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-circuit section (19, 20, 21) interposed between the end of the other conductor (18) and the other terminal (17).

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 21 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; 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 doubler consisting of two parallel, closely spaced half-wave wires connected 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 3/4 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, 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, metalized 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 described above. 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 mate-
rial.

One lead of the transmission line constitutes an output terminal 17. Between the other out-
put terminal 18 and the end of line 16 is a closed-circuited section consisting of spaced parallel
conductors 19 and 21, soldered together at 23. The electrical length of this section is approx-
imately one-half wave length at the center of the upper frequency band. Therefore this sec-
tion functions as a closed circuit during upper band operation and in effect connects output
terminal 17 to the end of the transmission line 15, 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 con-
ected to a two-terminal plug 4 in any suitable manner, but it is preferred that the conductors 21
and 23 leading to plug 4 be as short as possible and that they maintain the characteristic
impedance of the folded dipole and line. A length of four inches is satisfactory.

The upper band operation of the Fig. 1 an-
tenna 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 trans-
mission line conductor 16. During upper band operation, this antenna operates as a straight
forward "center-fed" type of antenna, the transmission line being connected in balanced rel-
ationship to the antenna portions. The overall electrical length of the conductor 10, 11, 12,
13, 14 is approximate one wavelength 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 6, 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 elec-
trical length of the conductive path formed by
proceeding in the sequence indicated approxi-
mating one wave length at the lower band. The
short connecting line 22, 24 is non-resonant, and
its connection to the last-mentioned lower band
folded dipole is unsymmetrical and not in bal-
dance. 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
closed transmission line.

It will be understood from the foregoing de-
scription 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 pre-
ferred 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 con-
tinuous 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 therefore it is appreciated that the provision
of an opening in the support member to the in-
terior thereof. The section 8 extends upwardly
outside of and adjacent side 31 and is then
brought past an opening on that side to a posi-
tion on top of member 33 and is finally laid back
alongside the edge of the lower band and to the
manner illustrated in Fig. 2. The assembly com-
prising the support members 30, 31, and 32, to-
gether with the antenna, may be very easily placed within the interior of a television cabinet.

It will be understood that the usual chassis compo-
nents 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 cir-
cuit of the tuner (not shown).

Preferably, 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 it 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 an-
tenna 5, 6 function collectively for the lower
band as a folded dipole antenna. I have found
a line 7 length of approximately 37 inches satis-
factory in a commercial embodiment of the in-
vention. Tolerances of ±5% in the length of line
7 have been found permissible within the limits
of accurate wave length at the frequencies.

The embodiment illustrated in Fig. 3 is suit-
able 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 sup-
port 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 con-
necting line 9 and the plug 4 may be disposed
toward the front and right side as shown.

Referring now to Fig. 4 of embodiment, which
is also suitable for installation in the interior
of a television receiver cabinet, the support
member 35 having an integral side member 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 forwardly 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.

2. The combination of a folded dipole antenna having such dimensions as to be broadly resonant throughout the upper 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.

3. 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 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 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.

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 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 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 of said two spaced bands.
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 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 upper 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 ±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 ±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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