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June 11, 1946. E. W. RIEMENSCHNEIDER ET AL 2,401,799

RADIO ANTENNA TOWER

Filed Aug. 4, 1941 3 Sheets-Sheet 1

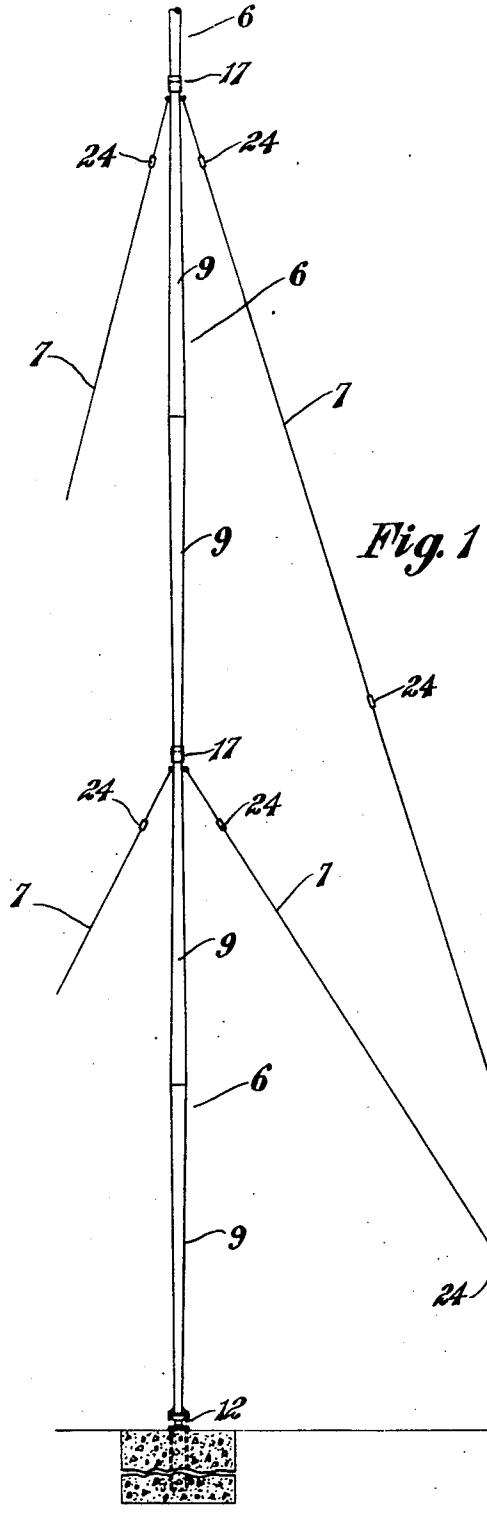


Fig. 1

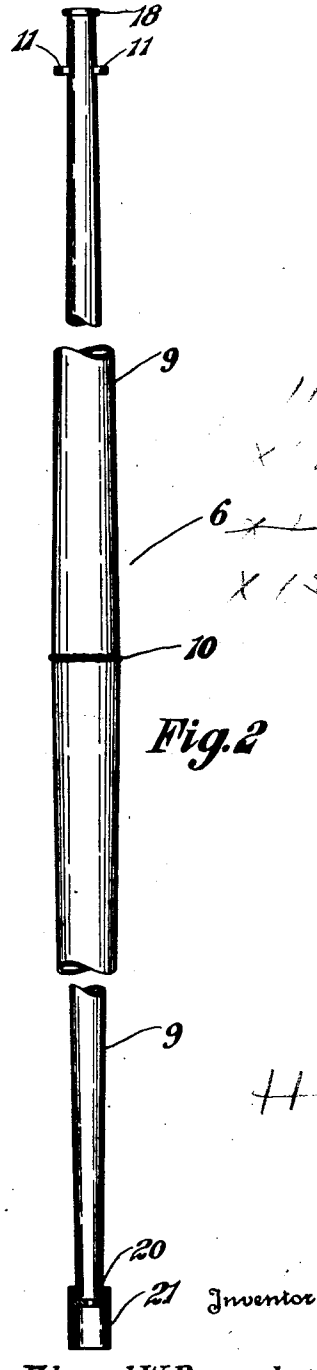


Fig. 2

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RADIO ANTENNA TOWER

Filed Aug. 4, 1941 3 Sheets-Sheet 2

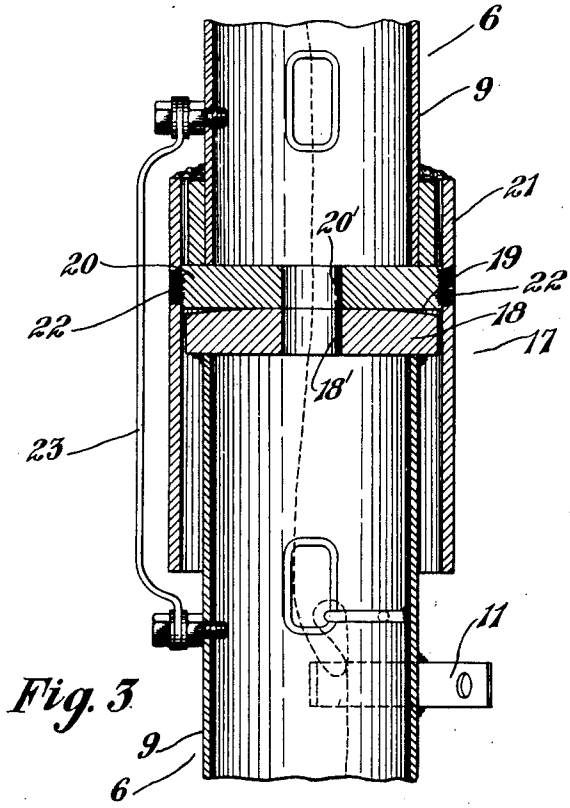


Fig. 3

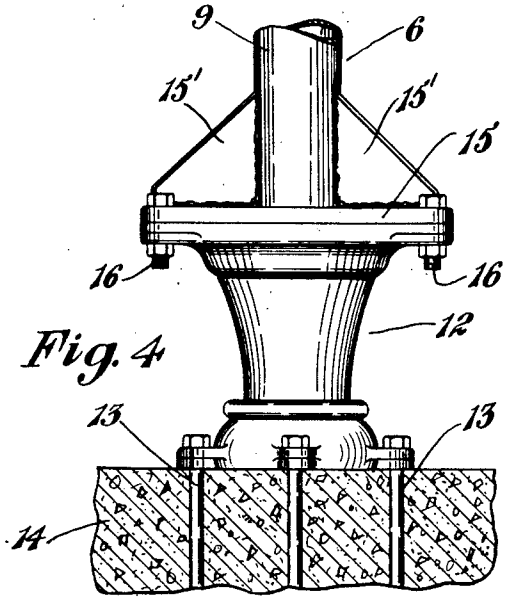


Fig. 4

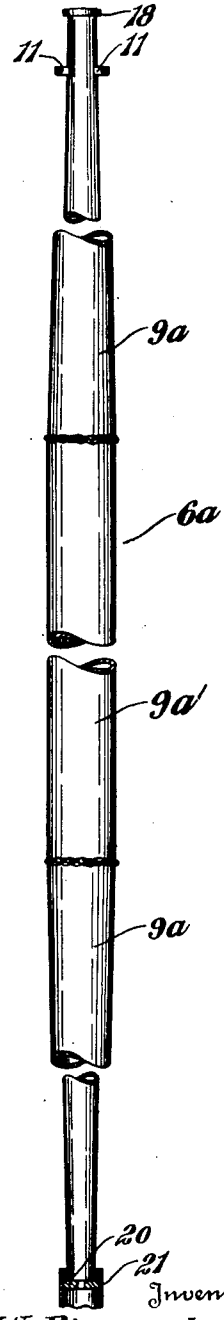


Fig. 5

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RADIO ANTENNA TOWER

Filed Aug. 4, 1941 3 Sheets-Sheet 3

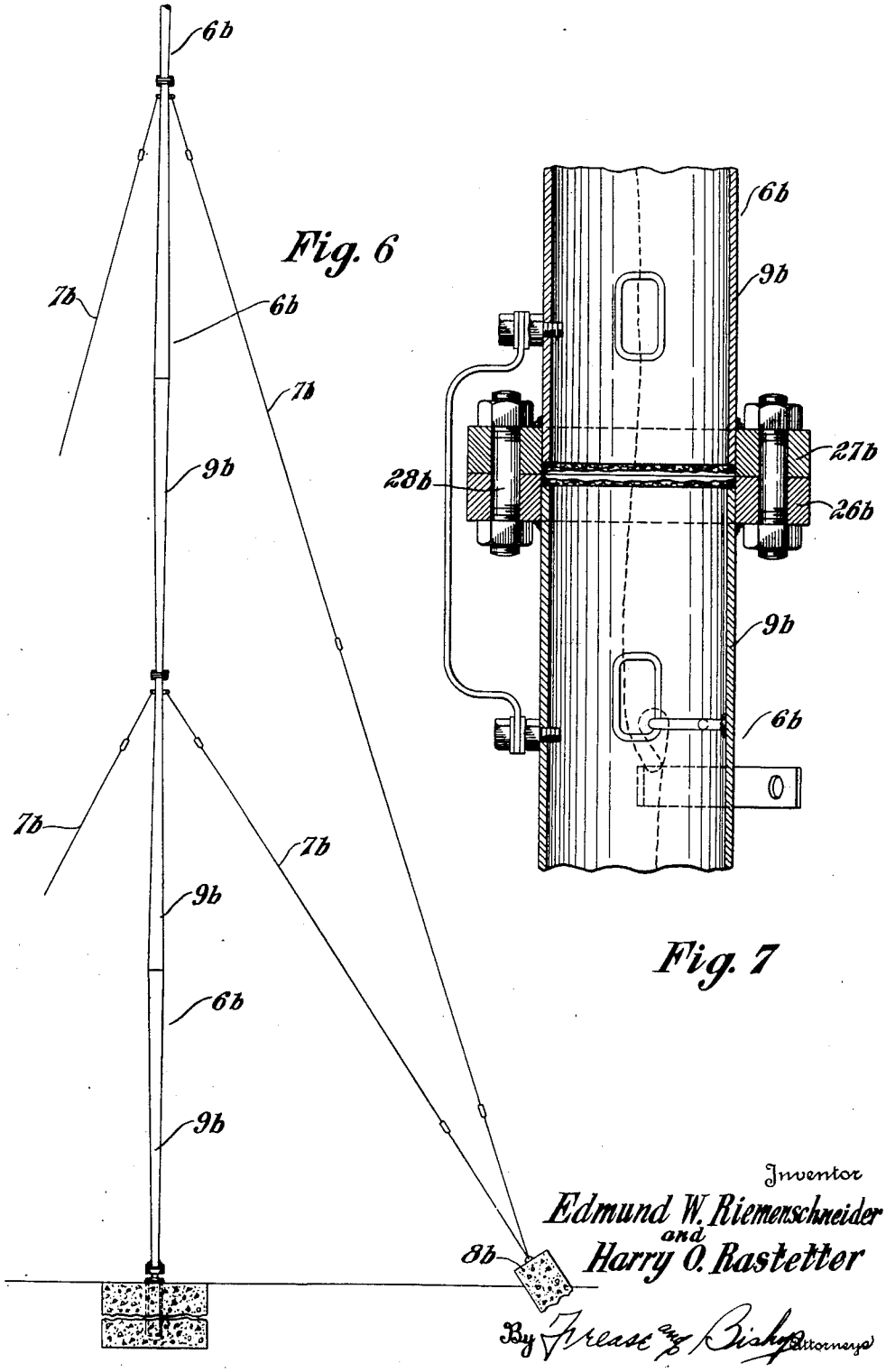


Fig. 6

Fig. 7

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UNITED STATES PATENT OFFICE

2,401,799

RADIO ANTENNA TOWER

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Application August 4, 1941, Serial No. 405,378

6 Claims. (Cl. 189—26)

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The invention relates generally to antennae or to supports for antennae for radio transmission, and more particularly to the construction of high towers and masts used in radio broadcasting and transmission.

It is recognized that a single vertical conductor is a very efficient antenna for radio broadcasting and transmission, but it is difficult to support such an antenna particularly as the usual broadcasting frequencies require an antenna tower several hundred feet in height. Accordingly, many such towers have included a very large number of structural members as well as guy wires, and such structural members absorb a considerable amount of radio energy and thus reduce the efficiency of the tower to a substantial extent.

Where the tower itself constitutes the antenna and is of rigid construction throughout, the construction and erection of the tower involves considerable labor, time and expense. Moreover, such a tower must be very well guyed and structurally very strong to resist wind loads, and the nodal vibrations which inherently occur in such a structure.

An object of the present invention is to provide an articulated antenna tower made up of novel compression members each having maximum compressive strength and exceptionally good radio transmitting properties.

Another object is to provide an articulated antenna tower in which the members take all of the compression load and the tension forces are taken by guy wires.

Another object is to provide an articulated antenna tower having self supporting tubular members so designed as to give maximum compressive and wind load strength with minimum weight, and at the same time having a contour offering a minimum of resistance to wind.

A further object is to provide an articulated tower having flexible joints eliminating the occurrence of nodal vibrations and permitting one or more members to be out of alignment without affecting the alignment of other members, and without transmitting bending moments to adjacent members.

Another object is to provide an articulated tower having flexible joints between tubular compression members each designed to act like a beam against wind loads.

And finally, it is an object of the present invention to provide a novel antenna tower which combines maximum radio transmitting efficiency with economy of material, which can be erected rapidly and cheaply to any required height, and

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which is inexpensive to maintain and has a pleasing appearance.

These and other objects are attained by the parts, elements and structures comprising the present invention, which are shown by way of example in the accompanying drawings and hereinafter described and claimed.

In general terms the invention may be stated as including an antenna tower consisting of a plurality of tubular compression members connected together by means of flexible joints, each compression member being a thin elongated tube having its greatest lateral dimension centrally of its ends, and being gradually tapered from said central portion to the ends, and guy wires connected to the upper end of each compression member.

Referring to the drawings in which preferred embodiments of the invention are shown by way of example,

Figure 1 is a fragmentary elevation of one form of improved radio tower supported on an insulator base;

Fig. 2 is an enlarged detached view of one of the novel compression members, with parts broken away;

Fig. 3 is an enlarged fragmentary sectional view showing the flexible joint connecting two of the improved compression members;

Fig. 4 is an enlarged fragmentary view of a suitable insulator base supporting the tower;

Fig. 5 is a view similar to Fig. 2 of a modified form of the improved compression member;

Fig. 6 is a view similar to Fig. 1, showing a tower comprising the novel compression members with rigid joints therebetween; and

Fig. 7 is an enlarged fragmentary sectional view of one of the rigid joints in the tower of Fig. 6.

Similar numerals refer to similar parts throughout the several views of the drawings.

As shown in Fig. 1 the improved antenna tower is made up of a plurality of tubular compression members indicated generally at **6** and connected at their ends to provide an articulated tower of great height and very narrow girth. As shown guy wires **7** are connected to the upper end of each compression member **6** and suitably anchored in the ground, as indicated at **8**.

The ideal shape and design for a compression member is one in which the greatest strength is at the center, and which tapers gradually from the center to the ends. Such a shape or design may be termed an elongated cigar-like shape and gives maximum compressive strength for minimum weight of material, and is particularly de-

sirable in a tower structure because it acts like a beam in resisting wind loads. Moreover, the long tapered shape such as shown in Figs. 1 and 2 provides very little resistance to winds from any direction, thereby decreasing the effective wind load on the tower.

As shown in Fig. 2, the novel tubular compression member 6 consists of two tapered poles 9 or frusto-conical tubes of substantially equal lengths, having their large ends welded or otherwise connected together in abutment with each other as indicated at 10, and being in substantial alignment throughout their length to form an elongated tubular compression member having equal strength in all lateral directions and having its greatest strength and lateral dimension intermediate the ends and tapering gradually therefrom to the ends. As shown each compression member 6 has ears 11 secured to and projecting from its upper end portion, and said ears are adapted to be connected to the upper ends of the guy wires 7.

Preferably, the tapered poles 9 are approximately forty to fifty feet long, and when welded together make the compression members 6, eighty to one hundred feet long. Thus a radio tower constructed according to the present invention may consist of one, two, three or more of the members 6 depending upon the tower height necessary for the broadcasting frequency used.

The outside diameter of the tapered poles 9 preferably varies from about five inches at the small end to eighteen inches at the large end, so that when two poles 9 are welded together as shown in Fig. 2 to make a compression member 6, the largest lateral dimension of the member is at its central portion and tapers gradually therefrom to the ends, making a compression member approaching the elongated cigar-shape characteristic of an ideal compression member.

The modified form of compression member 6*a* shown in Fig. 5 is made up of two tapered or frusto-conical tubes 9*a* with a straight tubular section 9*a'* welded to their large ends and forming the central portion of the compression member, the tubular sections being in substantial axial alignment throughout their length, and having equal strength in all lateral directions. The diameter of the straight section 9*a'* is equal to the diameter of the large ends of tapered tubes 9*a*, so that member 6*a* approaches the alongated cigar-shape which is characteristic of an ideal compression member, and offers little wind resistance. The length of said central section 9*a'* may be about ¼ to ½ of the total length of member 6*a*.

The gauge of the tubular members 6 or 6*a* varies considerably according to the height of the tower. Thus the member 6 at the bottom of the tower should be of heavier gauge than the one at the top because of the greater compression load on the bottom member. For example, where the tower height requires several members, say four members, the bottom one may be 0 gauge or $\frac{5}{16}$ inch in thickness, the next higher one may be 3 gauge or ¼ inch, the next higher member 7 gauge or $\frac{3}{16}$ inch, and the top member may be 11 gauge or ⅛ inch. In some cases the bottom one or two members may be made of two plies of metal, as for instance two plies of 7 gauge or two plies of 11 gauge.

As shown in Figs. 1 and 4 the bottom compression member 6 is supported on an insulator base 12 which is of well-known construction and forms no part of the present invention. Such a base is used where the tower itself acts as the antenna, and is not necessary where the tower is merely a support for the antenna.

As best shown in Fig. 4 the base 12 is anchored by anchor bolts 13 imbedded in a concrete foundation 14, and the lower end of the bottom compression member 6 has welded thereon a base plate 15 braced by gusset plates 15' welded to the pole 9, and the base plate 15 is securely bolted to the top of base 12 by bolts 16.

The several compression members 6 comprising the articulated tower are connected together at their ends preferably by means of flexible joints indicated generally at 17 and shown in detail in Fig. 3. The upper end of each member 6 preferably has welded thereon an abutment plate 18 the upper abutment surface 19 of which is convex or crowned as shown. The lower end of the member 6 connected thereto and resting thereon has an abutment plate 20 secured to its bottom end and having a flat surface abutting the convex surface 19.

A sleeve 21 is preferably welded at its upper end near the bottom end of the upper member 6 at the joint and depends downwardly therefrom to encircle the upper end of the lower member 6. The sleeve 21 may be welded also to the plate 20 by plug welds shown at 22 at intervals around the sleeve, and the diameter of plate 20 is somewhat greater than the diameter of plate 18 in order to provide a clearance between the sleeve and the plate 18 so that a certain amount of flexibility is had at the joint. Thus as the tower is erected, if one of the members 6 is slightly out of alignment, the convex surface 19 can rock laterally on the bottom of plate 20 to take care of the misalignment without affecting the alignment of other compression members in the tower.

As shown an electric jumper cable 23 is provided for electrically connecting the two compression members around each joint, and the abutting plates 18 and 20 are provided with registering holes 18' and 20' for permitting the passage of service cables up through the tower. The ears 11, provided near the top of each compression member for attaching guy wires thereto, are preferably welded to the member 6 so as to be located just below the sleeve 21 of the flexible joint when the tower is erected, as shown in Fig. 3.

In erecting a radio tower according to the present invention, the bottom member 6 is first raised in position with its bottom end anchored to a suitable base as previously described, the guy wires 7 having been attached to the ears 11 of the member before raising it. The lower ends of the guy wires are then put under considerable tension and anchored to the anchor blocks 8, and there being a plurality of insulators 24 of usual construction incorporated in the guy wires.

By means of a gin pole attached in usual fashion to the upper end of the bottom compression member 6, the next compression member 6 is raised with its guy wires 7 attached to its upper end and with the sleeve 21 of the flexible joint 17 attached to its lower end, and the sleeve is positioned over the upper end of the bottom compression member. The upper guys 7 are then attached to their anchors under a required amount of tension, and then another member 6 may be erected in the same manner if desired. The amount of tension on the guy wires 7 is calculated to take substantially all of the tension forces to which the tower is subjected, so that the members 6 will take all of the compression load.

When the improved articulated tower has flexible joints between the members, the occurrence of nodal vibrations inherent in a rigid tower is eliminated, and said joints permit some misalignment of one or more members without affecting the other members.

Under certain conditions it may be desirable to provide an improved radio antenna tower embodying the novel compression members connected together end to end by means of rigid joints. In Fig. 6, the improved antenna tower is made up of a plurality of compression members 6*b* with guy wires 7*b* connected to the upper end of each compression member 6*b* and suitably anchored in the ground, as indicated at 8*b*.

Each compression member 6*b* may include two tapered poles or frusto-conical tubes 9*b* having their large ends welded or otherwise connected together in abutment with each other, as shown, or including a central cylindrical tube as illustrated in Fig. 5; the tubular sections being in substantial axial alignment throughout their length, and having equal strength in all lateral directions.

As shown in Fig. 7, the rigid joints between members 6*b* may include an abutment ring 26*b* welded on the upper end of the lower member 6*b*, and a similar abutment ring 27*b* welded on the lower end of the upper member 6*b*. The rings 26*b* and 27*b* are provided with registering bolt holes through which bolts 28*b* are inserted for clamping the rings together in abutment and rigidly joining the members 6*b* together.

The present antenna tower in its several embodiments consists entirely of novel compression members having maximum strength with a minimum of weight, and having a contour which offers extremely low wind resistance. It has been determined in actual practice than an antenna made up of applicants' novel tubular compression members has exceptionally good radio transmitting and broadcasting properties.

The present improved radio antenna tower is pleasing in appearance, and inexpensive to erect and maintain.

We claim:

1. An articulated radio antenna tower including a plurality of tubular compression members supported end to end upon one another, means providing flexible joints between said members, each of said members consisting of tubular sections joined together in end-to-end abutment and having its greatest lateral dimension at its central portion and tapering gradually therefrom to its ends, and guy wires attached under tension to the upper end of each said member.

2. An articulated radio antenna tower including a pluraliy of tubular compression members supported end to end upon one another, means providing flexible joints between said members, said means including a rounded abutment on one adjoining member and a sleeve secured on the other adjoining member and loosely encircling the end portion of said one adjoining member, each of said members having its greatest lateral dimension at its central portion and tapering gradually therefrom to its ends, and guy wires attached under tension to the upper end of each said member.

3. An articulated radio antenna tower including a plurality of tubular compression members supported end to end one upon another, means providing for limited flexibility of the members relative to each other at the joints between the members, each of said members consisting of tubular sections joined together in end-to-end abutment and being tapered convergingly from its central portion to its ends, and guy wires attached under tension to the upper end of each said member.

4. An articulated radio antenna tower including a plurality of tubular compression members supported end to end upon one another, means providing flexible joints between said members, each of said members including two elongated frustoconical tubes having their large ends joined in abutment, and guy wires attached under tension to the upper end of each said member.

5. An articulated radio antenna tower including a plurality of tubular compression members supported end to end upon one another, means providing flexible joints between said members, each of said members comprising a central cylindrical portion and two elongated frusto-conical tubes having their large ends joined in abutment with the ends of said cylindrical portion, and guy wires attached under tension to the upper end of each said member.

6. An upright mast construction comprising a plurality of substantially rigid units, each unit having its maximum cross section at the middle part thereof and being of substantially uniformly reducing tapering form to the two ends thereof, said units being arranged vertically end to end with their small ends together and in strictly electro-conductive engagement with each other, means of universally articulated joint connection between said adjacent ends, and means axially surrounding said joint and overlapping said adjacent end portions so as to limit the extent of movement and to center the units at the joint between the same.

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