A Multiband Trap Dipole Antenna System

This easily-constructed HF antenna system is a perfect combo for use with portable rigs.

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It's been said, "there's nothing new under the sun," and so it is with this antenna system—its basic design dates back more than 40 years. What's unique about this antenna, however, is that it's a complete system, including a matching unit that I've found ideal for use with the newer compact HF rigs that do not include a built-in tuner (Kenwood's TS-50, ICOM's IC-706, etc.). And it's easy to build using components and parts which you should be able to locate at your local hardware store and/or in your junk box.

Trap dipoles

I've built several trap dipole antennas over the years, but the design that's worked best for me is that originally described by C. L. Buchanan and subsequently modified by Arthur Greenberg a number of years ago (see Bibliography). It used a single pair of traps resonating somewhere around 7.2 MHz to give "five-band" coverage, and this basic design, or some modification of it, has been carried for many years in various handbooks and antenna manuals. I've further modified this original design to use coaxial-cable traps in place of the open-wound inductor style originally used, to make the antenna a bit more rugged. **Photo A** shows the construction details of the traps I currently use.

While the original traps worked fine, but turned out to be high-maintenance items. No matter how well I tried to shield them, water invariably found its way in. Also, the originals, having a somewhat larger diameter, were good wind-catchers, which caused the antenna to come down a lot—usually resulting in something getting broken, like one of the ceramic capacitors. This type of capacitor has proved to be somewhat hard to find, and is usually expensive when you *do* find one. Since changing to coaxial cable traps, I've had a version of this antenna up for several years without having any of these problems.

"A multi-tapped coil, selector switch, variable capacitor, and a couple of coax connectors are all the components needed to build this L network."

Most trap dipole antennas represent a compromise over a full-length antenna, either in terms of bandwidth or performance, or both. This antenna by itself really worked satisfactorily on 40 meters and on a portion of the 80/75 meter band. Operation on other bands and/or full 80/75 meter coverage really requires the use of some type of matching unit. Previous rigs I've used having internal tuners worked fine, generally managing to load the antenna even on WARC bands. Since acquiring a TS-50, I needed some kind of external matching unit in order to use this antenna effectively, but I didn't want to use some big, bulky, or expensive tuner—thus the L network. **Photo B** is a picture of the L network matching unit I came up with.

L networks

L networks have been used as effective matching devices for a number of years. Their popularity fell off some during the heyday of TVI, however, because an L network's attenuation of harmonics or other spurious signals is not as good as that of a Pi or T network. From a simplicity standpoint, though, an "L" is hard to beat. Also, newer rigs typically use well-designed bandpass filters that do an excellent job preventing radiation of harmonic signals, making this shortcoming somewhat less of a concern.

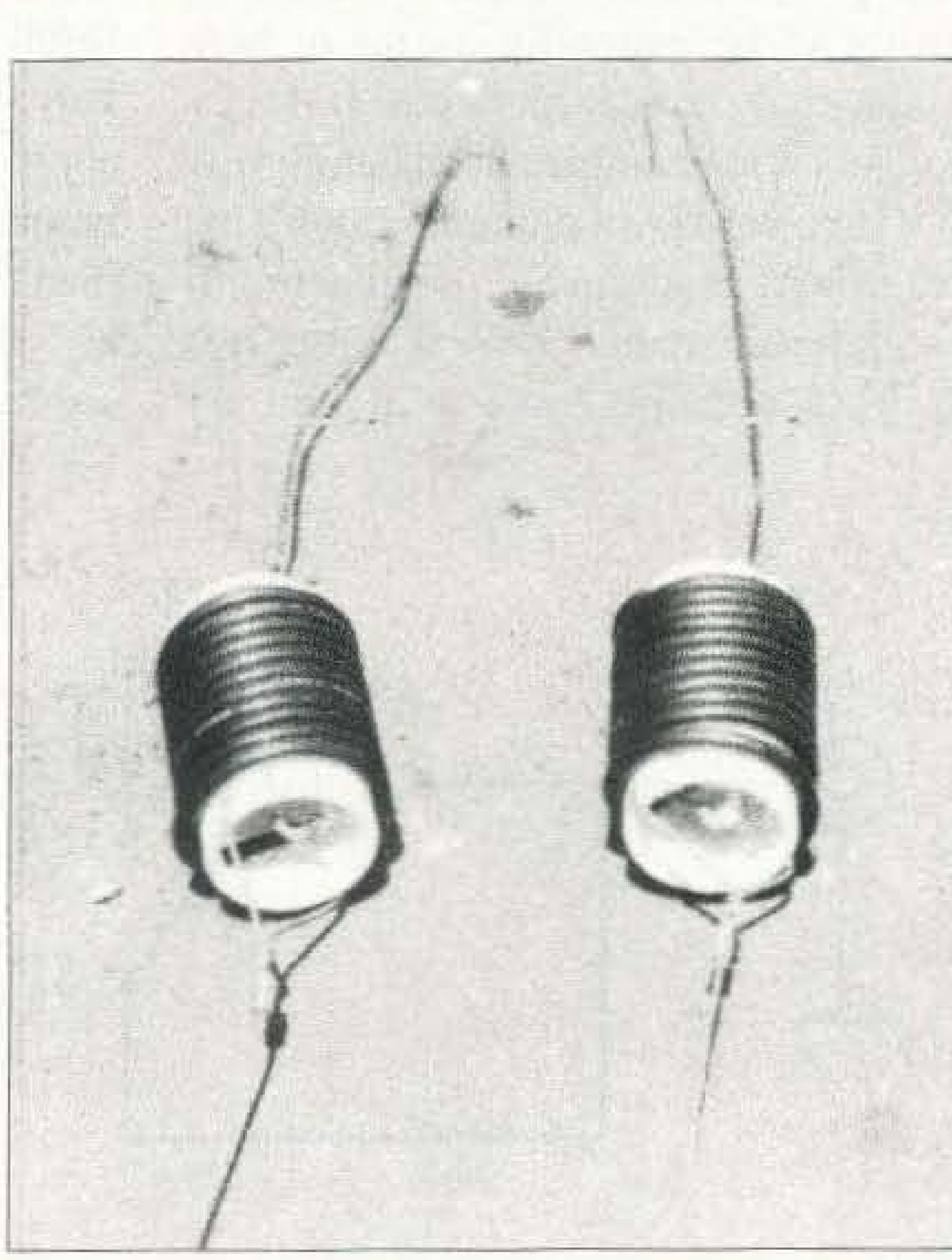

***Photo A**. Coaxial cable trap construction details.*

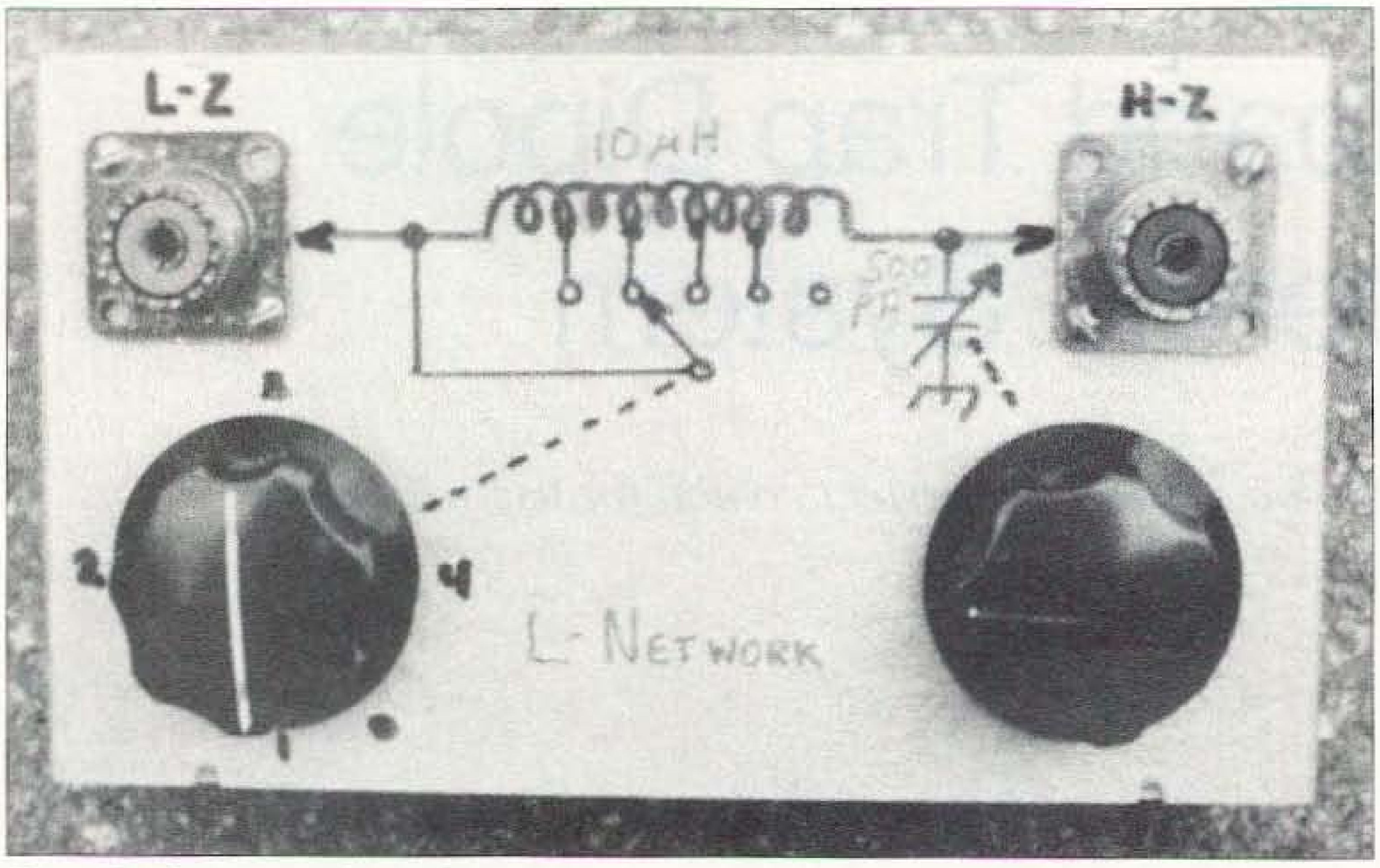

Photo B. The L network matching device.

The unit I use is small (see **Photo B**), measuring just 2" x 3" x 5", so it works quite nicely for portable operation. L networks can be arranged in a series/shunt (or shunt/series) fashion using capacitor-capacitor, inductor-inductor, or inductor-capacitor arrangements. The configuration I used has a series inductor with a shunt capacitor (see **Fig. 1**). This style permits matching low impedances to high when connected normally, and high to low when reverse-connected. L networks are bidirectional in terms of input and output, which makes them extremely useful in a variety of matching applications.

While originally intended for use with my trap dipole, I've since found this L network to be generally useful in both portable and mobile operation. It does a good job, for example, in matching my TS-50 to a variety of antennas, including random wire types and a mobile whip. If I can't find a match with it connected one way, I simply reverse it and try again. However, 75 meter mobile operation does require use of an additional base loading coil.

Building the L network

As shown in **Photo C**, a multi-tapped coil, selector switch, variable capacitor, and a couple of coax connectors are all the components needed to build this L network. It's built in a mini-box enclosure similar to one available from Radio Shack (#270-238, which is 5-1/4" x 3" x 2-1/8"), and wired as shown in **Fig. 1**.

The inductor used was made from an available section of mini-ductor stock, but a custom-wound coil can be made using a 3" piece of 3/4" PVC tubing as a form. It should be 23 turns of #16 or #18 wire, spaced to fill the 3" form to give approximately 10 µH inductance. (Some brands of PVC tubing are more suitable than others for RF applications. A quick test can be made by heating a sample section in your microwave for 15 to 30 seconds. If the sample appears to have warmed appreciably, I'd recommend trying another brand. I'd also suggest using some technique other than touching the sample to determine if it has been warmed by the microwave—the wrong stuff could be *very hot!*)

For my matching network, a five-position ceramic switch was used to select five tap points on the coil. The tap points were distributed evenly along the coil every four to five turns to match the switch positions. A switch with more positions would be better, as finer inductance steps could be selected, but this one was available from the junk box. A suitable substitute would be the 12-position switch sold by Radio Shack™ (#275-1385). Using a switch like this would require tapping the coil about every second turn, but would give great incremental resolution.

The capacitor used is an old broadcast replacement type having a maximum capacity of around 500 pF. Capacitors like this are getting harder to find but show up frequently at hamfests. Should your junk box fail you, Antique Electronic Supply of Tempe AZ carries a capacitor similar to the one used here, as well as others, as standard catalog items.

"I've found this system ideal for use with the newer compact HF rigs that do not include a built-in tuner."

Another viable option for the required shunt capacitor would be using the 12-position switch previously mentioned to select a series of 50 pF fixed capacitors. This switch is a shorting type which would make wiring something like this fairly easy. Should you try this option, I would suggest selecting capacitors with 500-volt or higher ratings.

Constructing the antenna and traps

My original five-band antenna's traps used a pair of 5 µH inductors shunted with 100 pF capacitors. Since the overall length of a trap dipole is largely governed by the inductive component of the trap coils, I wanted to get as close to the original design parameters as possible because I didn't want to alter the antenna's size significantly (at just over

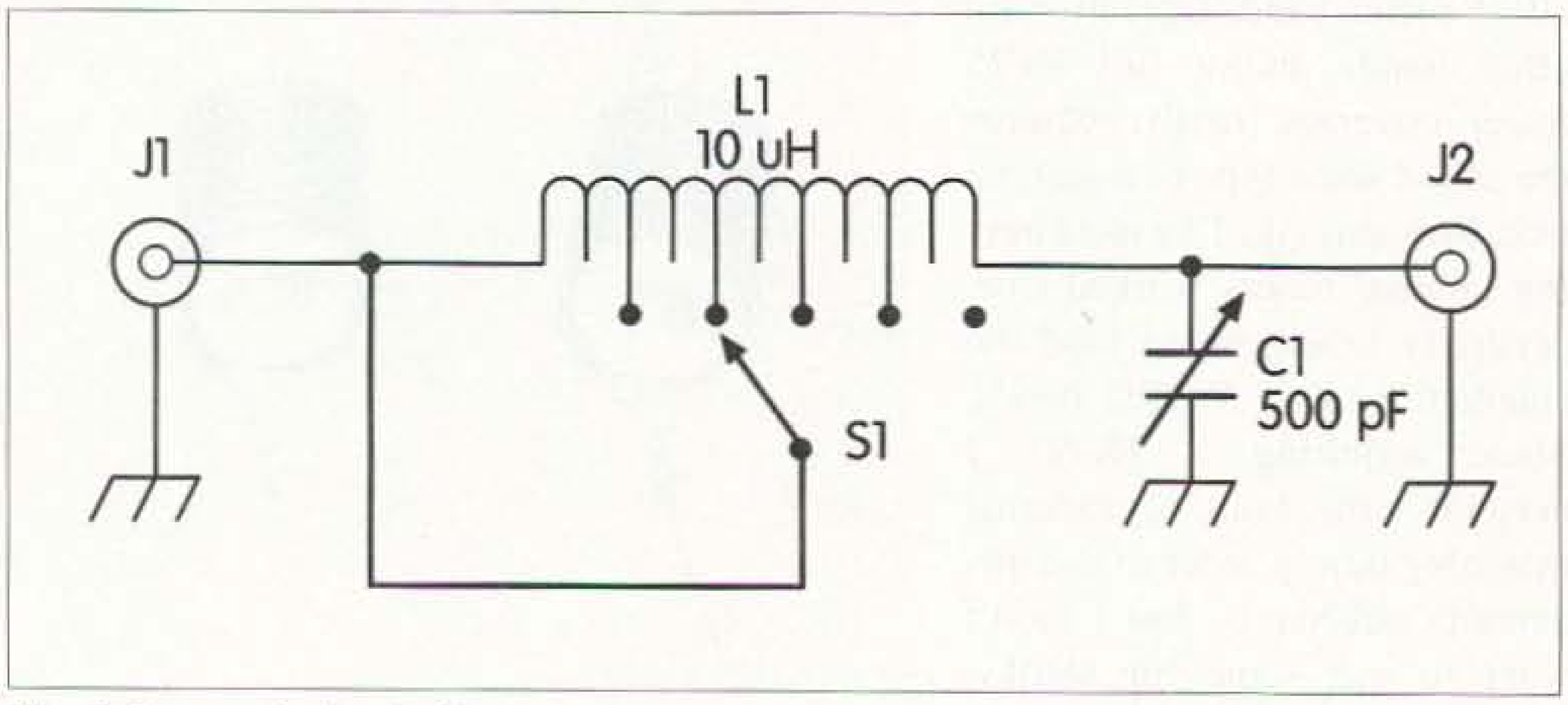

Fig. 1. L network circuit diagram.

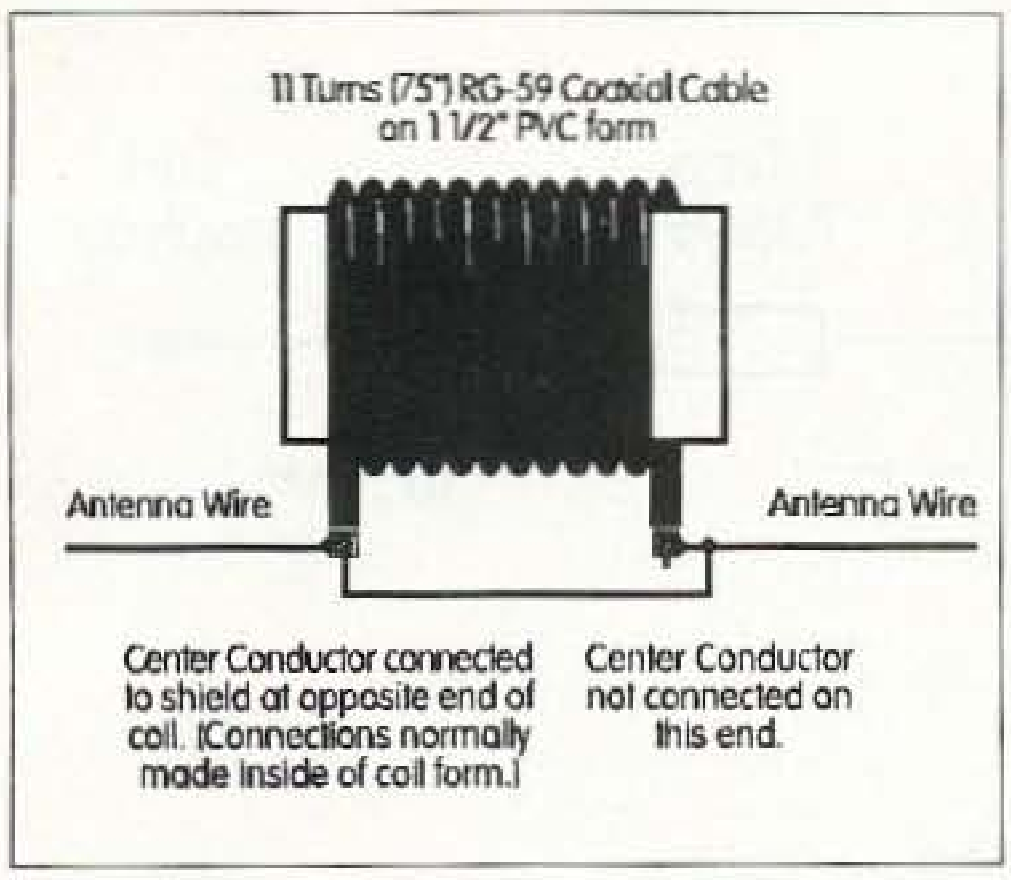

Fig. 2. A) Coax-cable trap circuit.

100 feet overall length, it fits nicely in the space I have available for it). With this objective and a desire to build traps with reasonable "Q," I chose RG-59 foam cable which has about 17 pF per foot as a good compromise for my new traps.

The traps are wound on a 1-1/2"-diameter by 4-1/2"-long PVC pipe forms which have a 2" outside diameter. I ended up using 75" of cable per trap in 11 close-wound turns to resonate near 7.15 MHz. This works out to approximately 100 pF and 5 µH, which is very close to the original design values and doesn't significantly affect my overall antenna length (or performance). **Fig. 2a** shows the trap circuit, and the construction details are shown in **Fig. 2b**.

After winding the cable on the forms, I drilled termination holes for the cable and wired the shield from one end of the coax to the center conductor of the other end, as shown in **Fig. 2a**. I then drilled two 1/8" holes, directly across from each other, at each end of the PVC form and ran some bare #12 wire through to form connecting points to tie the traps to the antenna wire. Finally, after soldering all connections, I sealed the coax cable ends with RTV sealant, coating everything completely to ensure that no water would get into the cable. **Photo A** shows details of the completed traps.

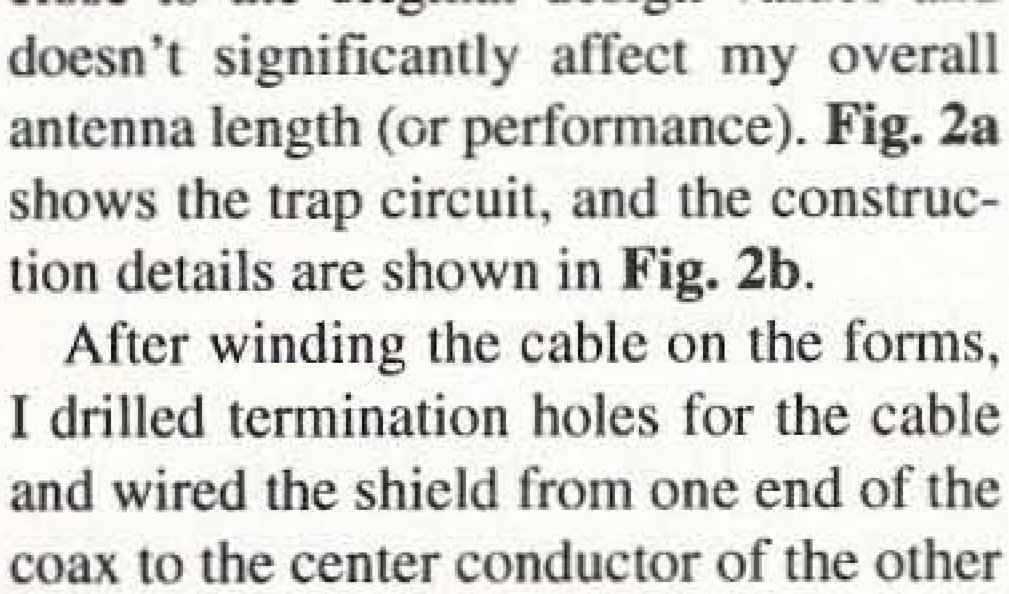

Fig. 2. B) Trap construction details.

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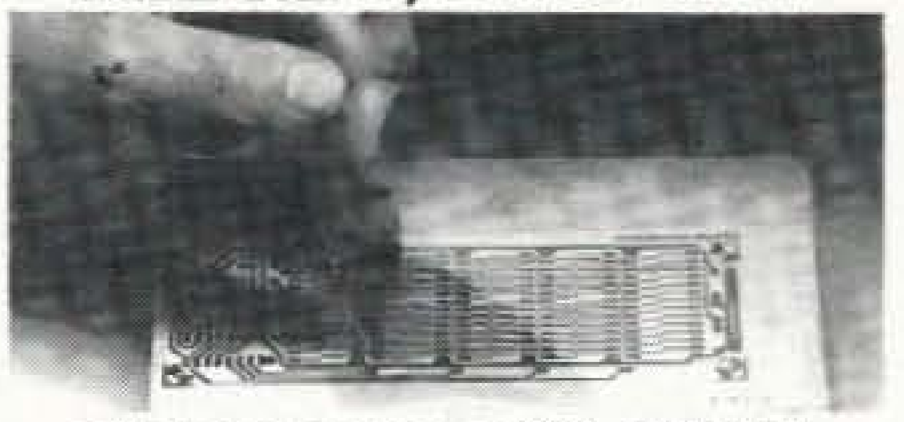

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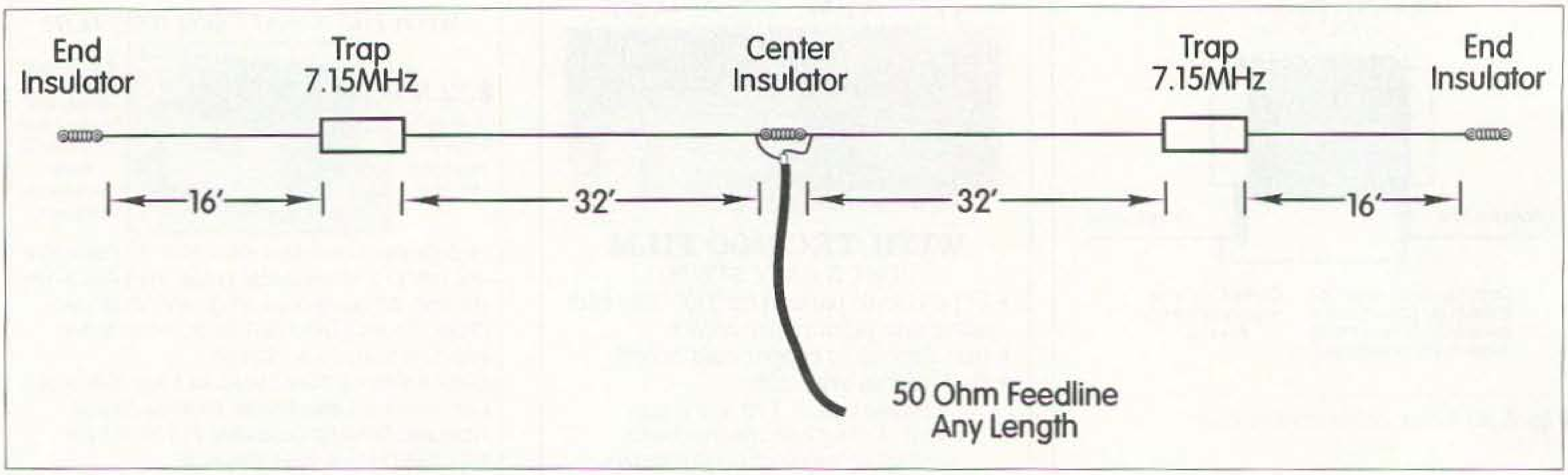

Fig. 3. Trap dipole construction details.

I originally intended to run egg insulators through the centers of my traps to provide strain relief, but I never got around to it. So far, the 1/8" holes in the PVC forms have not pulled out, and the antenna is still up, but using some type of strain relief is a good idea.

The antenna wire was attached to the traps using the dimensions shown in **Fig. 3**. I used #12 electrical wire with the insulation left on for the actual antenna wire. I typically buy Romex™ cable and strip it down to recover the individual wires. This stuff is cheap and makes good antenna wire.

I'm currently using RG-8 cable to feed the antenna, but I have used RG-58 or RG-59 (70-ohm) in the past with equally good results. In fact, the 70-ohm stuff is probably a better choice for this antenna, especially when using it with an L network matching device.

Tuning and operating

If this antenna is built using the dimensions shown and used with the L network described, no further antenna tuning should be necessary. Should you want to fine-tune it a bit, the 32' lengths (see **Fig. 3**) could be adjusted for resonance at 7.2 MHz or so, and the 16' lengths adjusted for your favorite part of the 80/75 meter band. If you have access to a grid-dip meter, you might also want to check the traps for resonance. However, I've built several sets of these traps and have found that when using 75" lengths of RG-59 cable (Radio Shack #278-1319), they always resonate where expected.

Having a built-in SWR indicator would probably facilitate adjusting the L network since my TS-50 does not include this metering function. I initially used an in-line meter with it until I became familiar with its operation. Now, I simply tune it for maximum output power as indicated by my TS-50's meter (relying on its SWR protection power cut-back circuitry). I generally use the 50-watt power level when tuning in order to offer some protection to the transceiver.

As previously mentioned, I've had this antenna and matching system for a few years now, and its performance has been excellent. I have on occasion had a full-length 80 meter dipole up, and in most instances my signal reports have been as good or better with this antenna system whenever I've made comparison tests. 73

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***Photo C.** L network construction details.*