

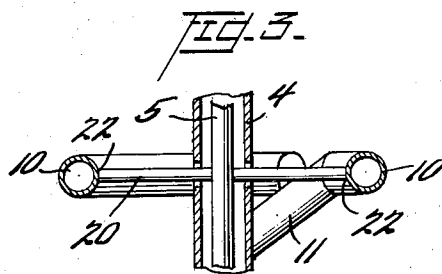
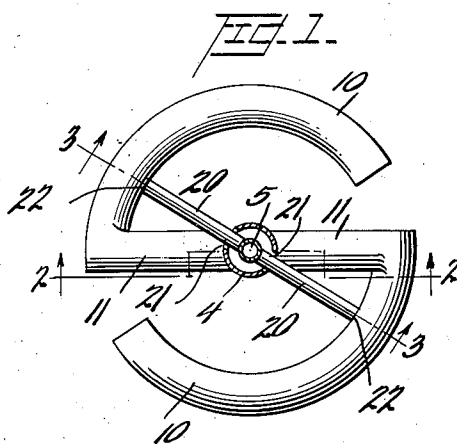
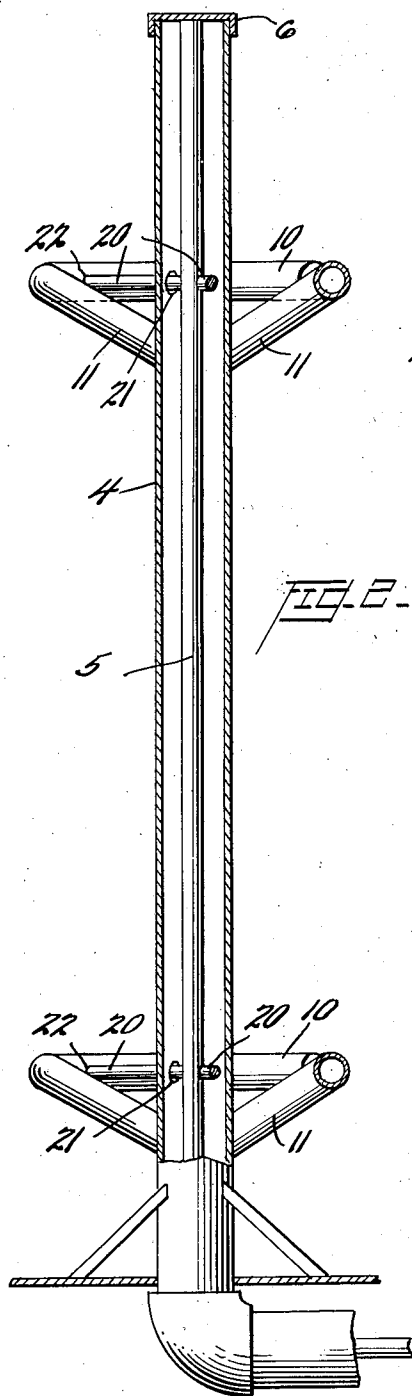
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HIGH-FREQUENCY ANTENNA

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HIGH-FREQUENCY ANTENNA

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This invention relates to high frequency antenna systems and is particularly concerned with improved antennae for radiating plane polarized waves.

The principal object of the invention is the provision of a highly efficient antenna capable of radiating high frequency energy in a pattern essentially uniform in the plane of polarization. It is a feature of the invention that no condensers or other impedance units need be employed. Radiating elements constructed in accordance with the invention are particularly adapted for use in a system such as that shown in application for U. S. Letters Patent by Caraway and Silliman, Serial No. 724,746, filed January 28, 1947, whereby insulation may be eliminated from the antenna structure, including the feeding line.

Further objects and features of the invention will be apparent from the following description, taken in connection with the accompanying drawings, in which

Figure 1 is a plan view of an antenna system illustrating a preferred embodiment of the invention;

Figure 2 is a vertical sectional view, taken substantially on the line 2—2 of Figure 1; and

Figure 3 is a fragmentary sectional view on the line 3—3 of Figure 1.

In order to facilitate an understanding of the invention, reference is made to the form chosen for illustration, and specific language is used to describe the same. It will, nevertheless, be understood that no limitation of the scope of the invention or of its mode of application is thereby intended, such further forms and modifications being contemplated as would normally occur to those skilled in the art.

The radiating members of the present invention are illustrated in conjunction with a coaxial line serving as a supporting mast, as described and claimed in the aforesaid patent application of Caraway and Silliman. Thus the mast 4 is a hollow, tubular member, preferably grounded at its base for convenience in mounting, the dimensions of which are chosen to afford adequate mechanical strength and sufficient spacing from the central conductor 5 to insure against leakage at high voltages. For instance, the internal diameter of the mast may be of the order of 6 inches when used with an inner conductor of 3/4-inch tubing. The height may vary considerably, but will be sufficient to accommodate the desired number of vertically spaced radiating members. Conductor 5 and mast 4 are electrically connected at the upper end, for instance by welding conductor 5 to the central portion of

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cap 6 which serves as a closure for the upper end of the mast. The central conductor may be rigid, but this is not essential, the spacing between the conductors being maintained by the conductive connections to the radiating members, as hereinbefore explained.

Each radiating member comprises a plurality of elements 10, two being shown. These elements are preferably arcuate in plan, and are arranged to define an interrupted loop, coaxial with supporting mast 4, each element or segment of the loop being supported at one end on a conducting arm 11, which may be welded or otherwise rigidly and conductively secured to the mast and the radiating element. Elements 10 and arms 11 may be formed, for convenience, of tubular stock of the same diameter. The arms 11 are generally radial to the mast, being inclined upwardly in the illustrated construction in order to clear the leads from the inner conductor 5. The plane figure defined by the several elements 10 of each radiating member may be polygonal rather than circular; the term "segment" where employed herein without other qualification is intended to include such minor variations in configuration.

Each segment 10 is fed from inner conductor 5 by a conducting element or signal conductor 20, extending through an aperture 21 in mast 4. Each element 20 is preferably secured rigidly to its segment 10 and to the conductor 5, and is itself sufficiently rigid to position conductor 5 within the mast 4, so that the use of insulating spacers and the like is unnecessary. It will be noted that each radiating member or loop provides a plurality of connections to the inner conductor 5, with consequent increase in rigidity of the structure.

The position of the point of connection of element 20 with segment 10, indicated at 22, will vary depending upon the characteristics of the system, i. e., with the number of radiating members or bays in the antenna system and the surge impedance of the transmission line feeding the antenna system at the lowermost bay. For approximately equal current distribution in all bays, the impedances of the several bays should be equal. The tap point is adjusted so that the sum of the reciprocal impedances of all bays equal the reciprocal of the line impedance.

The number of loops employed may vary widely; as is well known, the employment of a greater number of radiating members of this character increases the gain of the antenna system. A valuable feature of the invention resides in the feasibility of employing any desired number of loops, either odd or even. The uppermost loop should be located below the upper end of the

mast by a distance approximately one-fourth wave length of the signal to be radiated, or an odd multiple thereof, or by a commensurate electrical spacing (approximately 90 degrees) offering no shunting effect to the transmission line. The spacing between adjacent loops in the ordinary case will preferably approximate the wave length of the radiated energy, the electrical spacing (usually about 360 degrees) being determined by the propagation velocity of the inner conductor. The principles underlying these various relationships are well known in the art and need no elaboration.

It will be appreciated that the spacing of the loops may be halved by reversing the phase relation of adjacent loops, for instance by turning alternate loops upside down, so that the free ends of the segments 10 of adjacent loops extend in opposite directions from the supporting arms 11.

The feed lines 20 to the individual radiating segments 10 provide low inductance paths between the central conductor of the coaxial feed line and the driving points on the segments. It is possible to select almost any desired antenna driving resistance by varying the angle between the arm 11 and the conducting element 20 for each segment.

The loops are tuned to the frequency of the signal to be transmitted by appropriate selection of the length of the individual segments. Alternatively, the proper segment length may be obtained by telescoping a smaller tube of proper curvature into the tube comprising segment 10. These segments operate as independent quarter-wave resonant antennas, and will therefore have an effective length of one-fourth of the signal wave length, the actual length being slightly less. It should be noted that the current flows in the same direction in all segments at any given instant to give a uniform radiation pattern in the plane of the loop.

It will be perceived from the foregoing that the invention provides an extremely simple and inexpensive system combining many desirable electrical characteristics. Such alterations and modifications of the preferred structure as would be apparent to those skilled in this field are contemplated as part of the present invention.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. An antenna for high frequency radiation comprising a hollow conductor constituting a central support, a plurality of segments disposed about said central support to form an interrupted loop, a plurality of conducting arms extending outwardly from said support, each arm being conductively connected to said support and to one of said segments at one end of the latter, the other end of each segment being free, the free ends of the segments extending in the same angular direction from said arms and into proximity to the conducting arm for the adjacent segment, a central conductor within said central support, and means electrically connecting said central conductor to each segment at a point intermediate the supporting arm of the free end of the segment.

2. An antenna system for transmitting high frequency signals comprising a hollow mast and an inner conductor within said mast, said mast and inner conductor constituting a coaxial transmission line, a conducting connection between said conductor and said mast at the upper end thereof, at least one radiating member mounted

on said mast, said radiating member comprising a plurality of segments disposed about said mast to form an interrupted loop, a plurality of conducting arms extending outwardly from said mast, each arm being conductively connected to said mast and to one of said segments at one end of the latter, the other end of each segment being free, the free ends of the segments extending in the same angular direction from said arms and into proximity to the conducting arm for the adjacent segment, and means electrically connecting said inner conductor to each segment at a point intermediate the supporting arm of the free end of the segment, said last named means constituting the sole positioning and spacing means for said inner conductor.

3. An antenna for high frequency radiation comprising a central support, a plurality of segments disposed about said central support to form an interrupted loop, the effective length of each segment being one-fourth wavelength of the energy to be radiated, a plurality of conducting arms extending outwardly from said support, each arm being conductively connected to said support and to one of said segments at one end of the latter, the other end of each segment being free, the free ends of the segments extending in the same angular direction from said arms and into proximity to the conducting arm for the adjacent segment, and a signal conductor connected to each segment at a point intermediate the supporting arm of the free end of the segment.

4. An antenna for high frequency radiation of plane polarized waves comprising a central support forming the outer conductor of a coaxial transmission line, an inner conductor extending within said central support, at least one radiating member carried by said central support, each such member comprising a plurality of segments disposed about said central support to form an interrupted loop, a plurality of conducting arms extending outwardly from said support, each arm being conductively connected to said support and to one of said segments at one end of the latter, the other end of each segment being free, the free ends of the segments extending in the same angular direction from said arms and into proximity to the conducting arm for the adjacent segment, and means electrically connecting said inner conductor to each segment at a point intermediate the supporting arm of the free end of the segment and so spaced from the supporting arm that the sum of the reciprocals of the impedances of the radiating members is substantially equal to the reciprocal of the impedance of the feed line between the transmitter and the antenna.

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