July 11, 1950 C. R. EDELSOHN 2,514,992

COMPACT TELEVISION RECEIVER ANTENNA

Filed Oct. 15, 1949 3 Sheets-Sheet 1

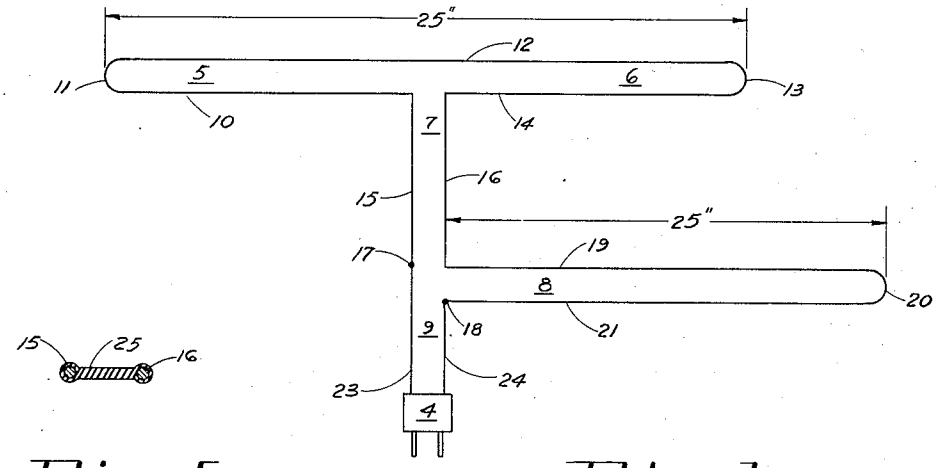

Fig. 5

Fig. 1

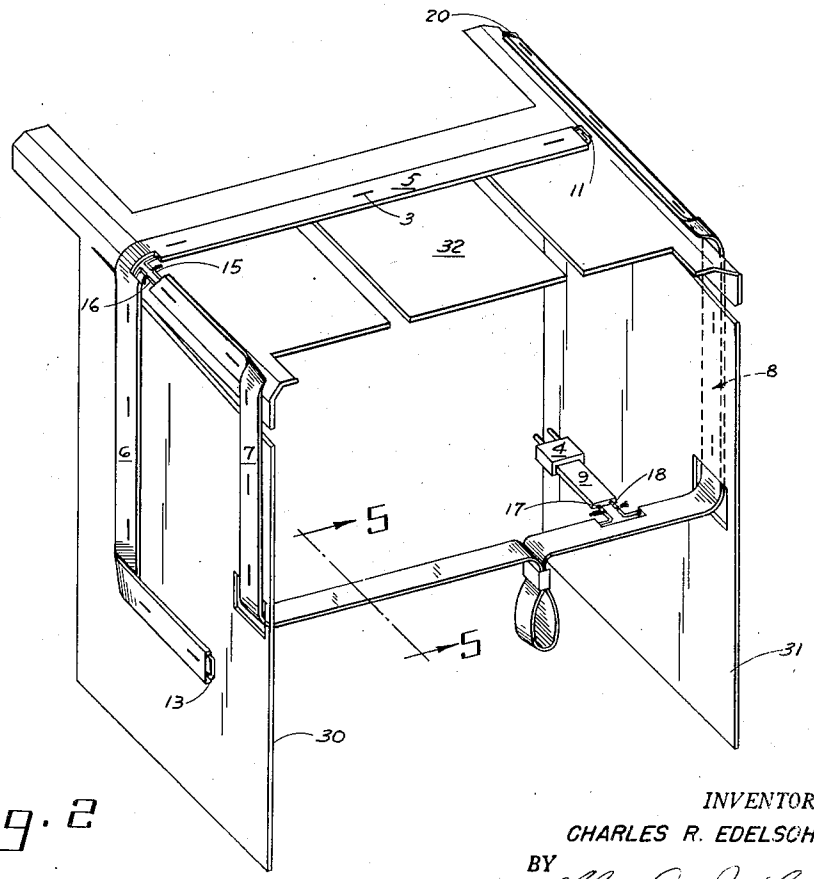

Fig. 2

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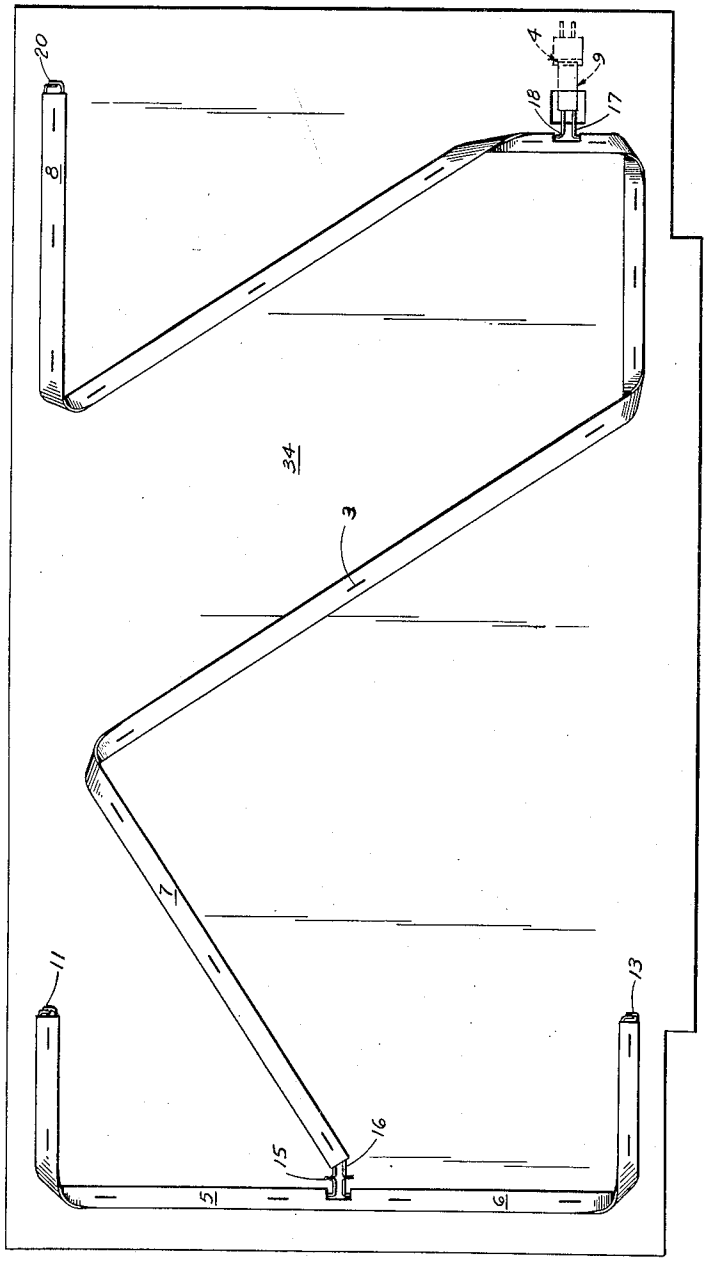

Fig. 3

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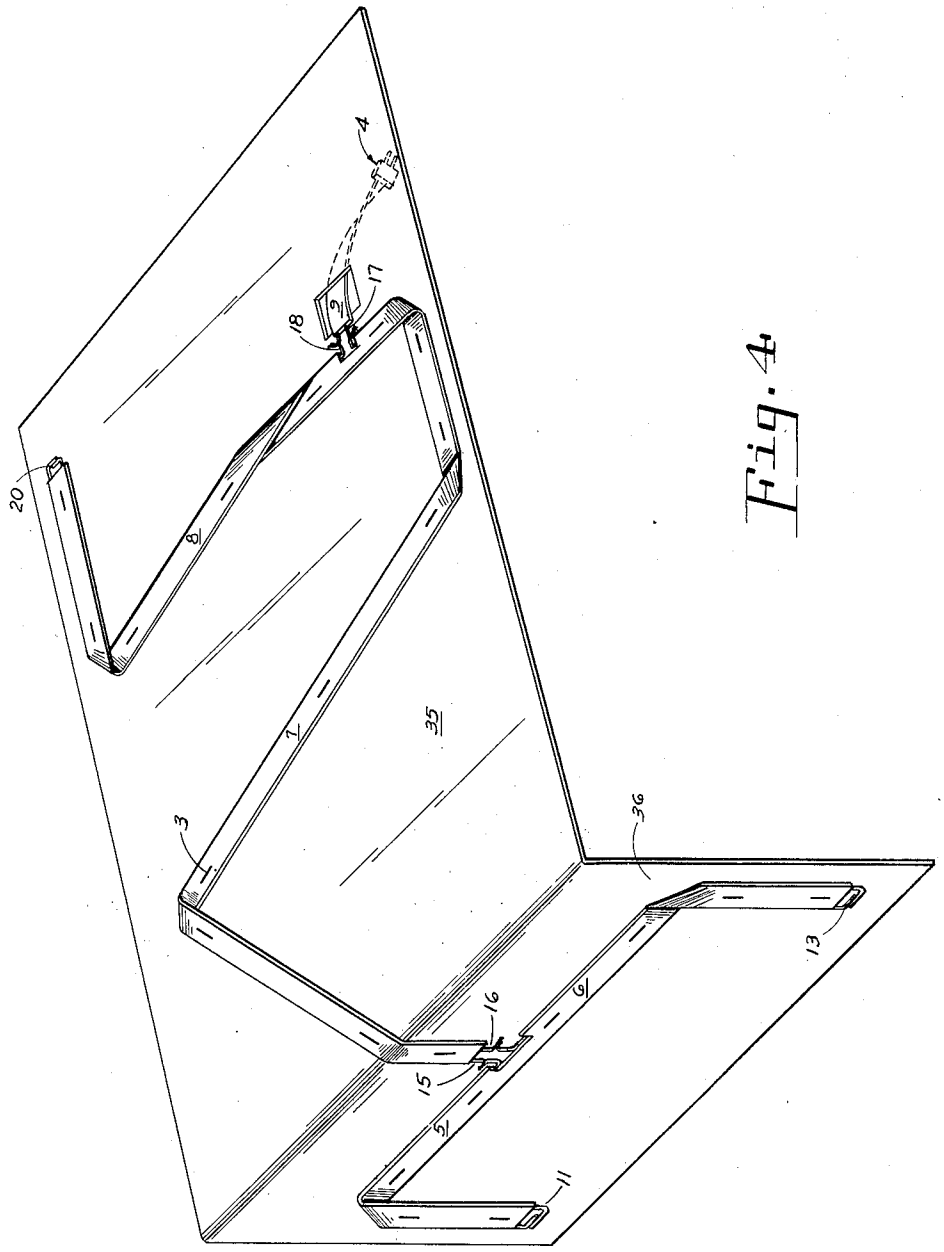

Fig. 4

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2,514,992

COMPACT TELEVISION RECEIVER ANTENNA

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Application October 15, 1949, Serial No. 121,547

14 Claims. (Cl. 250—33)

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The present invention is a compact, confined antenna system. The term "confined" means that the antenna system is intended for installation in a television receiver cabinet.

The primary object of the invention is to provide a unitary antenna system which operates as a broadly tuned antenna for both of the two spaced V. H. F. standard television broadcast bands (54–88 megacycles and 174–216 megacycles).

Another object of the antenna is to provide a physically flexible antenna system requiring a minimum of space, which can be confined within a television receiver cabinet, without requiring radical departures from conventional chassis designs or increases in cabinet size, or physically expanded to improve its performance where cabinet design will permit.

In accordance with the invention there is provided a folded dipole antenna (10, 11, 12, 13, 14, Fig. 1) having such dimensions as to be broadly resonant throughout the upper band (174–216 megacycles), a two-conductor transmission line 15, 16 matched to said dipole, a pair of output terminals 17, 18 one (17) of which is integral with one conductor 15 of said line, and a closed-circuited section (19, 20, 21) interposed between the end of the other conductor 16 and the other terminal 18. This section has an electrical length of one-half wave substantially at the center of the upper band, whereby it acts as a short circuit effectively to connect said other terminal 18 and said other conductor together during upper band operation. The electrical lengths of the transmission line 15, 16 and the section 19, 20, 21 and the upper-band antenna 10, 11, 12, 13, 14 are such that they cooperate effectively to function as a folded dipole which is broadly resonant throughout the lower standard television broadcast band (54–88 megacycles). During upper-band operation the section 19, 20, 21 collectively designated 8 does not interfere with the operation of the upper band folded dipole 10, 11, 12, 13, 14 collectively designated 5, 6, and line 15, 16 collectively designated 7.

For a better understanding of the present invention, together with other and further objects, advantages, and capabilities thereof, reference is made to the accompanying drawings, in which there are shown three illustrative embodiments of the antenna system in accordance with the invention.

In the drawings:

Fig. 1 is a circuit schematic employed as an aid in describing the underlying theory of the construction and operation of the invention;

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Fig. 2 is a front perspective view of a preferred type of antenna in accordance with the invention, particularly suitable for installation in a small size receiver cabinet;

Figs. 3 and 4 are top and perspective views of other forms of the invention, shown in configurations suitable for incorporation in a television receiver cabinet of larger size; and

Fig. 5 is a cross-sectional view through the transmission line included in the various illustrative forms of antenna herein disclosed.

Referring now specifically to Fig. 1 of the drawings, there is shown a folded dipole antenna which is so proportioned and dimensioned as to attain its peak of resonance approximately in the middle of the upper broadcast band (174–216 megacycles). This folded dipole is optimized, as it were, for the upper television band, and it comprises a continuously arranged conductor having portions 10, 11, 12, 13, and 14. The elements 10 through 14 constitute a two-wire half-wave doublet consisting of two parallel, closely spaced half-wave wires connected together at the ends 11, 13 and brought out to a transmission line 15, 16. Since the dimensions which should be provided for a folded dipole antenna for the upper television band are well-known to those skilled in the art and will vary with the dielectric constant of the surrounding medium, it is not necessary to specify detailed dimensions for the folded dipole 10, 11, 12, 13, 14. However, a length of 25 inches (between 11 and 13) and a spacing between conductors of approximately $\frac{5}{16}$ inch have been found entirely satisfactory in one commercially successful device made in accordance with the teachings of the invention. The folded dipole 10, 11, 12, 13, and 14 may be made up from a single section of parallel-pair transmission line such as the well-known Amphenol twin lead 300 ohm transmission line. While Twin Lead has been found very suitable, it will be understood by those skilled in the art that ordinary wire, metallized paper tape, or thin sheet metal strip, for example, or even rods, could be employed within the spirit of the generic claims appended hereto. The Twin Lead type of line comprises two spaced conductors secured in a flexible assembly by a molding 25 (Fig. 5) of polyethylene dielectric. Any flexible dielectric will suffice for this purpose. The ends of the line are soldered together to form the physically doubled-back ends 13 and 11, and the leads of the folded dipole are brought through the insulation and connected to a transmission line 15, 16.

A folded dipole has an input impedance of approximately 300 ohms at resonance, and it is

therefore desirable to employ a non-resonant 300 ohm transmission line 15, 16, terminated by the folded dipole in its characteristic impedance.

The 300 ohm transmission line 15, 16 is properly matched to the upper band folded dipole. The transmission line 15, 16 is preferably of a parallel-pair construction such as the Twin Lead line mentioned. It will be appreciated that other types of transmission line may be employed for the elements 15, 16, but a parallel-pair type of line is preferred so that the folded dipole 10, 11, 12, 13, 14, and the line 15, 16 may be made from the same type of standard commercial line material.

One lead of the transmission line constitutes an output terminal 17. Between the other output terminal 18 and the end of line 16 is a closed-circuited section consisting of spaced parallel conductors 19 and 21, soldered together at 20. The electrical length of this section is approximately one-half wave length at the center of the upper frequency band. Therefore this section functions as a closed circuit during upper band operation and in effect connects output terminal 18 to the end of transmission line 16. Output terminal 18 is integral with one lead of the section, which may also be made of Twin Lead line. The output terminals 17 and 18 are connected to a two-terminal plug 4 in any suitable manner, but it is preferred that the conductors 23 and 24 leading to plug 4 be as short as possible and that they maintain the characteristic impedance of the folded dipoles and line. A length of four inches is satisfactory.

The upper band operation of the Fig. 1 antenna will be obvious to those skilled in the art, the dipole portions 5 and 6 simply functioning as a folded dipole, the line 7 functioning as a transmission line, properly matched to the dipole, and the section 8 operating as a short circuit effectively to connect output terminal 18 to transmission line conductor 16. During upper band operation this antenna functions as a straightforward "center-fed" type of antenna, the transmission line being connected in balanced relationship to the antenna portions. The overall electrical length of the conductor 10, 11, 12, 13, and 14 approximates one wave length at the mid-frequency of the upper band, so that the folded dipole is broadly resonant throughout the upper band.

During lower band operation the conductor 21, 20, and 19 of section 8, 16 of line 7, 14, 13, 12, 11, and 10 of the upper band folded dipole, and 15 of line 7 function collectively as a half-wave folded dipole for the lower band, the total electrical length of the conductive path formed by proceeding in the sequence indicated approximating one wave length at the lower band. The short connecting line 23, 24 is non-resonant, and its connection to the last-mentioned lower band folded dipole is unsymmetrical and not in balance. During lower band operation the folded dipole 5, 6 for the upper band, the transmission line 7 and the section 8 function together as a folded dipole.

It will be understood from the foregoing description that the presence of section 8 does not interfere with upper band operation in any way.

Referring now to Fig. 2, there is shown a preferred embodiment of the invention suitable for installation within the cabinet of a small size television receiver. This antenna is mounted on a suitable support, preferably made of one continuous piece of stiff cardboard or the like. This support is generally rectangular in shape, and it comprises integral side members 30 and 31 and an integral top member 32. Antenna portion 5 is simply laid on top of the support, and portion 6 is permitted to hang down the side thereof, the end which terminates at 13 being bent forwardly. The transmission line 7 is extended forwardly and then downwardly and then brought through an opening in the support member to the interior thereof. The section 8 extends upwardly outside of and adjacent side 31 and is then brought past an opening on that side to a position on top of member 32 and is finally laid back alongside the edge of the top member in the manner illustrated in Fig. 2. The assembly comprising the support members 30, 31, and 32, together with the antenna, may be very easily placed within the interior of a television cabinet. It will be understood that the usual chassis components are placed within the interior of the support 30, 31, 32. The plug 4 is inserted in a suitable socket which is provided on the receiver and suitably connected to the antenna input circuit of the tuner (not shown).

Preferably, when one side of the line must be grounded by an unbalanced input circuit, the side of the connecting line 9 which is associated with the section 8 should be grounded, although performance is substantially equivalent when the other side is grounded. This grounded point should be as close to the grounded side of the receiver input circuit as possible, in order to minimize stray ground currents and to maintain transmission line impedance match.

The proper length of section 8 will now be known to those skilled in the art, and it is not necessary to specify a particular length, but 25 inches has been found entirely satisfactory in one commercial embodiment of the invention. The length of the transmission line 7 should be such that line 7, section 8, and upper band antenna 5, 6 function collectively for the lower band as a folded dipole antenna. I have found a line 7 length of approximately 37 inches satisfactory in a commercial embodiment of the invention. Tolerances of ±5% in the length of line 7 have been found permissible within the limits of acceptable results.

The embodiment illustrated in Fig. 3 is suitable for use in a large size television receiver, the antenna elements then being mounted on a suitable support 34 of stiff cardboard or other insulating material which may be placed on the interior of the cabinet near its top. The portions 5 and 6 are laid out on the left side of the support with their ends bent at right angles as shown. The transmission line 7 extends diagonally to the right and to the rear and then diagonally to the right and forwardly, then laterally to the right, then rearwardly. The section 8 extends rearwardly, then rearwardly and to the left, and then laterally to the right as shown. The connecting line 9 and the plug 4 may be disposed toward the front and right side as shown.

Referring now to the Fig. 4 embodiment, which is also suitable for installation in the interior of a television receiver cabinet, a stiff support member 35 having an integral side 36 is provided. The upper dipole elements are arranged in the shape of a U and mounted on the exterior of this side, with the transmission line portion 7 extending upwardly and centrally of the side, then diagonally rearwardly and to the right on the top, then diagonally forwardly and to the right, then laterally to the right, then rearwardly.

The general location of the section 8, the connecting line 9 and the plug 4 is substantially the same as in the Fig. 3 embodiment.

The antenna elements may be secured to the support member by any suitable expedient, such as the staples 3.

It will be understood that the drawings, and particularly Fig. 1, have been prepared with a view to clarity in description rather than proportion.

While there have been shown and described what are considered to be the preferred embodiments of the present invention, it will be obvious to those skilled in the art that various modifications and substitutions of equivalents may be made therein without departing from the true scope of the invention as defined by the appended claims.

I claim:

1. The combination of a folded dipole antenna having such dimensions as to be broadly resonant throughout the upper standard television broadcast band extending from 174 to 216 megacycles, a two-conductor transmission line matched to said dipole, a pair of output terminals one of which is integral with one conductor of said line, and a closed-circuited section interposed between the end of the other conductor and the other terminal, said section having an electrical length of one-half wave substantially at the center of said upper band, whereby it acts as a short circuit effectively to connect said other terminal and said other conductor together during upper-band operation, the electrical length of said transmission line being such that said line and said section and said upper band antenna cooperatively effectively function as a folded dipole which is broadly resonant throughout the lower standard television broadcast band extending from 54 to 88 megacycles.

2. The combination of a folded dipole antenna having an impedance of 300 ohms and a physical length of approximately 25 inches so that it is resonant within the upper standard television broadcast band extending from 174 to 216 megacycles, a two-conductor 300 ohm transmission line matched to said dipole, a pair of output terminals one of which is integral with one conductor of said line, and a closed-circuited section having a physical length of approximately 25 inches interposed between the other conductor and the other terminal, said section having an electrical length of substantially one-half wave within said upper band, whereby it acts as a short circuit effectively to connect said other terminal and said other conductor together during upper band operation, the physical length of said transmission line being approximately 37 inches and the electrical length being such that said line and said section and said upper-band antenna cooperatively function as a broadly tuned antenna which is resonant within the lower standard television broadcast band extending from 54 to 88 megacycles.

3. The combination of a folded dipole antenna broadly resonant throughout the upper standard television broadcast band extending from 174 to 216 megacycles, a two-conductor transmission line coupled in balance to said dipole, a pair of output terminals one of which is integral with one conductor of said line, and a closed-circuited section interposed between the other conductor and the other terminal, said section having an electrical length of one-half wave substantially at the center of said upper band.

4. The combination of a folded dipole antenna having such dimensions as to be broadly resonant throughout the upper standard television broadcast band extending from 174 to 216 megacycles, a two-conductor parallel-pair transmission line coupled in balance to said dipole, a pair of output terminals one of which is integral with one conductor of said line, and a closed-circuited section interposed between the other conductor and the other terminal, said other terminal being constituted by one lead of said section, said section having an electrical length of one-half wave substantially at the center of said upper band, whereby it acts as a short circuit effectively to connect said other terminal and said other conductor together during upper-band operation, the electrical length of said transmission line being such that said line and said section and said upper-band antenna cooperatively effectively function as a folded dipole which is broadly resonant throughout the lower standard television broadcast band extending from 54 to 88 megacycles, said output terminals being symmetrically related to the upper-band dipole and non-symmetrically related to the lower-band dipole.

5. The combination of a folded dipole antenna having such dimensions as to be broadly resonant throughout the upper of two spaced broadcast bands, a two-conductor transmission line matched to said dipole, a pair of output terminals one of which is integral with one conductor of said line, and a closed-circuited section interposed between the other conductor and the other terminal, said section having an electrical length of one-half wave substantialy at the center of said upper band, whereby it acts as a short circuit effectively to connect said other terminal and said other conductor together during upper-band operation, the electrical length of said transmission line being such that said line and said section and said upper-band antenna cooperatively effectively function as a folded dipole which is broadly resonant throughout the lower of said two spaced bands.

6. The combination of a folded dipole antenna having such dimensions as to be broadly resonant throughout a very high frequency band, a two-conductor transmission line coupled to said dipole, a pair of output terminals one of which is integral with one conductor of said line, and a section of resonant line interposed between the other conductor and the other terminal, said section having such an electrical length as to provide a short circuit and effectively to connect said other terminal and said other conductor together during operation on that band.

7. The combination of a folded dipole antenna having such dimensions as to be broadly resonant throughout the upper standard television broadcast band extending from 174 to 216 megacycles, a two-conductor transmission line matched to said dipole, a pair of output terminals one of which is integral with one conductor of said line, and a closed-circuited section interposed between the other conductor and the other terminal, said section having an electrical length of one-half wave substantially at the center of said upper band, whereby it acts as a short circuit effectively to connect said other terminal and said other conductor together during upper-band operation, the electrical length of said transmission line being such that said line and said section and said upper-band antenna cooperatively effectively function as a folded dipole which is broadly

resonant throughout the lower standard television broadcast band extending from 54 to 88 megacycles, said closed-circuited section and line comprising a single length of standard parallel-pair line broken to provide two output terminals, the first-mentioned dipole antenna comprising a single length of standard parallel-pair line broken to provide leads connected to leads of the first-mentioned parallel-pair line.

8. The combination of a stiff support member adapted to be disposed in the interior of a television receiver cabinet and flat antenna elements supported within said cabinet by said member, said elements comprising a folded dipole antenna having such dimensions as to be broadly resonant throughout the upper standard television broadcast band extending from 174 to 216 megacycles, a two-conductor transmission line matched to said dipole, a pair of output terminals one of which is integral with one conductor of said line, and a closed-circuited section interposed between the other conductor and the other terminal, said section having an electrical length of one-half wave substantially at the center of said upper band, whereby it acts as a short circuit effectively to connect said other terminal and said other conductor together during upper-band operation, the electrical length of said transmission line being such that said line and said section and said upper band antenna cooperatively effectively function as a folded dipole which is broadly resonant throughout the lower standard television broadcast band extending from 54 to 88 megacycles.

9. The combination of a stiff wrapper member adapted to be disposed in the interior of a television receiver cabinet and flat antenna elements supported by and disposed at least in part about the exterior of said wrapper member, said elements comprising a folded dipole antenna having such dimensions as to be broadly resonant throughout the upper standard television broadcast band extending from 174 to 216 megacycles, a two-conductor transmission line matched to said dipole, a pair of output terminals one of which is integral with one conductor of said line, and a closed-circuited section interposed between the other conductor and the other terminal, said section having an electrical length of one-half wave substantially at the center of said upper band, whereby it acts as a short circuit effectively to connect said other terminal and said other conductor together during upper-band operation, the electrical length of said transmission line being such that said line and said section and said upper band antenna cooperatively effectively function as a folded dipole which is broadly resonant throughout the lower standard television broadcast band extending from 54 to 88 megacycles.

10. The combination of a flat flexible folded dipole antenna having an impedance of 300 ohms and a physical length of approximately 25 inches so that it is resonant within the upper standard television broadcast band extending from 174 to 216 megacycles, a flat flexible two-conductor 300 ohm transmission line matched to said dipole, a pair of output terminals one of which is integral with one conductor of said line, and a closed-circuited flat flexible section having a physical length of approximately 25 inches interposed between the other conductor and the other terminal, said section having an electrical length of substantially one-half wave within said upper band, whereby it acts as a short circuit effectively to connect said other terminal and said other conductor together during upper band operation, the physical length of said transmission line being approximately 37 inches and the electrical length being such that said line and said section and said upper band antenna cooperatively function as a broadly tuned antenna which is resonant within the lower standard television broadcast band extending from 54 to 88 megacycles.

11. In combination, a folded dipole antenna for the uper one of two spaced bands, a parallel-pair transmission line coupled to said antenna, a pair of output terminal means, one of which is provided by one lead of said line and the other of which is provided by one lead of a line section resonant within the upper band, the remaining leads of said dipole and line section being connected together, said transmission line and line section and upper-band dipole providing a folded dipole for the lower one of said bands.

12. The combination in accordance with claim 11 wherein the spaced bands are the upper and lower television broadcast band and the length of said lines is 37 inches $\pm 5\%$.

13. The combination of a flat flexible folded dipole antenna having an impedance of 300 ohms and such a physical length that it is resonant within the upper standard television broadcast band extending from 174 to 216 megacycles, a flat flexible two-conductor 300 ohm transmission line matched to said dipole, a pair of output terminals one of which is integral with one conductor of said line, and a closed-circuited flat flexible section interposed between the other conductor and the other terminal, said section having an electrical length of substantially one-half wave within said upper band, whereby it acts as a short circuit effectively to connect said other terminal and said other conductor together during upper band operation, the physical length of said transmission line being approximately 37 inches $\pm 5\%$ and the electrical length being such that said line and said section and said upper band antenna cooperatively function as a broadly tuned antenna which is resonant within the lower standard television broadcast band extending from 54 to 88 megacycles.

14. The combination set forth in claim 3 wherein said dipole, said line and said section comprise flexible insulated conductive material.

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