medium-power toroidal antenna tuner

Design and construction of a compact antenna tuner that will handle up to 500 watts

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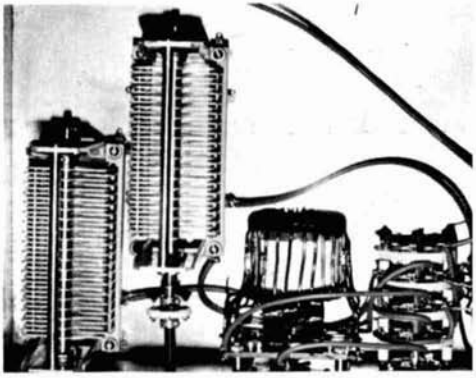
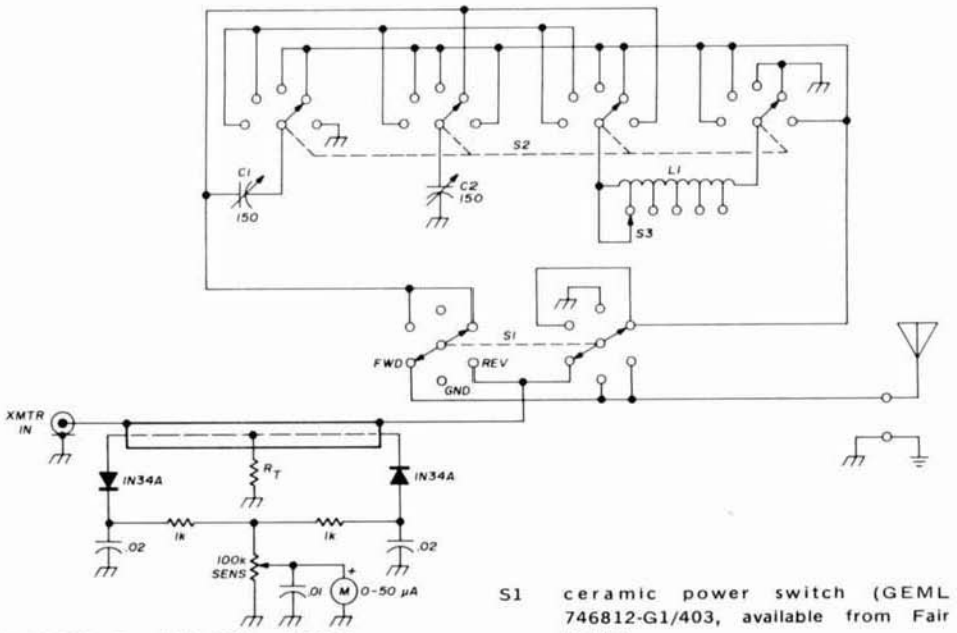
Though numerous designs have been presented for antenna tuners, most are anything but simple and convenient to use. Moreover, the tuners described for limited space applications are themselves often far from compact.

The antenna tuner described here overcomes these problems by attacking the primary culprit — the inductor. Designs using plug-in, rotary or clip-tapped inductors are superseded with the use of a switch-tapped toroidal coil, thereby substantially reducing space requirements and the inconvenience of bulky tap connections. The circuit is based on the recommendations of W2EEY,[1] and provides matching to random length wires. An indicator is included for "hands-free" tuning.

The coupler provides nine different circuits using two capacitors and one coil (see **fig. 2**). Configurations A through E are provided by switch S2, and the forward/reverse function is accomplished by switch S1. The different circuit arrangements provide for a variety of impedance-matching situations.



Closeup of the matching network components in the toroid antenna tuner. Variable capacitors C1 and C2 are to the left, toroid inductance L1 is to the right.



C1,C2 150-pF variable (Millen 12515)

L1 24 turns no. 12 Formvar wound on two Amidon T-200-2 cores, tapped at 4, 6, 8, 10 and 12 turns (see text)

R_T same resistance as load, 50 ohms for most amateur systems (see reference 2)

S1 ceramic power switch (GEML 746812-G1/403, available from Fair Radio)

S2 4-pole, 6-position, non-shorting rotary switch (CRL 2553)

S3 12-position tap switch (JBL Inst. 240 type BPBN-1-RA-83-3Z9825-40.2, available from Fair Radio)

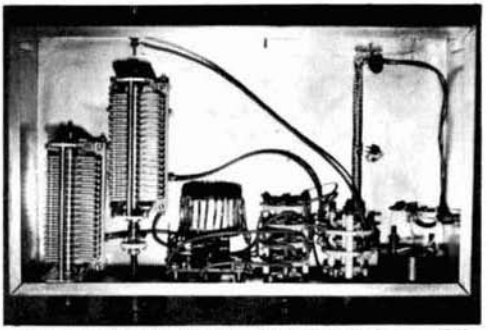
fig. 1. Schematic diagram of the toroid antenna tuner. This tuner will handle up to 500 watts CW without arcing, and is designed primarily for matching long-wire antennas from 80 through 10 meters.

construction

Building the toroidal antenna tuner is relatively straightforward. The toroid is the most unusual part of the circuit and consists of two Amidon T-200-2 toroidal cores epoxied together. The entire surface of each of the toroids is covered with epoxy to prevent flashover from the coil to the cores. Spacers of 1/4-inch polystyrene are then cut out as shown in **fig. 3** and glued to the ends of the dual toroid.

When the epoxy has cured, the wire may be wound on the toroids – 24 turns of number-12 Formvar-insulated wire are required. Care should be taken not to flex the wire more than necessary, as this will work harden the wire. Also, the neater the job, the less likely you will have arcing problems in the finished tuner. Leave enough wire at each end to secure the coil to the tap switch.

The tap leads from the coil are connected before the coil is wired to the



Construction of the toroid antenna tuner. All components are mounted in a small aluminum chassis.

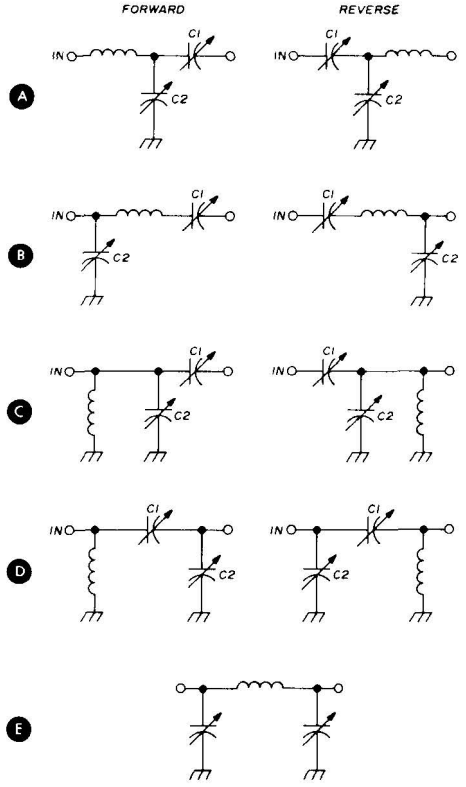


fig. 2. Different matching network arrangements possible with the antenna tuner shown in fig. 1.

switch. Beginning after the first 4 turns, taps are connected every 2 turns, for a total of 12 leads, including those at each end of the coil. To connect the taps, scrape away the insulation on the proper turn on the outside of the coil between the spacers. Another piece of number-12 wire with a clean end is then wrapped to this point with several turns of small gauge wire. Then the connection is soldered.

When the tap leads are all connected, the coil may be wired to the switch. The first contact is left blank, and the second contact connects to the first tap after the initial 4 turns on the coil. The wires are connected around, in turn, and support the coil. The wiper should be connected to the end of the coil with the 4-turn tap.

The capacitors were obtained, in new condition, from a surplus A-27 Phantom Antenna unit.* These units also supplied the ground and antenna binding posts, which are more rugged than most. Note that one capacitor must be fully insulated from ground.

Since the forward/reverse switch provides 3 positions, the center position is used to ground the antenna when the equipment is not in use. A dummy load might be connected to the input side in this position to provide a tune option.

The swr indicator shown in **fig. 1** is a modification of an earlier design.[2] I used a pickup braid 8-inches long to give significant indication in the transmitter tune-up position. The sensitivity control used was a subminiature type, but a front-panel adjustment would be more satisfactory. The indicator portion of the tuner should be shielded to prevent possible rfi effects.

The tuner could easily be built into a small enclosure. Front panel space is the main limitation on compactness. The finished unit is capable of handling 500 watts CW without arcing. Using a long-wire antenna of sufficient length, the tuner will easily match transmitter outputs from 80 through 10 meters.

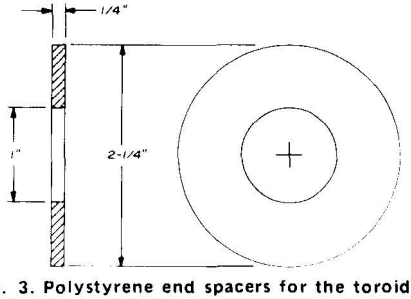


fig. 3. Polystyrene end spacers for the toroidal core (see text).

references

1. John J. Shultz, "Random-Length Antenna Couplers," *ham radio,* January, 1970, page 32.
2. Gregory P. Widin, "SWR Bridge," *ham radio,* October, 1971, page 55.
3. E. L. Klein, W4BRS, "The Whole of the Doughnut," *73,* June, 1967, page 6.

ham radio

*A-27 Phantom Antenna units, used, are priced at $2.95 plus shipping (3 pounds) from Fair Radio Sales Co., Post Box 1105, Lima, Ohio 45802.