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Transmitter Hunting with the D.F. Loop

A Simple Unit for 10 Meters

BY LOREN R. NORBERG,* W9PYG

• Hidden-transmitter searching has long been a favorite diversion for the mobile members of radio clubs. Here is a directional 10-meter loop antenna that will help you run the "fox" down in a minimum of time. It has proved to be very accurate, even within 100 feet of the transmitter hide-out.

THE increasing popularity of hidden-transmitter hunts, and the author's desire to be among the first few teams to arrive "on location," forced us to consider something more directive than the regular quarter-wave whip mounted on the rear bumper. We needed something economical, convenient, safe to operate, and yet reliable. After several attempts and almost heartbreaking failures, the loop shown in the photograph was developed.

Design Considerations

There are several things one must consider when designing a direction-finding loop antenna. The loop must be small compared to a wavelength, in which case the currents may be considered of the same magnitude and phase throughout the loop. The inner conductor should be less than 0.08 wavelength long.[1] At 29.6 Mc. the inner conductor should be less than 31.9 inches. In other words, the maximum diameter of the loop is about 10 inches for 10 meters.

The inductance of the loop with the distributed capacitance and the capacitance of the tuning condensers forms a series-resonant circuit. When a voltage of the resonant frequency is inserted in series in a resonant circuit, the voltage that appears across either the coil or the condenser is considerably higher than the applied voltage; and is equal to Q times the voltage inserted in series.[2]

This point of maximum voltage in the loop is converted to a point of maximum current in the antenna coil of the converter by a quarter wavelength (electrical wavelength) of coaxial cable. A 67-inch length of coax will provide this transformation with less losses than any other length of lead-in.

The bearing obtained with a loop antenna will be erroneous unless the loop is carefully balanced electrostatically with respect to ground. If the loop is not so balanced there will be a residual antenna effect that distorts the directional pattern of the loop. The accuracy with which electrostatic balance to ground can be obtained in a loop antenna is increased by inclosing the loop in an electrostatic shield. Such a shield ensures that all parts of the loop will always have constant capacitance to ground irrespective of the loop orientation or the nearness of other objects. In constructing the loop from a length of RG-11/U the outer braid serves as an electrostatic shield, while the inner conductor serves as the loop itself. The continuity of the outer shield should be broken at the apex; otherwise the outer shield will act as a closed loop.

A small differential condenser is used to maintain symmetry with respect to ground. This condenser provides a balance to ground that may be varied to compensate for any unbalance introduced by the wiring or placement of parts, etc. The proper adjustment of this condenser may be made by taking advantage of the fact that a properly balanced loop has two nulls differing in direction by exactly 180 degrees.

Constructional Details

The loop shown is made from an 18-inch length of RG-11/U secured to an aluminum box of almost any convenient size, with two coaxial cable hoods (Amphenol 83-1HP/U). The outer shield must be broken at the exact center. C_1

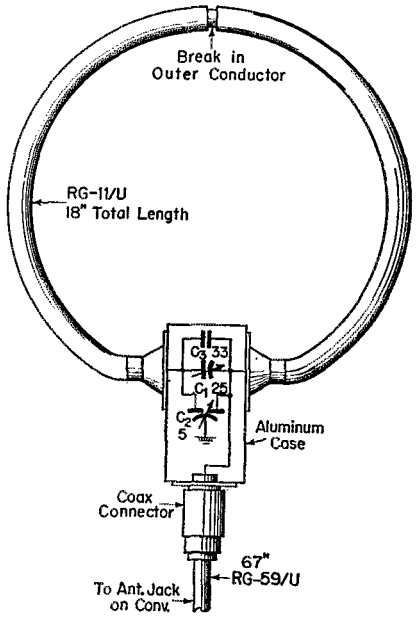
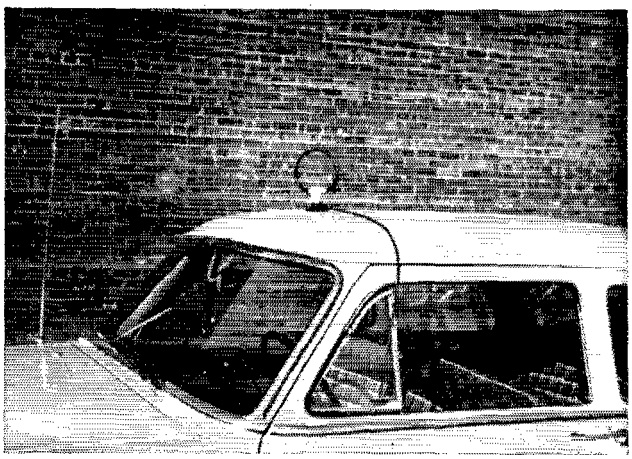


Fig. 1 — Sketch showing constructional details o the transmitter-hunt loop. The outer braid of the coax loop is broken at the center of the loop. The gap is covered with weatherproof tape. Several suitable small aluminum boxes are available on the market.

* Chatham and North, Villa Park, Ill.

[1] *ARRL Antenna Book*, 5th edition, p. 62.

[2] *The Radio Amateur's Handbook*, 30th edition, p. 42.



If desired, the 10-meter d.f. loop can be mounted on the roof of the car with a rubber suction cup.

is a 25-$\mu\mu$f. variable condenser in parallel with a 33-$\mu\mu$f. mica padder condenser, C_3. These values apply at the author's installation when tuned to 29.6 Mc. Any variation in the circuit elements will require a corresponding variation in C_1 or the padder. C_1 must be tuned to the desired frequency while the loop is connected to the converter as it will be operated on the hunt. C_2 is a small differential condenser (Johnson 6MA11) used to provide electrical symmetry. The lead-in to the converter is 67 inches of RG-59/U cable. The smaller cable is more flexible and convenient to use.

One model of this little loop was mounted on a large rubber suction cup as sold by auto-supply stores for auto-top luggage carriers. This is a convenient way of mounting the loop on the auto top for a "fox hunt." The loop may be removed between hunts without any damage to the finish of the car. It is advisable to spray the loop with a weather-resistant coating after it is completed.

This little loop is small enough to be operated within the car and reasonably true bearings may be obtained through the windshield (without center post) when the car is pointed in the general direction of the "fox." Of course, more accurate bearings may be obtained with the loop held out an open window and the signal coming toward the side of the car.

When using the loop on the roof of the car, it will usually be found that an approximate bearing can be taken simply by weaving the car down the road — a complete circle isn't necessary. (Naturally, such a maneuver should be executed with due consideration for traffic conditions!)

Operation

There are several general considerations involved when using this or any other loop. First, the loop must be balanced. To check this, the two nulls should differ in direction by 180 degrees. If not, the loop is unbalanced and should not be trusted.

[3] Short, "Automotive Radio Noise Elimination," *QST*, April, 1952.

Second, the residual signal must be reduced to less than the null when using the loop. Otherwise, one will get broad nulls or perhaps no null at all. The author found that the 29.6-Mc. signal was coming in on the b.c. antenna lead to the receiver in such strength as to make very poor nulls. Disconnecting the b.c. antenna lead during the "fox hunt" did the trick. Of course, ignition noises must be reduced to a negligible value. It is assumed that this is already accomplished as part of the mobile installation.[3]

Third, an S-meter is very helpful, and more reliable than the human ear when taking bearings. The author found that simply connecting a 20,000-ohms-per-volt voltmeter across the a.v.c. bus was sufficient to disable partially the a.v.c. as well as to give good meter indications of signal strength.

Finally, one should drive with caution and observe all traffic rules when engaged in this most fascinating aspect of mobile radio. An assistant should always handle the d.f. gear. Happy "Fox Hunting."

Strays

W2CPG counts eighteen hams, including himself, among the inhabitants of a four-square-block section of Brooklyn. Woe unto the bird who shows up with clicks or splatter.

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The accidental death of Herschel C. Griner, W6JKB, as a result of monoxide poisoning, points up a particular need for caution in amateur mobile work. W6JKB succumbed while working on his mobile gear with the car's engine running in an insufficiently ventilated garage.