March 3, 1953 — L. H. FINNEBURGH, JR — 2,630,531

TELEVISION ANTENNA

Original Filed Sept. 16, 1950 — 2 SHEETS—SHEET 1

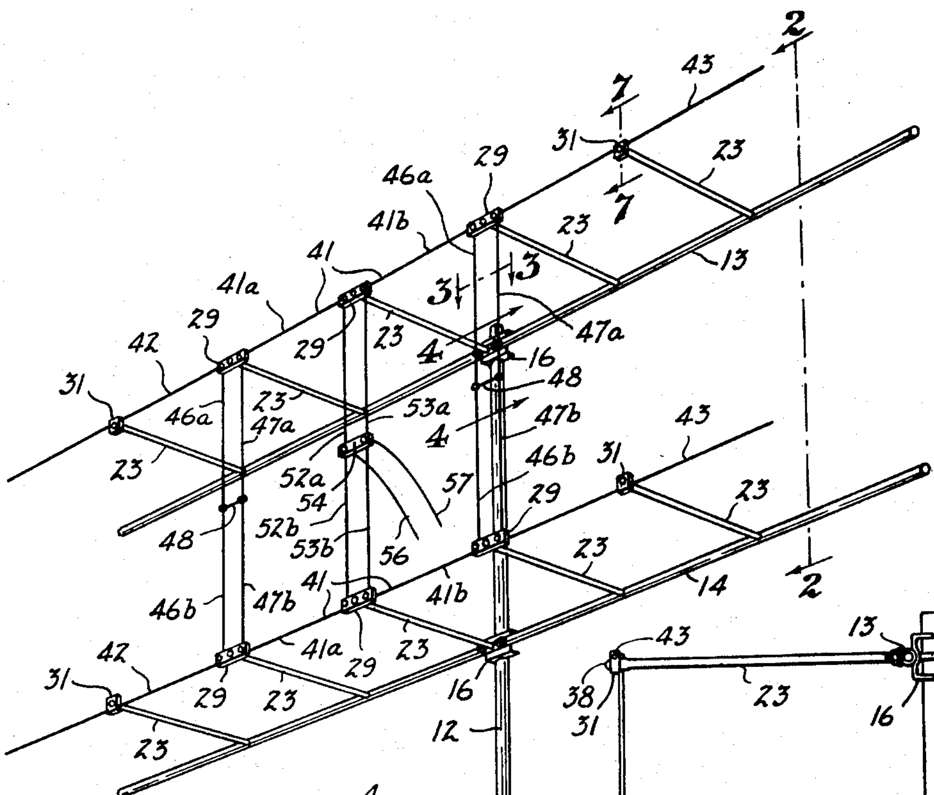

Fig. 1

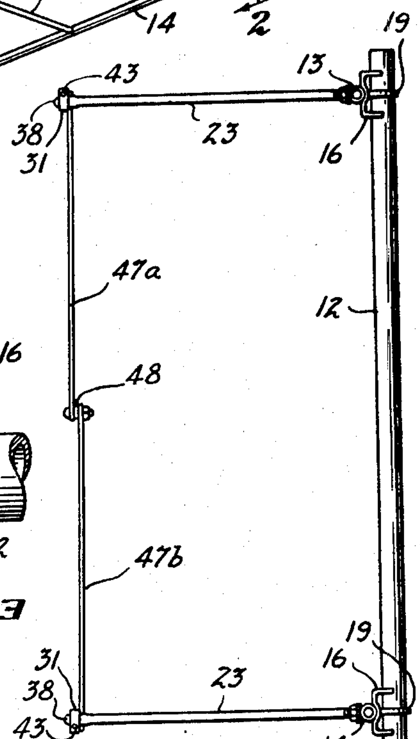

Fig. 2

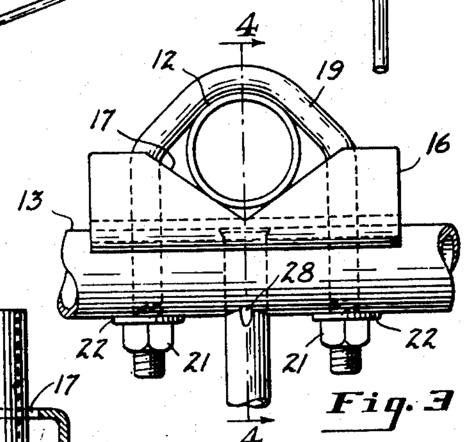

Fig. 3

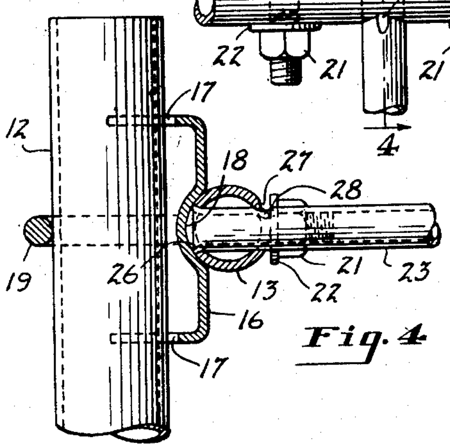

Fig. 4

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TELEVISION ANTENNA

Original Filed Sept. 16, 1950

2 SHEETS--SHEET 2

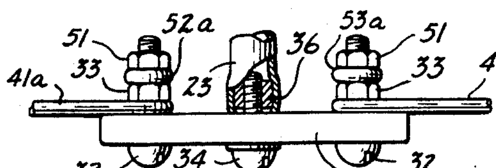

Fig. 5

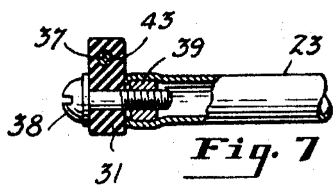

Fig. 7

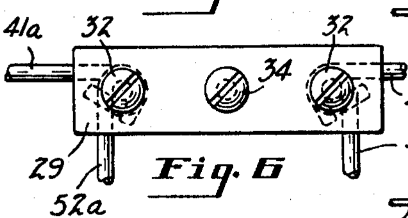

Fig. 6

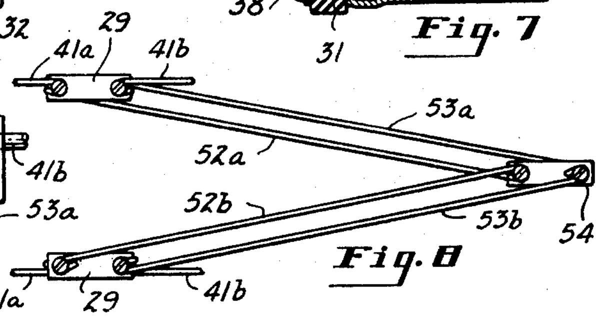

Fig. 8

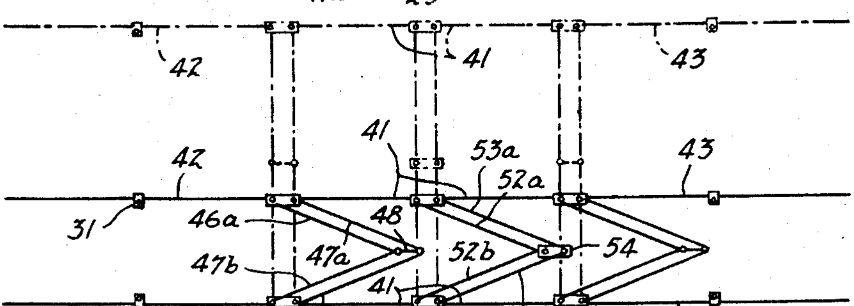

Fig. 9

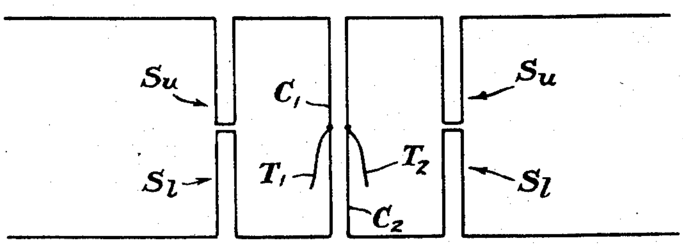

Fig. 10

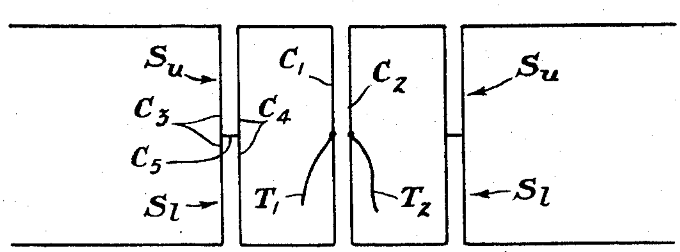

Fig. 11

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TELEVISION ANTENNA

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Original application September 16, 1950, Serial No. 185,197, now Patent No. 2,566,287, dated August 28, 1951. Divided and this application July 20, 1951, Serial No. 237,806

10 Claims. (Cl. 250—33.57)

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This invention relates to antenna systems and particularly to high gain, directive antenna systems for television transmission and reception.

The principal object of the invention is to provide a high-gain antenna system that will be responsive with almost uniform, maximum gain over a wide range of frequencies covering at least the range of the present high or low television bands, and that will be responsive with good performance over both the present high and low bands.

Another object of the invention is to provide an antenna system having the foregoing performance characteristics and having an aerial structure suitable for mounting on a single, rotatable mast.

A further object of the invention is to provide an aerial structure that may be shipped in a completely assembled, collapsed condition, and that may be quickly extended in an accordion-like manner at the place of installation for mounting on a mast to provide an antenna system of the character described.

Still another object of the invention is to accomplish the foregoing objectives while making the greatest possible structural use of electrically functional members, thereby keeping the amount of material in the aerial structure to a minimum consistent with the results to be achieved.

Structurally, the aerial resembles two vertically stacked sets of three half wave collinear units with quarter wave, phase reversing stubs, one of the two sets being inverted with respect to the other to bring their stubs back to back, both sets being supported in laterally spaced parallel relationship with respect to a pair of similarly stacked reflectors, and the whole being mounted on a vertical mast. Electrically, however, the antenna system differs radically from such an assembly, and, in addition, possesses certain novel structural characteristics not immediately apparent from an inspection of the complete assembly.

The principal electrical feature of the invention resides in the discovery that remarkable broad banding effects are achieved when such a vertically stacked pair of back to back sets of collinear units have the adjacent ends of their oppositely disposed stubs electrically connected, as by closing their ends with a common conductor. Antennas and antenna systems embodying this electrical feature of the invention are the subject of my copending application Serial No. 185,197, filed September 16, 1950, and granted as Patent No. 2,566,287, granted August 28, 1951.

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The principal structural feature of the invention resides in the employment of pivotal connections at each corner of each individual stub so that each pair of oppositely disposed rectangular stubs having a common side may be collapsed, as folding parallelograms, to permit the two sets of collinear units and reflectors to be brought together for packaging, pulled apart again at the place of installation, and quickly converted into a relatively rigid structure.

The present application is a division of my aforementioned copending application and is directed to the various mechanical features of the invention.

A third feature of the invention resides in the use of the upper and lower cross arms as electrically functioning units, serving the purpose of reflectors, as well as supports for the upper and lower sets of collinear units, respectively.

These special features of the invention and various other objects and advantages thereof will be more fully understood from the following detailed description of an illustrative embodiment of the invention, taken in conjunction with the accompanying drawings, in which:

Figure 1 is a perspective view looking upwardly at an antenna embodying the invention;

Fig. 2 is an end elevation on an enlarged scale of the aerial structure and mast of the antenna shown in Fig. 1, the view being taken as indicated by the line **2—2** of Fig. 1;

Fig. 3 is a fragmentary plan view on a further enlarged scale of the aerial structure and mast of Fig. 1, the view being taken as indicated by the line **3—3** of Fig. 1.

Fig. 4 is a fragmentary vertical section through the aerial structure and mast of Fig. 1, the view being on the same scale as Fig. 3 and taken as indicated by the lines **4—4** in Figs. 1 and 3;

Fig. 5 is another fragmentary plan view showing a detail of the aerial of Fig. 1 on the scale of Figs. 3 and 4.

Fig. 6 is a front elevation of the detail of Fig. 5;

Fig. 7 is another fragmentary, vertical section showing a detail of the aerial of Fig. 1 on the same scale as Figs. 3 to 5.

Fig. 8 is a fragmentary elevation of the aerial of Fig. 1 in a partially collapsed condition;

Fig. 9 is a diagrammatic elevation of the principal aerial elements of Fig. 1 in a partially collapsed condition, the relationship of the elements when fully extended being indicated in dot-and-dash lines;

Fig. 10 is a diagrammatic elevation of a pair of conventional aerial units arranged in stacked relation with one inverted with respect to the other, this illustration being given for comparative purposes;

Fig. 11 is a similar, diagrammatic elevation showing the changes from Fig. 10 that were most significant in bringing about the improved electrical operation achieved by the invention.

Referring principally to Fig. 1 and to the details shown in Figs. 2 to 7, the aerial structure of the antenna system illustrated is carried by a single vertical mast 12, that may take the form of a rigid, hollow, metal tube mounted in any desired manner (not shown) for rotation about its vertical axis.

A top cross arm 13 and a lower cross arm 14 are mounted at their centers adjacent the top of the mast and extend horizontally in vertically spaced-apart parallel relation. The cross arms 13 and 14 may also take the form of hollow, metal tubes, preferably being made of a light metal and smaller in diameter than the mast 12, but large enough in diameter to remain substantiallly rigid while carrying the remainder of the aerial structure.

The cross arms 13 and 14 are rigidly secured to the mast 12 by suitable brackets, such as the one illustrated in detail in Figs. 3 and 4. In this illustrative embodiment, the bracket comprises a short, channel shaped member 16 extending horizontally and having notches 17 in its flanges for receiving the mast 12. The web or back of the channel shaped member 16 is formed with a longitudinally extending groove 18 therein to receive the cross arm 13 (or 14). The channel shaped member is secured against the mast and the cross arm is secured against the channel shaped member by a U-bolt 19 that straddles the mast with its legs extending through aligned pairs of apertures in the channel shaped member and in the cross arm, and by a cooperating pair of nuts 21 and washers 22. As will be apparent, the nuts 21 may readily be tightened to hold the described assembly in position.

The embodiment of the invention illustrated herein includes a set of three separated collinear units of equal, selected resonant lengths mounted on each cross arm to form structures having the required rigidity to be self sustaining in space as shown when the cross-arms 13 and 14 are mounted on a mast in the desired positions, all being more fully described hereinafter. To mount the two sets of collinear units on their respective cross arm supports, each cross arm 13 (or 14) has an array of identical, parallel supports 23 projecting laterally therefrom. In this instance, five such supports are preferably mounted on each cross arm in substantially equally spaced relation and extending in the same horizontal direction. These supports may also take the form of hollow tubes of light metal, and may be of still smaller diameter than the cross arms 13 and 14. They are conveniently mounted in apertures drilled diametrically through the cross arms with an end of each support flared out at 26 to prevent its withdrawal. Movement of the supports in the opposite direction may conveniently be prevented by deforming portions of the walls of the cross arms to form lips 27 extending into notches 28 in the supports.

The center and two adjacent supports 23 on each cross arm all carry suitable spacing insulators 29 thereon for supporting adjacent ends of the collinear units in spaced-apart relation, and for supporting the center unit at a break in the center thereof. The two outermost supports 23 on each cross arm both carry suitable bracing insulators 31 thereon for giving additional support to the end collinear units of each set.

The spacing insulators 29 may conveniently be rectangular in form with holes drilled therethrough at their ends to receive machine screws 32, to which the adjacent looped ends of collinear units are secured by nuts 33. Each spacing insulator 29 may be mounted on its support 23 by another machine screw 34, which may be threaded into a nut 36 jammed into the end of the support 23.

The bracing insulators 31 are preferably in the form of square blocks of sufficient thickness for holes 37 to be drilled edgewise therethrough to receive the end collinear units. Each bracing insulator may be mounted on its support 23 by means of a machine screw 38 threaded into a nut 39 jammed into the end of the support 23.

The two sets of collinear units respectively associated with the upper and lower cross arms 13 and 14 are identical, and a description of one is equally applicable to the other. Referring to either set, the center unit 41 is broken in the middle, as noted above, to provide two separated conductor parts 41*a* and 41*b* having their adjacent ends connected to a spacing insulator 29, as described above. The outer units 42 and 43 are unbroken conductors that are collinear with the center unit and are physically and electrically spaced therefrom at opposite ends thereof by additional spacing insulators 29, as described above.

The physical lengths of the units 41, 42, and 43 are empirically selected in accordance with well-known principles to be of substantially equal resonant lengths of ½ wave length each, or any whole multiple thereof, the wave length upon which their dimensions are based being a selected one in about the center of the range of wave lengths to which maximum response of the connected circuit is desired. Thus, the upper and lower sets of collinear units per se are conventional.

As will be apparent from the foregoing description of the manner in which each set of collinear units is mounted with respect to its cross arm, each cross arm is insulated from the collinear units carried thereby and serves both as a structural support and as a reflector therefor. This arrangement effects a considerable economy of material by eliminating the electrically nonfunctional cross arm usually disposed between the collinear units and the reflector.

In an effort to find means for improving the gain and for broadening the band response of two vertically stacked sets of collinear units of the character described above (each unit having an effective resonant length of one-half of the selected wave length in the high television band) I first added a conventional, quarter wave, phase reversing stub between each two adjacent units of each set. With this arrangement, the two sets of collinear units were rotated about their longitudinal axes to dispose the stubs at various angles to the vertical and to dispose the stubs of one at various angles with respect to the stubs of the other (no reflectors being employed). One such arrangement is diagrammatically illustrated in Fig. 10 where the stubs S_u of the upper set hang downwardly in a vertical plane and the stubs S_l of the lower set project upwardly in the same plane. A conductor C_1 was connected between the center units of the two sets on one side of the central break therein, and a parallel conductor C_2 was connected between the center units of the two sets on the opposite side of the central break therein. The terminal ends T_1 and T_2 of a two-conductor radio frequency transmission line were connected to the mid-points of the conductors C_1 and C_2.

With the general arrangement shown in Fig. 10, the gain of the antenna over the entire high and low television bands reached its maximum at about 190 megacycles and dropped off sharply to less than half the maximum at 170 megacycles and to less than two-thirds the maximum at 220 megacycles. In the low band, the gain reached a maximum of about 40% of the high band maximum at 65 megacycles and dropped off sharply to about 50% of the low band maximum at 50 megacycles and to less than 50% of the low band maximum at 90 megacycles.

The characteristics of this antenna as regard the impedance match of the antenna to the line (standing wave ratio) corresponds closely to the gain characteristics, as should be expected. In the high band, this ratio was about 1.25 at about 190 megacycles, but rose sharply to about 4 at 220 megacycles and to about 4.7 at 170 megacycles. In the low band, this ratio was a minimum of about 2.3 at about 65 megacycles and rose sharply to about 3.9 at 90 megacycles and to about 4.2 at 50 megacycles. Since the required condition for high gain broad band perfarmance is a standing wave ratio near unity over the entire useful band, it is apparent that this antenna showed no particularly unusual broad band characteristics, though the gain at the optimum frequencies was very good.

Rotation of the two sets of collinear units to vary the angles of the planes of the stubs to the vertical had essentially no effect on the standing wave ratio or gain of the antenna over any part of the high and low bands. When the planes of the stubs were horizontal, the radiation pattern of the antenna in a horizontal plane, measured with horizontally polarized waves, exhibited slight lobes at the 90° position, but this effect was small and varied only slightly with frequency.

Thus, while the two sets of vertically stacked collinear units with phase reversing stubs could be connected in parallel by conductors C_1 and C_2 to obtain greater gain, the combination was still responsive only to a very narrow range of frequencies, regardless of the orientation of the two sets. The addition of reflectors produced the expected effects of further increasing the gain and making the combination more highly directional, but nothing more.

After considerable experimentation, I finally electrically connected the stubs of one set to the respectively aligned stubs of the other set, as diagrammatically illustrated in Fig. 11. Upon testing the performance of this arrangement, startling broadbanding effects were obtained. The gain over the high television band reached substantially the same maximum as the arrangement of Fig. 10 at about 190 megacycles, but it fell off slowly not over 5% up to 220 megacycles and down to 170 megacycles. In the low band, the gain reached a maximum at about 65 megacycles, which was about 20% greater gain than was obtained in this band with the arrangement in Fig. 10, and the gain fell off slowly only about 25% up to 90 megacycles and only about 20% down to 50 megacycles. The standing wave ratio curves were similar to the gain curves when plotted against frequency. In the high band, this ratio varied between the optimum figure of 1.25 at 190 megacycles to a maximum of only about 1.5 at 220 megacycles and 1.6 at 170 megacycles. In the low band, the optimum ratio was about 1.75 at 65 megacycles and rose only to about 2.6 at 90 megacycles and 2.1 at 50 megacycles. This remarkable uniformity of gain at the high level indicated by the standing wave ratio over the entire high band, and the excellent characteristics in the low band with the same antenna, far excel the performance characteristics of any antenna with which I am familiar. For an easier comparison of the improvement obtained with the antenna of Fig. 11 over the antenna of Fig. 10, reference may be made to the following tabulation of the figures given in the foregoing discussion with approximate intermediate values added:

Frequency (Megacycles)	Standing Wage Ratio		Gain, percent of Maxima	
	Fig. 10	Fig. 11	Fig. 10	Fig. 11
50	4.2	2.1	50	80
60	2.7	1.75	90	98
65	2.3	1.75	100	100
70	2.7	1.8	98	96
80	2.8	2.2	78	82
90	3.9	2.6	47	75
170	4.7	1.6	40	95
180	2.0	1.4	82	98
190	1.25	1.25	100	100
200	1.5	1.3	90	99
210	2.7	1.4	78	97.5
220	4.0	1.5	65	96

I am unable to explain, by any satisfactory analysis of the arrangement shown in Fig. 11, why it has the outstanding performance characteristics described above. Connecting the stubs back-to-back, however, is obviously largely responsible for such performance characteristics, which far exceed anything achieved heretofore to the best of my knowledge.

Upon translating this electrical arrangement into a physical form suitable for commercial production, I first constructed each pair of back-to-back stubs S_u and S_l of three conductor elements C_3, C_4, and C_5 (Fig. 11) so that the assembled aerial resembled a ladder with the stub conductors C_3 and C_4 and the center set of interconnecting conductors C_1 and C_2 forming the rungs and holding the two sets of collinear units in fixed, spaced, parallel relation. When preassembled on the cross arms **13** and **14**, this structure is so bulky as to make packaging and shipping costs prohibitive. If shipped disassembled, the assembly time required at the point of installation is excessive compared to other aerials of simpler construction, but inferior performance, which have been in wide commercial use. To overcome these commercial objections to my new aerial arrangement, I have devised a collapsible physical embodiment of the electrical elements which can be compactly packaged for shipment and quickly extended and mounted at the point of installation.

Referring again to Figs. 1 and 2 and also to Figs. 5, 6, 8, and 9, collapsibility of the unit shown therein is achieved by constructing each pair of back-to-back stubs (such as S_u and S_l in Fig. 11) of five pivotally connected conductor elements instead of three conductor elements. Thus, each upper stub includes a pair of parallel, vertical conductors **46a** and **47a**, and each lower stub includes a pair of identical, parallel, vertical conductors **46b** and **47b**; and a common, short conductor **48** is pivotally connected at one end to both the upper and lower aligned conductors **46a** and **46b**, and at its opposite end to both the upper and lower aligned conductors **47a** and **47b**.

These pivotal connections may conveniently be made by forming loops in the ends of the conductors to be joined and simply inserting a machine screw through the loops, applying a nut loosely thereon, and mutilating the threads on the portion of the screw that projects beyond the nut to prevent its accidental removal.

The upper ends of the conductors **46a** and **47a** are also pivotally connected, respectively, to the adjacent ends of the associated upper collinear units **42** and **41**, or **43** and **41**, and to the intervening insulator **29**, as shown in Figs. 5 and 6. Similarly, the lower ends of the conductors **46b** and **47b** are pivotally connected, respectively, to the adjacent ends of the associated lower collinear units **42** and **41**, or **43** and **41**, and to the intervening insulator **29**. The machine screws which may suitably be employed to form these pivotal connections, such as the screws **32**, preferably have the vertical conductors applied after the nuts **33** have been applied and tightened, and additional nuts **51** are then loosely applied. Again, the assembly may be held together against accidental removal of the nuts **51** from the machine screws by mutilating the threads of the portions of the screws that project beyond the nuts.

Similarly, the conductors C_1 and C_2, to which the terminal ends T_1 and T_2 of the transmission line are connected in Fig. 11, are respectively replaced in Fig. 1 by an identical pair of vertically aligned conductors **52a** and **52b** and by another identical pair of vertically aligned conductors **53a** and **53b**. The upper ends of the conductors **52a** and **53a** are pivotally connected, respectively, to the adjacent ends of the sections **41a** and **41b**, of the central collinear unit **41**. The lower ends of the conductors **52b** and **53b** are pivotally connected, respectively, to the adjacent ends of the sections **41a** and **41b** of the lower collinear unit **41**. These pivotal connections may be made in the same manner shown in Figs. 5 and 6.

The adjacent ends of the upper and lower conductors **52a** and **52b** are pivotally connected to each other and to one end of a short insulator **54**, as by a suitable machine screw and nut; and the adjacent ends of the upper and lower conductors **53a** and **53b** are similarly connected to the opposite end of the short insulator **54**. The terminal ends **56** and **57** of a two-conductor radio frequency transmission line, such as a conventional "twin-lead" line, are respectively connected to these pairs of upper and lower conductors, the connections conveniently being made by means of the same machine screws and nuts employed on the short insulator **54**.

With this structural arrangement of the pairs of back-to-back stubs and the pairs of conductors to which the transmission line leads are attached, three parallel motion linkages are provided for connecting the upper set of collinear units to the lower set of collinear units, as diagrammatically illustrated in Fig. 9. The fully extended positions of the various elements of the structure are indicated in Fig. 9 in dot-dash lines, and the partially collapsed positions of the elements of the structure are shown in solid lines. The collapsing action is also illustrated, in part, by Fig. 8, showing the partially collapsed parallel motion linkage formed by the conductors **52**, **52b**, **53a** and **53b** to which the leads of the transmission lines are connected.

This collapsible structure permits the entire aerial unit to be completely assembled in the factory with the machine screws and nuts forming the various pivotal connections loosely assembled, as described above. By moving the upper, relatively rigid frame of collinear units and cross arm **13** toward the lower frame of collinear units and cross arm **14**, the completely assembled structure may be collapsed into a compact unit, little thicker in its vertical dimension than the combined vertical height of the two brackets employed for mounting the aerial unit on the mast **12**. If it is desired to collapse the structure further to form a still flatter package, these brackets may be left off the assembly at the factory and packaged loosely therewith.

When the collapsed unit is removed from a package or carton at the location where it is to be installed, the structure may readily be pulled out to its fully extended condition and the nuts and machine screws forming the pivotal connections may be quickly tightened by means of a screwdriver and suitable wrench or pliers. The resulting structure, when mounted on the mast **12** in the manner described above, is sufficiently strong and rigid to withstand winds of gale force.

The antenna assembly of this invention is adapted to be duplicated, to the extent desired to obtain still further gain, by stacking one such assembly above another on the same mast and connecting them to the transmission line in parallel in a well-known manner.

While the features of the invention responsible for high gain, broad band performance have been illustrated as applied to sets of collinear units comprising three units each, they are applicable to arrangements having any desired larger number of collinear units per set. An odd plurality of collinear units per set is preferred, because of the natural impedance match of the antenna to the transmission line when the line is connected through transverse conductors to a center unit of each set at a central break therein. However, with suitable matching of the impedance of the antenna to that of the line, by adjusting in a well-known manner the impedance of the transverse conductors to which the line leads are attached, excellent characteristics can also be obtained with four, six, eight, etc. collinear units per set. With an even number of units per set, the line leads are, of course, connected to transverse conductors respectively joining adjacent ends of the center-most units in one set to adjacent ends of corresponding units in the other set.

The structural features of the invention which render the fully assembled aerial unit collapsible are obviously applicable to numerous other forms of aerials. Accordingly, the scope of the invention is to be construed as limited to aerials employing spaced sets of collinear units only as required by the terms of the appended claims.

For convenience, in this specification and in the appended claims, the terms "antenna" and "antenna system" have been employed to designate the entire energy receiving or transmitting apparatus that is normally connected to the antenna terminals of a transmitter or receiver, and the term "aerial" has been employed to designate only the energy radiating or intercepting members and their physical supporting structure, excluding the transmission line.

From the foregoing description of my invention, it will be appreciated that I have provided a high gain antenna system having remarkable broad band characteristics. It will also be appreciated that the system has been embodied in a physical form which may be preassembled in the factory, packaged, and shipped in a collapsed condition and quickly extended and made rigid at the place of installation for convenient mounting on a single, vertical mast of any desired type. It will also be appreciated that these operational results have been accomplished with greater than usual economy of materials.

Having described my invention, I claim:

1. An antenna comprising a pair of rigid elongated reflector rods of relatively large diameter disposed in transversely aligned parallel relationship, means on said reflectors for separately securing them in superposed horizontal positions to a vertical mast, including means for positively restraining said reflectors against rotation about their respective longitudinal axes, each of said reflectors carrying a series of conductor supporting rods of relatively small diameter, each of which has one end rigidly secured to its reflector, said conductor supporting rods being carried entirely by their reflector and extending horizontally therefrom in the same direction as parallel cantilevers, a first set of at least three generally collinear conductors of relatively small diameter mounted in longitudinally spaced relationship on the opposite ends of the series of conductor supporting rods carried by one reflector to form a cantilever assembly supported by its reflector, each collinear conductor being supported at points spaced along its length by at least two of said conductor supporting rods, a second set of at least three generally collinear conductors of relatively small diameter correspondingly mounted in longitudinally spaced relationship on the opposite ends of the series of conductor supporting rods carried by the other reflector to form another cantilever assembly supported by its reflector, and a plurality of vertically extending phasing units spaced along the lengths of said sets of collinear conductors and mechanically connecting each conductor of each collinear set to the corresponding conductor in the other collinear set for stabilizing the cantilever assemblies and maintaining the sets of collinear conductors in vertically spaced, generally parallel, relationship.

2. An antenna according to claim 1 in which each of said phasing units comprises a pair of spaced, transversely aligned, generally vertical, conductors extending between said sets of collinear conductors and a generally horizontal member mechanically connecting the mid-points of said generally vertical conductors and maintaining the transverse spacing thereof.

3. An antenna according to claim 1 in which each of said phasing units comprises an upper pair of spaced, transversely aligned, generally vertical, conductors and a lower pair of spaced, transversely aligned, generally vertical, conductors mechanically connected to said upper pair midway between said sets of collinear conductors, said upper and lower pairs of generally vertical conductors being hingedly connected together and to the upper and lower sets of collinear conductors, respectively, for pivotal movement about parallel horizontal axes to provide a parallel motion linkage permitting collapsing of the antenna structure.

4. An antenna according to claim 1 in which each of said phasing units comprises an upper pair of spaced, transversely aligned, generally vertical, conductors and a lower pair of spaced, transversely aligned, generally vertical, conductors mechanically connected to said upper pair midway between said sets of collinear conductors, said upper and lower pairs of generally vertical conductors being hingedly connected together and to the upper and lower sets of collinear conductors, respectively, for pivotal movement about parallel horizontal axes to provide a parallel motion linkage permitting collapsing of the antenna structure, and means for tightening at least one of said hinged connections of each of said phasing units to resist pivotal movement and rigidify the structure when said reflectors are secured to a mast.

5. An antenna comprising a pair of rigid elongated reflector rods of relatively large diameter disposed in transversely aligned parallel relationship, means on said reflectors for separately securing them in superposed horizontal positions to a vertical mast, including means for positively restraining said reflectors against rotation about their respective longitudinal axes, each of said reflectors carrying a series of conductor supporting rods of relatively small diameter, each of which has one end rigidly secured to its reflector, said conductor supporting rods being carried entirely by their reflector and extending horizontally therefrom in the same direction as parallel cantilevers, a first set of at least three generally collinear conductors of relatively small diameter mounted in longitudinally spaced relationship on the opposite ends of the series of conductor supporting rods carried by one reflector to form a cantilever assembly supported by its reflector, each collinear conductor being supported at points spaced along its length by at least two of said conductor supporting rods, a second set of at least three generally collinear conductors of relatively small diameter correspondingly mounted in longitudinally spaced relationship on the opposite ends of the series of conductor supporting rods carried by the other reflector to form another cantilever assembly supported by its reflector, and a plurality of vertically extending members spaced along the length of said sets of collinear conductors and mechanically connecting each conductor of each collinear set with the corresponding conductor in the other collinear set for stabilizing the cantilever assemblies and maintaining the sets of collinear conductors in vertically spaced parallel relationship.

6. An antenna according to claim 5 in which said vertically extending members include at least two spaced pairs of generally vertical conductors, the conductors of each pair mechanically connecting adjacent ends of two collinear conductors of one set to adjacent ends of two collinear conductors of the other set.

7. An antenna comprising a pair of rigid elongated metallic reflectors disposed in transversely aligned parallel relationship, brackets on said reflectors for separately securing them in superposed horizontal positions to a vertical mast, each of said reflectors carrying a series of metallic conductor supporting rods, each of said rods having one end rigidly secured to its reflector and extending horizontally therefrom in the same direction to form a series of parallel cantilevers, insulators on the opposite ends of said conductor supporting rods, a first set of at least three generally collinear conductors mounted in longitudinally spaced relationship on said insulators on the series of rods carried by one reflector to form a cantilever assembly supported by its reflector, a second set of at least three generally collinear conductors respectively mounted in longitudinally spaced relationship of

said insulators on the series of rods carried by the other reflector to form another cantilever assembly supported by its reflector, each of said sets of collinear conductors being provided with at least two spaced pairs of phasing conductors and each pair of phasing conductors being respectively connected to adjacent ends of spaced collinear conductors of the same set for rotation about a horizontal axis, the pairs of phasing conductors of the two sets being of substantially the same length and symmetrically arranged and the pairs of phasing conductors of each set normally extending toward the respectively opposite pairs of phasing conductors of the other set, and each pair of phasing conductors of one set being hingedly connected to the opposite pair of phasing conductors of the other set midway between the two sets to provide a parallel motion connection permitting collapsing movement of the rigid assemblies of the collinear conductors and their respective reflectors and supporting rods toward and away from each other.

8. An antenna according to claim 7 in which the hinged connections between opposite pairs of said phasing conductors include generally transverse elements connecting the phasing conductors of each pair with a fixed spacing at said hinged connections.

9. An antenna according to claim 7 in which said pairs of phasing conductors are respectively connected to adjacent ends of spaced collinear conductors for rotation about a horizontal axis normal to the plane defined by said reflectors, and opposite pairs of phasing conductors are hingedly connected for relative pivotal movement about axes normal to the plane defined by said reflectors.

10. An antenna according to claim 7 in which said pairs of phasing conductors are respectively connected to adjacent ends of spaced collinear conductors for rotation about a horizontal axis normal to the plane defined by said reflectors, and opposite pairs of phasing conductors are hingedly connected for relative pivotal movement about axes normal to the plane defined by said reflectors, the hinged connections between opposite pairs of said phasing conductors including generally transverse elements connecting the phasing conductors of each pair with a fixed spacing at said hinged connections.

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