Loop and tuning unit mounted on author's sedan. Supporting braces toward rear are of aluminum tubing, which must be insulated from the loop.

The MABAL Antenna

Mobile All-Band Amateur Loop

BY WILLIAM S. BRIDGES,* K1KLM

An interesting and effective application of the "Army"-type loop antenna, for increased efficiency and convenience in mobile operation.

In common with most other mobile operators, the author has never been quite satisfied with the performance of the loaded-whip antenna, in respect to either performance on the lower-frequency bands, or facility in changing bands. Therefore, an article that appeared in a recent issue of *Electronics* describing a loop-type antenna[1,2] was of more than passing interest.

In attempting to apply this principle to a mobile installation, the chief difficulty was in solving the mechanical problems. It was obvious that vertical mounting of a loop of such size on a car was impractical. However, it was reasoned that, since such a loop is essentially non-directional, it should work in a horizontal position. Accordingly, several models were built and tested. The final arrangement is shown in the photographs.

Although 75-meter operation was the prime objective, it was found that the loop could be resonated, and a match to 50-ohm line obtained, at frequencies from 2.8 to 7.3 Mc., and from 14 to 22 Mc. with the matching and tuning values available. It was also found possible to extend the operation to as high as 30 Mc. with an s.w.r. not exceeding 3 to 1.

Careful comparisons made by rapidly switching between the loop and a conventional center-loaded whip invariably have shown the loop to be better by 6 to 10 db. In some instances, fixed stations have reported an improvement of as much as 18 db. No directional characteristics are apparent.

In spite of its size, the loop has some physical advantages over the whip. It is possible to drive directly into the garage without having to get out to telescope a whip. (However, an encounter with a car-washing machine is not recommended!) The loop-type antenna also lends itself well to installation on station wagons and panel trucks where whip antennas often present problems.

Control Circuit

As shown in Fig. 1, the loop is fed with a capacitive network. The balanced network suggested by Patterson was tried. Although the loop could be tuned to resonance with this configuration, signal reports were down. (I suspect that this may be a result of some capacitive effect between the car body and ground.) The fixed capacitors used are some that I happened to have on hand. The Vitramon capacitors had been tested earlier and found to be capable of handling the necessary r.f. current. Transmitting-type mica capacitors would probably be equally satisfactory, although they take up more space.

To make adjustment of the antenna compatible with the flexibility of the multiband

*547 Bishop Drive, Orange, Conn. 06477.

[1] Patterson, "Down-to-Earth Army Antenna," *Electronics*, Aug. 21, 1967. This antenna was also reported in *QST* for March, 1968.

[2] The advantages of loop-type mobile antennas have been pointed out by other amateurs in past issues of *QST*, e.g., W4IBZ (Feb., 1951), W4TKL (July, 1953), and W4IMM (June, 1954).— *Editor.*

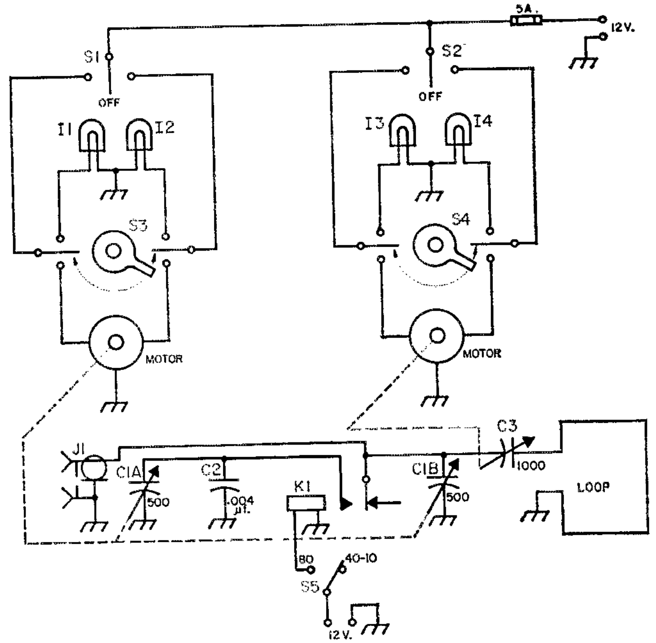


Fig. 1—Wiring diagram of the remote tuning system for the mobile loop antenna. If desired, relay-contact connections may be altered to connect in the 80-meter padding in the unenergized position.

C_1—Dual t.r.f. variable, approx. 500 pf. per section.
C_2—Parallel combination of fixed capacitors. These capacitors must be capable of carrying significant r.f. current. The combination used by the author consists of two 500-pf. 20-kv. ceramic TV "doorknob" capacitors, and two 1500-pf. 500-volt ceramic capacitors (Vitramon) in parallel.
C_3—Same as C_1, sections connected in parallel.
I_1-I_4—12-volt indicator lamp.
J_1—Chassis-mounting coaxial receptacle.
K_1—12-volt d.c. d.p.s.t. relay, 25-amp. contacts, poles in parallel.
S_1, S_2—S.p.d.t., center off, spring-return lever switch (Switchcraft 3033, nonlocking, suitable). Each may be replaced by two momentary-contact push-button switches, one button for forward, and one for reverse.
S_3, S_4—Limit switch (included as part of motor). Motors are available from Electro Sales Co., 356 Mystic Ave., Somerville, Mass. 02145, Stock No. M4012EVB3 ($9.50 each). These are actually 28-volt motors, but operate very satisfactorily at 12 volts.
S_5—S.p.d.t. toggle switch.

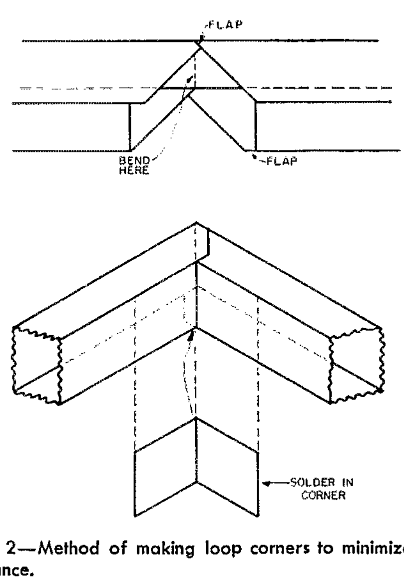


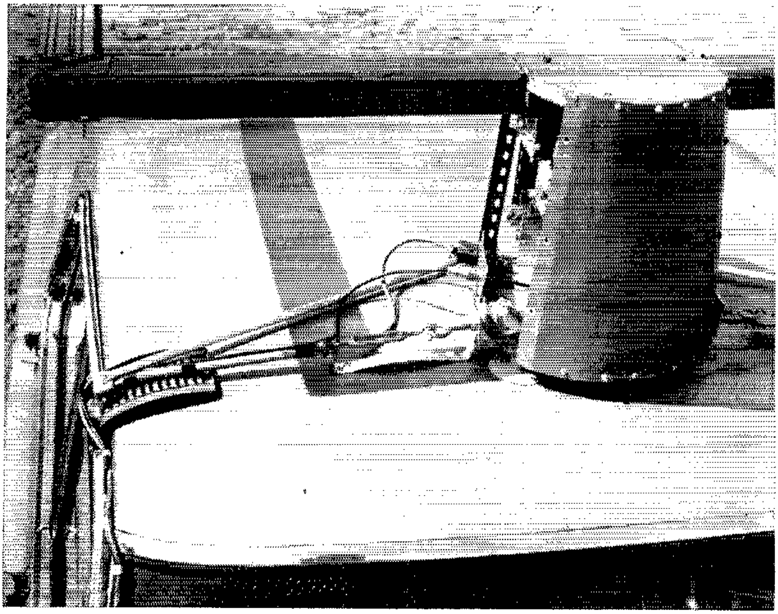
Fig. 2—Method of making loop corners to minimize resistance.

transceiver used, it was decided to provide for remote operation of the tuning and matching capacitors from the driver's seat. This was accomplished by using small motors (surplus aircraft control actuators) to drive the two multisection variable capacitors, C_1 and C_3. A relay is used to switch in additional capacitance (C_{1A} and C_2) for 75-meter operation.

The motors used have built-in limit switches. These switches can be adjusted to limit rotation to anything between 45 and 180 degrees. When rotation has reached the limit for which the switches have been set, rotation in that direction ceases automatically, and a lamp (I_1-I_4) lights, signifying that the limit has been reached. Adjustment is monitored by means of an s.w.r. meter permanently installed in the coax line, while a field-strength meter is used for output indication.

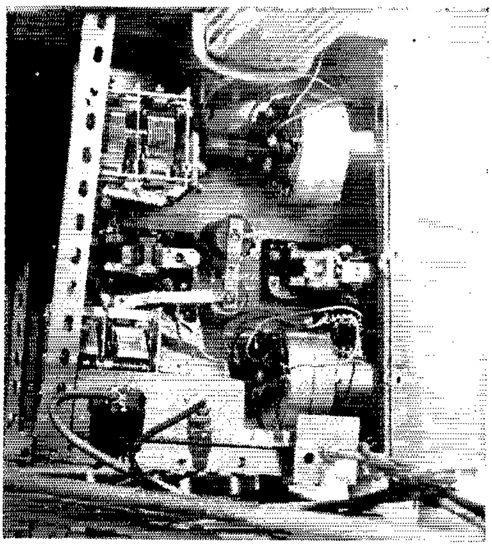
Construction

The importance of low r.f. resistance in the loop circuit was stressed by Patterson. In constructing the mobile loop, both aluminum TV



This view shows the general construction of the tuning-unit housing, and the manner of fastening it to the roof of the car. One side of the loop feed point may be grounded; the other side must be kept insulated from ground.

masting and plain rectangular aluminum down-spouting were tried initially. However, both presented difficulties in achieving reliable low-loss joints. In the final and most-satisfactory model, copper-plated aluminum down-spouting was used. This material has the advantage that it can be readily soldered for good low-loss joints.



Interior of the tuning unit, showing remote-control motors coupled to the variable-capacitor shafts. The original motor covers have been removed. The shaft coupling must be insulated for at least C_3. The 80-meter relay and padding capacitors are at left center. The relay at right is for the insertion of additional capacitance for future expansion to 160 meters. Notice the insulating sheet between the loop feed-point ends at the top of the photograph.

The dimensions of the loop used by the author are approximately 4 feet wide by 8 feet long. The downspouting comes in 10-foot lengths, so three lengths are required. To minimize r.f. resistance, it is advisable to make the loop with as few joints as possible. The corners should be made as bends in the downspouting, as shown in Fig. 2, rather than to attempt to join two pieces together at this point. The two rear corners should be made by bending a single length of downspouting approximately 3 feet from each end. All joints should be made watertight by the generous use of solder and patching plates (not to exclude water, but to assure maximum electrical contact).

The housing for the tuning unit was made of sheet over plywood top and bottom pieces fashioned to teardrop shape. All connections in the unit should be made with the shortest possible lengths of heavy copper braid, or wide copper strap.

Adjustment

Tuning is simply a matter of adjusting the two variable capacitances for maximum output as indicated on the field-strength meter, and minimum s.w.r. as indicated by the s.w.r. meter. Segments of about 50 kc. can be covered on 75 without readjustment of the tuning or matching. By making slight readjustments, an s.w.r. of 1 to 1 can be maintained across the entire band.

In conclusion, I would like to thank all those who assisted in testing and evaluating the antenna, especially WA1BHU, and also my wife, Penny, for her patience and understanding.