April 19, 1949. J. B. CARAWAY, JR., ET AL 2,467,961

ANTENNA

Filed Feb. 20, 1946

Fig. 1

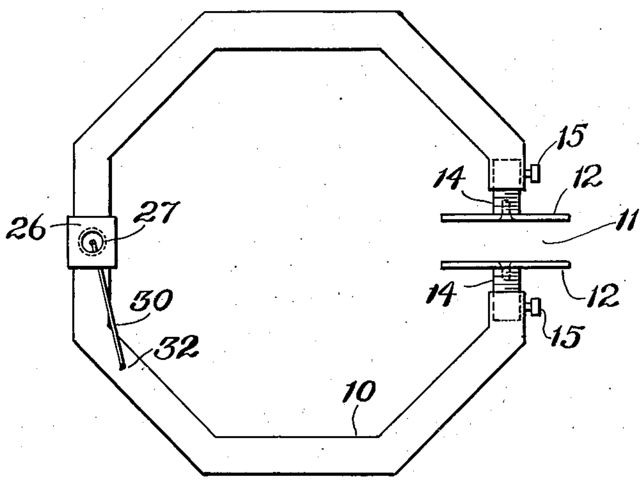


Fig. 2

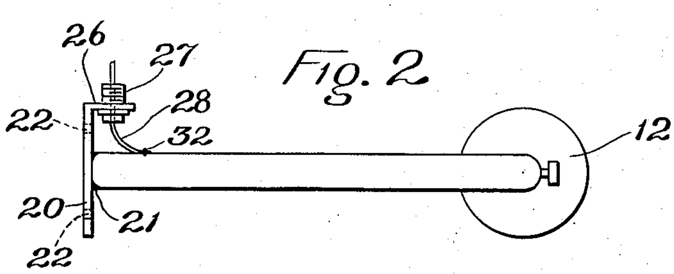
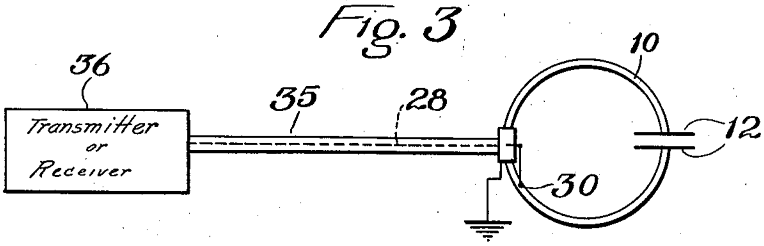


Fig. 3



Inventors

John B. Caraway, Jr., & Harvey Kees

By Watson, Cole, Grindle & Watson

Attorneys

Patented Apr. 19, 1949 2,467,961

UNITED STATES PATENT OFFICE

2,467,961

ANTENNA

John B. Caraway, Jr., and Harvey Kees, Evansville, Ind., assignors to Electronics Research, Inc., Evansville, Ind., a corporation of Indiana

Application February 20, 1946, Serial No. 648,840

2 Claims. (Cl. 250—33)

1

This invention relates to improvements in antennae for the reception and transmission of high frequency signal energy, for example, energy having a frequency of the order of from 20 to 250 megacycles. It is an object of the invention to provide an antenna of simplified construction which may be easily and simply mounted and adjusted, having an efficiency comparable to that of more complicated conventional antennae, and having a generally circular field pattern.

Specifically, it is proposed to provide an antenna of the loop type which may be formed of a tubular or rodlike member shaped to define a generally circular plane figure, the figure being interrupted at one side to provide a gap which is bridged by a reactance, and being grounded at its opposite side. The loop is preferably fed from a coaxial transmission line; by the use of a conducting supporting means, the loop may be simply mounted and grounded through its support, the supporting means being constructed for coupling engagement with the outer conductor of a coaxial transmission line. The inner conductor of the transmission line is connected with a point on the loop so spaced from the grounded portion as to match the impedance of the transmission line. When the loop is used as a transmitter, horizontally polarized rays are radiated.

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 a loop antenna embodying the principles of the present invention;

Figure 2 is a side elevation of the structure shown in Figure 1; and

Figure 3 is a wiring diagram illustrating the preferred method of feeding the loop.

In order to facilitate an understanding of the principles of the invention, reference is made herein to the embodiment illustrated in the drawing, and specific language is used to describe the same. It will nevertheless be understood that no limitation of the scope of the invention is thereby intended, various further modifications and alterations of the illustrated structure, falling within the broad principles of the invention, being contemplated herein.

As shown in Figure 1 of the drawing, the principal element of the antenna is a single loop 10, defining an hexagonal plane figure, which may be formed for convenience by brazing, welding, or otherwise securing together a plurality of straight sections of conducting pipe or tubing of a suitable metal, such as brass or copper. The

2

plane figure defined by the loop may be any polygon or a true circle, all such structures being described for convenience as generally circular. The blank from which the loop is formed may be tubular or solid, and need not be circular in transverse section; the blank is therefore described broadly as a rodlike member.

The loop is interrupted at one side to provide a gap 11 between the adjacent ends of the loop, and the gap is bridged by a reactive coupling, preferably of the capacitive type. A convenient method of effecting this coupling is illustrated in the drawing, opposing plates 12 of a condenser being mounted on the respective ends of the loop for relative adjustment toward and away from each other, whereby the capacity may be varied. Each plate 12 may be secured to the end of a stud 14 having threaded connection with the loop structure, set screws 15 being provided to prevent unintentional displacement of the threaded connection following adjustment to establish the necessary capacity.

At its opposite side the loop is rigidly secured to a supporting member 20, for instance by brazing or welding as shown at 21. Member 20 is apertured as at 22 to receive bolts to facilitate attachment thereof to a supporting pole or the like. The member 20 and the pole may be formed of conducting material, whereby the loop is grounded, it being understood that when the loop is mounted on a vehicle, aircraft, or the like, grounding may be effected by connection to a relatively large conducting surface, such as the vehicle body.

As shown in Figure 2, the member 20 is provided with a portion 26, extending in parallelism with and in spaced relation to the plane defined by the loop. Portion 26 is apertured to receive a connector 27 having an externally threaded portion adapted to couple with the external conductor of a concentric transmission line. The inner conductor of such a line, indicated at 28, is connected with the loop at a point 32 which is spaced from the grounded portion of the loop. The position of the point 32 will vary depending upon the characteristics of the system, and especially upon the resistance of the coaxial transmission line, the impedance of the line being thereby matched. The optimum location is that which gives the best standing wave ratio on the line when fed by a signal of the frequency to which the loop has been adjusted by tuning the condenser 12.

As will be apparent from the wiring diagram of Figure 3, the coaxial cable 35 is connected at one end to the loop, as hereinbefore described and at its other end to a transmitting or receiving apparatus 36 for high frequency signals. The various elements of the loop are illustrated diagrammatically in this figure and bear the reference numerals employed in Figures 1 and 2.

In one installation embodying the invention, suitable for the reception or transmission of signal frequencies of about 100 megacycles, the loop 10 was constructed with a physical circumference of approximately three-eighths of the wave length of the signal energy, the diameter of the loop being about 13 inches. It was found that with circumferences substantially larger, a circular pattern could not be obtained, and that the Q of smaller loops was objectionably high. The blank from which the loop was formed was one-inch brass pipe, about 48 inches long. The condenser plates were formed of one-eighth inch aluminum of 4 inches diameter. A concentric transmission line of 50 ohms impedance was connected between the loop and a receiver having a non-reactive input impedance of 50 ohms, and the loop was tuned by adjusting the condenser plates. The location of the feed point was varied to obtain the best standing wave ratio on the 50-ohm line when fed by a 100-megacycle signal generator, the spacing of this point from the grounded portion of the loop being about 6 inches. The loop was mounted in a horizontal plane on a 12-foot pole in an open field, and comparative tests were made with a straight half-wave dipole, a 100-megacycle signal being supplied from a signal generator and antenna system 100 feet distant. As the result of these tests it was observed that the receiving effectiveness of the loop was comparable with that of the half-wave dipole, the loop pattern being circular within plus or minus one decibel. The band width of the loop was approximately one megacycle, and the standing wave ratio on the 50-ohm line was better than two to one over this range, no resonating capacitor being required in the feeding circuit.

It will be observed that an antenna constructed in accordance with the invention consists essentially of a half-wave dipole, the electrical length of which may be adjusted by varying the end capacitor. The outstanding advantage of the loop is its mechnical and electrical simplicity. It will be appreciated that when an increase in intensity is desired, a plurality of antenna, each constructed as herein described, may be mounted on a common support and fed from a common transmission line.

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

1. In a high frequency antenna system, the combination with an antenna comprising an interrupted loop having a condenser interposed between the ends thereof, said loop being grounded opposite said condenser, a coaxial transmission line having the outer conductor extending adjacent and connected to the grounded portion of said loop and the inner conductor connected with a point on said loop spaced from said grounded portion.

2. In a high frequency antenna system, the combination with an antenna comprising an interrupted loop having a reactive coupling between the ends thereof, said loop being grounded at an intermediate portion, of a coaxial transmission line extending to a point adjacent the grounded portion of said loop, the inner conductor of said transmission line being connected with a point on said loop so spaced from said grounded portion as to match the impedance of said transmission line.

JOHN B. CARAWAY, Jr.
HARVEY KEES.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,153,768	Morrison	Apr. 11, 1939
2,202,368	Berndt	May 28, 1940
2,293,136	Hampshire	Aug. 18, 1942
2,324,462	Leeds	July 13, 1943
2,405,123	Fyler	Aug. 6, 1946
2,447,879	Scheldorf	Aug. 24, 1948