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Fig. 1

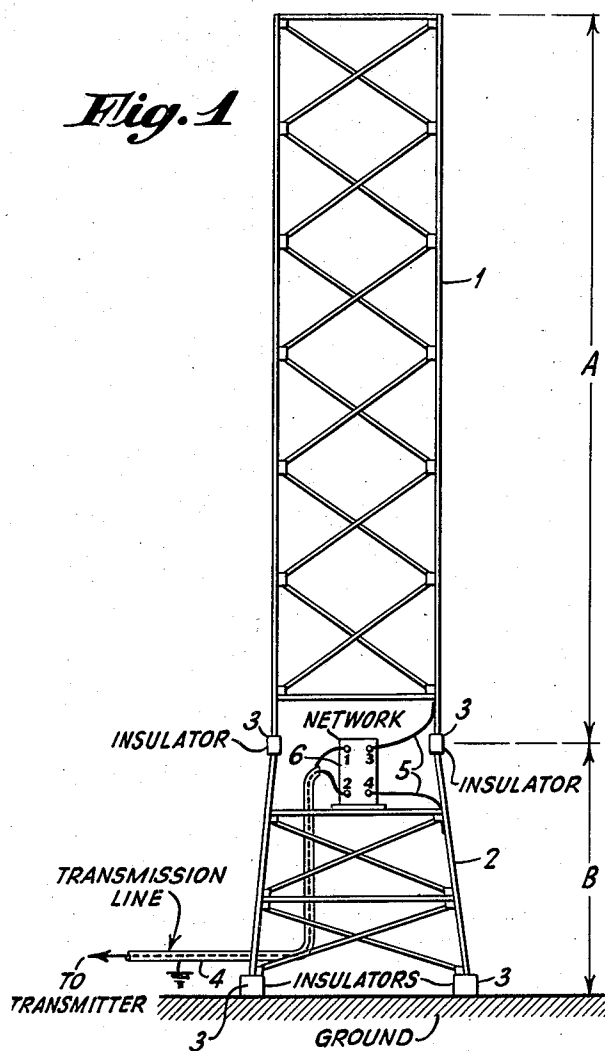


Fig. 2

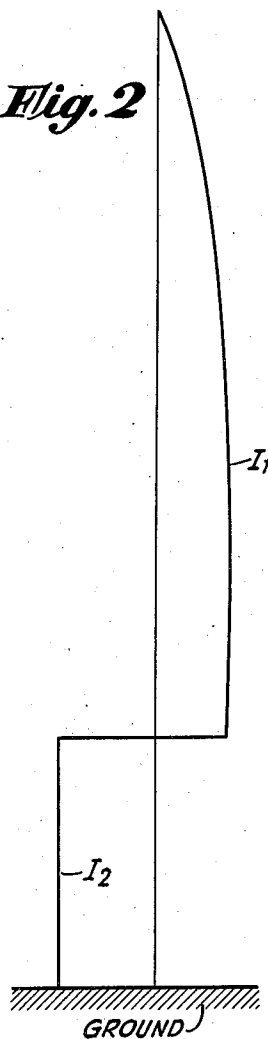
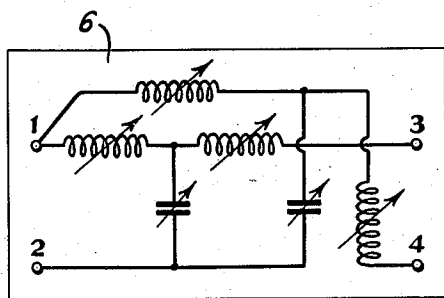


Fig. 3

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This invention relates broadly to transmitting antenna structures, particularly of the mast or tower type, and has for its primary object to provide a simple and less costly antenna for reducing high angle radiation than antenna structures hitherto proposed for this purpose.

The useful range of radio transmission on many frequencies, especially those of broadcast service, is unduly limited at night time by fading which often causes distortion. This fading which occurs at a relatively nearby point, is caused by reflection of the high angle radiation from the ionized layer of atmosphere. The reflected ray or rays arrive at this nearby point and by interference with the ground wave cause fading and distortion. It is known that high angle radiation can be reduced either by building an antenna sufficiently high so that the natural current distribution results in a reduction of the high angle radiation, or by producing a suitable artificial current distribution in a shorter antenna, as by employing a capacity and tuning coil arrangement at the top of an antenna. Because of the cost of building an antenna to the optimum height for least high angle radiation, and the mechanical drawbacks of such a tall structure, the tendency is toward a shorter antenna which will produce some of the results obtained from the larger structure.

Another disadvantage in known antenna structures where a capacity top and tuning coil arrangement is used, or where a sectionalized antenna is used with a tuning coil electrically coupling the sections together, for purposes of reducing high angle radiation, lies in the existence of comparatively high voltages across the tuning equipment of the antenna at the sectionalized point, when high power is used.

The foregoing disadvantages of antenna structures as heretofore constructed, are largely overcome in the antenna structure of the present invention. The invention consists essentially in the provision of a relatively short sectionalized transmitting antenna having a current reversal in the two sections of the antenna. The bottom section of the antenna is excited in such phase and amplitude that the radiation therefrom materially reduces the ratio of high angle to ground wave radiation emanating from the antenna.

Other objects, features and advantages will appear hereinafter from a reading of the following description taken in conjunction with the accompanying drawing, wherein:

Fig. 1 is a view in side elevation of a vertical

sectionalized antenna constructed in accordance with the present invention;

Fig. 2 shows the general shape of the current distribution in the antenna of Fig. 1 when energized in accordance with the principles of the invention; and

Fig. 3 is a detail of one type of suitable network, given by way of example only, which can be inserted between the transmission line and the two sections of the antenna for obtaining the desired phase and amplitude relations of the currents in the two sections of the antenna.

In Fig. 1 there is shown a sectionalized tower structure, whose top section 1 has the general dimension A, and whose lower section 2 has the general smaller dimension B. The lower section 2 is insulated from the top section 1 and may be insulated from ground by means of suitable insulators 3, 3. Although the antenna has been shown of the self-supporting type formed of structural steel members and reinforcing struts and girders, it may, if desired, be a vertical tubular mast, with or without guy wires, or even a straight aerial wire. The dimensions of sections 1 and 2 are not critical, the length of the top section being at least twice that of the lower section. As an illustration of one particular type of antenna, the ratio of the height of section 1 to that of section 2 may be of the order of 5:1. The overall length of the antenna structure should be less than 200 electrical degrees at the operating frequency.

It is essential in the practice of the invention that the sections 1 and 2 be energized with currents of opposite phase. This may be suitably effected by means of a concentric transmission line such as 4 feeding the lower section 2 at its upper part and the top section 1 at its lower part, through a suitable network 6, as shown. Where a concentric line is used, the outer tubular conductor is connected to one input terminal of the network, while the inner conductor is connected to the other input terminal of the network, the two output terminals being connected through suitable leads such as 5 to the sections of the antenna. These leads 5 are preferably soldered or welded to the tower members. Network 6 is herein shown mounted within the antenna structure on a suitable platform of any desired type.

One suitable type of network which can be used to give the desired current distribution of Fig. 2 is shown in Fig. 3. This network provides an adjustment of the ratio of currents I_1 and I_2 in the two sections of the antenna and gives a phase difference between the currents I_1 and I_2 of the

order of 180°. In other words, the currents I_1 and I_2 are of substantially opposite phase and flow in opposite directions in the tower. By proper choice of the amplitudes and the phase angle between currents I_1 and I_2 as effected by the adjustment of capacitors and inductors in the network 6, the high angle radiation from the antenna is reduced, and by keeping the energy losses low, the ground signal is increased. Optimum adjustment of the antenna may be obtained by observing fading at a distant point or points while the above mentioned changes are made.

Although the sections 1 and 2 of the antenna have been shown sectionalized at a feeding point which coincides with the current reversal location, it should be understood that the invention is not limited thereto inasmuch as the lower section 2 can be excited at the base near the ground, while the upper section 1 can be excited at the point shown or at a higher location, the essential requirement being that both sections be separately fed in order to obtain the desired relationship between the currents in the two sections. These currents in the two sections should be of substantially opposite phase and of proper relative magnitude to effect the desired reduction in high angle radiation.

It will be obvious, of course, that the invention is not limited to the particular type of network shown since any other suitable arrangement for achieving the desired result may be employed, whether this network employs concentrated reactances or reactances of substantially uniformly distributed constants. Nor is the invention limited to any particular location for this network inasmuch as it may be located near the ground or outside the antenna structure. Furthermore, the side elevation of Fig. 1 is intended to typify a tower structure of any suitable design such as the four-leg or three-leg, or single leg, either self-supporting or guyed tower, and a tower with or without a tapered cross section.

What is claimed is:

1. A vertical antenna structure having an overall length less than 200° at the operating frequency and including two vertical adjacent sections of unequal lengths insulated from each other, said sections being devoid of concentrated reactance, the upper section having a length at least twice as long as the lower section, and means for individually energizing said sections in such manner that the currents in said sections are substantially of opposite phase and of relative magnitude sufficient to reduce high angle radiation.

2. A vertical sectionalized antenna comprising an upper section and an adjacent lower section,

said upper section being longer than said lower section, insulators between said sections for insulating said sections from one another, feeding means for individually exciting said sections, a network of capacitance and inductance located between at least one of said sections and said feeding means, said network being so adjusted as to produce in said sections currents of substantially opposite phase and of such magnitude as to reduce high angle radiation.

3. A vertical sectionalized transmitting antenna including two adjacent sections of unequal lengths, the upper one of which is longer than the lower one, means for insulating said sections from each other, a concentric transmission line, conductors individually extending from said sections to said transmission line, and a network of inductance and capacitance located between said conductors and said line, said network being adjusted to produce in said sections currents of substantially opposite phase and of proper magnitude to reduce high angle radiation.

4. An antenna system in accordance with claim 3, characterized in this that said antenna is of the self-supporting type formed of structure steel members and reinforcing struts, and said network is mounted within the structure of said antenna and near the upper part of said lower section.

5. A transmitting antenna including two vertical adjacent sections of unequal lengths, the upper section having a length longer than the lower section, insulators between said sections for insulating said sections from each other, a concentric transmission line feeder extending upward a substantial portion of the length of said lower section, leads individually connecting the lower part of said upper section and the upper part of said lower section to said transmission line, a network located between said leads and said transmission line, said network being adjusted such that the currents in the upper and lower sections are of substantially opposite phase and proper magnitude to reduce high angle radiation.

6. A vertical sectionalized antenna comprising an upper section and an adjacent lower section, said upper section being at least twice as long as said lower section, insulators between said sections for insulating said sections from one another, feeding means for individually exciting said sections, a network of capacitance and inductance located between at least one of said sections and said feeding means, said network being so adjusted as to produce in said sections currents of substantially opposite phase and of such magnitude as to reduce high angle radiation.

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