Dec. 1, 1936. W. M. VENABLE 2,062,846

RADIO ANTENNA

Filed March 5, 1935

Fig. 1.

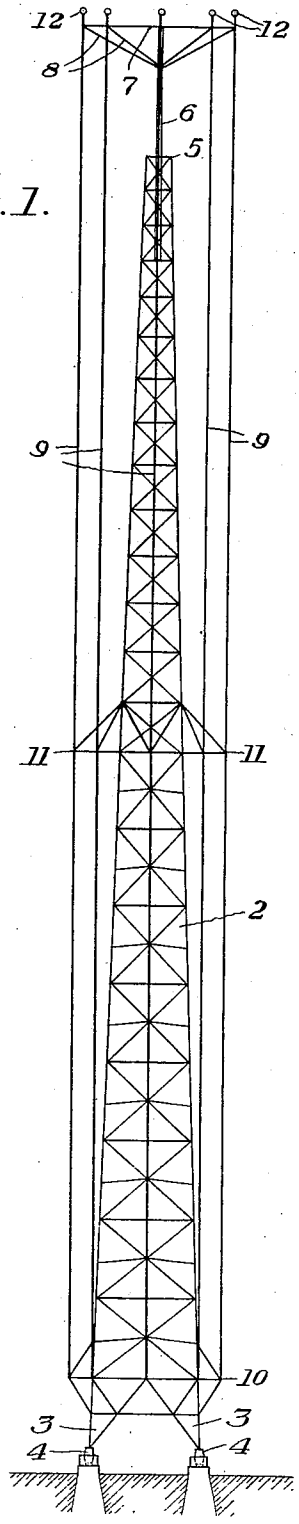
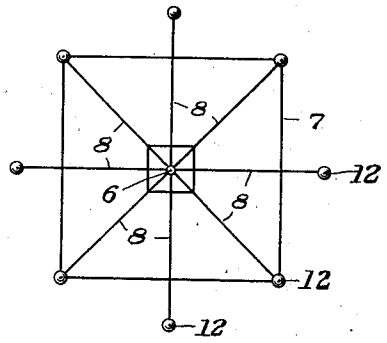


Fig. 2.



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RADIO ANTENNA

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10 Claims. (Cl. 250—33)

This invention relates to radio antennae, and more particularly to an antenna of the vertical tower type for radiating or broadcasting purposes.

It is known to those skilled in the art that a number of parallel wires symmetrically disposed about a common axis are, for the purpose of broadcasting, more effective with a less expenditure of power than a single wire, whether such symmetrical arrangement of wires is disposed substantially horizontally or is arranged in a vertical position. It is also known that for broadcasting parallel to the earth's surface, i. e., for general broadcasting purposes, in all directions from a given station as a center, vertical antennae are more effective than antennae arranged in any other direction. For this reason, among others, vertical structural towers formed of conducting metal, insulated at their bases, have recently come into quite extensive use. The towers are ordinarily quite slender in comparison with their height, the towers usually tapering toward the top. Sometimes the towers are in the form of a single structural mast having a single insulating support at the base and maintained in vertical position by means of guy wires. Other towers have a plurality of legs which are supported on specially constructed insulators. These towers taper from a point adjacent the base toward the top. The taper toward the top of the mast or tower in either case is advantageous from a structural point of view, because it offers less surface to the wind and is consequently less expensive than a tower of uniform section throughout its height capable of withstanding high wind velocities. However, a tapering tower is less efficient for broadcasting purposes than if the top portion of the tower were wider and broader.

An example of a tower for this purpose having a single supporting base is found in Patent No. 1,897,373 to Gerten et al., dated February 14, 1933, while an example of a type of mast having a plurality of legs carried on insulating supports is disclosed in the patent to Jenner No. 1,937,968, dated December 5, 1933. The present invention is applicable to either of these types of towers. For the purpose of illustration only, the invention has been specifically described and shown in connection with a tower supported without guy wires.

The patents referred to show the towers as being comprised of conducting material. They are connected directly into and form the antenna for the broadcasting circuits. According to the present invention the efficiency of antennae of this type is improved and the effect on broadcasting efficiency due to the taper of the tower in the upper sections is overcome without, however, adding materially to the cost of the tower and without materially increasing the wind resistance of the tower. In carrying out the present invention, a supporting element is secured to or above the conducting top of the metal tower. From this support depends a series of vertical wires, all of which are electrically insulated at their upper ends from the tower itself and which are secured at their lower ends to the conducting tower. These wires, which are preferably symmetrically arranged about the vertical axis of the tower, form in effect, a conducting cage of substantially uniform diameter throughout its entire height. By reason of this arrangement, the wires surrounding the tower, because of their distribution and well-known principles of electromagnetic induction, carry most of the energy effective in broadcasting, the tower itself above the point of attachment of the wires carrying but little of the current. Because of this, the effectiveness of the antenna as a whole is improved.

This effectiveness may be further increased by increasing the electrical capacity at the top of the wires or wire cage, keeping the capacity of the top of the tower itself as small as possible.

The invention may be readily understood by reference to the accompanying drawing, in which

Figure 1 is a vertical view of one form of structural conducting tower embodying my invention; and

Figure 2 is a plan view looking down from the top.

Referring to the drawing, the tower itself which is designated **2** and which is usually formed of steel, may be of any known or preferred type of structural mast. The tower is shown as being supported on legs **3** carried on insulators **4** of a type known to those skilled in the art and by means of which the structural tower is insulated from the ground while the tower itself is maintained and supported in vertical position. The tower decreases in width from its base toward its uppermost point **5**. At the top of the tower is a pole or mast **6** which in the construction shown in Figure 1 may be of wood, and which carries a spider or frame **7** at the top thereof, this frame having a number of horizontal arms **8** suitably braced and of equal length. Secured to the outer end of each of these arms **8** is a depending wire **9**, the wires **9** preferably extending down to a point **10** near the base of the tower where they are

electrically connected to the tower. Where desired, the wires may also be supported by the tower and/or attached thereto at the intermediate point marked 11. The upper ends of the wires 9 are, of course, insulated from the top of the conducting tower by reason of the wooden or other insulating pole 6. Preferably, the pole 6 projects an appreciable distance above the top of the conducting tower.

In the drawing, I have shown eight of these vertical wires 9 symmetrically arranged about the vertical axis of the tower, but this number may be varied as may be desired. Where the supporting frame 8 or spider 7 does not have sufficient inherent capacity, a number of balls 12 may be provided above the spider, one being preferably located at the upper end of each of the wires 9 and by reason of which the capacity of the upper portion of the structure is effectively increased.

By reason of this arrangement it will be seen that the wires 9, in effect, form a cylindical cage of uniform diameter throughout the greater portion of the height of the tower, particularly the upper part thereof. This acts to compensate, so far as radiating efficiency is concerned, for the diminishing width of the conducting tower toward the top. Moreover, by reason of the fact that the upper ends of the wires are insulated from the top of the tower, most of the energy is dissipated from the wires 9 and relatively little from the upper conducting portion of the tower. By increasing the electrical capacity at the top of the wires or of the cage formed by the wires, and by keeping the capacity of the top of the tower itself as small as possible, the effectiveness of the tower is further increased. The effectiveness of the antenna is further increased in the preferred embodiment by reason of the fact that the top of the cage formed by the vertical wires 9 is well above the conducting top of the tower.

In the case of very tall towers, it may be necessary to use a metal pole in place of the wooden pole 6, in which case the metal pole may be insulated from the top of the tower and in which case the wires 9 would be insulated from the supporting pole, the arrangement in such case being designed to provide a minimum capacity coupling between the wires and this upper tower structure.

It may be noted that the construction illustrated offers protection to the wooden pole 6 against lightning, by the presence of the balls 12 at a higher elevation, or at least as high an elevation as the top of the pole. If the spider be of metal and have sufficient capacity so that the balls 12 are not necessary, it is, of course, apparent that the spider may be provided with points to give added protection against lightning discharges.

The advantages of the present invention arise from the fact that the wires or cage 9 make use of the known principle that a number of parallel wires symmetrically disposed about a common axis are more effective for broadcasting purposes than a single conductor. A further advantage resides in the increased efficiency resulting from the fact that the upper end of the wires are not connected to the conducting top of the tower, and from the fact that the capacity of the tower is relatively less inside this portion of the cage where the upper ends of the wires have no connection to the tower. Further advantages derived from the increased efficiency result from extending the cage above the conducting top of the tower.

While I have specifically illustrated and described a preferred embodiment of my invention, it will be understood that various changes and modifications may be made therein and that the invention can be adapted to various types of structural masts, all of which changes and modifications are within the scope of the following claims.

I claim:

1. A vertical antenna structure for broadcasting comprising a central supporting tower, a plurality of antenna wires surrounding said tower, said wires being electrically connected to the tower at the lower extremities, the upper extremities of the wires being supported from the top of the tower but insulated therefrom.

2. A vertical antenna structure for broadcasting comprising a central tower of relatively slender shape converging toward its top, a plurality of antenna wires arranged about said tower, said wires having their lower ends electrically connected to the tower, the upper ends of said wires being supported from the tower but being insulated therefrom and extending well above the conducting top of the tower.

3. A vertical antenna structure for broadcasting comprising a structural mast having a plurality of antenna wires arranged thereabout in spaced relation thereto, the wires being parallel with the vertical axis of the mast, the upper ends of the wires being supported by but out of electrical contact with the mast, said wires being electrically connected to the mast at a point well below the top thereof.

4. A vertical antenna structure for broadcasting comprising a conducting structural tower converging toward its top, a plurality of antenna wires surrounding but spaced from said tower substantially parallel with the vertical axis thereof, and means at the top of the tower for supporting said wires out of conducting relation with the top of the tower, said wires being connected to the tower at a point well below the top thereof.

5. A vertical antenna structure for broadcasting comprising a structural tower of conducting material tapering toward the upper end thereof, and a series of wires parallel to the vertical axis of the tower arranged about the outside of the tower in spaced relation thereto, the lowermost ends of the wires being connected to the tower, the upper ends of the wires being insulated from the conducting tower and extending above the conducting top of the tower.

6. A radio antenna structure for broadcasting comprising a rigid structural conducting tower having a tapered upper portion and a cylindrical cage comprising vertically extending wires surrounding said tapered upper portion, said cage having its upper end electrically insulated from the tower and its lower portion electrically connected to the tower.

7. A radio antenna structure for broadcasting comprising a series of vertical conducting wires symmetrically arranged to form a cage about a vertical axis, a tower on the same axis within the cage, supporting means at the top of the tower from which the cage is suspended, said supporting means being constructed to insulate the top of the cage from the tower, the lower portion of each wire comprising the cage and the tower being electrically connected.

8. A radio antenna structure for broadcasting

comprising a symmetrical series of parallel wires arranged about a vertical axis, a conducting tower inside the series of wires and substantially co-axial therewith, means at the top of the tower for supporting said wires at their upper ends with said upper ends insulated from the tower, the lower portions of the wires being electrically connected to the tower, and means at the upper end of the series of wires providing an effective increase of electrical capacity therefor.

9. A radio antenna structure for broadcasting comprising a symmetrical series of parallel wires arranged about a vertical axis, a conducting tower inside the series of wires and substantially co-axial therewith, means at the top of the tower for supporting said wires at their upper ends with said upper ends insulated from the tower, the lower portions of the wires being electrically connected to the tower, and means at the upper ends of the series of wires providing an effective increase of electrical capacity therefor, said means comprising metal balls at the uppermost ends of the wires.

10. A radio antenna structure for broadcasting comprising a symmetrical series of parallel wires arranged about a vertical axis, a conducting tower inside the series of wires and substantially co-axial therewith, means at the top of the tower for supporting said wires at their upper ends with said upper ends insulated from the tower, the lower portions of the wires being electrically connected to the tower, and means at the upper ends of the series of wires providing an effective increase of electrical capacity therefor, said means comprising metal balls at the uppermost ends of the wires, the balls constituting the highest part of the antenna structure.

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