

March 19, 1963

W. B. WATKINS

3,082,422

PLURAL FOLDED DIPOLES WITH CENTER MOUNTED TRANSFORMER COUPLING

Filed Feb. 9, 1960

2 Sheets-Sheet 1

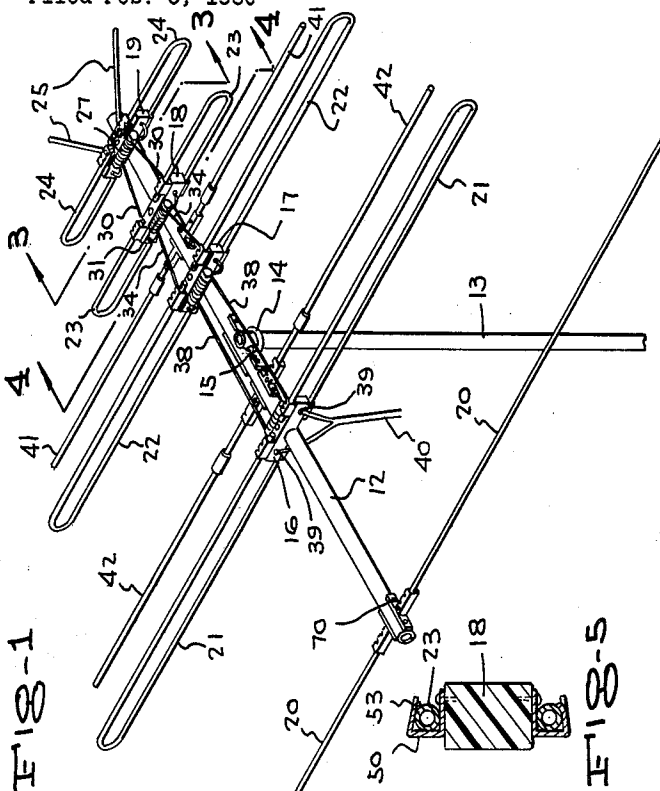


FIG-1

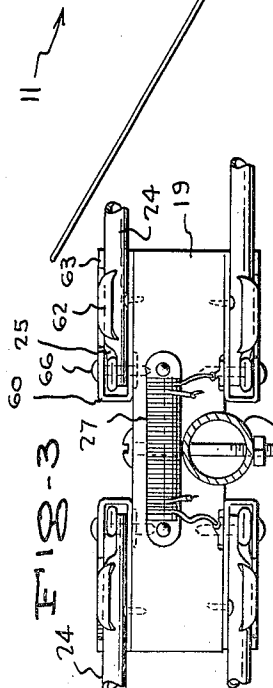


FIG-3

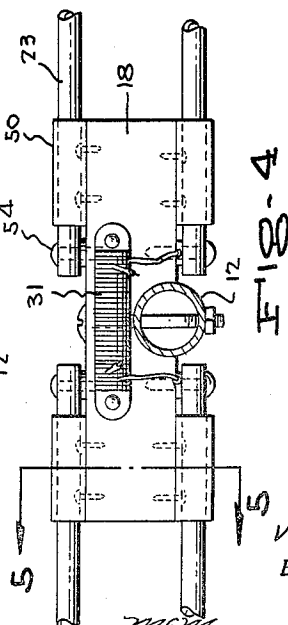


FIG-4

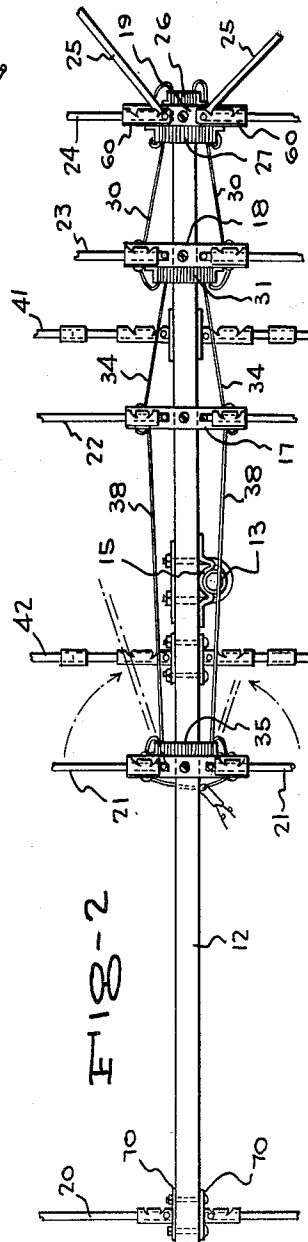


FIG-2

INVENTOR.
WILLIAM B. WATKINS
BY

McMorrow, Bertram & Davidson
ATTORNEYS

March 19, 1963

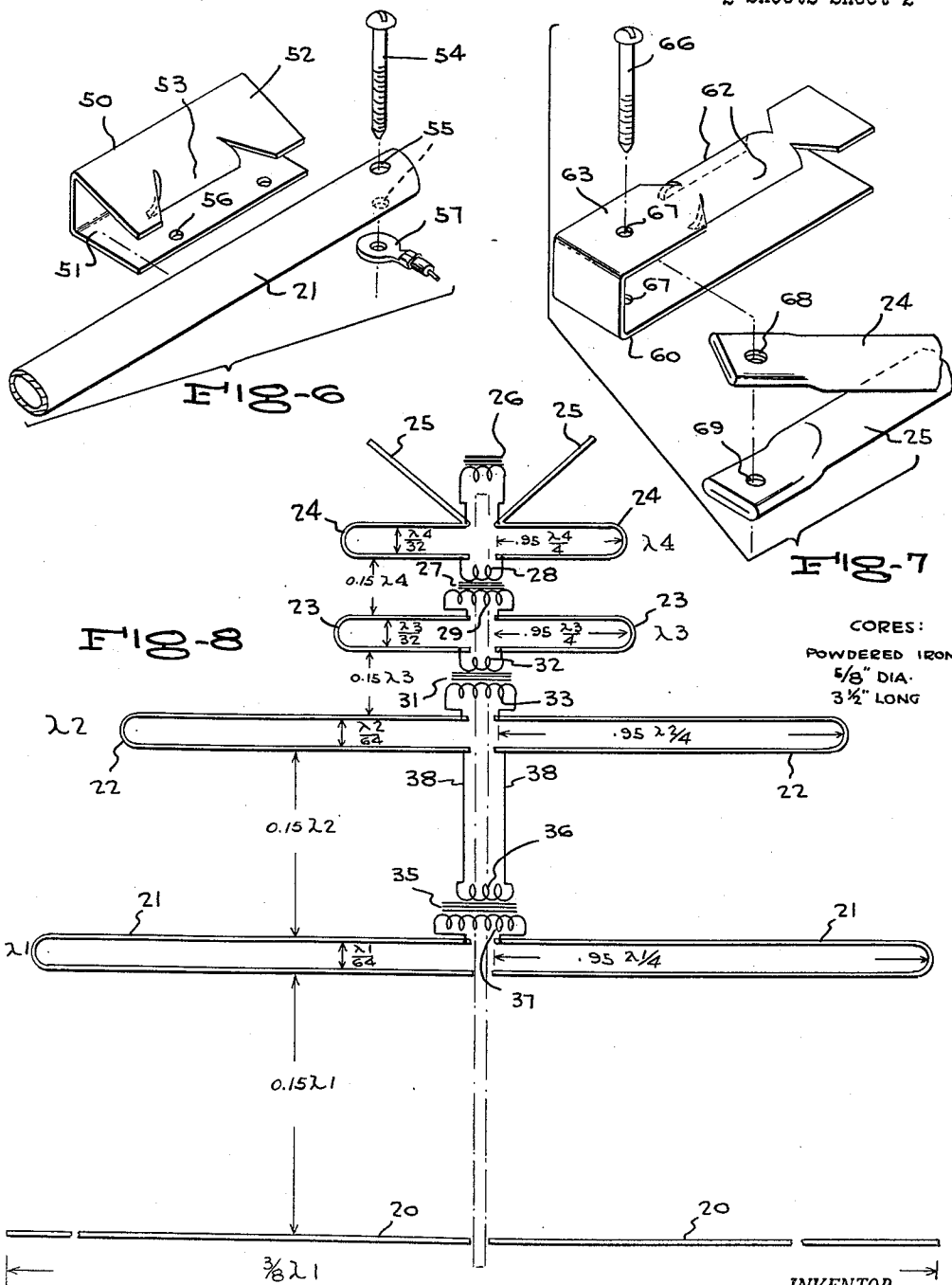
W. B. WATKINS

3,082,422

PLURAL FOLDED DIPOLES WITH CENTER MOUNTED TRANSFORMER COUPLING

Filed Feb. 9, 1960

2 Sheets-Sheet 2



INVENTOR.

WILLIAM B. WATKINS

BY

McMorrow, Perman & Davidson
ATTORNEYS

1

3,082,422
**PLURAL FOLDED DIPOLES WITH CENTER
MOUNTED TRANSFORMER COUPLING**

William B. Watkins, 928 W. Cotton St.,
Winston-Salem, N.C.

Filed Feb. 9, 1960, Ser. No. 7,590

10 Claims. (Cl. 343-803)

This invention relates to antennas, and more particularly to a wide band antenna of the multiple-element type particularly adapted for use in the reception of television signals.

A main object of the invention is to provide a novel and improved multiple-element antenna for use in the reception of television signals, frequency modulation signals, or similar relatively high frequency radio signals, the antenna being simple in construction, being easy to install, and providing an effective field strength pattern over a wide range of frequencies, particularly, over a selected range of frequencies such as that which includes the television bands represented by the low band channels, namely, channels two to six inclusive, and the high band channels, namely, channels seven to thirteen inclusive.

A further object of the invention is to provide an improved wide band antenna which includes respective signal collector elements of the folded dipole type which are substantially tuned to respective television channel frequencies, but which are coupled and interconnected in a manner whereby satisfactory response is obtained for all channel frequencies in the television bands.

A still further object of the invention is to provide an improved multiple-element antenna of the folded dipole type which provides satisfactory reception over the entire range of frequencies employed in television broadcasting and which provides satisfactory reception of frequency modulation broadcast signals, the antenna involving relatively inexpensive components, being foldable to a relatively compact size for transportation or storage, and being relatively light in weight, so that it is easy to install and will remain in satisfactory operating condition over a long period of time.

Further objects and advantages of the invention will become apparent from the following description and claims, and from the accompanying drawings, wherein:

FIGURE 1 is a perspective view of a multiple-element antenna constructed in accordance with the present invention.

FIGURE 2 is an enlarged fragmentary top plan view of the antenna shown in FIGURE 1.

FIGURE 3 is an enlarged transverse vertical cross sectional view taken substantially on the line 3-3 of FIGURE 1.

FIGURE 4 is an enlarged transverse vertical cross sectional view taken substantially on the line 4-4 of FIGURE 1.

FIGURE 5 is a transverse vertical cross sectional view taken on the line 5-5 of FIGURE 4.

FIGURE 6 is a perspective view showing a fragmentary portion of one end of a half folded dipole element employed in the antenna of FIGURE 1 and the associated resilient locking clip employed to pivotally connect the element to its supporting block on the antenna.

FIGURE 7 is a perspective view similar to FIGURE 6, but showing the end portions of the forward elements of the antenna and the pivot clip associated therewith, as employed in the antenna of FIGURE 1.

FIGURE 8 is a schematic diagram showing the electrical connections of the active elements of the antenna of FIGURE 1.

Referring to the drawings, and more particularly to FIGURE 1, 11 generally designates a multiple-element

2

television antenna constructed in accordance with the present invention.

The antenna 11 comprises a horizontal supporting bar 12 which is suitably secured to the top end of a vertical mast 13, as by means of a U-bolt 14 and a channeled cooperating seat member 15 which receives the top end of the mast 13 and which enables said top end to be clamped to the intermediate portion of the horizontal supporting bar 12, as is clearly illustrated in FIGURES 1 and 2.

Secured to the horizontal supporting bar 12 are the respective spaced, transversely extending insulating blocks 16, 17, 18 and 19, spaced in a manner presently to be described, the foremost insulating block 19 being located adjacent the forward end of the horizontal supporting bar 12, said supporting bar 12 being of sufficient length so that the rearmost insulating block 16 is located a sufficient distance from the rear end of the bar 12 to enable a pair of suitable reflector elements 20, 20 to be secured thereto, as will be presently described.

Secured to the opposite end portions of the respective insulating blocks 16, 17, 18 and 19 are respective pairs of opposing quarter-wave, half folded dipole elements 21, 21, 22, 22, 23, 23 and 24, 24. As will be presently explained, each pair of opposing quarter-wave, half folded dipole elements substantially represents a particular folded dipole element cut to resonate to a selected television channel frequency. Thus, in a typical design, the opposing half folded dipole elements 21, 21 may be cut to define a folded dipole resonating to the frequency of television channel 3, the folded dipole represented by the opposing half folded dipole elements 22, 22 may be cut to resonate to the frequency of television channel 5, the folded dipole represented by the opposing half folded dipole elements 23, 23 may be cut to resonate to the frequency of television channel 8, and the equivalent folded dipole represented by the opposing pair of quarter wave, half folded dipole elements 24, 24 may be cut to resonate to the frequency of television channel 11.

As will be presently explained, the opposing pairs of half folded dipole elements are interconnected in a manner to make them effective as an equivalent folded dipole with respect to the television channel frequency for which they are intended, while at the same time allowing currents of different frequencies to flow therein without substantial attenuation.

The forward pair of opposing quarter wave, half folded dipole elements 24, 24 are provided with forwardly divergent antenna stub elements 25, 25 which are connected to the input ends of the leading pair of opposing folded dipole elements 24, 24 and which diverge symmetrically with respect to the axis of the main horizontal supporting bar 12, so as to provide somewhat directional characteristics for the antenna array. The antenna stub elements 25, 25 are cut to the same length as the half folded dipole elements 24, 24. Thus, the stub elements 25, 25 define a dipole which is substantially resonant to the same television channel frequency as the folded dipole defined by the opposing half folded dipole elements 24, 24.

As will be presently explained, the stub elements 25, 25 are also resonant to harmonics of the lower television channel frequencies, for example, channel frequencies similar to those to which the equivalent folded dipoles represented by the opposing pairs of quarter wave dipole elements 21, 21 and 22, 22 resonate.

A loading coil 26 is mounted on the forward side of the insulating block 19 and is electrically connected across the input ends of the quarter wave dipole elements 24, 24, serving as a matching impedance to match the antenna stub elements 25, 25 to the folded dipole defined by the opposing quarter wave dipole elements 24, 24. The loading coil 26 comprises three turns of number 12 wire wound

on a powdered iron core of approximately $\frac{5}{8}$ of an inch diameter and $3\frac{1}{2}$ inches long.

Mounted on the rear side of the insulating block 19 is a coupling transformer 27 which comprises a primary winding 29 and a secondary winding 29. The windings 28 and 29 are wound on a powdered iron core of approximately $\frac{5}{8}$ inch diameter and $3\frac{1}{2}$ inches long, similar to that employed for the loading coil 26. The primary 28 comprises three turns of number 12 wire and is electrically connected across the output ends of the quarter wave dipole elements 24, 24. The secondary winding 29, comprising six turns of number 12 wire is electrically connected by relatively short conductors 30, 30 to the input ends of the next adjacent pair of opposing quarter wave, half folded dipole elements 23, 23. Mounted on the rear side of the insulating block 18 is a coupling transformer 31 having a primary winding 32 and a secondary winding 33, the primary winding 32 comprising six turns of number 12 wire and the secondary winding 33 comprising twelve turns of similar wire, said windings being wound on a $\frac{5}{8}$ inch diameter powdered iron core approximately $3\frac{1}{2}$ inches long as in the case of transformer 27 and loading coil 26. The primary winding 32 is connected across the output ends of the opposing quarter wave, half folded dipole elements 23, 23, and the secondary winding 33 is connected by relatively short conductors 34, 34 to the input ends of the next adjacent pair of opposing quarter wave, half folded dipole elements 22, 22.

Mounted on the forward side of the insulating block 16 is a coupling transformer 35 comprising a primary winding 36 and a secondary winding 37. The winding 36 comprises six turns of number 12 wire and the secondary winding 37 comprises twelve turns of number 12 wire, the windings being wound on a $\frac{5}{8}$ inch diameter powdered iron core $3\frac{1}{2}$ inches long, as in the case of the previously described transformers 31 and 27 and the loading coil 26. The output ends of the opposing quarter wave, half folded dipole elements 22, 22 are connected by conductors 38, 38 to the terminals of the primary winding 36, and the secondary winding 37 is connected across the input terminals of the quarter wave, half folded dipole elements 21, 21. The output ends 39', 39' of the quarter wave half folded dipole elements 21, 21 may be suitably connected to terminals 39, 39 provided on the insulating block 16, as shown in FIGURE 1, to which the respective conductors of a conventional transmission line 40 may be connected.

Referring to FIGURE 8, it will be seen that the respective tuned signal collector elements are coupled together in a manner to provide superimposed signal currents collected by the elements in the final electrical branch of the system, namely, in the branch comprising the half folded dipole elements 21, 21 and the secondary 37, whereby the composite signal currents are available at the output terminals 39, 39 of the antenna. Thus, the initial stage of the system comprises the pair of outwardly divergent stub elements 25, 25 coupled to the folded dipole defined by the opposing quarter wave half dipole elements 24, 24 and the loading coil 26, the loading coil acting as a matching impedance, so that in effect, the stub elements 25, 25 act mainly to provide a directional pattern, although they do function to some extent as signal collecting elements. The signal currents induced in the input stage of the antenna namely, the folded dipole defined by the opposing elements 24, 24 and the loading coil 26, develop a voltage across the primary 28 which is stepped up in the secondary 29 and which is applied to the circuit branch comprising the opposing half dipole elements 23, 23. Thus, a signal current derived from the preceding circuit branch flows in the opposing quarter wave half dipole elements 23, 23, and additional signal currents induced in the folded dipole defined by the elements 23, 23 are superimposed on the signal currents produced by the applied voltage derived from the secondary 29. The superimposed currents develop a signal voltage across the primary 32. The secondary 33 of the transformer 31 steps up this voltage and applies it

to the circuit branch comprising the opposing quarter wave half dipole elements 22, 22. The action continues, until a composite signal voltage is provided at the output terminals 39, 39, representing substantially all of the signals picked up by the collector elements and coupled through the system in the manner above described to the output terminals 39, 39. It will be seen that the signal collecting elements are thus arranged in substantially a cascade relationship so that signals derived at the forward or input portion of the system are converted into signal voltages and are stepped up, being coupled through the system and superimposed on the signals to which the respective succeeding folded dipole stages are respectively resonant.

As above mentioned, the folded dipoles defined by the respective pairs of opposing half folded dipole elements are not only resonant to fundamental signal frequencies, but in certain cases are also resonant to harmonic frequencies of television channel frequencies. Substantial signal voltage gain is obtained by the stepup transformers 27, 31 and 35, which are especially effective because radiation loss is minimized by making the connecting conductors, such as the conductors 30, 30, 34, 34 and 38, 38 relatively short and keeping these conductors relatively close to the horizontal main supporting bar 12, as illustrated in FIGURES 1 and 2. Due to the proximity of the successive folded dipole elements, a substantial amount of such radiation as occurs at the forward portion of the array will be picked up by the dipole elements at the rear portion of the array and will be converted into useful output signal currents.

As is well understood, in a folded dipole, there is normally minimum voltage at the center point of the folded dipole. In the system above described, the transformer primaries are in effect inserted in the center portions of the folded dipoles, thus placing an impedance in the central portion of each dipole which is effective to provide a voltage drop thereacross due to the signal currents flowing in the folded dipole elements. The use of the stepup transformers, as above described, provides an effective means of transferring and superimposing the signal voltages with minimum loss and for ultimately providing an output which includes a wide range of frequencies, for example, the frequencies contained in both the upper and lower television broadcast bands and which includes the frequency modulation broadcast band.

In the specific example of a typical antenna assembly in accordance with the present invention, the width of the quarter wave dipole loop elements 23 and 24 was $\frac{1}{32}$ of the wave length corresponding to the respective frequencies associated therewith, whereas the width of the quarter wave dipole loops 22 and 21 were $\frac{1}{64}$ of their associated wave length. The spacing between the dipole elements 23, 23 and 24, 24 was 0.15 of the wave length associated with the dipole elements 24, 24 and the spacing between the dipole elements 22, 22 and 23, 23 was likewise 0.15 of the wave length associated with the dipole elements 23, 23. Likewise, the spacing between the dipole elements 21, 21 and 22, 22, was 0.15 of the wave length associated with the dipole elements 22, 22 and the spacing between the reflector members 20, 20 and the dipole elements 21, 21 was 0.15 of the wave length associated with the dipole elements 21, 21.

Each dipole element was cut approximately 5% shorter than the actual quarter wave length corresponding to the frequency associated therewith to compensate for the end loading effect of the outer portion of the dipole element. The various elements were formed of one-half inch diameter aluminum tubing.

As shown in FIGURE 1, respective director bars 41, 41 and 42, 42 may be provided, the director bars being spaced forwardly of the respective pairs of opposing quarter wave dipole elements 22, 22 and 21, 21, to provide a more directional pattern. The director bars are spaced a distance equal approximately to 0.1 of the wave length for which their associated dipole elements are cut.

5

The respective dipole elements, reflector bars and director bars are fastened to the main horizontal support bar 12 in a manner whereby the elements may be folded to positions adjacent and parallel to the main support bar 12. Thus, as shown in FIGURE 6, the dipole elements may be pivotally connected to their associated insulating blocks by employing channeled bracket members 50 which face forwardly and whose bottom flanges 51 are fastened respectively to the top and bottom surfaces of the insulating blocks. The brackets are provided with outer flanges 52 formed with inwardly curved resilient tongues 53 which are curved arcuately and which are adapted to lockingly receive the associated dipole portion and align same longitudinally with respect to the bracket members. Thus, the bracket members normally maintain the antenna elements in positions directed substantially perpendicular to the horizontal main support bar 12. To fold up the antenna, the elements may be swung forwardly, causing the tongue elements 53 to flex sufficiently to allow the antenna elements to swing therepast and to be rotated to positions substantially parallel to the main horizontal support member 12. The antenna elements are pivotally connected to the bracket members by means of fastening screws 54 which engage through diametrically opposed apertures 55, 55 provided at the inner ends of the antenna elements and through apertures 56 provided in the flanges 51 of the brackets, the bolts 54 being threadedly secured in the insulating blocks associated with the antenna elements. The electrical connections to the antenna elements are made by conductors provided with terminal lugs 57, as is clearly shown in FIGURE 6, the terminal lugs being clamped to the antenna elements by the pivot screws 54.

At the forward end of the antenna, generally U-shaped brackets 60, 60 are provided on the top and bottom surfaces of the insulating block 19 at its outer end portions, as shown in FIGURE 2, the bracket members 60 extending outwardly in opposite directions and being formed with arcuate resilient tongue elements 62 which curve inwardly at the intermediate portions of the outer arms 63 of the brackets. The arcuately curved tongues 62 define channels which receive portions of the associated quarter wave dipole elements 24 and which act to maintain said dipole elements in positions extending substantially perpendicular to the horizontal main supporting bar 12. The associated stub elements 25 are pivotally connected to the inner ends of the associated dipole elements 24 by pivot screws 66 which engage through openings 67, 67, provided at the inner end portions of the respective arms of the bracket members and through openings 68 and 69 provided respectively in the members 24 and 25, said members being received in the inner end portions of the bracket members 60 so as to be pivotally connected thereto by the pivot screws 66. The pivot screws 66 are threadedly engaged in the block 19.

As will be readily apparent, the stub members 25, 25 are normally retained in their forwardly diverging relationship by the friction produced by the clamping effect of the brackets 60 with the pivot screws 66 tightly engaged in the insulating block 19, the brackets being sufficiently resilient to flex so as to provide the required friction. Since the outer arms 63 of the bracket members are relatively flexible, the elements may be folded to positions substantially parallel to the horizontal supporting bar 12 by merely exerting manual force on the elements to rotate them inwardly.

The director bars 41, 41, 42, 42 and the reflector bars 20, 20 are foldably secured to the horizontal supporting bar 12 by bracket means substantially similar to that above described in connection with the dipole elements and illustrated in FIGURE 6, the bracket means including mounting plates 70 which are arcuately curved to conform to the curvature of the supporting bar 12, so that the bracket means may be rigidly clamped to the

6

supporting bar in the positions illustrated in FIGURES 1 and 2.

The director bars 41, 42 and the reflector elements 20 act as parasitic elements and produce re-radiation and reflection which build up the signal intensity and accentuate the directional pattern of the antenna array. However, the antenna system is responsive with substantial efficiency to the re-radiated signal energy as well as to that which is received directly, and, as above explained, the signal collecting elements may, to some extent, act as parasitic elements to produce re-radiation of the signal energy. However, a relatively high proportion of the re-radiated signal energy is returned into the system and ultimately is made available as useful signal voltage at the output terminals 39, 39.

The reflector bars 20, 20 are cut to a length of approximately $\frac{3}{4}$ of the wave length associated with the channel frequency of the rearmost half-folded dipole elements 21, 21.

While a specific embodiment of a wide band antenna has been disclosed in the foregoing description, it will be understood that various modifications within the spirit of the invention may occur to those skilled in the art. Therefore, it is intended that no limitations be placed on the invention except as defined by the scope of the appended claims.

What is claimed is:

1. A wide band antenna of the character described comprising a horizontal support, a plurality of folded dipoles mounted in parallel spaced relation on said support, each folded dipole being tuned to a different frequency and comprising a pair of opposing quarter wave half folded dipole elements, and respective step-up coupling transformers interconnecting said folded dipoles at their center portions in cascade relation, the transformer windings being inserted in the center portions of the coupled folded dipoles, whereby each transformer primary defines an impedance in the center portion of the associated folded dipole which is effective to provide a signal voltage drop thereacross which is stepped up in the transformer secondary winding with relatively small loss and is added thereby to the normal signal in the folded dipole containing said secondary winding.

2. A wide band antenna of the character described comprising a horizontal support, a plurality of folded dipoles mounted in parallel spaced relation on said support, each folded dipole being tuned to a different frequency and comprising a pair of opposing quarter wave half folded dipole elements, and respective step-up coupling transformers connected between the folded dipoles and coupling said folded dipoles in cascade relation, the primaries of the transformers being connected across the output ends of the pairs of quarter wave half folded dipole elements and the secondaries of the transformers being connected across the input ends of the next adjacent quarter wave half folded dipole elements, whereby each transformer primary defines an impedance in the center portion of a folded dipole which is effective to provide a signal voltage drop thereacross which is stepped up in the transformer secondary winding with relatively small loss and is added thereby to the normal signal in the folded dipole containing said secondary winding.

3. A wide band antenna of the character described comprising a horizontal support, a plurality of folded dipoles mounted in parallel spaced relation on said support and being dimensioned to resonate to different frequencies corresponding to respective signal channels, each folded dipole comprising a pair of opposing quarter wave half folded dipole elements, and respective step-up coupling transformers interconnecting said folded dipoles at their center portions in cascade relation, the transformer windings being inserted in the center portions of the coupled folded dipoles, whereby each transformer primary defines an impedance in the center portion of the asso-

ciated folded dipole which is effective to provide a signal voltage drop thereacross which is stepped up in the transformer secondary winding with relatively small loss and is added thereby to the normal signal in the folded dipole containing said secondary winding.

4. A wide band antenna of the character described comprising a horizontal support, a plurality of folded dipoles mounted in parallel spaced relation on said support and being dimensioned to resonate to different frequencies corresponding to respective signal channels, each folded dipole comprising a pair of opposing quarter wave half folded dipole elements, and respective step-up coupling transformers connected between the folded dipoles and coupling said folded dipoles in cascade relation, the primaries of the transformers being connected across the output ends of the pairs of quarter wave half folded dipole elements and the secondaries of the transformers being connected across the input ends of the next adjacent quarter wave half folded dipole elements, whereby each transformer primary defines an impedance in the center portion of a folded dipole which is effective to provide a signal voltage drop thereacross which is stepped up in the transformer secondary winding with relatively small loss and is added thereby to the normal signal in the folded dipole containing said secondary winding.

5. A wide band antenna of the character described comprising a horizontal main support, spaced transversely extending insulating members mounted on said support, respective pairs of opposing quarter wave, half folded dipole elements secured at their inner ends to the end portions of the insulating members and extending transverse to and outwardly from said main support, respective step-up coupling transformers mounted on said insulating members, means connecting the primaries of the transformers across the output ends of the pairs of half folded dipole elements, and means connecting the secondaries of the transformers to the input ends of the next adjacent pairs of half folded dipole elements, whereby the pairs of half folded dipole elements substantially define folded dipole elements connected in cascade relation, the half folded dipole elements being dimensioned so that said folded dipole elements are tuned to respective different television channel frequencies, and whereby each transformer primary defines an impedance in the center portion of a folded dipole which is effective to provide a signal voltage drop thereacross which is stepped up in the transformer secondary winding with relatively small loss and is added thereby to the normal signal in the folded dipole containing said secondary winding.

6. A wide band antenna of the character described comprising a horizontal main support, spaced transversely extending insulating members mounted on said support, respective pairs of opposing quarter wave, half folded dipole elements secured at their inner ends to the end portions of the insulating members and extending transverse to and outwardly from said main support, respective step-up coupling transformers mounted on said insulating members, means connecting the primaries of the transformers across the output ends of the pairs of half folded dipole elements, means connecting the secondaries of the transformers to the input ends of the next adjacent pairs of half folded dipole elements, whereby the pairs of half folded dipole elements substantially define folded dipole elements connected in cascade relation, and forwardly divergent antenna stub elements connected to the input ends of the leading pair of half folded dipole elements, the half folded dipole elements being dimensioned so that said folded dipole elements are tuned to respective different television channel frequencies, and whereby each transformer primary defines an impedance in the center portion of a folded dipole which is effective to provide a signal voltage drop thereacross which is stepped up in the transformer secondary winding with relatively small loss and is added thereby to the normal

signal in the folded dipole containing said secondary winding.

7. A wide band antenna of the character described comprising a horizontal main support, spaced transversely extending insulating members mounted on said support, respective pairs of opposing quarter wave, half folded dipole elements secured at their inner ends to the end portions of the insulating members and extending transverse to and outwardly from said main support, respective coupling transformers mounted on said insulating members, means connecting the primaries of the transformers across the output ends of the pairs of half folded dipole elements, means connecting the secondaries of the transformers to the input ends of the next adjacent pairs of half folded dipole elements, whereby the pairs of half folded dipole elements substantially define folded dipole elements connected in cascade relation, forwardly divergent antenna stub elements connected to the input ends of the leading pair of half folded dipole elements, and a loading coil connected across the input ends of said leading pair of half folded dipole elements, the half folded dipole elements being dimensioned so that said folded dipole elements are tuned to respective different television channel frequencies.

8. A wide band antenna of the character described comprising a horizontal main support, spaced transversely extending insulating members mounted on said support, respective pairs of opposing quarter wave, half folded dipole elements secured at their inner ends to the end portions of the insulating members and extending transverse to and outwardly from said main support, respective coupling transformers mounted on said insulating members, means connecting the primaries of the transformers across the output ends of the pairs of half folded dipole elements, means connecting the secondaries of the transformers to the input ends of the next adjacent pairs of half folded dipole elements, whereby the pairs of half folded dipole elements substantially define folded dipole elements connected in cascade relation, forwardly divergent antenna stub elements connected to the input ends of the leading pair of half folded dipole elements, and respective director bars secured to said main support forwardly adjacent to and parallel to certain of the remaining half folded dipole elements, the half folded dipole elements being dimensioned so that said folded dipole elements are tuned to respective different television channel frequencies.

9. A wide band antenna of the character described comprising a horizontal main support, spaced transversely extending insulating members mounted on said support, respective pairs of opposing quarter wave half folded dipole elements pivotally connected at their inner ends to the end portions of the insulating members, means to yieldably lock said half folded dipole elements in positions extending transverse to and outwardly from said main support, respective step-up coupling transformers mounted on said insulating members, means connecting the primaries of the transformers across the output ends of the pairs of half folded dipole elements, and means connecting the secondaries of the transformers to the input ends of the next adjacent pairs of half folded dipole elements, whereby the pairs of half folded dipole elements substantially define folded dipole elements connected in cascade relation, the half folded dipole elements being dimensioned so that said folded dipole elements are tuned to respective different television channel frequencies, and whereby each transformer primary defines an impedance in the center portion of a folded dipole which is effective to provide a signal voltage drop thereacross which is stepped up in the transformer secondary winding with relatively small loss and is added thereby to the normal signal in the folded dipole containing said secondary winding.

10. A wide band antenna of the character described comprising a horizontal main support, spaced trans-

versely extending insulating members mounted on said support, respective pairs of opposing quarter wave half folded dipole elements secured at their inner ends to the end portions of the insulating members and extending transverse to and outwardly from said main support, respective coupling transformers mounted on said insulating members, means connecting the primaries of the transformers across the output ends of the pairs of half folded dipole elements, means connecting the secondaries of the transformers to the input ends of the next adjacent pairs of half folded dipole elements, whereby the pairs of half folded dipole elements substantially define folded dipole elements connected in cascade relation, forwardly divergent antenna stub elements connected to the input ends of the leading pair of half folded dipole elements, respective director bars secured to said main support forwardly adjacent to and parallel to certain of the half folded dipole elements, and reflector

bars secured to said main support rearwardly of and parallel to the rearmost pair of half folded dipole elements, the half folded dipole elements being dimensioned so that said folded dipole elements are tuned to respective different television channel frequencies.

References Cited in the file of this patent

UNITED STATES PATENTS

10	1,120,054	Harrison	Dec. 8, 1914
	1,914,886	Franklin	June 20, 1933
	2,045,987	Green	June 30, 1936
	2,567,577	Pariser	Sept. 11, 1951
	2,641,703	Valach	June 9, 1953
15	2,673,295	Wentworth	Mar. 23, 1954
	2,817,085	Schwartz et al.	Dec. 17, 1957
	2,881,430	Bird	Apr. 7, 1959
	2,921,310	Anderson	Jan. 12, 1960