BY KENT BRITAIN,* WA5VJB

Low-Profile Mobile Antennas

Over the years there have been many techniques for hiding antennas on a vehicle. One way back in the 1950s and '60s was to use the "curb feeler." As you can see in photo A, this was a flexible spring, much like a rubber duck without the rubber, and usually just one spring. The feeler was mounted on the passenger side of the car near the rear tire. The feeler would make a scraping noise as you parallel parked your car and let you know that any closer to the curb would scratch up your hub caps. You almost have to be over 50 to remember curb feelers, and I had a heck of a time finding one to photograph. However, back in the 1950s the Dallas Police used to replace the curb feelers on their unmarked police cars with a short antenna. They also used 450 MHz. Very few home receivers could listen to 450 MHz back then, so they were pretty good secret channels.

One hidden antenna that I have used on my van is the AM/FM radio antenna. Of course, these worked better in the days when you really had a whip out there, not conductive glass in the windshield. By adding a diplexing filter, the antenna could be used on 6 or 2 meters without the transmitter blowing out the AM/FM radio.

In photo B is a trunk hinge on my 1992 Tempo, but one Japanese auto manufacturer used to mount its trunk lid on plastic bushings. Now the entire trunk lid was electrically isolated from the car body, and it was the trunk lid that was used as the AM/FM antenna. Either the trunk or the hood could be used as an antenna with this technique.

Another hidden antenna used on some government vehicles is the trunk-lid gap in photo C. This is an antenna design we will be talking more about

*1626 Vineyard, Grand Prairie, TX 75052
e-mail: <wa5vjb@cq-amateur-radio.com>

Photo A– Remember curb feelers?

Photo B– Electrically-isolated trunk hinges.

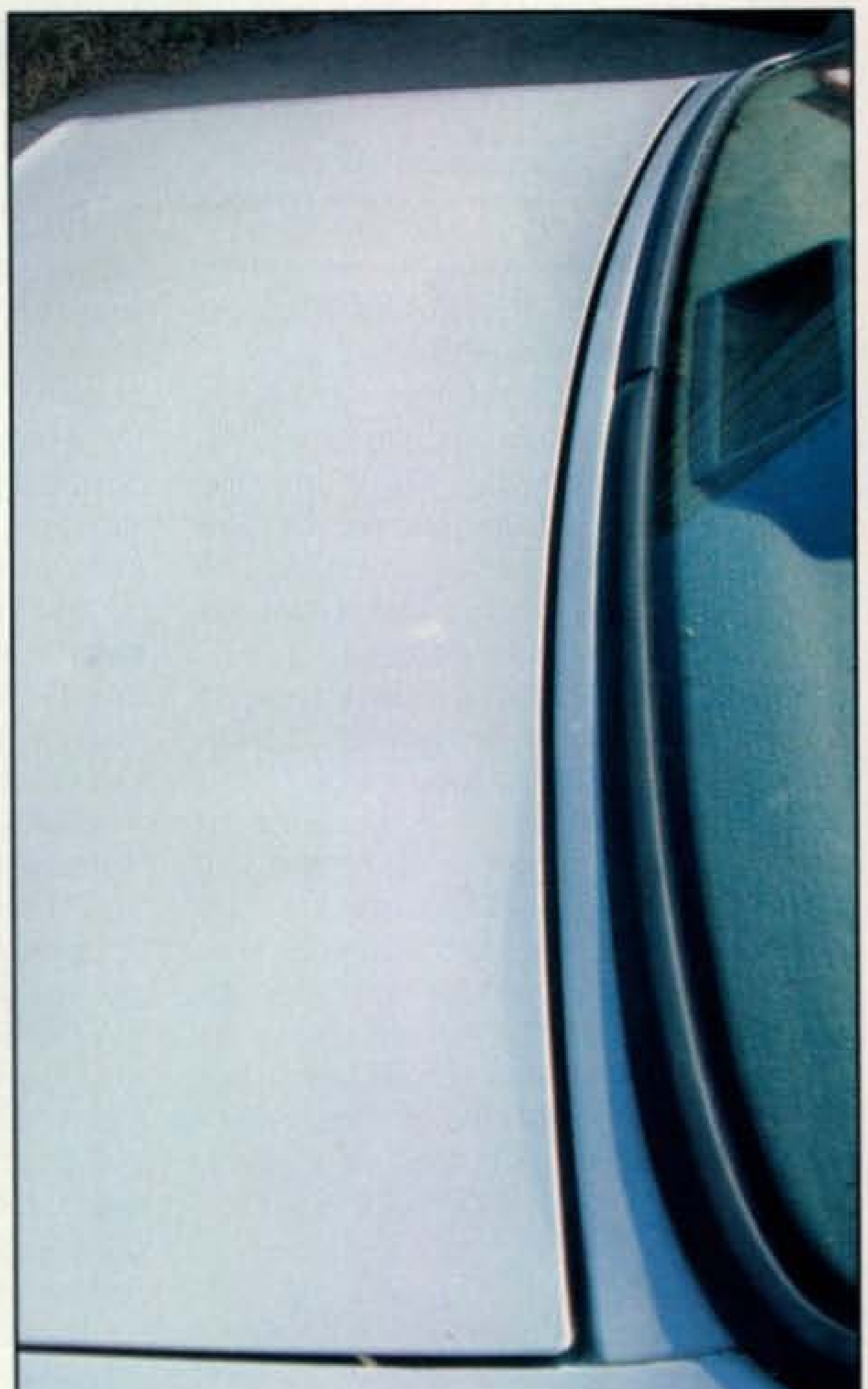

Photo C– Using parts of the vehicle as a slot antenna.

in coming months–the *slot antenna.* As shown in fig. 1, a dipole is a half-wave of electrical conductor in a large insulator. A slot antenna is a half-wave of *insulator* in a large *conductor.* Therefore, the gap between the trunk lid and the car body can be used as an antenna. The engine hood will work as well, but the trunk-lid gap is usually easier.

In this example, the coax is fed across the slot. The coax shield goes to the car body, and the center lead goes to the trunk lid. I have this one in the center of the slot, but you can also feed the slot off center. That is, the coax can be attached most anywhere along the slot, and the feed point can be optimized for your favorite band. Plan on using an antenna tuner to get the SWR down, but when you can design the slot instead of just using something that is already there, a good match without the antenna tuner is easy.

The extremely low profile of slot antennas also makes them very popular on high-speed aircraft. I also took advantage of the low/zero profile of a slot antenna to design one for an ATM machine. Ever see an ATM machine at a sporting event or a concert? No chance to connect it to a high-speed network, so these temporary ATMs have a cell phone in there and calls in your card number and waits for an authorization. I came up with a dual-band slot-antenna design for both the 850 MHz and 1900 MHz cell-phone bands that just looked like the back of the ATM machine. You would need a few minutes with a sledge hammer to vandalize that ATM's antenna.

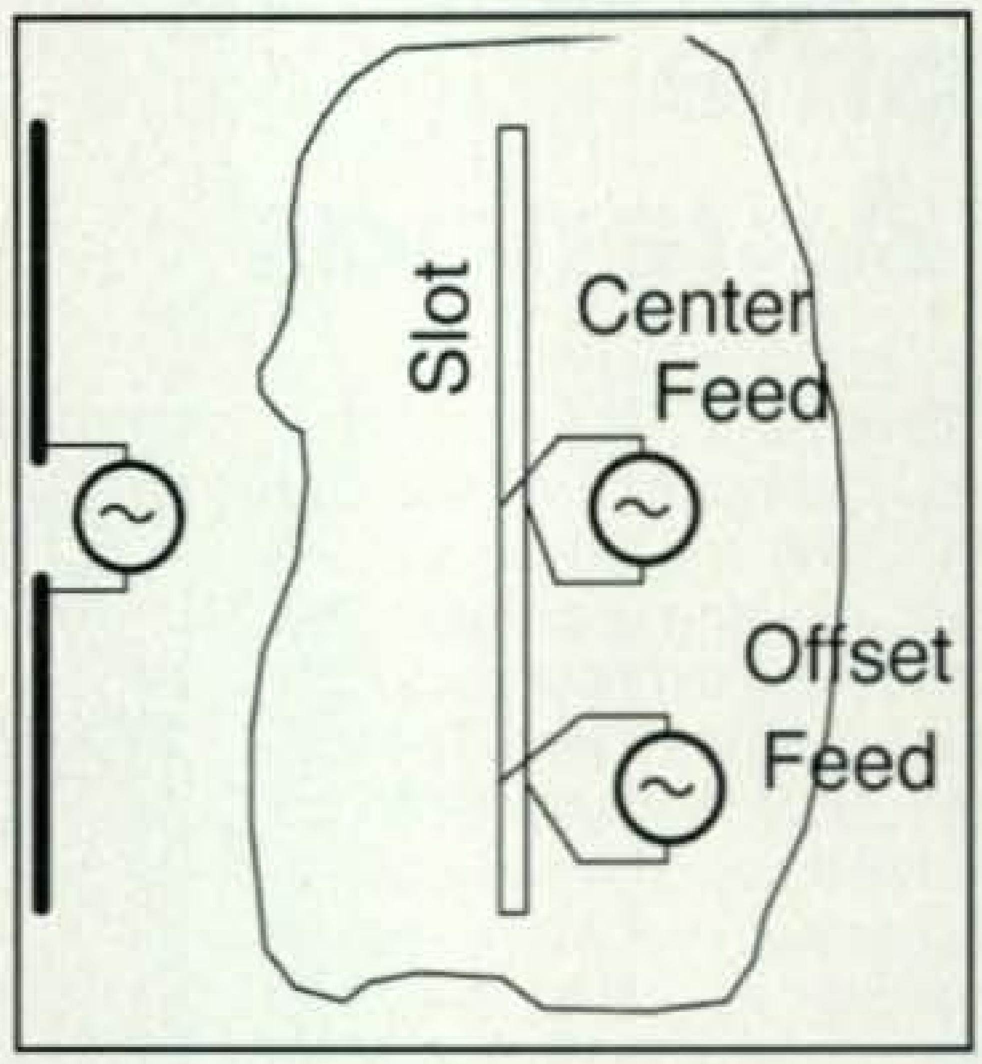

Fig. 1– Slot antennas and conventional dipoles.

Electrically Conductive Glass

Many electrical accessories are now being hidden in the glass itself. During manufacturing, a layer of tin oxide is layered on the glass. Tin oxide is electrically conductive and almost invisible all by itself. Next, the glass is reheated almost to its melting point. The tin oxide bakes into the glass, making an electrically conductive "frit" that is now just part of the windshield. Electric window-heater elements, AM, FM, cell-phone, and Bluetooth® antennas are now just part of the transparent glass and you are looking through your antennas. While fine for local radio broadcasts, I'm not sure I would want to pump 100 watts on 20 meters into that tin-oxide layer.

Does anyone know if they have successfully used these tin-oxide layers as the GPS antenna? I've never heard of anyone getting one of these tin-oxide antennas to work with GPS, and with the poor conductivity and poor placement, a GPS antenna would be quite a challenge.

I'm not sure if I would call the antenna in photo D a hidden antenna. This antenna is advertised as having lots of gain on the 800-MHz and 1900-MHz cell bands, and with a TNC coax connector it is not going to fit many cell phones these days. However, a quick frequency sweep showed it was resonant just below the 2-meter band, so a quick trim and it's now a 2-meter antenna. The tip is bent back as a safety precaution. It seems that just about any commercial antenna can be trimmed/pruned/modified to a ham band—not always the one you were hoping for, but if they are cheap enough it's worth a shot. That sounds like a good topic to expand on in a future column. RadioShack used to sell a CB antenna that looked like an early cell-phone antenna and these were easily retuned to 10 meters.

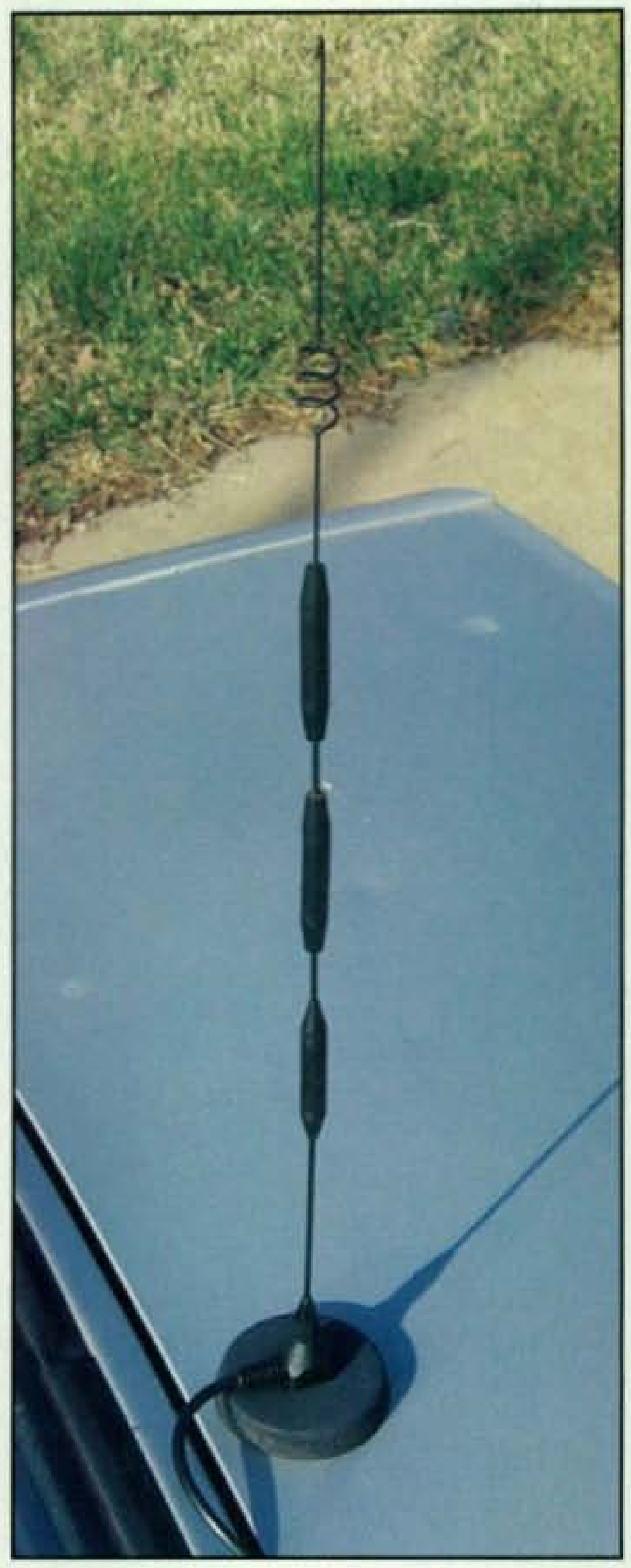

Photo D– Camouflage antennas.

Other Multiband-Vertical Techniques

With commercial ham verticals, one common way to make the antenna work on more than one ham band is with a "trap." As shown in fig. 2, a trap is just a parallel tuned circuit tuned to a ham band. At its tuned frequency, this trap looks like about a *10,000 ohm resis-*

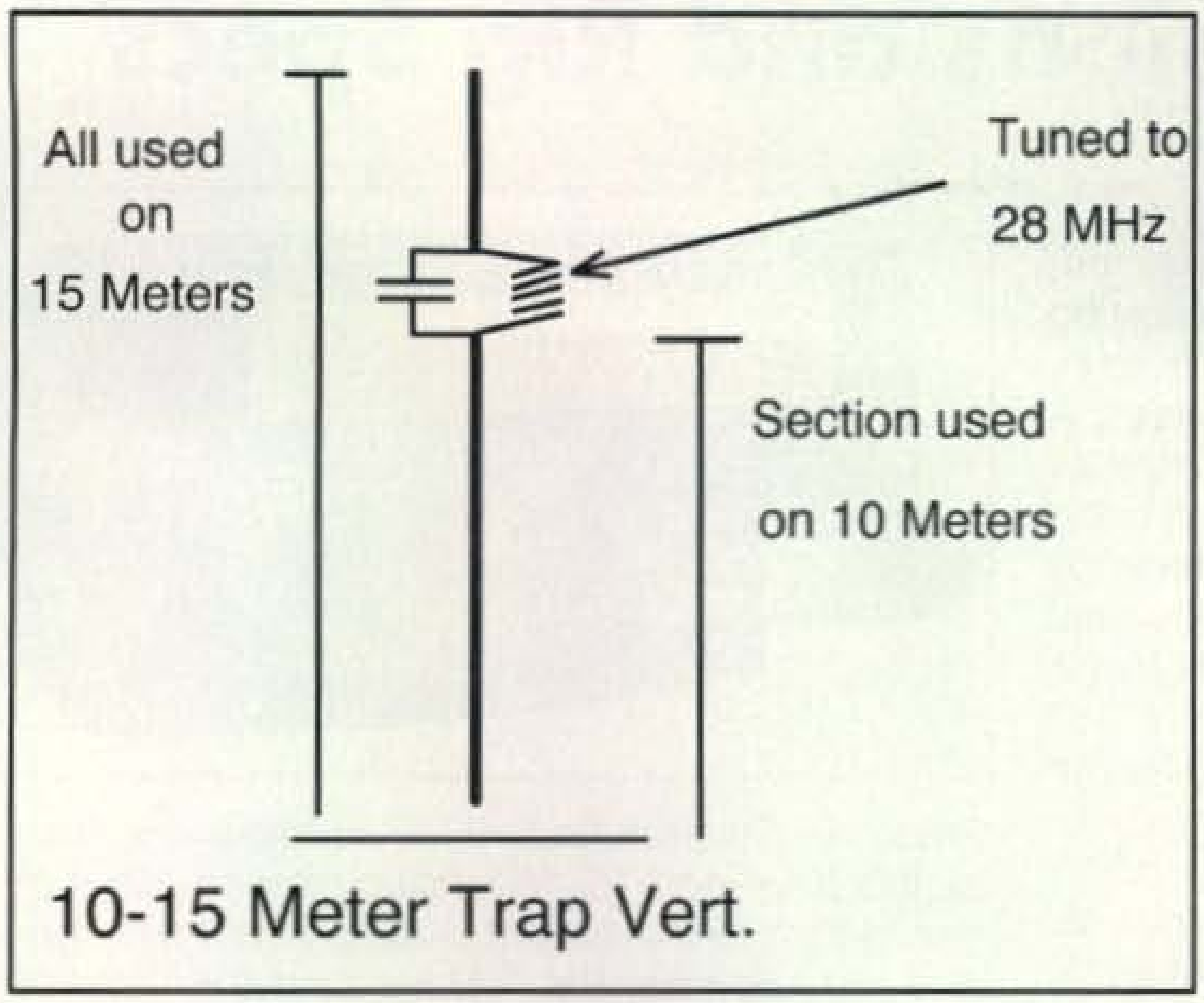

Fig. 2– Diagram of a dual-band trap vertical.

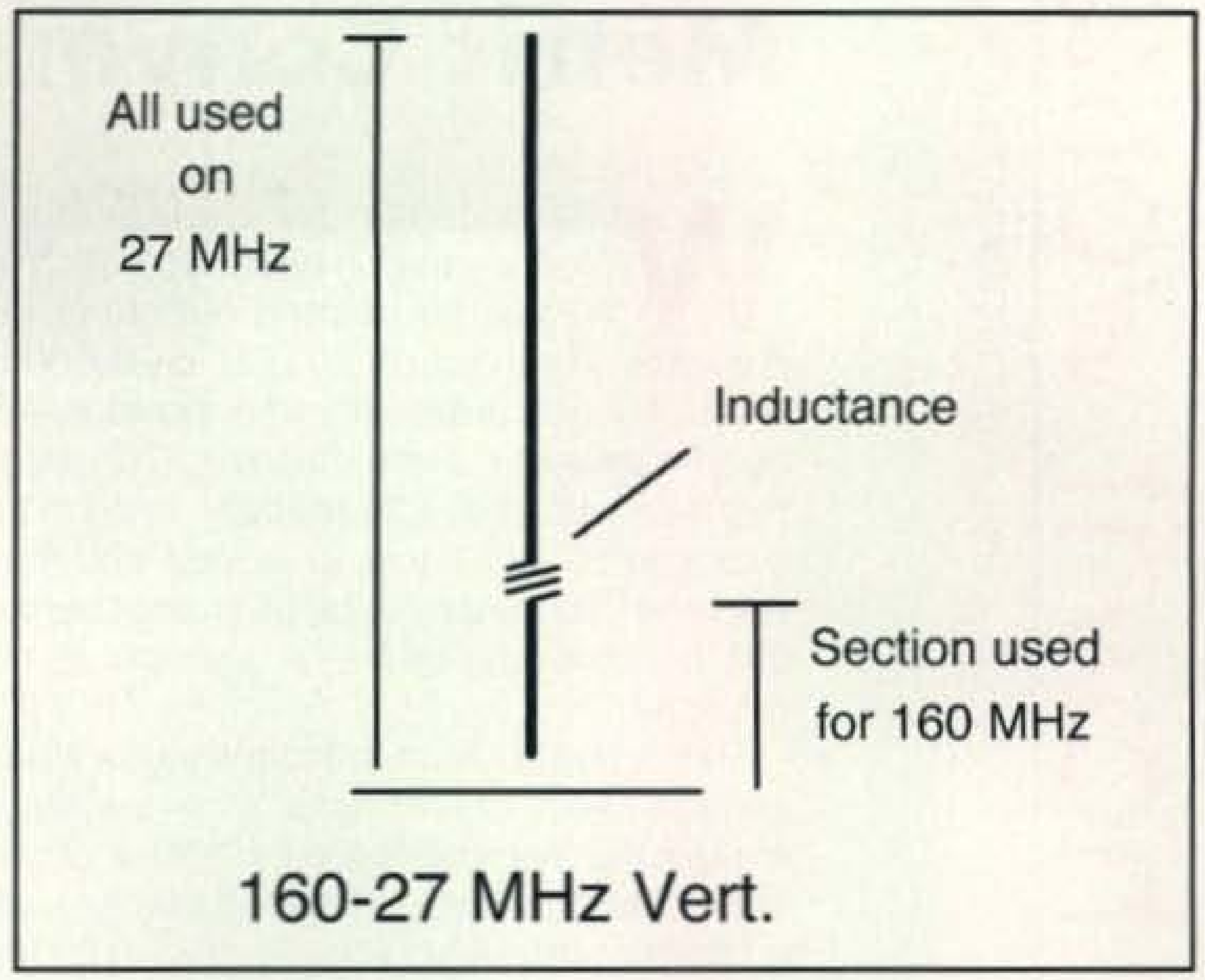

Fig. 3– Position of the band-separating inductor.

Photo E– Band-separating inductor.

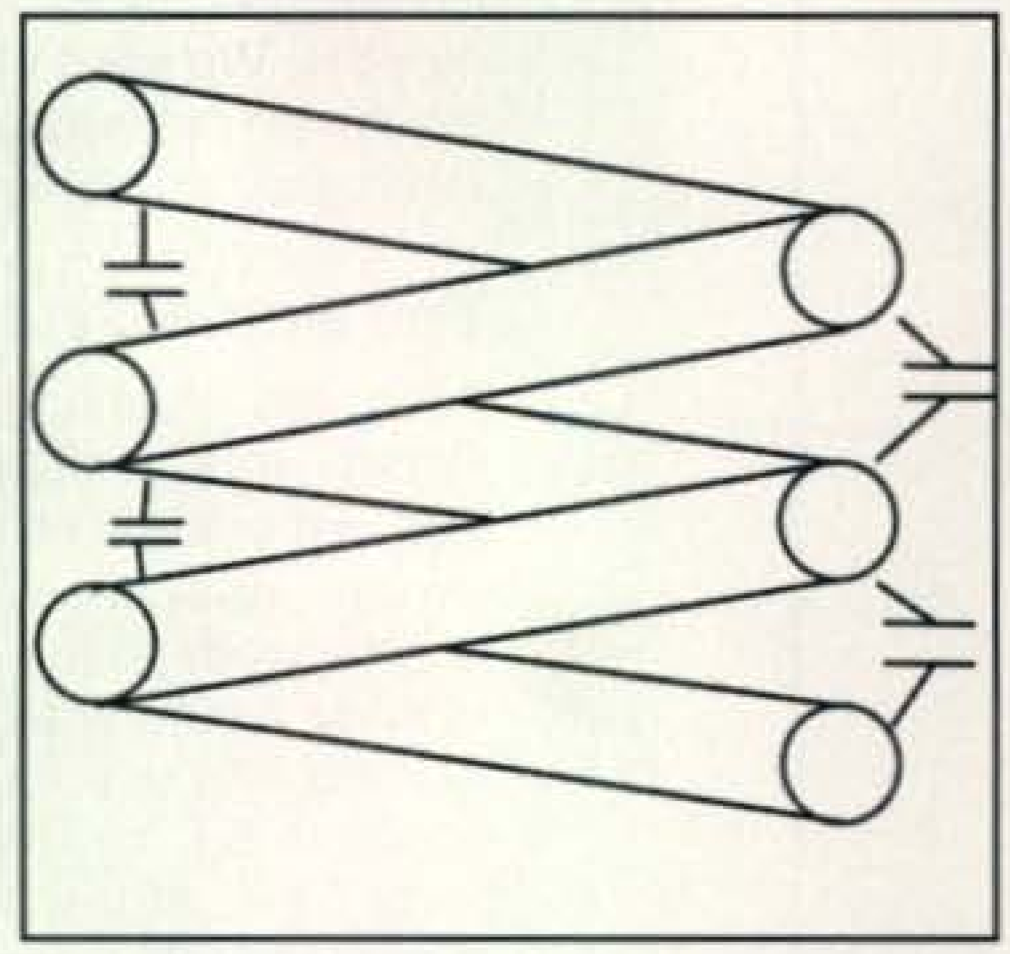

Fig. 4– Parasitic capacitance and self-resonance.

tance, or reactance, and keeps the radio wave from using the top part of the antenna. For those of you who can pick fly specks out of pepper, yes, that reactance is going to vary with the design and "Q" (Quality Factor) of the trap and where it is tuned in the band. For the rest of you, the trap looks like a very high-resistance, and the signal pretty much goes up to the trap and stops. The trap is tuned to one frequency; on lower frequencies the trap looks like an inductor or a loading coil. Thus, on the second band the antenna becomes sort of a center-loaded vertical using the coil in the trap as its loading coil.

Another way to add bands is to use just an inductance. I have used both a Hy-Gain 18AVQ and a Hustler 5 BTV on HF, and they used just inductance to separate the 40-meter and 80-meter bands. Using just inductance to separate bands works, but not if the bands are close together. So, while 40-, 30-, 20-, 17-, 15-, 12-, and 10-meter trap verticals are available, a 40-, 20-, 10-meter model would be about the best you can do using only inductors. I would be interested in hearing from any readers with experience in this area. There is a another effect at work here, though.

In photo E are a few turns of wire forming a band trap on a fiberglass rod antenna. In this case the coil gives the 27-MHz rod a 160-MHz resonance. As we mentioned last time, many CB radios today also have a 160-MHz weather-band receiver, and truckers often like to listen to local weather reports. By putting this coil about a quarter wave above the base, as shown in fig. 3, the antenna now has both a 27-MHz and a 160-MHz resonance.

Self-Resonance

In fig. 4 you can see how the wire itself forms a capacitor. Thus, any coil also contains a parasitic capacitor and at some frequency forms its own parallel resonant circuit. By putting just the right number of turns in this band trap, it is possible to make a tuned trap out of just a coil of wire. This is a bit trickier way to make a multiband fiberglass vertical than the aluminum-foil trick we went over last time, but easy to make in the thousands, especially with an automatic coil winding machine. Next time I'll show a combination of these two techniques to make a three-band fiberglass whip.

As always, we welcome your questions and topic suggestions. Just drop a snail mail to the address on the first page of this column or an e-mail to <wa5vjb@cq-amateur-radio.com>. For other antenna articles and projects, you are welcome to visit <www.wa5vjb.com>.

73, Kent, WA5VJB