Antennas & Things

BY JOE CARR, K4IPV

SIMPLE ANTENNAS AND ACCESSORIES FOR SIGNAL IMPROVEMENT

Glimpse of Heaven and Hell: The Rhombic Antenna

Many years ago, a ham radio publication had a humorist who wrote occasional articles (especially for the April issues!). In one article, he stated that his idea of heaven came in a dream. He was given a high hilltop location, with an HF rhombic antenna, a 2,000-watt SSB transceiver, and a massive rotator that rotated the hill (!?!) to point the rhombic wherever he wanted it. But, he averred, there was a down side to his vision of heaven...but more of that later.

One of my ham radio mentors from the late 1950s was a U.S. Army Signal Corps colonel, who also was a "big gun" ham radio DXer. He was stationed in Turkey in the 1950s, when that country did not allow ham radio operations. At a diplomatic reception, Dick met up with a friend who was Turkey's minister of communications, and obtained a license for a single amateur radio station, valid only for 24 hours of the weekend of the CQ World Wide DX Contest, with official permission to contact foreign ham stations. Dick had a U.S. Army 7.5-kW transmitter fed into a very long rhombic antenna aimed on the eastern United States.

He could put a bodacious signal stateside with that "rig." Dick fired up the transmitter, called CQ on the 20-meter CW band, only to be met with a storm of what today's Internet freaks would call flaming: "Off the air pirate!" It seems that everyone "knew" that there were no legal Turkish stations on the air, so anyone signing a Turkish call sign was a pirate operator ...and flamed him. Frustrated, Dick went to the 15-meter and 40-meter novice bands, and worked a bunch of newcomers who didn't know that Turkey was a "banned country"...and Dick saw to it that those novices got a proper QSL card! Revenge—even passive revenge—was sweet, he said.

The rhombic antenna (Fig. 1) gets its name from the fact that it is diamond-shaped, a pattern that is known in geometry as a rhombus. It is essentially a pair of front-to-front V-beams as discussed last time, with legs several hundred feet long (for coverage of the entire HF band). As with the unterminated long-wire and V-beam antennas, this antenna is resonant, and operates on both the fundamental frequency it is cut for, and its harmonics.

If the ends are left open, then the rhombic is a resonant antenna (Fig. 1); if it is terminated (Fig. 2) in its characteristic impedance (typically 400 to 800 ohms), then it is a non-resonant "traveling wave" antenna. The resonant rhombic, like the V-beam, is bidirectional along the line that bisects the end angles, while non-resonant rhombics are unidirectional. The direction of maximum radiation is toward the termination resistor, and away from the feedline.

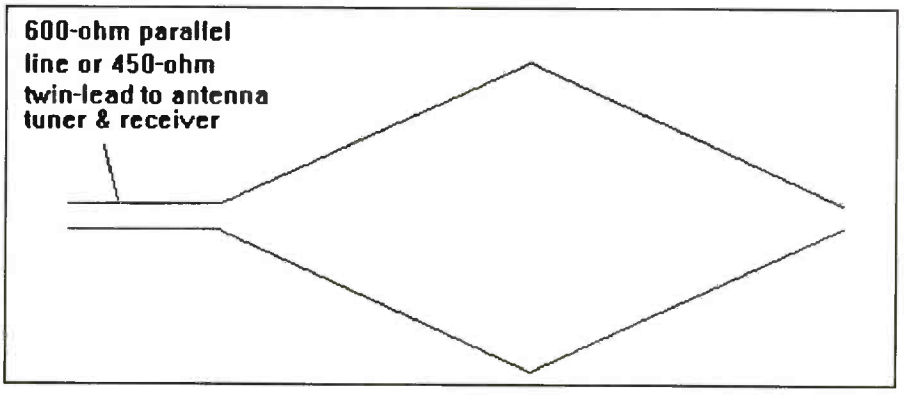

Fig. 1–Unterminated rhombic antenna

The rhombic antenna is a high-gain, wideband antenna capable of good directivity. Although the main use is in HF communications, there have been others in use on other frequencies. The late Vic Clark, W4KFC, former ARRL president (and another of my early mentors) told me once that he saw a Peruvian navy rhombic for VLF frequencies (about 20 kHz) that was 24 miles on each leg.

Vic was director of the U.S. Coast Guard Electronic Engineering Laboratory in Virginia at the time, and was on a business trip to Peru. He traveled by train up into the mountains, and on the way saw a single wire strung on telephone poles. At first, he thought it was a landline telegraph system like we had in the 19th century, but he was wrong: it was the rhombic. Those low frequencies are used to communicate with submarines just below the surface.

In the early days of television, before wideband, high-gain, highly directional VHF antennas were available, it was common practice for remote viewers to use terminated, wideband rhombic antennas with about 56 feet of wire per leg. Regular high-gain television antennas were costly affairs, and often came down with even relatively low wind speeds. Unfortunately, the "sail area" of 30- and 40-element TV antennas is huge. I know one 220-pound weightlifter who was blown off a roof while installing such an antenna...he "hang-glided" to the ground when the wind kicked up...breaking his pelvis and leg in the bargain.

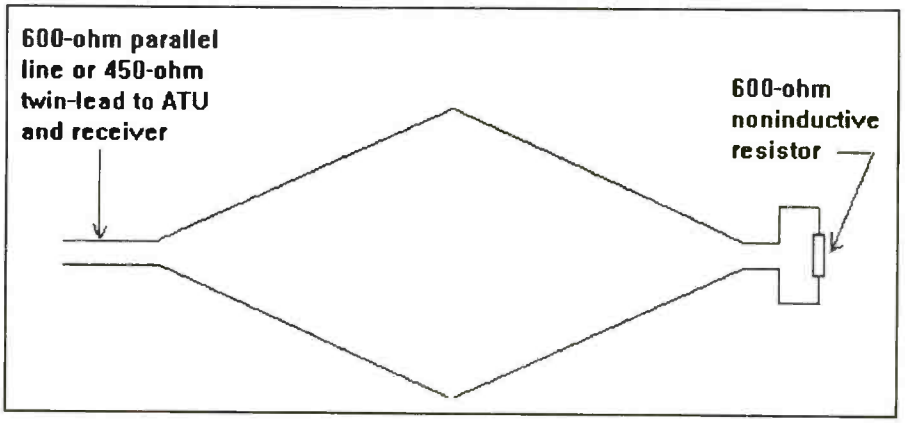

Fig. 2–Terminated rhombic antenna.

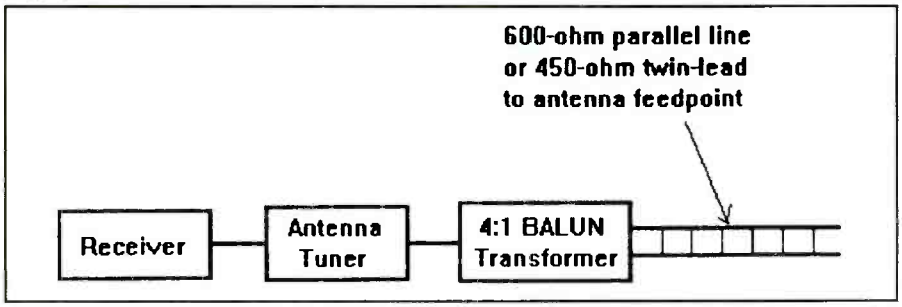

Fig. 3–Using a 4:1 balun transformer to make an antenna tuner work with a parallel or twinlead transmission line.

Down Side? You're Kidding!

What could be the down side of a ham station with a high hilltop location, an HF rhombic antenna, a 2,000-watt SSB transceiver, and a rotator that rotated the hill to point the rhombic wherever desired? The hell of it was that he called CQ for eternity and no one answered...not even an SWL's QSL card! Only kidding.

Feeding Long-Wire, V, Rhombic Antennas

The transmission lines used with the antennas discussed in this month's column, and the two previous columns, usually are fed with either 450-ohm twin-lead transmission line, or 600-ohm parallel "open-wire" transmission line (the 450-ohm twin-lead is easier to work, by the way). This cable is not compatible with the antenna inputs of most receivers.

Another little problem is that an antenna tuner usually is required, and most antenna tuners sold today are intended for coaxial cable transmission line, or random length single-wire radiators that are not longwires. The transmission line used on these antennas wants to see a balanced output antenna tuner.

Figure 3 shows a way to make a conversion from coaxial cable tuners to parallel/twinlead. A 4:1 impedance ratio balun ("balanced-unbalanced") transformer will do the trick nicely. Insert it into the transmission line after the antenna tuner. In some cases, you can mount the balun transformer at the feedpoint of the antenna, and run coaxial cable all the way. However, that may not be what you want to do if you want to depend on the tuned feeders to help resonate the antenna; try it, though, it might well work.

Antenna Installation Safety

I keep harping on antenna installation safety because it is so important. A lot of installers lack experience or knowledge of what can happen when installing simple wire antennas. These antennas seem so simple that little could go wrong...want to bet? There are both electrical and physical hazards.

The electrical hazards come from being in close proximity to the AC power lines that come into your house. Don't even think about tossing an antenna wire over the AC power lines! The insulation on the power line might look intact, but it ages and could be cut by the antenna wire. That puts 110 volts onto the antenna wire, and it could kill you if you touch the wire. Every year, it seems, we hear some sad story of someone trying to run an antenna across the power lines, and being electrocuted in the process.

Also be careful to install the antenna so that it won't be wind-whipped into the power lines if it breaks. After all, breaking is fairly common in wire antennas, especially with ice and winds.

Another rule is to never work on an antenna when it is connected to the receiver. Although most receivers are well designed, and won't cause a harm if you touch the antenna and ground at the same time, there are short-circuit conditions that could be lethal. Also, if you have one of those old-fashioned AC/DC shortwave receivers, like we had in the 1950s, then there is a distinct danger. I make it a rule to always disconnect the antenna from the receiver before working on it.

The physical hazards come from the fact that wire can get away from you. I recall one accident where a friend of mine was installing an ordinary 80-to-10-meter ham trap dipole (about 133 feet long). He was standing on a ladder trying to secure one end, when the wire somehow looped around one leg. When he tried to climb one rung down on the ladder, he tripped over the wire and did a "Superman" act toward the ground. Only the fact that he wasn't far off the ground, and is a tough sonovagun, kept him from being injured very seriously.

Write In

You can write to me here at *Popular Communications*, or send e-mail via the Internet to CARRJJ@aol.com. ■