June 22, 1926. 1,589,344

M. K. AKERS

RADIO SIGNALING SYSTEM

Filed Dec. 2, 1920

Fig. 1.

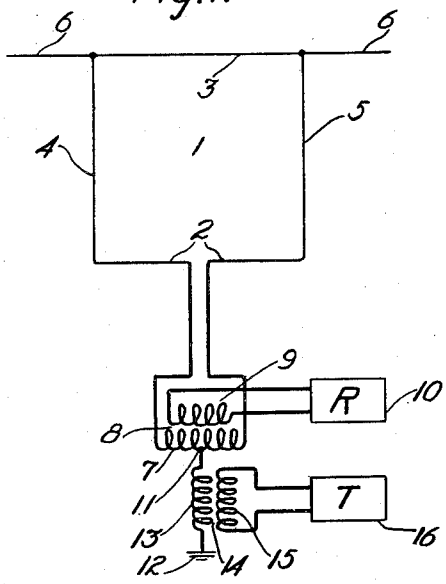
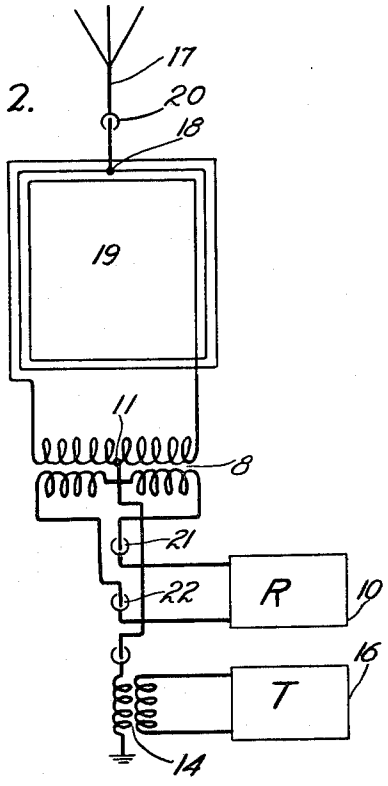


Fig. 2.



Inventor:
Milton K. Akers.
by C. A. Sprague. Atty.

Patented June 22, 1926. 1,589,344

UNITED STATES PATENT OFFICE.

MILTON K. AKERS, OF TROY, OHIO, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

RADIO SIGNALING SYSTEM.

Application filed December 2, 1920. Serial No. 427,782.

This invention relates broadly to a radio signaling system in which a loop antenna and an open antenna are combined in differential relation to other apparatus to permit of the transfer of energy through one antenna without affecting the transfer of energy through the other antenna.

One object of this invention is to provide a radio antenna comprising more than one channel, so that waves may be transmitted over any one channel in either direction without interfering with waves in another channel.

Another object is to provide a duplex system in which waves may be simultaneously radiated and received without mutual interference.

A further object is to arrange the circuits of a loop antenna and an open antenna differentially with respect to other apparatus so that the directional effect of the loop antenna may be employed to maximum advantage by rotating the plane of the loop.

The distributed capacity to ground of the loop antenna is employed to supplement the radiation capacity of the open antenna, while at the same time the differential relation of the two antennæ with respect to other apparatus is preserved.

For a detailed description of the invention, reference is had to the accompanying drawings.

Fig. 1 is a diagram showing the circuit and relative positions of the open and loop antennæ in one modification of the invention.

Fig. 2 is a diagram showing a modification in which the loop antenna is rotatable with respect to the open antenna.

In Fig. 1 the loop antenna 1 is made up of the horizontal conductors 2 and 3 and the vertical conductors 4 and 5. The open antenna is located at the upper side of the loop antenna and includes conductor 3 and extensions 6 therefrom. In the conductor 2 mid-way between the vertical conductors 4 and 5 is the winding 7 of transformer 8, the other winding 9 of which is connected to the station 10 which is preferably a receiving station as indicated by R, but may be a transmitting station, or a combination transmitting and receiving station. Between the midpoint 11 of the winding 7 and the ground 12 is connected the winding 13 of transformer 14, the other winding 15 of which is connected to the station 16 which is preferably a transmitting station as indicated by T, but may be a receiving station, or a combination transmitting and receiving station. The distributed capacity of the two conductors 4, 2 and 5, 2 in the parallel circuit to ground 12 is additive to the capacity of the open antenna 6, 3, 6.

Waves radiated or received by the open antenna 6, 3, 6 will pass differentially through the winding 7 and directly through the winding 13 so that waves will pass in one or the other direction between station 16 and the open antenna 6, 3, 6 without producing any effect on the station 10. In other words, the station 16 is conjugate with respect to the station 10. Waves radiated or received by the loop antenna 3, 4, 2, 5 will pass cumulatively through the windings 7 and 9 and will produce no current in the winding 13 because of the balance obtained by making the ground connection 11 at the midpoint of the winding 7, and in view of the equal length of the conductors 4, 2 and 5, 2.

It is thus seen that the circuit between station 10 and the loop antenna is differential to the circuit between the station 16 and the open antenna, so that waves passing over one of these circuits flow independently of waves passing over the other of said circuits whereby two independent channels for communication are provided.

The general arrangement shown in Fig. 2 resembles that in Fig. 1. The open antenna 17 is, however, connected to the midpoint 18 of the upper side of the loop antenna 19 so that equal lengths of conductor extend between the point 18 and the point 11 to which ground connection is made through the transformer 14. The loop antenna 19 is provided with sliding contacts 20, 21, 22 which permit the loop to be rotated with respect to the open antenna 17 and thus render the loop antenna readily adjustable to a position giving a maximum wave transmission in a given direction.

The station 10, Fig. 2, together with transformer 8 and loop 19, constitute one channel for the transmission of waves, while station 16, together with transformer 14, open antenna 17, and the conductors connected therebetween constitute a second channel for

transmitting waves independently of waves passing through the first mentioned channel. Any desired directional effect may be obtained by rotating the loop 19.

In the modifications disclosed in Figs. 1 and 2, the capacity to ground of the open antenna is supplemented by the capacity to ground of the loop antenna thus providing a circuit having a resultant capacity greater than that of the open antenna alone. Such an antenna is adapted to be used efficiently as a transmitting antenna and would permit of the radiation of a greater amount of energy from a given source than would be possible from the loop antenna alone, or from the open antenna alone. At the same time advantage is had of the characteristics of a loop antenna for the purposes of reception. Although in some cases it may be preferable to employ the open antenna for the purpose of transmission and the loop antenna for the purpose of reception, it is obvious that either antenna may be employed for either transmission or reception.

In order to clearly describe the invention, certain specific modifications thereof have been disclosed, but it is not intended that the scope of the invention should be limited to these specific forms. Many modifications will be obvious from the above description and it is intended to cover these modifications broadly in the appended claims.

What is claimed is:

1. In a radio signaling system, a radio apparatus including separate elements, a rotatable loop antenna comprising a closed metallic path and an open antenna connected thereto, said antennæ having a path in common and means for coupling said elements to said antennæ in conjugate relation to each other.

2. In a radio signaling system, a plurality of sets of radio apparatus, a rotatable loop antenna comprising a closed metallic path, an open antenna connected to one side of said loop antenna, and coupling means including a balanced transformer for associating said sets with said antennæ in conjugate relation to each other.

3. In a radio signaling system, a receiving apparatus and a transmitting apparatus, a rotatable loop antenna comprising a closed metallic path coupled in energy transfer relation, only to said receiving apparatus, and an open antenna coupled in energy transfer relation, only to said transmitting apparatus, said antennæ including a conductor in common.

4. In a radio signaling system, a receiving device and a transmitting device, a rotatable loop antenna comprising a closed metallic path and an open antenna coupled to said devices, said antennæ being differently connected with respect to said devices and means for rendering said devices conjugate with respect to each other.

5. In a radio signaling system, a plurality of sets of radio apparatus, a rotatable loop antenna comprising a closed metallic path and an open antenna connected to said loop antenna, said antennæ being differently connected to said sets of apparatus and means rendering said sets of apparatus conjugate with respect to each other.

In witness whereof, I have hereunto subscribed my name this 27 day of Nov., A. D., 1920.

MILTON K. AKERS.