to Philip S. Carter and assigned to the Radio Corporation of America. The high impedance terminals 22 and 23 are electrically insulated and mechanically fixed by means of low loss dielectric insulation 24. As explained in the above mentioned U. S. patent, little or no loss will be effected at the portion of the folded diploe element opposite the terminals if it is electrically connected to a metallic support, hence rod members 13 and 14 may be made of any conducting material desired, and preferably are in most installations. Preferably, folded dipole elements 21 are adjustable by means of trombone end-sections 25 although a fixed construction resonant to a frequency near the center of the higher television band may be used with entirely satisfactory results.

Midway between folded dipole 21 a "double V" element comprising arms 31, 32, 33, and 34 is fastened to mounting member 15 by means of metal plates 35 and 36. Arms 31 and 32 arranged at an angle of approximately 45° and electrically connected to plate 35 and arms 33 and 34, are arranged at the same angle and connected to plate 36, which plates form the terminals for the "double-V" element. In the preferred embodiment, plates 35 and 36 are mechanically fastened to insulating member 15, which is in turn fastened to a metallic block 12 in order to obtain maximum mechanical strength; however, if block 12 is made of low loss dielectric material, plates 35 and 36 may be fastened thereto directly, eliminating any need for an additional member 15.

By means of insulating rings 40 mounted on support 11 by means of clamps 41, a transmission line 42 leading to a receiver or other transducer (not shown) is brought to the antenna system. At a suitable point along support 11 transmission line 42 is electrically connected in parallel to further transmission lines 44, 48, and 49. Transmission lines 48 and 49 are equal in length and terminate at folded dipoles 21, while transmission line 44 terminates at terminal plates 35 and 36 of the "double-V" element for a purpose later to be described. This line is folded and fastened in place on rod members 4 by any convenient means, such as rubber tape or suitable metal clamps, to prevent it from whipping in the wind.

Preferably some means of protection against lightning should be provided in any antenna installation and the arrangement according to the invention readily lends itself to this purpose as shown in Fig. 1 wherein a lightning rod 51 is

clamped to a metal support 11 by means of clamps 52.

Further details of the construction of the antenna system according to the invention will most conveniently appear as the operation of the system is described with reference to Fig. 2, schematically showing the electrical connections and in which primed reference numerals indicate schematic symbols for corresponding structural elements shown in Fig. 1. The "double-V" dipole is resonant to a frequency near the center of the 54–88 mc./s. band to provide satisfactory performance on all channels of that band and the end-fire folded dipole array is resonant to the center of the 174–216 mc./s. band to provide satisfactory performance on all channels of that band. Any tendency for mutual interaction between the two arrays is prevented because of the fact that the folded dipole elements 21 are connected out of phase with each other by means of transmission lines 48 and 49 as can be seen more clearly in Fig. 2, where folded dipole elements 21' are connected by lines 48' and 49' in transposed relationship, and the "double-V" array lies in a neutral plane midway between the folded dipole array, thus preventing extraneous side lobes from appearing at the higher frequencies.

It should be understood that the antenna system as expressly described merely constitutes an example of an arrangement according to the invention and other arrangements will be immediately suggested to the artisan. For example, the ordinary dipole may be substituted for the "double-V" dipole, a conical dipole antenna may be equally well employed, or in other words any broadside antenna capable of being confined to a neutral zone midway between the elements of the end-fire array, but not necessarily in line with the end fire elements, will serve to effect an arrangement according to the basic principle of the invention. Accordingly any end fire array which will provide such a neutral zone will fulfill the requirements of an arrangement according to the invention. In addition, it should be obvious that the end fire array may be used in the lower band and the broadside antenna on the higher-band also without departing from the invention. It should be understood that the term "broadside array" must be construed in this specification to include single elements such as the ordinary dipole as well as multi-element arrays since the invention uniquely lends itself to the use of both.

Preferably, all of the transmission line sections have the same characteristic impedance, though it is entirely possible to use sections of different characteristic impedance together with suitable transformer sections and remain within the scope of the invention. Since most commercially produced television receivers are designed for 300 ohm input transmission lines, which are readily obtainable in quantity, it is preferable to employ 300 ohm lines throughout and thus avoid difficulties in matching lines of varying characteristic impedances.

Transmission line 46 is a quarterwave long at the center of the high frequency band (195 mc./s. for the presently allotted channel) and thus short circuits the terminals of the "double-V" array at the higher frequencies. Transmission line 44 is also a quarterwave long at the higher frequencies and thus presents an infinite impedance (or open circuit) to the junction point C of transmission lines 42, 44, 48, and 49. Hence when signals on the higher frequency channels are received, only the folded dipole array is effective.

At the lower frequencies, however, folded dipole 21' functions as two short circuited stubs, B and B, connected in series. Transmission lines 48 and 49 are of such length as to present a high reactance at point C. Transmission line 46 will have little effect on the "double-V" array when signals at the lower frequencies are received. Hence, when lower band signals are received, only the "double-V" array is effective.

The antenna system as described provides substantially figure-eight field patterns in the same direction in the azimuthal plane for the twelve presently allotted television channels. It is also possible to provide a somewhat different directivity for the low frequency band with respect to the high frequency band by varying the azimuthal position of one of the antennas with respect to the other, care being taken that the broadside array is so arranged with respect to the endfire array that equal and opposite voltages are induced in one by the other.

While the invention has been described in terms of express embodiments, it is to be understood that obvious modifications thereof will be suggested to those skilled in the art without departing from the spirit and scope of the invention.

I claim:

1. A bi-directional antenna system including an element resonant to a first frequency, and other elements resonant to a second frequency arranged equidistantly on either side of the first said element, said other elements being coupled to each other in phase opposition, the first said element and said other elements being electrically independent of each other, and means to connect transducer apparatus to the first said element and said other elements and maintain said electrical independence therebetween.

2. An antenna system including an antenna resonant to a first frequency and comprising two elements intercoupled by a pair of conductors to provide an end-fire array, an antenna resonant to a second frequency and electrically equidistant from each of the elements of said first antenna whereby interaction between said antennas is prevented, a length of transmission line, a multiple, including unity, of a half wave length long at said first frequency coupled at one end to the pair of conductors of said first antenna and coupled at the midpoint thereof to said second antenna, and means to couple transducer apparatus to the system at said one end of said length of transmission line.

3. A bi-directional antenna system including an antenna resonant to a first frequency and comprising two elements intercoupled by transmission line means to provide an end-fire array, an antenna resonant to a second frequency and located electrically equidistant from the elements of said first antenna whereby interaction between said antennas is prevented, a length of transmission line, a multiple, including unity, of a half wave length long at said first frequency at one end to said transmission line, means of said first antenna and coupled at the midpoint thereof to said second antenna, and means to couple transducer apparatus to the system at said one end of said length of transmission line, said transmission line means intercoupling said two elements having a length at which a high reactance is presented at said one end of said length of transmission line.

4. An antenna system including an antenna

resonant to a first frequency, said antenna comprising two elements and a transmission line intercoupled to provide an end-fire array, an antenna resonant to a second frequency and located between the elements of said first antenna at a point electrically equidistant from each of said elements whereby interaction between said antennas is prevented, a further transmission line a half wave length long at said first frequency coupled at one end to the midpoint of said first transmission line and coupled at the midpoint thereof to said second antenna, and means to couple transducer apparatus to the system at said one end of said further transmission line, said first transmission line having a high reactance at the midpoint thereof at said first frequency.

5. An antenna system including dipole elements resonant to a first frequency, other dipole elements resonant to a second frequency arranged equidistantly on either side of the first said dipole elements, said other dipole elements being coupled to each other in phase opposition and coupled to the first said dipole elements in phase opposition at said second frequency, and means effectively to short circuit the first said dipole elements at said second frequency.

6. An antenna system including dipole elements resonant to a first frequency, other dipole elements resonant to a second frequency arranged equidistantly on either side of the first said dipole elements, transmission line elements coupled at one end to said other dipole elements and coupled to each other at the other ends to couple said other dipole elements in phase opposition, and transmission line sections coupled to the first said dipole elements, one of said transmission line sections being coupled to the junction of said transmission line elements, said transmission line elements having lengths at which a high reactance at said second frequency is presented at said junction and said transmission line sections having lengths at which the first said dipole elements are short circuited at said second frequency.

7. An antenna system including a pair of folded dipoles resonant to a first frequency and arranged parallel to each other and spaced apart, a dipole antenna resonant to a second frequency and having two arms each comprising conductor elements diverging from the center thereof, said elements being arranged parallel to said folded dipoles and located at a point intermediate said folded dipoles, a length of transmission line coupling said folded dipoles out of phase with each other, a transmission line having a length of one-quarter wave length at said first frequency coupling said dipole antenna to the midpoint of the first said transmission line, and means to couple said midpoint to transducer apparatus.

8. An antenna system including a pair of folded dipoles resonant to a given frequency and arranged parallel to each other and spaced apart, a dipole antenna resonant to a frequency lower than said given frequency and having two arms each comprising V-shaped conductor elements, said elements being arranged parallel to and located at a point intermediate said folded dipoles, a length of transmission line coupling said folded dipoles out of phase with each other, a transmission line having a length of one-half wave length at said given frequency coupled to the midpoint of said length of transmission line, said dipole antenna being connected to the midpoint of said halfwave line, and means to couple transducer apparatus to said system at the junction of said length of transmission line and said halfwave line.

9. An antenna system including a pair of folded dipoles resonant to a given frequency and arranged parallel to each other and spaced apart, a dipole antenna resonant to a frequency different from said given frequency and having two arms each comprising V-shaped conductor elements, said elements being arranged parallel to and located at a point intermediate said folded dipoles, a length of transmission line coupling said folded dipoles out of phase with each other, a transmission line having a length of one-half wave length at said given frequency coupled to the midpoint of said length of transmission line, said dipole antenna being connected to the midpoint of said halfwave line, and means to couple transducer apparatus to said system at the junction of said length of transmission line and said halfwave line.

10. An antenna system including two separate antennas, one of said antennas being resonant to a given frequency and comprising two dipole elements arranged substantially parallel to each other and coupled in phase opposition, and the other antenna being resonant to a different frequency and being arranged substantially in between said dipole elements and electrically equidistant from each of said two dipole elements thereby effectively to neutralize electrical coupling between said antennas, and means to couple a transducer to both of said antennas while maintaining said antennas operable individually at each of said frequencies.

11. An antenna system including an end-fire array comprising an even number of elements and resonant at a given frequency and a dipole antenna array resonant to a different frequency and arranged substantially in between and electrically equidistant from the outer most elements of said end-fire array, and means to couple a transducer to both of said arrays while maintaining said arrays operable independently of each other.

12. An antenna system including two separate antennas, one of said antennas comprising two folded dipoles resonant at a given frequency and arranged substantially parallel to each other and coupled in phase opposition, and the other antenna comprising a dipole element resonant to a different frequency and located substantially in between and electrically equidistantly between said two folded dipoles, thereby effectively to neutralize electrical coupling between said antennas, and means to couple a transducer to both of said antennas while effectively electrically isolating one antenna from the other.

OAKLEY McDONALD WOODWARD, JR.

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