

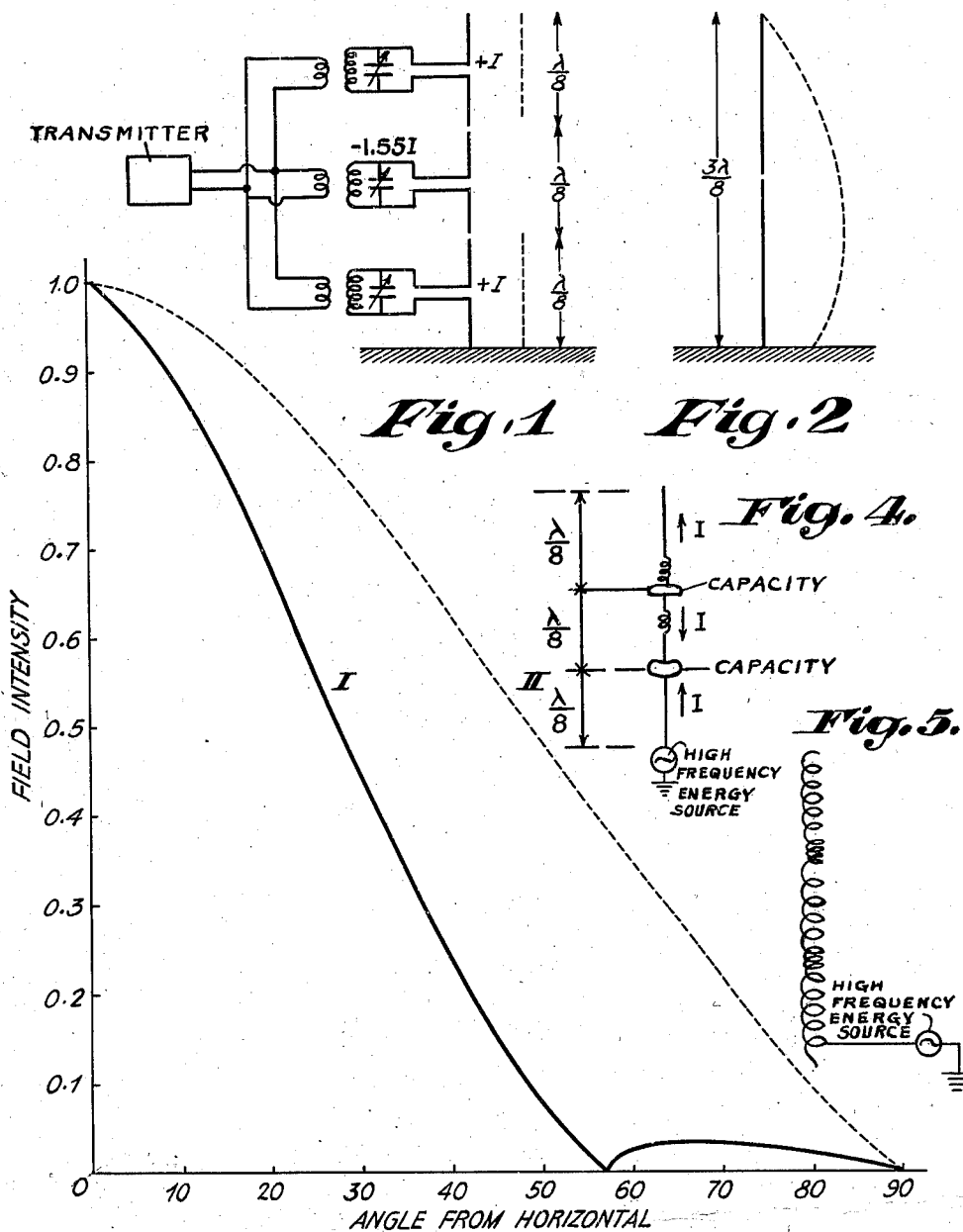
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In operating with medium and long waves (above 100 m.) only the ground radiation can be utilized for safe transmission. The space radiation either becomes lost or causes disturbing fading phenomena, when they are reflected by the Heaviside layer. Therefore, attempts have been made for a long time to construct antenna with reduced space radiation. Theoretically this can be achieved by means of very high antennas. Practically, antennas have been constructed the height of which is of the order of one half wave length and in which radiation is suppressed below a definite angle of elevation. However, this suppression has only been effective for some angles, but not for a larger range of angles.

The greatest, economically operating antenna height is held to be about 200 m. Thus, for broadcasting waves between 200 and 550 m. it is 1λ to 0.36λ , where λ is the symbol for wave length. In accordance with the present invention for antenna heights equal to or less than one wave length, vertical diagrams are effected which, practically speaking, do not produce radiation within a large range of angles. This is accomplished by subdividing the antenna into several parts, which are arranged to radiate alternately at opposite phase. Each antenna of the height of one half wave length is made to be constructed from at least three such parts radiating in opposite phase. Where the antenna height is greater than one half wave length, any sector of the antenna of $\lambda/2$ length is to be composed of at least three parts radiating alternately at opposite phase.

The length of the individual radiating parts, their height above ground, and their current amplitudes are variable and are designed for each individual case in such manner that the desired vertical diagram is fulfilled to the fullest extent. If, for instance, an antenna height of $\frac{3}{8}\lambda$ is prescribed, and if it is intended to suppress as far as possible the radiation within an angle range between 55 and 90° from the horizontal, this can, for instance, be attained by the following arrangement:

The entire antenna height according to the invention is divided into three equal parts of $\lambda/8$ each; the lower and upper part are fed at equal phase and at equal amplitude J ; the middle part is fed at opposite phase and at an amplitude being 1.55 as large (see Figure 1). Thus a vertical diagram is obtained with the greatest field intensity in the horizontal direction. In the angle range between 55 and 90° angle the

field intensity is at the most 3% of the maximum intensity.

Figure 1 shows, by way of example only, an antenna in accordance with the present invention. Figure 2 is merely given by way of comparison to show the current distribution in a straight linear antenna of a particular height, Figure 3 represents graphically field intensity and angle of rise for both Figures 1 and 2; and Figures 4 and 5 show modifications of the arrangement of Figure 1.

More specifically, Figure 3 shows a graphical representation of the vertical diagram of the antenna arrangement (curve I) in rectangular coordinates. In the abscissa axis the angles of rise from the horizontal are plotted and the ordinate shows the relative field intensities. For the purpose of comparison there is also shown the diagram (curve II) of an antenna of $\frac{3}{8}\lambda$ in height with the ordinary current distribution (Figure 2) (current node at the top). Both diagrams are reduced to the same horizontal field intensity. In the first diagram (curve I) the field intensity is lower than 3% maximum field intensity only between the rise angles 57–90°.

It is obvious that the above example is not the only solution of the problem to be considered, but represents only an example of particular simplicity. By varying the length of the individual radiating parts as well as their amplitude relations, diagrams can be obtained solving the problem in consideration even better.

The single radiating parts may be individually fed by energy lines. A common feed may also be provided at the bottom of the antenna, as shown in Figure 4. In this case the predetermined current distribution is obtained by suitable dimensioning of self-inductance and capacity of the individual radiating parts. The self-inductance can be changed in regard to a straight wire for instance in winding this wire into a coil. The latter arrangement has the advantage that the current distribution along the antenna can be changed by varying the pitch of the wire turns whereby the desired current distribution is obtained, as shown in Figure 5. In this way the self-inductance of the conductor is primarily changed. In order to vary the capacity the diameter of the coil may, for instance, be changed or in case of a straight antenna the same may be formed as bow net aerial.

Due to the separate variation of self-inductance and capacity it is possible to shorten the length of the conductor as may be desired so that in one sector of one half wave length three

parts radiating alternately at opposite phase can be produced. The shortening of the length can also be produced in another manner, for instance, in forming the antenna wire of zigzag shape. In this case the attainable shortening of the length is dependent upon the length of the wire provided for a definite antenna length.

We claim:

1. A vertical antenna having a section not exceeding one-half wave length and which section has at least three parts, and means for causing alternate parts to radiate in phase and adjacent parts out of phase.

2. The combination with a vertical antenna having a physical height less than one-half the length of the communication wave, said antenna constituting at least three radiating sections, of means for causing alternate sections to radiate in phase and adjacent sections out of phase.

3. A vertical antenna having a physical height less than one-half the length of the communication wave, said antenna comprising three radiating sections one above the other, means for supplying the uppermost and lowermost of said three radiating sections with currents of equal

amplitude and the middle section with current of greater amplitude.

4. A vertical antenna having a physical height less than one-half the length of the communication wave, said antenna comprising three radiating sections one above the other, means for supplying the uppermost and lowermost of said three radiating sections with currents of equal phase and amplitude and the middle section with current which is out of phase with said first mentioned currents and of greater amplitude.

5. A vertical antenna having a section not substantially exceeding one-half wave length and which section comprises three radiating sections one above the other, means for supplying the uppermost and lowermost of said three radiating sections with currents of equal phase and amplitude and the middle section with current which is out of phase with said first mentioned currents and of greater amplitude.

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