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R. W. MASTERS

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BROADCAST ANTENNA

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Fig. 1.

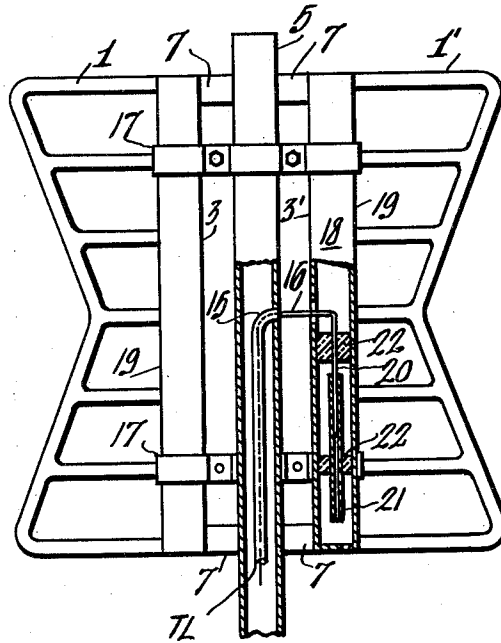
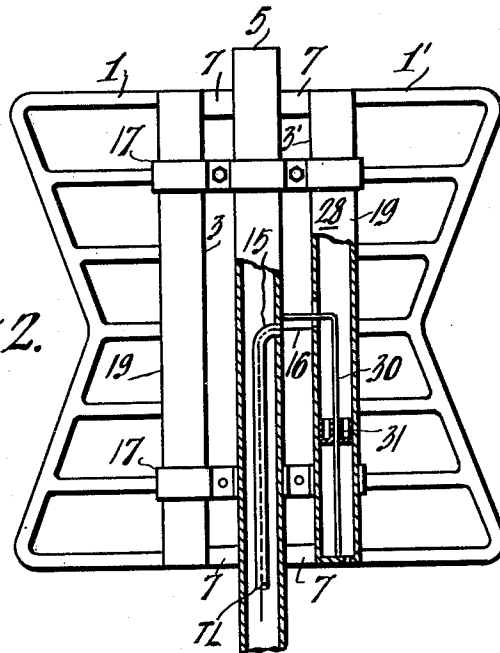


Fig. 2.



INVENTOR
Robert W. Masters
BY *H. S. Grover*
ATTORNEY

UNITED STATES PATENT OFFICE

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BROADCAST ANTENNA

Robert W. Masters, Erlton, N. J., assignor to Radio Corporation of America, a corporation of Delaware

Application May 29, 1946, Serial No. 672,950

10 Claims. (Cl. 250—33)

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The present invention relates to antennas and more particularly to broad band antennas suitable for television broadcast operation.

An object of the present invention is to provide an antenna structure which will permit the adjustment of the impedance characteristic thereof without in any way altering the shape of the radiation pattern.

Another object of the present invention is to increase the band coverage of a television broadcast antenna.

Still another object of the present invention is to provide an antenna system which is less frequency selective in the neighborhood of a given frequency than heretofore known antennas.

Still another object of the present invention is the provision of a simple broadcast antenna system which may easily be adjusted for optimum operating characteristics.

The foregoing objects and others which may appear from the following detailed description are attained by utilizing a dipole antenna having conductive screen radiator elements as described in my copending U. S. patent applications, Serial No. 574,898, filed January 27, 1945, Serial No. 574,899, filed January 27, 1945 and Serial No. 580,120, filed February 28, 1945, respectively Patent Numbers 2,480,153; 2,480,154; and 2,480,155, granted August 30, 1949.

The screen radiator elements of the antennas disclosed in the above-mentioned applications are, in the present invention, modified so as to contain within each of the screen radiator elements a section of a coaxial line constituting a dissipationless reactance network which may be connected either in series with the radiator element or in shunt from the radiator element to the ground. Thus, the operating parameters of the antenna may readily be adjusted.

The present invention will be more fully understood by reference to the following detailed description which is accompanied by a drawing in which:

Figure 1 illustrates in elevation and partly in section an embodiment of the present invention, while

Figure 2 illustrates a modified form of the invention.

Referring now to Figure 1, there is shown an antenna including at least a pair of plane screen radiator elements 1 and 1', each including a substantially rectilinear edge 3 and 3' respectively. The rectilinear edges 3 and 3' may each be of the order of one-half wavelength long at the operating frequency. The antenna is not limited to the particular form of construction here shown since solid plane conductive sheet radiating elements as described in copending application S. N. 574,898 will perform in exactly the same manner; however, in the preferred embodiment the sheet

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radiator elements each comprise a plurality of horizontally disposed rod or tubular members spaced from each other by a small fraction of a wavelength. The horizontally disposed members thus effectively act as a single radiator as though it were a conductive sheet. The radiators 1 and 1' are preferably supported on a conductive mast 5 by means of brackets 7 at the upper and lower ends of the inner edges 3 and 3'. Mast 5 need not necessarily be conductive. Under some circumstances it may be desirable to use a wooden or non-conductive mast. Also, if desired, the mast may be omitted, the sheet radiator elements themselves being self supporting. Shorting clips 17 may be provided to electrically connect the rectilinear edges 3 and 3' at selected points to the conductive mast 5. The screen radiator elements 1 and 1' are preferably energized by means of coaxial transmission lines, only one of which is actually shown in the drawing. This coaxial line is associated with radiator element 1' and is identified by reference character TL. The outer conductor 15 of transmission line TL may be electrically connected to the conductive mast 5. The inner conductor 16 may be coupled to radiator element 1' through the intermediary of a series reactance network 18. In arrangements wherein no mast or a non-conductive mast is used, the energization of the radiating elements also may be accomplished as explained in my prior application Serial No. 580,120, filed February 28, 1945. The series reactance network 18 includes a hollow tubular member 19 lying along rectilinear edge 3' of radiator 1'. It may be an integral part of the conductive structure or may be a separate tube welded or otherwise secured along edge 3'. Within the tubular member 19 and electrically directly connected to inner conductor 16 of the transmission line TL is an inner conductor 20. In order that the reactance effect of network 18 may be varied conductor 20 is arranged to have its length conveniently variable. This may be done by providing a close fitting conductive sleeve 21 arranged to slide over the conductor 20, and acts as an extension thereof. Suitable access holes may be provided at the lower end of tubular member 19 whereby an actuating rod may be inserted to engage tubular sleeve 21, whereby the effective electrical length of the conductor constituted by members 20 and 21 may be adjusted. It is desirable to support members 20 and 21 in a coaxial relationship within tubular member 19 by means of insulating spacers such as those indicated at 22. While I have not so shown the structure, it may be desirable that the transmission line TL and the series impedance matching section 18 be weatherproofed to prevent the entry of rain and moisture into the space between the inner and outer conductors thereof. If it is desired to operate the present antenna

as a dipole radiator, the screen radiator element 1 may be connected to a second transmission line through a series impedance section similar to that just described with reference to screen radiator element 1'. The two transmission lines will then be energized in a push-pull relationship from a single transmitter.

The present improvement may also be applied to a turnstile type of radiator wherein four screen radiator elements are utilized, spaced at mutual angles of 90° around a conductive mast and fed in a mutual phase quadrature relationship. This arrangement and the manner of energizing the transmission lines is described in greater detail in one or more of the previously filed applications mentioned above, to which reference may be made for complete details.

The modified form of the invention shown in Figure 2 utilizes the same general arrangement of the screen radiator elements 1 and 1' and the conductive mast 5 as described with reference to Figure 1. Likewise the radiators are similarly mounted and the mounting means are given the same reference numerals as in the case of Figure 1. However, in the modification of Figure 2 the reactance network 28 is connected in shunt to the input of the radiator; that is, across the points to which the conductors of the transmission line TL are connected. Thus, the inner conductor 16 of the transmission line EL is directly connected to the rectilinear edge 3' of the radiator member 1' while the inner conductor 30 of the reactance network 28 is connected to mast 5'. In a dipole arrangement using an insulating mast, conductor 30 is connected to the opposite polarity input terminal. The exterior conductors should be as short as possible, or at least symmetrical. The inner conductor 30 of the reactance network 28 is connected to the interior of tubular member 19 by a shorting plug 31, sliding within the tubular member 19. Its position may be varied up and down the length of tube 19 to vary the effective electrical length of the shunt transmission line section, constituting the shunt reactance 28.

It will be apparent from an inspection of Figures 1 and 2 that the adjustable reactance networks effectively form an integral part of the radiating screen structures since the tubular members 19 may actually constitute a vertical stiffening rib for the edge of the radiator near the supporting pole 5. The length of the radiators are such that nearly a half wave of line may be used if needed.

While I have illustrated a particular embodiment of the present invention, it should be clearly understood that it is not limited thereto since many modifications may be made in the several elements employed and in their arrangement, and it is therefore contemplated by the appended claims to cover any such modifications as fall within the spirit and scope of the invention.

What is claimed is:

1. An antenna system including a conductive supporting member and a pair of radiating members, said radiating members being constituted by a pair of hollow tubular conductors arranged adjacent and parallel to said supporting member, said conductors being connected together at the ends thereof through the intermediary of said conductive supporting member and a plurality of further conductors arranged in a single plane and normal to said tubular conductors, said further conductors having lengths varying from a minimum at the central part of

said tubular conductors to a maximum near the ends of said tubular conductors, and other conductors connecting the ends of said further conductors remote from said tubular conductors to completely close the structure of said radiating members, an inner conductor arranged within one of said tubular conductors to form a section of concentric transmission line, means to vary the effective electrical length of said section of concentric line, a coaxial transmission line having center and sheath conductors, said sheath conductor being connected to said conductive supporting member, and means to couple said coaxial transmission line to one of said radiating members, said means including interconnections between said center and said sheath conductors and said inner and said tubular conductors.

2. An antenna system including a conductive supporting member and a pair of radiating members, said radiating members being constituted by a pair of hollow tubular conductors arranged adjacent and parallel to said supporting member, said conductors being connected together at the ends thereof through the intermediary of said conductive supporting member and a plurality of further conductors arranged in a single plane and normal to said tubular conductors, said further conductors having lengths varying from a minimum at the central part of said tubular conductors to a maximum near the ends of said tubular conductors, and other conductors connecting the ends of said further conductors remote from said tubular conductors to completely close the structure of said radiating members, an inner conductor arranged within one of said tubular conductors, means to vary the effective electrical length of said inner conductor, a transmission line having center and sheath conductors, said sheath conductor being connected to said conductive supporting member, and means to connect said center conductor to said inner conductor.

3. An antenna system including a conductive supporting member and a pair of radiating members, said radiating members being constituted by a pair of hollow tubular conductors arranged adjacent and parallel to said supporting member, said conductors being connected together at the ends thereof through the intermediary of said conductive supporting member and a plurality of further conductors arranged in a single plane and normal to said tubular conductors, said further conductors having lengths varying from a minimum at the central part of said tubular conductors to a maximum near the ends of said tubular conductors, and other conductors connecting the ends of said further conductors remote from said tubular conductors to completely close the structure of said radiating members, an inner conductor arranged within one of said tubular conductors, means to vary the effective electrical length of said inner conductor, means to connect said inner conductor to said supporting member, a transmission line having center and sheath conductors, said sheath conductor being connected to said conductive supporting member, and means to connect said center conductor to said tubular conductor.

4. An antenna system including a conductive supporting member and a radiating member comprising a hollow tubular conductor arranged adjacent and parallel to said supporting member, said conductor being connected at the end thereof to said conductive supporting member, a plurality of further conductors arranged in a single

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plane and normal to said tubular conductor, and another conductor connecting the ends of said further conductors remote from said tubular conductor to completely close the structure of said radiating member, an inner conductor arranged within said tubular conductor, means to vary the effective electrical length of said inner conductor, said inner conductor being connected to said conductive supporting member, and means to couple a source of high frequency energy between said supporting members and said radiator.

5. An antenna system including a conductive supporting member and a radiating member comprising a hollow tubular conductor arranged adjacent and parallel to said supporting member, said conductor being connected at the end thereof to said conductive supporting member, a plurality of further conductors arranged in a single plane and normal to said tubular conductor, and another conductor connecting the ends of said further conductors remote from said tubular conductor to completely close the structure of said radiating member, an inner conductor arranged within said tubular conductor, means to vary the effective electrical length of said inner conductor, and means to couple a source of high frequency energy between said supporting member and said inner conductor.

6. An antenna system including a conductive supporting member and a radiating member comprising a hollow tubular conductor arranged adjacent and parallel to said supporting member, said conductor being connected at the end thereof to said conductive supporting member, a plurality of further conductors arranged in a single plane and normal to said tubular conductor, said further conductors having lengths varying from a minimum at the central part of said tubular conductor to a maximum near the ends of said tubular conductor, and another conductor connecting the ends of said further conductors remote from said tubular conductor to completely close the structure of said radiating member, an inner conductor arranged within one of said tubular conductors, means comprising a close fitting conductive sleeve carried by and extending beyond the end of said inner conductor to vary the effective electrical length thereof, a transmission line having center and sheath conductors, said sheath conductor being connected to said conductive supporting member, and means to connect said center conductor to said inner conductor.

7. An antenna system including a conductive supporting member and a radiating member comprising a hollow tubular conductor arranged adjacent and parallel to said supporting member, said conductor being connected at the end thereof to said conductive supporting member, a plurality of further conductors arranged in a single plane and normal to said tubular conductor, said further conductors having lengths varying from a minimum at the central part of said tubular conductor to a maximum near the ends of said tubular conductor, and another conductor connecting the ends of said further conductors remote from said tubular conductor to completely close the structure of said radiating member, an inner conductor arranged within one of said tubular conductors, means comprising an adjustable conductive member shorting said tubular conductor to said inner conductor to vary the effective electrical length thereof, said inner con-

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ductor being connected to said supporting member, a transmission line having center and sheath conductors, said sheath conductor being connected to said conductive supporting member, and means to connect said center conductor to said radiator.

8. An antenna system including a conductive supporting member and a pair of radiating members, said radiating members comprising a pair of hollow tubular conductors arranged adjacent and parallel to said supporting member and being connected at the ends thereof to said conductive supporting member and a plurality of further conductors arranged in a single plane and normal to said tubular conductor, an inner conductor arranged within said tubular conductor, means to vary the effective length of said inner conductor, a transmission line having center and sheath conductors, said sheath conductor being connected to said conductive supporting member, and means to connect said center conductor to said inner conductor.

9. An antenna system including a conductive supporting member and a pair of radiating members, said radiating members comprising a pair of hollow tubular conductors arranged adjacent and parallel to said supporting member and being connected at the ends thereof to said conductive supporting member and a plurality of further conductors arranged in a single plane and normal to said tubular conductor, an inner conductor arranged within said tubular conductor, means comprising a close fitting sleeve carried by and extending beyond the end of said inner conductor to vary the effective electrical length thereof, a transmission line having center and sheath conductors, said sheath conductor being connected to said conductive supporting member, and means to connect said center conductor to said inner conductor.

10. An antenna system including a conductive supporting member and a pair of radiating members, said radiating members comprising a pair of hollow tubular conductors arranged adjacent and parallel to said supporting member and being connected at the ends thereof to said conductive supporting member and a plurality of further conductors arranged in a single plane and normal to said tubular conductor, an inner conductor arranged within said tubular conductor, means comprising an adjustable conductive member shorting said tubular conductor to said inner conductor to vary the effective electrical length thereof being connected to said supporting member, a transmission line having center and sheath conductors, said sheath conductor being connected to said conductive supporting member, and means to connect said center conductor to said radiator.

ROBERT W. MASTERS.

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The following references are of record in the file of this patent:

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