Oct. 8, 1940. H. O. PETERSON 2,217,623

ANTENNA SYSTEM

Original Filed Jan. 28, 1937

Fig. 1

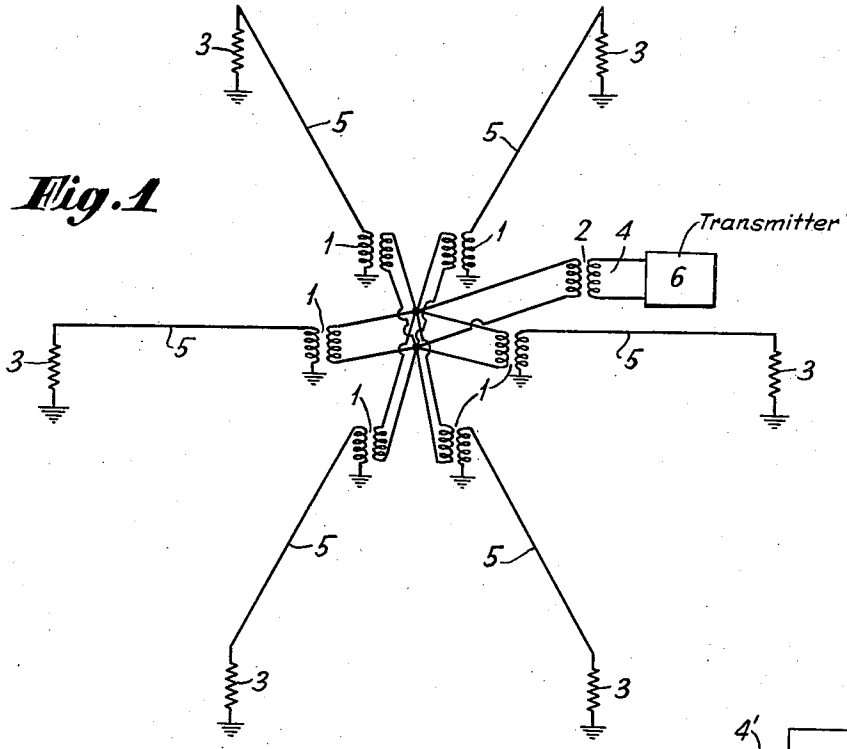
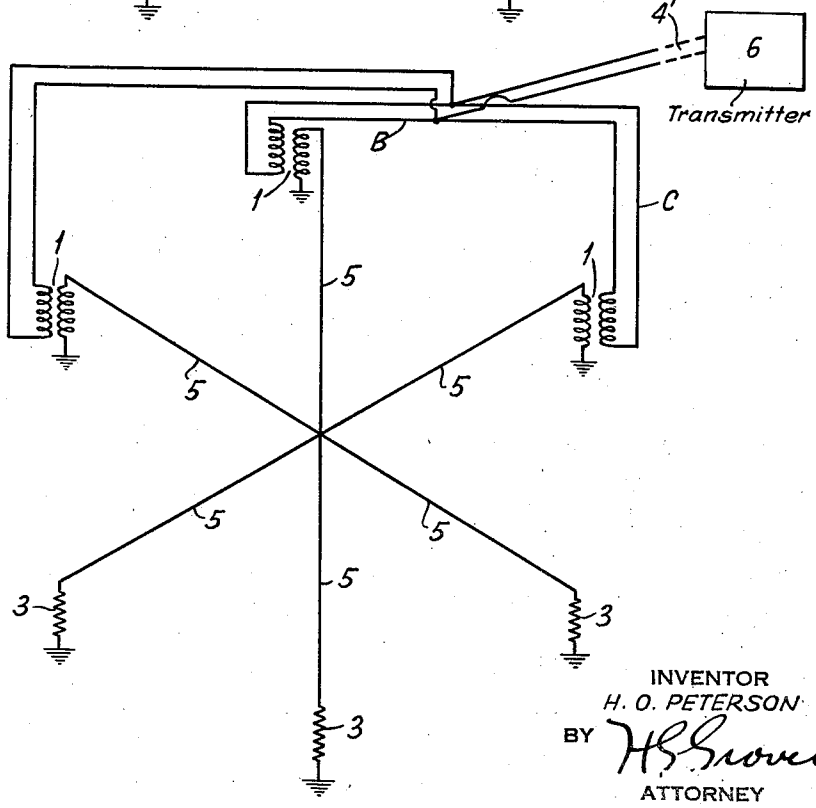


Fig. 2



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ANTENNA SYSTEM

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5 Claims. (Cl. 250—33)

This invention relates to antenna systems and, more particularly, to transmitting antennas for radiating power at broadcast frequencies.

The present application is a division of application No. 122,699, filed January 28, 1937, in the United States Patent Office.

One common cause of interference at a receiver results from the recombination of waves arriving at a receiver over paths of different lengths, such as the earth path and the sky path. In the earth path are components of the wave which are transmitted horizontally, while in the sky paths are components which are transmitted at a high angle of elevation and reflected back to the earth by the Heaviside layer. It has heretofore been proposed to overcome this interference by radiating waves at a low angle to the earth by employing one or more vertical transmitting antenna doublets, each having a length equal to half the length of the communication wave. At broadcasting frequencies, however, in the range of wavelengths of 200 to 600 meters, it is impractical both from an expense standpoint and because of the great height involved to build a half wavelength vertical doublet.

The present invention overcomes the foregoing difficulties and provides a transmitting antenna system which gives relatively low angle radiation without using structures of great height. More especially, the antenna of the invention comprises a plurality of horizontal wave antennas which are disposed radially with respect to a central point, and which have a length at least as long as half the length of the communication wave. These antennas are at a relatively short distance above the earth and are designed each to produce maximum radiation in one direction, that is, in the direction away from the feeding point. Such wave antennas radiate vertically polarized waves, and maximum radiation occurs at relatively low angles with respect to the earth.

A more detailed description of the invention follows in connection with the accompanying drawing, wherein Figures 1 and 2 show two embodiments of the invention. In these figures the same parts are represented by the same reference numerals.

Referring to Figure 1, there is shown in plan view a transmitting antenna system constituted by a plurality of horizontal wave antennas disposed radially with respect to a central feeding point. The wave antenna is well known per se, and is adequately described in United States Patent No. 1,381,089, granted June 7, 1921, to Harold H. Beverage, to which reference is herein made. Each wave antenna is designated by the reference numeral 5 and is fed through a transformer 1 from a central transformer 2 whose impedance is designed to match the impedance of the circuit to which it is connected. The primary winding of transformer 2 is coupled to a transmission line 4 over which energy is fed from a transmitter 6. The far ends of the wave antennas 5 are damped, i. e., connected to earth, through surge resistors 3 to prevent reflections. In this manner, the flow of energy along the wave antenna is in one direction only and the individual antenna is given a unidirectional transmitting characteristic. Antennas 5 are located at a height above ground somewhere between twenty feet and one hundred twenty feet, depending upon local conditions, such as ground characteristics, height of trees, the cost of towers, and the length of the communication wave. The length of each antenna is dependent on the directivity desired therefrom. Generally, a length for each antenna between one-half wavelength and three wavelengths will be found satisfactory, although the exact length must be determined by the conditions to be satisfied.

Antennas 5 are so spaced as to give the desired result, and if it is desired that radiation take place in all directions, the spacing between antennas will generally be of the order of 60°. Although with this spacing there may be some overlapping between the adjacent radiation patterns of adjacent antennas, it will be found that because the invention employs the vertical polarization component of radiation, this component from two overlapping antenna patterns will arrive at the receiving point substantially in phase, and consequently no interference will result therefrom. The angle of elevation in the radiated wave from each antenna will depend upon the length of the wire and upon the ground condition. It is preferred that the angle of elevation be confined to something below 30° or 40° with respect to ground.

Figure 2 discloses a modification of the arrangement of Figure 1, and differs therefrom mainly in arranging the antennas to cross each other near their midpoints. In this arrangement the antennas 5 are each fed at one end through transformers 1, 1 over suitable transmission lines A, B, C, these lines being adjustable in length and connected to a common feeding point which is coupled to the transmitting apparatus 6 over line 4'. Suitable damping resistors 3 prevent reflections in the antennas in the same manner

as above described in connection with Figure 1. The average phase of each of the antennas 5 is the phase of each of their midpoints. By a suitable adjustment of the phase at each of the feed points 1 by an adjustment of the lengths of transmission lines A, B, C, or otherwise, the average phase of each of the antennas may be made the same at the exact geographical center. The polar diagram of the antenna system in the horizontal plane will be much simplified due to the consequent absence of interference patterns caused by geographical spacing of the midpoints of the several antenna components.

It will be understood, of course, that if uniform radiation in all directions is not desired, one or more antennas 5 may be eliminated from the system in the direction toward which it is not desired to transmit. Nor is the invention limited to the number of wave antennas shown, since this number will depend on such factors as the spacing, radiation patterns from each antenna, etc.

What is claimed is:

1. An antenna arrangement comprising a plurality of horizontal antennas, each at least one-half the length of the communication wave, said antennas crossing each other at substantially their midpoints, high frequency energy transducer means so coupled to each of said antennas at one end only that energy at all of said coupling points is in phase and means for preventing reflection from the ends of said antennas remote from the ends first mentioned whereby the directivity of said antenna is confined to a low vertical angle.

2. A transmitting arrangement comprising a plurality of horizontal antennas, each at least one-half the length of the communication wave, said antennas crossing each other at substantially their mid-points, means for so energizing said antennas, each from one end only, that the energy therein is in phase at their mid-points and means for preventing reflection from the ends of each of said antennas remote from the ends first mentioned whereby radiation is obtained from said antennas at substantially low angles.

3. A transmitting arrangement comprising a plurality of horizontal wave antennas, each at least one-half the length of the communication wave, said antennas crossing each other at substantially their mid-points, means for so energizing said antennas at one of each of their ends that the energy therein is in phase at their mid-points and means for preventing reflection from the other ends of each of said antennas whereby radiation is obtained from said antennas at substantially low angles.

4. A transmitting antenna arrangement comprising a plurality of horizontal antennas, each at least one-half the length of the communication wave whereby maximum radiation from each of said antennas takes place in a direction along the direction of said antennas, the exact length of each of said antennas being such that the angle of radiation with respect to the horizontal is below 40 degrees, said antennas crossing each other at substantially their mid-points, means for so energizing said antennas, each from one end only, that the energy therein is in phase at their mid-points and means providing a surge impedance at the ends of said antennas remote from the ends first mentioned for preventing reflection of waves along said antennas, the radial spacing between adjacent antennae being such that substantially equal radiation takes place in all directions.

5. A transmitting antenna arrangement comprising a plurality of horizontal antennas, each at least one-half the length of the communication wave whereby maximum radiation from each of said antennas takes place in a direction along the direction of said antennas, the exact length of each of said antennas being such that the angle of radiation with respect to the horizontal is below 40 degrees, said antennas crossing each other at substantially their mid-points, means for so energizing each of said antennas from one end only that the energy therein is in phase at their mid-points and means providing a surge impedance at the ends of each of said antennas remote from the ends first mentioned for preventing reflection of waves along said antennas, the radial spacing between adjacent antennae being generally of the order of 60 degrees whereby equal radiation takes place in all directions.

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