Enjoy All Five Bands

—*with this novice no-trap antenna*

Karl T. Thurber W8FX/4
233 Newcastle Lane
Montgomery AL 36117

If there is a fundamental rule about getting the most from your radio equipment, regardless of the size of your pocketbook, it is this: *Don't skimp on your antenna.*

This antenna tuner, or matching network, is representative of current designs, incorporating a built-in wattmeter which allows accurate and continuous power measurement and swr indication. Rated at 200 Watts rf power-handling capability, this tuner enables feedline swrs of 5:1 to be matched to the transmitter, being designed primarily for coax-to-coax matching. Other wider-range tuners enable loading of balanced-line (twinlead) or single-wire antennas to the low-impedance coax output of modern transmitters and transceivers. An antenna coupler should always be used in conjunction with multiband antennas for good harmonic suppression. (Photo courtesy of R. L. Drake Co.)

For top-notch DX work, a well-designed and properly installed skyhook is nearly as important as the transmitter or transceiver itself. You simply can't get maximum efficiency and radiated power output using a poor antenna system. Particularly with the relatively low power limitation of 250 Watts placed on the Novice, a good antenna is the best hope for the newcomer to work his fair share of DX.

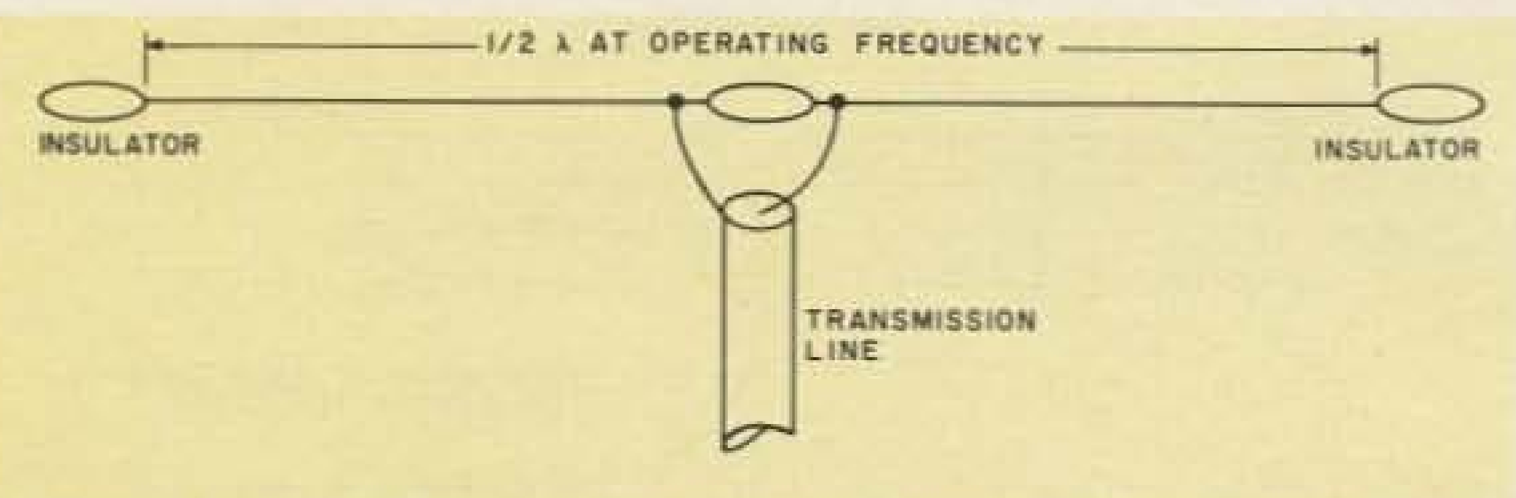
Many hams (and not just beginners) run into problems in erecting just one antenna, so the thought of constructing antennas for each of the five HF bands seems ridiculous, not to mention the effect on your neighbors. But, with about 66 feet of antenna space, you can erect a single five-band (80/75, 40, 20, 15, and 10 meter) antenna — one that uses a separate dipole for each band and which uses no traps.

First, before describing this antenna in detail, let's take a look at some common single and multiband antennas that are often suggested for the Novice and beginner, noting the advantages and disadvantages of each.

Old Faithful: The Half-Wave Dipole

You can cut a separate antenna for each band you want to work, although a 40 meter dipole will also work fairly well on 15 meters (due to an "odd half-wave harmonic" relationship existing between the 7 and 21 MHz dipoles). This is the only case where a dipole cut for one band will also work on another. Normally, trying to use a half-wave dipole on another band results in mismatches, high swr, increased possibility of BCI and TVI, and other problems, the least of which is poor efficiency.

The half-wave dipole shown in Fig. 1 is normally run in a straight line and centerfed with 75-Ohm coaxial cable or even 75-Ohm twinlead (though the latter appears to be going out of favor because it radiates and is harder to handle). The total length of the antenna is calculated by dividing the desired center



Unquestionably the world's most popular and most commonly used antenna, it is probably next to the single-wire in simplicity. However, its use is normally limited to the band for which it is designed. An exception to this is that an antenna resonant in the 40 meter band will also operate with a low swr (standing wave ratio) on 15 meters, three times the basic operating frequency.

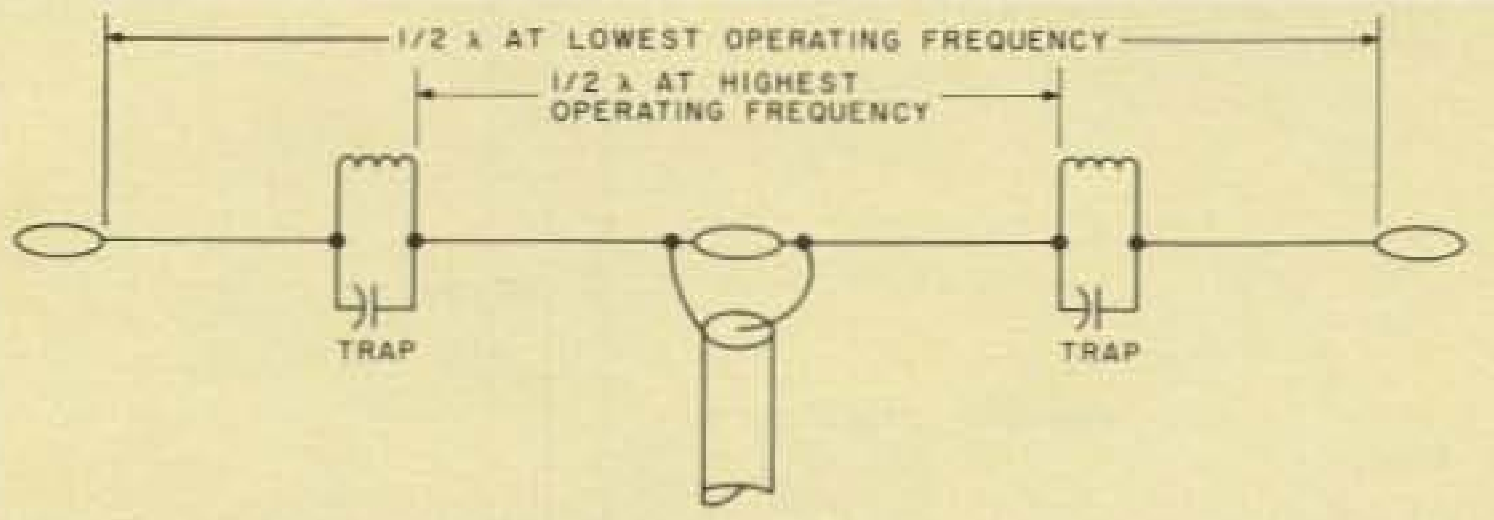
The half-wave dipole offers a good match to 75-Ohm coaxial cable or transmitting type twinlead. At the fundamental design frequency, the swr should be under 2:1 over a range of plus or minus 2 percent of resonance.

The dipole is basically a balanced antenna, both sides being symmetrical in nature. For this reason, a balun (or "balanced-to-unbalanced") transformer coil is often used to feed the dipole with coax, which is inherently an unbalanced cable (center conductor plus grounded outer shield).

The five-band antenna described in this article is a variation of the basic half-wave dipole. Other versions of the dipole are possible, such as the folded dipole, designed to directly match 300-Ohm feedlines. Again, the folded dipole is also a single-band affair.

Multiband operation is also possible using so-called "tuned feeders" (open-wire or twinlead transmission lines), coupling the transmitter to the antenna through a wide-range coupler or matching network. The flattop is usually cut to the lowest operating frequency to be used and transmission line lengths selected to give the least problems with the high line swr and antenna currents flowing on the line.

Fig. 1. Basic half-wavelength dipole antenna.



The trap antenna operates on two or more bands with practically the same efficiency as if a separate antenna was constructed for each band. In the two-band trap antenna shown, each parallel-resonant trap consists of a capacitor and coil placed at the ends of the shorter dipole section. The traps completely isolate the rest of the antenna (including other traps for other bands) from this section, thereby acting as insulators for rf energy at their design frequency. At lower frequencies, however, they will pass rf with little effect.

The same principle follows on up to the lowest frequency band on which the multiband trap antenna is designed to operate. The lowest frequency band doesn't require a set of traps, of course — it's simply the entire length of flattop end to end. A 160 through 6 meter trap antenna, for example, would require six traps on each side, for a total of twelve, to allow 7-band operation.

Note that, when traps are installed, there is some shortening of the antenna, due to the inductive loading effect of each trap. For example, the typical half-wavelength 75 meter dipole section would only have to be about 100 feet long because of the effects of the traps. The exact degree of shortening depends on the ratio of inductance to capacity in the traps; the more the capacity in the traps relative to the inductance, the closer the antenna will be to standard formula length.

Like the basic dipole, the trap is a balanced-type antenna and may be fed by coax through a balun transformer.

Fig. 2. Simple trap antenna configuration.

operation frequency in megahertz (MHz) into 468. Therefore, a dipole for the Novice segment of 40 meters (7.10 to 7.15 MHz) would be about 65′ 8″ long. But an 80 meter CW dipole cut for the low end of the band would be all of 133′ 8″, a length not all suburban lots can easily accommodate, even using the so-called inverted vee configuration where the center insulator is mounted at a fairly high point and the ends of the antenna are brought down close to the ground.

In practice, the center impedance of the half-wave antenna varies slightly with the antenna's height above the ground, wire diameter, proximity to other objects such as trees and buildings, etc. But it is safe to assume a close impedance match to 70- or 75-Ohm coax or twinlead; you can use 50-Ohm coax with only a slight swr increase. Furthermore, most recent transmitters and transceivers are specifically designed to work into 50- to 75-Ohm transmission lines, so tuning or matching is usually no problem with this kind of one-band, one-antenna setup. (You might be interested to know that RG-11/U and RG-8/U coax have about a 6% loss per 100 feet on 75 meters, while the smaller RG-59/U and RG-58/U cables have a loss of about 11%. Foam-type coax has less loss, while 73-Ohm balanced twinlead has about an 8% loss. Those losses tend to increase at higher frequencies and with impedance mismatches.)

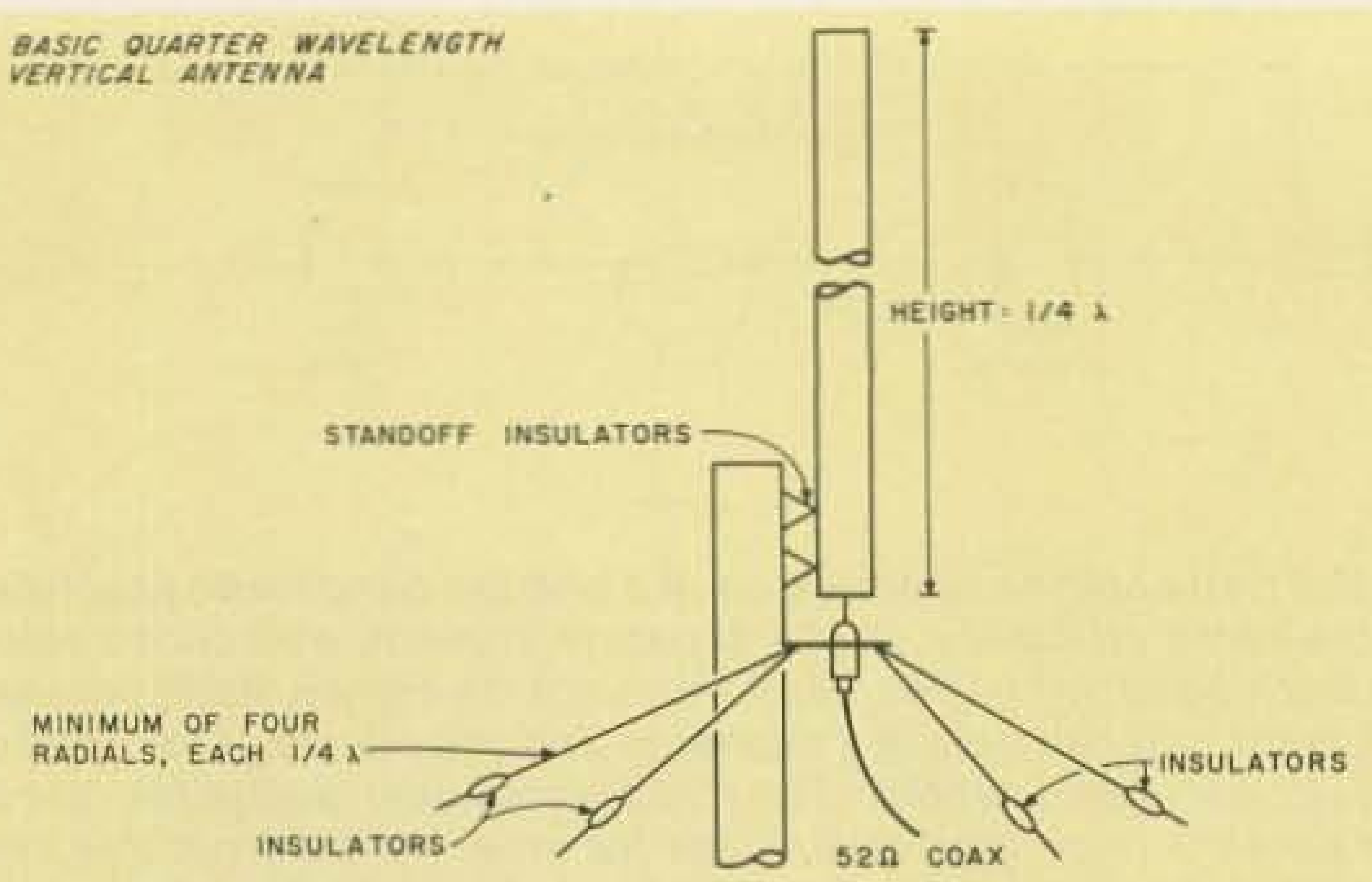
Although the basic half-wave dipole, being very straightforward in design and not relying on any gimmicks, gives the least trouble of any antenna, a separate antenna must be constructed for each band (except 15 meters). And that's not usually possible in most urban and suburban locations.

A Fair Compromise: The Trap Dipole

The "trap" antenna is a good choice for the operator who has the space for one full-sized dipole and wants multiband operating capability. It is similar to a regular wire dipole but has tuned traps that electrically isolate part of the antenna length. In a simple two-band example, if the antenna length from trap to trap in Fig. 2 is cut for 20 meters, then, from end to end, the same antenna can cover the 75 meter band as well, if its full length is a half wavelength on that band.

Two traps are needed for each band, one on each side of the feedline connection, except for the lowest band. They are parallel-tuned circuits enclosed in a waterproof casing, designed to resonate at the center frequency of the band. At their resonant frequency, they represent a high impedance to rf (thereby effectively acting as insulators), so the portion of the antenna beyond the traps will be out of the circuit, electrically speaking. As the traps are difficult to construct and properly adjust (not to mention making them waterproof), they're best purchased commercially. They are not terribly expensive. About a dozen manufacturers make amateur band traps. Most can be obtained complete with precut flattop, though just the traps alone are available for anyone who prefers to construct his own antenna.

The main advantage of the trap dipole over other multiband antennas is that a single antenna length will do for several bands. However, as is the case with all multiband antennas, the trap introduces a problem in harmonic radiation. If, for example, a transmitter is operating in the 80 meter Novice band, the second harmonic of the



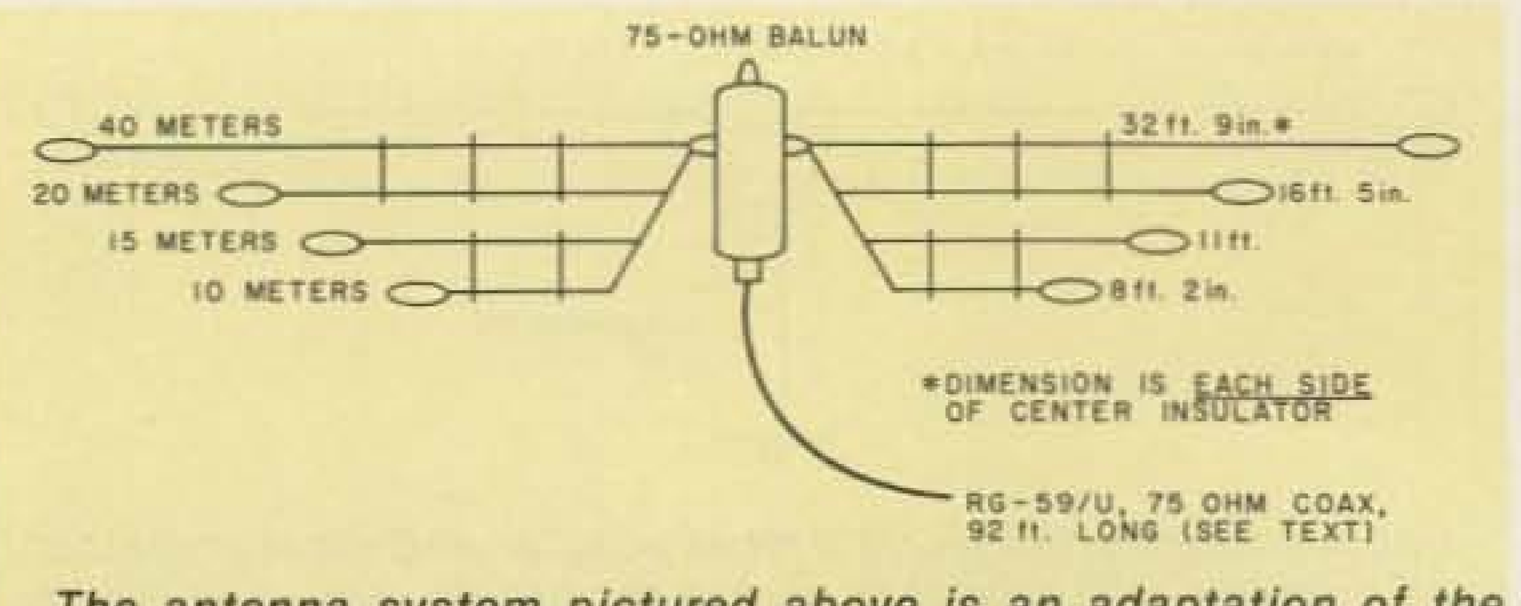
The quarter-wavelength antenna shown above is frequently used on the HF bands to put out a signal with a low radiation angle, especially good for DX work. It's also a good choice when there is insufficient room to support full half-wave flattops at the desired operating frequency.

A vertical antenna may be fed as a so-called "ground plane" as shown above, with at least four wires, each a quarter wavelength, extending radially from the base. The radials form an "artificial" metallic ground, allowing good low-angle radiation regardless of height above the ground.The vertical can also be fed directly against ground, eliminating the above-ground radials, as long as the antenna has a good low-resistance ground connection in the form of at least a half-dozen buried radials and several ground rods installed at the base.

At HF frequencies, the physical lengths required usually limit the vertical height to a maximum of a quarter wavelength at the operating frequency, whereas the smaller dimensions at VHF frequencies allow lengthening the antenna for some gain; 5/8-wavelength and even 3 half-wavelength in-phase configurations are common, giving several dB of effective gain over the basic quarter-wavelength antenna.

The vertical,.like the dipole, is essentially a single-band affair, although traps may be inserted at appropriate points for multiband use.

Fig. 3. Vertical ground-plane antenna.



The antenna system pictured above is an adaptation of the basic dipole antenna; a group of centerfed dipoles are connected in parallel where the transmission line joins them.

On 40, 20, 15, and 10 meters, the antennas act as ordinary dipoles. There is fairly little interaction between the separate flattops. On 75 and 80 meters, the antenna is fed through the shorted ends of the coax (see text) as a single-wire-type antenna.

As the antenna, like the basic dipole, is essentially a balanced system, a balanced feedline would normally be used, such as 75-Ohm transmitting-type twinlead. However, direct coax feed will present little in the way of problems, or the balun transformer can be used as shown in the illustration to prevent possible imbalances in the system introduced by using the unbalanced coaxial cable.

As described in the text, the antenna itself is constructed of 450-Ohm open-wire TV transmission line, although other variations are suggested, such as the use of 300-Ohm twinlead or "ladder line."

Note that, in the configuration shown above, the 20 and 10 meter dipoles are the cutaway lower halves of the 40 and 15 meter dipoles, respectively. Each set of dipoles should be separately supported on the ends to minimize strain on the open wire line.

The physical design is flexible and may be varied to suit individual operating needs and available space, as suggested in the article.

Fig. 5 shows how the coax is jumpered at the transmitter end for 75 and 80 meter operation, while Fig. 6 shows details of the center insulator mechanical support connections.

Fig. 4. Short five-band no-trap antenna.

signal will also be radiated very nicely by the antenna — but it will be out of the top end of the 40 meter band, representing illegal operation and inviting a so-called "pink ticket" from the FCC.

Usually, you can stay out of trouble with multiband antennas by always feeding the antenna through an antenna coupler, which can offer an added 20 to 30 dB or more of harmonic suppression.

The problem of increased harmonic radiation and TVI applies also to the five-band antenna which will be described later on. It, too, should be fed through an antenna coupler, although most transmitter pi-network output circuits have fairly good second and third harmonic rejection characteristics if not "loaded" too heavily in an effort to get out that last Watt of rf. (If you suspect excessive harmonic radiation, check with a friend a few miles away, having him tune to your second or third harmonic — it should be received very weakly, if at all. It's a fairly good test for harmonic radiation, provided he's at least a few miles away.)

Using a multiband antenna may also aggravate TVI problems. So be sure to use a low-pass TVI filter installed in the coax between the transmitter and the antenna tuner and use the minimum grid drive necessary for full power output.

DXer's Choice: The Ground Plane

The ground-plane vertical is an excellent choice when horizontal space is a problem and if you're mainly interested in working DX. This type of antenna has a very low radiation angle, can be either ground- or mast-mounted, and can be directly fed with coaxial cable. It is shown in Fig. 3.

The quarter-wave vertical radiator must be insulated from ground for coax feed, presenting a feedpoint impedance of around 25 to 40 Ohms. This allows a reasonable match to 52-Ohm coax without using matching stubs or other devices in the transmission line. The antenna can also be fed with 70- or 75-Ohm coaxial line using a quarter-wavelength section of 50-Ohm coax between the line and antenna.

The vertical can be fed "against ground" rather than using the ground-plane radials running above ground (a little inconvenient on 80 and 40 meters because of their length). In this case, care is taken to get a good ground "mirror" by using several six- to eight-foot ground rods and using at least a half-dozen buried radials of various lengths to obtain the ground-plane effect and a low rf ground resistance.

While it's a particularly good DX antenna, the vertical sometimes doesn't work as well at the medium distances typically worked on 75 and 40 meters. Also, installing the radial system often presents a problem. Then, too, the ground-plane vertical is normally a one-band affair that also has a nasty tendency to aggravate TVI and RFI problems because of its vertical polarization and consequent low angle of radiation, which tends to direct your signal down and into the neighbors' TV, stereo, and other electronic equipment.

A hybrid-type antenna that is becoming increasingly popular is the trap vertical, which uses tuned traps much like those used in the trap dipole, but which are inserted into the vertical antenna elements at the proper isolation points to allow multiband operation.

The multiband trap vertical — some designs are as short as 30 feet or less for full 80-10 meter operation — is an excellent all-around antenna and a fine DX choice when worked against a good ground system, but it is a lot more expensive than the simple wire flattop. Also, due to the complicated mechanical problems introduced by the traps, it's usually not practical to build your own trap vertical from scratch, whereas single-band verticals and dipoles are "snaps" for ease of construction.

Another popular and inexpensive multiband vertical is base-loaded, the antenna usually being 20-35 feet long and in one continuous length. With this antenna, a tap on the base-loading coil is manually moved to different positions on the coil until a good coax match is obtained. While 80 through 10 meters can be worked using one antenna and coil combination, the tap must be changed manually, a distinct disadvantage in inclement weather. The coil must also be waterproofed and otherwise protected from the elements.

A Short Multiband Antenna Using No Traps

As shown in Fig. 4, this antenna is a complete, easy-to-build, coax-fed, five-band, separate-dipole system. As with the basic half-wave dipole antennas discussed earlier, the dipoles are individually cut to any desired frequency within a particular band using the familiar dipole equation L = 468/F, where L is in feet and F in MHz. For general all-around operation, each dipole should be resonant in the center of its band. (On 10 meters, however, the antenna is cut for 28.5 MHz to cover the CW segment and the lower end of the phone band starting at 28.5 MHz.)

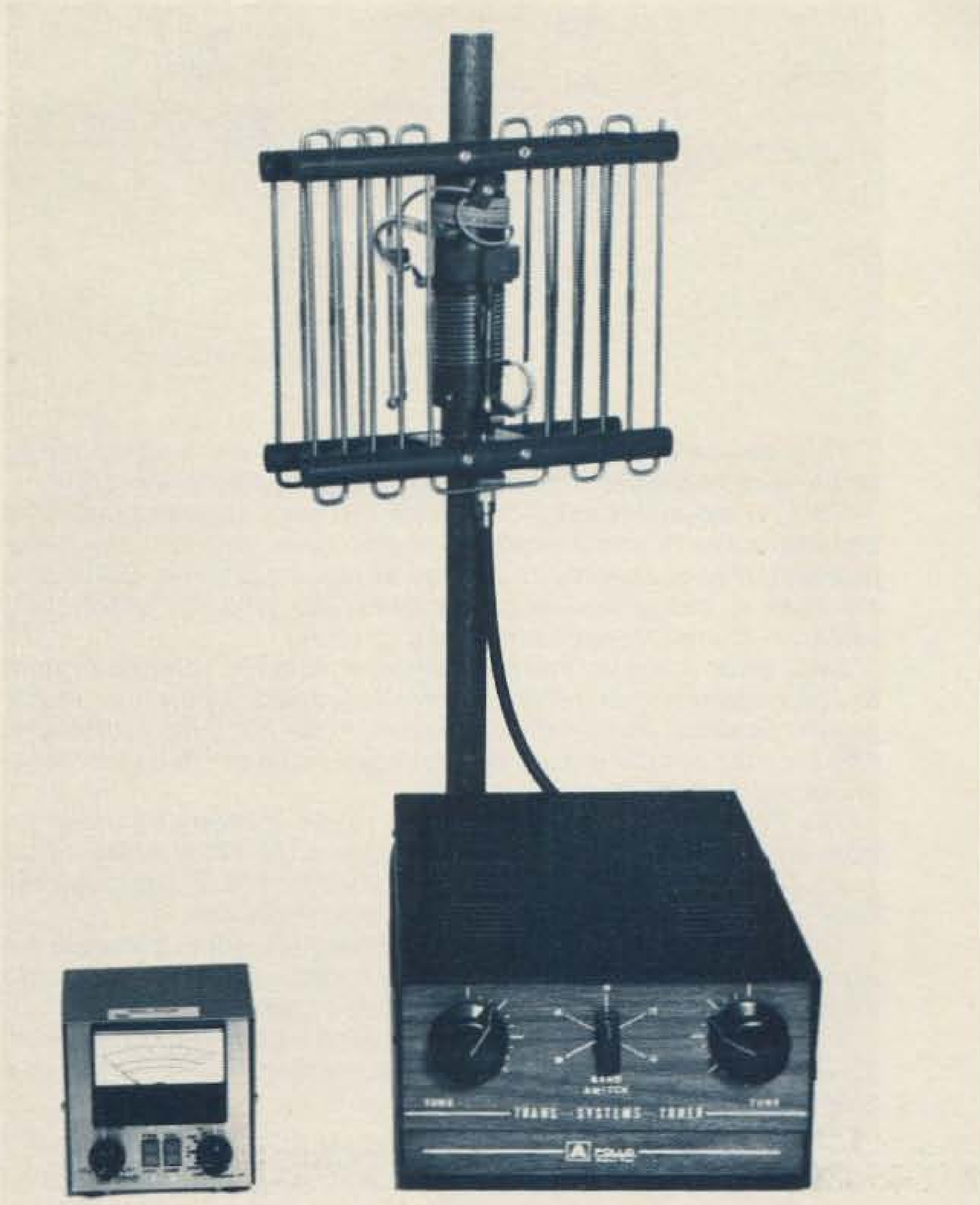
With this setup, on the band you're working, the transmitter and coax feedline "see" a good 75-Ohm match; the other paralleled dipoles — having a high impedance on other than the band they're designed for — just aren't there, electrically speaking, so they don't much affect operation on the other bands.

You'll find that, on 40, 20, and 15 meters, the antenna maintains a fairly consistent swr of less than 2:1. On the 10 meter band, the "bandwidth" of the antenna is roughly 500 kHz either side of the design center frequency (28.5 MHz) before the swr starts to become excessive. On ten, however, if a wide-range antenna tuner is used, the antenna may be made to load fairly well over the entire band.

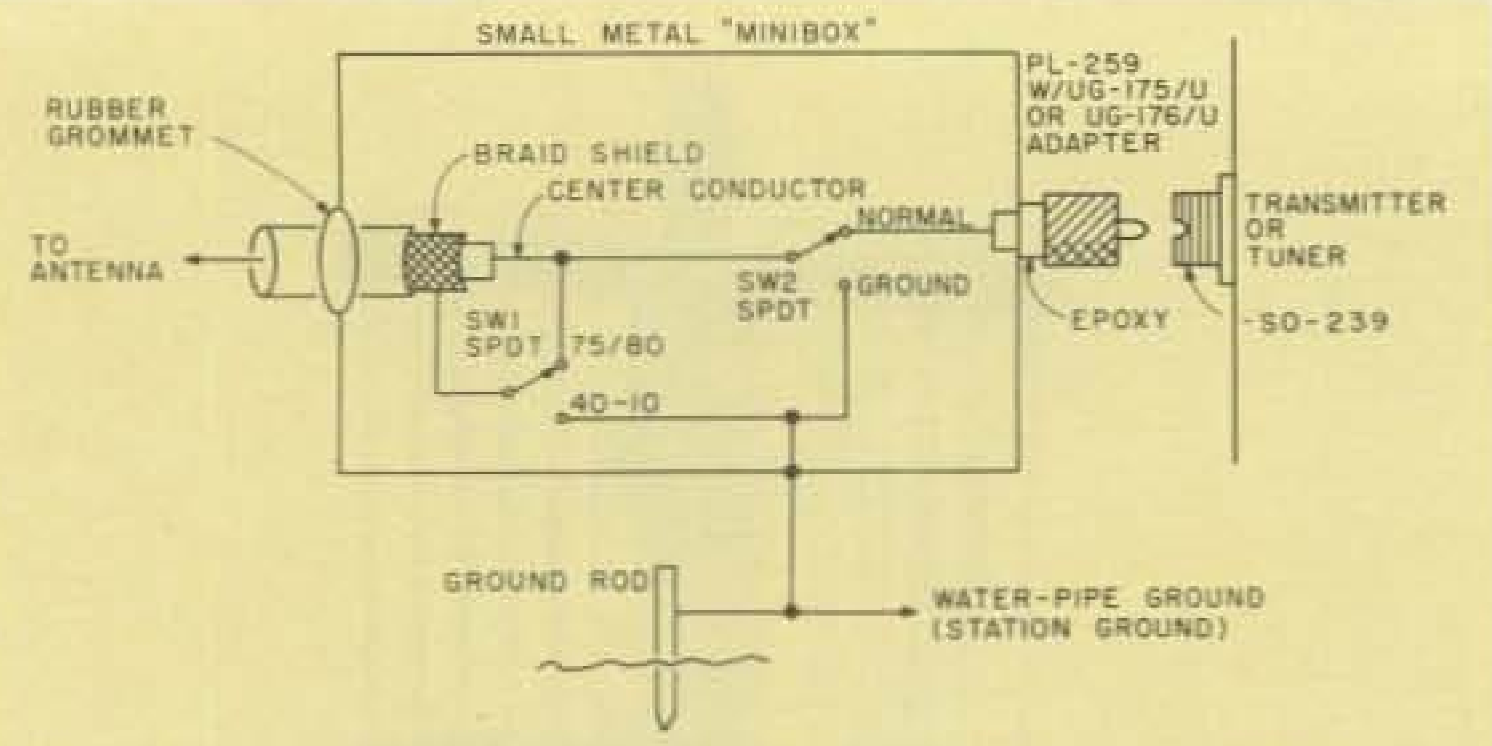
Using paralleled dipoles with one common feedline is a very common practice, but the fact is that it still takes about 125' of flattop to radiate effectively on 80 meters. Even using commercially-designed trap dipoles, the length needed for 80 is usually at least 100 feet, with a very narrow operating frequency range due to the high "Q" of the traps. Again, this kind of space often is not available.

Here's how to get to 75 and 80 meters with this antenna: First, recall that the basic antenna length at 7.15 MHz is determined from the formula of 468/F, or 65' 6". Dividing this by two gives us the 32' 9" length on each side of the center insulator. Now, adding a length of coax of about 92 feet to the 32' 9" gives an effective antenna length of 124" 9", which represents a half wavelength resonant at the approximate center of the 75/80 meter band.

On 75 and 80, you should find that the swr is fairly low for about 150 to 200 kHz around the design frequency and shouldn't exceed 3:1 or so at these limits. But on this band — and this band only — the inner and outer conductors of the coaxial cable are connected together at the transmitter or antenna tuner end and fed like a single-wire antenna. (Note that a good ground connection for the transmitter or transceiver is important for good results when the antenna is, in effect, fed as a single wire against



One of the few antenna tuner kits on the market today, the 5-band Apollo Trans System tuner kit is a wide-range coupler based on the classic design by Lew McCoy which appeared several years ago in QST. The tuner will match low-impedance coax cable or open-wire lines. It will also handle random-wire antennas. The kit sells for about $125. Also shown here is a combination wattmeter and direct-reading standing wave ratio bridge, a useful device in tuning up and adjusting any antenna. The device behind the antenna coupler is the Apollo "Little Giant" beam antenna, a very unusually-configured mini-antenna designed for single-band operation on 40, 20, 15, or 10 meters. It measures just 27" high and 22" wide. A slightly larger version is designed for 80 meter operation. (Photo courtesy of Apollo Products, Box 245, Vaughnsville OH 45893.)



This device allows convenient switching from a 75/80 meter single-wire configuration to straight multiple-dipole operation.

SW1, in the upper position, shorts the coax shield to the inner conductor for 75 and and 80 meter operation, while, in the lower position, it is connected to ground in regular fashion. (Note that the coax is not grounded to the metal box where it enters but, rather, is routed through a rubber grommet.)

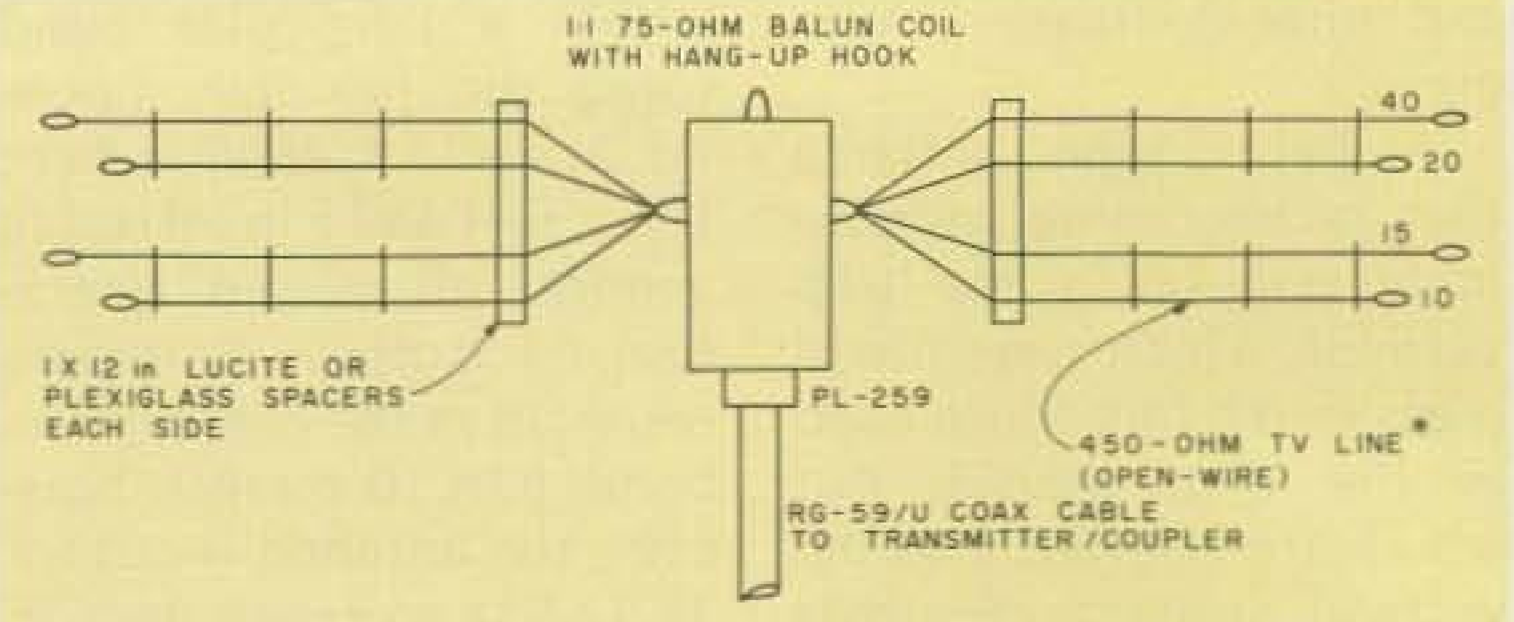
SW2, when in the normal position, connects the antenna system to the transmitter or antenna tuner for regular operation. In the ground position, the antenna is grounded for lightning protection. The antenna should always be grounded when not in use for maximum protection.

The PL-259 connector is mounted to the minibox by drilling a hole just large enough to accommodate a UG-175/U or UG-176/U reducer adapter, screwing the reducer onto the PL-259 through the cabinet wall. It can be epoxied into place if desired.

The two SPDT switches can be ordinary electrical switches for low-power work. However, heavy-duty ceramic rotary switches are suggested for more than 100 Watts or so power levels.

The jumper box should be connected to a good ground system. This is particularly important when working the antenna as a single-wire on the lowest band.

Fig. 5. 75/80 meter jumper box pictorial diagram.



A commercially-manufactured 1:1 balun is used as a convenient center insulator for the antenna; the hang-up hook may be used if you want to tilt the antenna for space into the inverted vee arrangement mentioned in the text.

The 450-Ohm open-wire line may be run directly to the balun, but a neater and stronger antenna results if you run the dipole sets to a 1" × 12" Lucite™ or Plexiglas™ bar, firmly anchoring the line ends to the bar. Short (6-8") wires may be run from the bar to the anchoring hooks on either side of the balun coil. Note that all wires on each side of the balun are connected to each other, resulting in each dipole being electrically paralleled with the others.

For maximum strength, each dipole set should be separately supported, minimizing strain on the antenna as a whole. Most baluns are equipped with a coax receptacle; therefore, the cable should be fitted with a PL-259 connector for easy connection to the antenna.

As discussed in the text, 300-Ohm heavy-duty twinlead may also be used to construct the antenna, as may polyethylene "ladder line." Solid copper wire may also be used to form the 40 meter antenna with the other dipoles being suspended from it. The ARRL Antenna Book *gives a number of mechanical techniques for multiple-diode center support and may be consulted for more information.*

If you prefer, the balun coil may be eliminated and replaced with a standard center insulator with little effect on performance.

*Fig. 6. Center insulator mechanical support connections for 5-band antenna. *Burstein-Applebee catalogue no. 2A9967-9.*

ground.)

The jumpering can be done manually using alligator clips, or you can construct a jumper box for the purpose, as shown in Fig. 5. The box also provides for grounding the antenna when not in use, for lightning protection, and for discharge of static buildup on the antenna.

Since the antenna operates with a fairly low swr, even on 75 and 80, the transmission line could be fed directly by the pi-network output circuit of the transmitter or transceiver without using an external antenna tuner or coupler. But, an antenna tuner or coupler should in fact be used to reduce the very real possibility of radiating out-of-band harmonics — something a multiband antenna will do very well, as mentioned previously. The tuner also does a nice job tuning out any reactance at the band edges, which is particularly useful on both 75/80 and 10 meters where swr may get a bit ragged at the band edges.

This low-pass filter provides extremely high attenuation of signals higher than 43 MHz, effectively eliminating the possbility of radiating undesirable harmonics in the TV bands through the antenna. Multiband antennas tend to aggravate harmonic radiation problems, including TVI, but the use of a low-pass filter and antenna coupler in the transmission line will do a great deal to reduce the possibility of TVI problems. While the particular Drake filter shown is rated at only 100 Watts, other filters by Drake and a number of other manufacturers will handle all amateur power levels. (Photo courtesy of R. L. Drake Co.)

On the top four bands, the radiation pattern will closely resemble the familiar "broadside" half-wave dipole pattern, while on 75 and 80 meters, the pattern is essentially omnidirectional with elements of both vertical and horizontal polarization caused by the radiating coax which is now an integral part of the antenna. If your space is even more limited, you can mount the antenna in inverted vee fashion, which requires only a single high support and less horizontal space. By doing this, you very slightly reduce the antenna's resonant frequency, feedpoint impedance, and bandwidths, as the angle between the two parts of the dipole is decreased. As long as you don't make the angle at the apex smaller than about 90 degrees, you should have no problems using the vee, and the slightly lowered angle of radiation should be a plus for DX work.

Build It

The five-band antenna is made of good-quality TV-type 450-Ohm open-wire transmission line, heavy-duty 300-Ohm twinlead, or commercially-available polyethylene "ladder line" sold by many large mail-order electronic suppliers, such as Burstein-Applebee, Lafayette Radio, and others. In most situations, the open-wire line or twinlead is strong enough to support the antenna, if the lower dipoles are run separately to a support and if the coax is also supported at some point so the full weight of its entire length doesn't fall on the antenna flattop. (You can also use #12 or #14 copper wire for the main 40 meter flattop if you like—I'll discuss that variation later on.)

Each end of the 40 and 15 meter dipoles (the top halves of the open-wire) is connected to an insulator, with the centers being tied through a Lucite™ or Plexglas™ support bar to the main center insulator. The 15 meter dipole should be separately supported on the ends and run to a nearby tree or any available mast or pole. The 20 and 10 meter dipoles are simply the cutaway lower portions of the 40 and 15 meter open-wire line or twinlead. The center of each dipole is connected in parallel with the one above it at the center insulator. Fig. 6 is a close-up view showing how all this is done.

When hanging the antenna, you should place it as high as you possibly can above the ground (at least 25 to 30 feet) and far away from other objects that might detune it or block its radiation path. You can orient it for the direction you're mainly interested in covering, but it will still radiate fairly well in all directions. Maximum radiation will be in a "doughnut pattern" lying at right angles to the wire.*

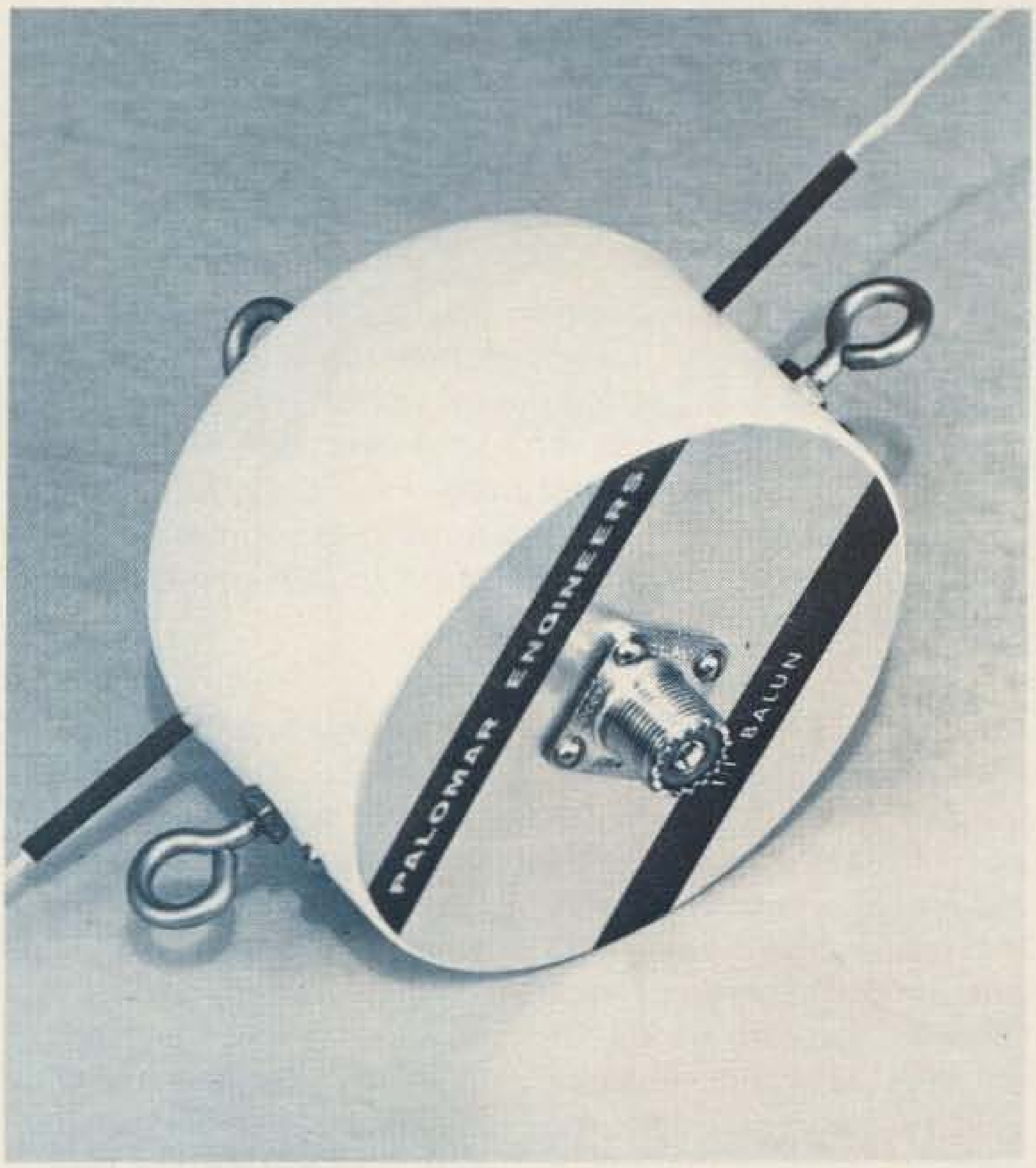
Getting down to the nitty-gritty of actually constructing the antenna, your best bet is to use a commercial 1:1, 75-Ohm balun coil as the center insulator. While a balun isn't absolutely necessary, it's helpful in getting a symmetrical radiation pattern and keeping down antenna currents on the coax (except on 75 and 80, where the coax is part of the antenna itself). If you want to use a balun — and it is a good idea to do so — they are hard to build and waterproof yourself, so it's probably best to buy a commercial model, costing anywhere from $10 to $20. Unadilla Radiation, Green Insulator, Kaufman Industries, Barker and Williamson, Palomar Engineers, and a host of others make them. Their ads can be found each month in the various amateur publications.

They're all good products. Two added pluses for the baluns are that, first, they usually come equipped with a built-in SO-239-type coax connector for easy feedline attachment, and second, their internal construction usually places the antenna at dc ground potential, affording some degree of built-in lightning protection for the antenna. Just make sure that you use the one-to-one (1:1) kind of balun, not the 4:1 type, which is designed to transform a 300-Ohm folded dipole's impedance to match standard 75-Ohm coax.

Whether or not the inherently balanced dipole should always be fed through a balun is a moot technical point that is likely never to be decided with any finality. I have never found it absolutely necessary to use one, though you will find that many antenna purists insist that baluns are necessary to keep current from flowing on the outside of the coax transmission line. (Some operators prefer to use balanced 75-Ohm twinlead and mount the balun at the transmitter end — take your pick.)

While on the subject of baluns and dipole center connectors, some balun manufacturers also sell the connectors less the balun "innards." These connectors are very handy even if you don't want the balun feature, making it easier to build a professional-looking antenna with a good weatherproof feedpoint connection. They're well worth the cost — usually less than $9 or $10 — and are a lot less hassle than building your own center connectors. Of course, since they are weatherproof, they can be reclaimed and used again and again with future antennas.

To complete the installa-



This Palomar balun is designed to match unbalanced coaxial line to balanced dipole antennas over the range of 1.7 to 30 MHz. According to the manufacturer, dipoles fed directly with coax cable are susceptible to cable radiation which can lead to TVI, BCI, rf feedback in the station, and noise pickup when receiving. The balun (balanced-to-unbalanced transformer) converts from the essential unbalanced coax to a balanced output by transformer action. Note the "hang-up" hook" useful in supporting inverted-vee-type antennas. Baluns are made by numerous manufacturers, such as Unadilla Radiation, Kaufman Industries, Greene Insulator, and others. (Photo courtesy of Palomar Engineers)

*Note: A centerfed, horizontal half-wave dipole radiates in a fairly wide pattern broadside to its length and poorest off the ends of the wire. However, from a practical standpoint, it's really not that important in what direction you run a dipole, especially on 80 or 40 meters, although orienting its ends in a north-south direction is a pretty fair compromise for stateside contacts. On the 20, 15, and 10 meter bands, directivity is somewhat more pronounced, so, if DX is your forte, you might want to route it with this in mind. In any case, don't be overly concerned about its orientation.

1. Keep horizontal antennas as high as possible — at least 25 or 30 feet above the ground or buildings.
2. Bend the dipole into a vee if you like, but avoid bending the ends if at all possible. Don't be overly concerned with the antenna's orientation.
3. Feed horizontal flattops at the center rather than at the ends; balun matching coils are nice, but are not absolutely necessary.
4. Use high-quality coax feedline; its advantages far outweigh its disadvantages. Small-diameter coax is okay up to about 500 Watts.
5. Vertical antennas are good, provided they are worked against a good ground system. But they tend to be noisy on receiving and may aggravate TVI and BCI.
6. Protect your antenna against lightning and ground it whenever you're not using it. You may be very sorry if you don't!
7. Use an swr meter or R-X antenna bridge to check out and adjust your antenna, but don't get hung up on swr. It can't always work out to 1:1.
8. Install a good station ground using connections to cold-water pipes and/or ground rods driven into the earth. (This goes hand in hand with lightning protection.)
9. Use an antenna coupler or matching network in the coax line if for no other reason than getting added harmonic suppression. The ones with built-in swr bridges and rf power meters are very handy and allow continous monitoring.
10. Use a low-pass filter between the transmitter or transceiver and the antenna coupler — don't give harmonic-caused TVI a chance!
11. Multiband trap antennas are fine, but can be frustrating to adjust if you've never "pruned" an antenna before. Be prepared to do some tweaking to get consistent performance from band to band.
12. Beams, rhombics, and other advanced antennas will add punch to your signal, but cut your teeth on some basic types first.
13. If your antenna doesn't work properly, check for continuity and look for shorts in the line; also check the swr carefully. Double check all solder joints and make sure all connections are mechanically sound. Above all, don't try to force power into an antenna that doesn't want to load up — find out what the problem is before ruining a final output tube or messing up your final tank circuit.

Table 1. Antenna installation tips for the beginner. Summarized here are a baker's dozen rules of thumb that should help you in getting the maximum results from that HF skyhook. Take heed! While not everyone would agree with all the items of my "laundry list," they do represent some 20-plus years of observations in experimenting with a wide range of antennas, from short indoor single-wires to multi-element beams.

tion, you can connect the ends of the dipole to good-quality ceramic, glass, or porcelain insulators and support the ends with weatherproof rope, heavy-duty plastic clothesline, or wire (broken up with strain insulators at random intervals to prevent undesired resonances near the antenna which may affect its performance or swr). Also, don't pull the antenna too tight; leave just enough sag to keep it flexible in the wind. In very limited space, you can hang the center of the antenna on any available high support (preferably nonmetallic) and let the ends droop in inverted vee style. You can also run the center portion of the antenna horizontally between two closely-spaced supports, bending the ends and hanging them vertically. (I don't recommend the latter with this antenna unless absolutely necessary, as it will result in a reduction in efficiency and is a bit tricky if open-wire is used to make up the dipoles. But supporting the center is a good idea, especially if you use open-wire line for the main 40 meter section, which has to bear a good deal of weight.)

The coax transmission line is best kept away from trees, power lines, and buildings, particularly since, on 75 and 80 meters, it is being fed as a resonant or tuned line. It should be run outdoors as much as possible, at right angles to the dipoles, if possible, to minimize undue distortion of the radiation pattern by the coax. Use TV-type standoff insulators in routing the coax to the shack.

Incidentally, RG-59/U coax is suitable for up to 500 or 600 Watts input if the swr is low, while you should use RG-11/U if you're running more power than that. Be wary of using cheap CB-type coax, as the shielding tends to be poor. The cable also tends to become very lossy at the higher frequencies.

The dipoles will interact with one another to a very small extent. If you experience problems in keeping the swr fairly consistent from one band to another, you can try pruning the antenna slightly for each band using a grid-dip meter, R-X antenna bridge, or swr meter. You can also experiment by adding about 4 feet of 75-Ohm coax to the specified 92-foot length and then trimming off about 4" of coax at a time, until the swr becomes fairly consistent from band to band. The extra length of coax won't adversely affect 75 and 80 meter operation, but it will shift the resonant frequency somewhat lower than originally designed.

Do your initial antenna tune-up without the coupler or tuner being in the line, so that you'll be sure that you're measuring the antenna's characteristics, not the coupler's ability. After you have attained an acceptable swr on all bands, move the swr bridge to between the coupler and the transmitter for routine tune-up and band changing.

One point before leaving the subject of tuning: Tweak the antenna all you like, but, if it works well on all bands and shows a reasonable swr on your favorite band segments, leave it alone. Tuning any multiband antenna for a perfect 1:1 match on all bands is almost impossible and probably won't make much difference in overall performance anyway. Actually, from a practical standpoint, an swr of even 4 or 5 to 1 doesn't cause a great signal loss or necessarily cause loading problems at the transmitter. This would start to matter at 6 and 2 meters with a long feedline, but, as a rule, if the power is going into the line, the antenna has to get most of it. Spending a lot of time trying to get the swr down to exactly 1:1 at all points in the band just won't help your signal that much.

Don't Be Afraid To Experiment

The antenna should work well as designed, but by no means must it be constructed exactly as described. After all, a good deal of the fun in amateur radio is experimenting to determine what works best for your own purposes.

For example, you may want to use a nonbalun center insulator instead of the balun coil. Or, you may, for added strength, want to use #12 or #14 copperweld steel wire for the 40 meter section, using the open-wire line or twinlead for the 20 and 10 meter dipoles and skipping the 15 meter section entirely, since the 40 meter antenna will do a fairly good job on 15. Many variations are possible. Refer to the *Radio Amateur's Handbook*, the *ARRL Antenna Book*, or the book *73 Dipole and Long-Wire Antennas* for more ideas on multiband antenna configurations.

You may even elect to forget the 75/80 feature, if that band isn't important to you. In that case, the lowest band you have to consider is 40 meters, so the length of the coax is unimportant, since it operates as an untuned line on all bands covered.

Then, too, each dipole's length can be set to favor a particular portion of the band. For instance, you might want to cut them for the CW portions of 40 and 20, but make them resonant in the middle of the 15 and 10 meter phone bands instead, depending on your interests and the operating privileges your class of license conveys.

Bear in mind that, if you want to carefully tune the antenna for a particular band segment, it's best to start with lengths several inches longer than calculated from the dipole formula to give yourself a little play when pruning the antenna. Also, if the 92 feet of coax specified seems a bit long, there's nothing magic in the length. It was chosen to make up a half wavelength on 75 and 80 when combined with each leg of the antenna for ease in loading. You can experiment with shorter lengths. With other lengths of coax, however, on 75 and 80 the antenna may behave more like a random wire, and a wide-range antenna coupler may have to be used to tune out the large amounts of reactance you can expect.

In any case, make all measurements carefully and be sure to solder all joints properly. A cold solder joint can wreak all kinds of havoc, with intermittent operation, TVI, and RFI very likely results.

This is a simple antenna, but one not involving too many performance-robbing compromises. And, you will very likely find that, in general, the simpler the antenna, the better the results and the fewer operating problems you're going to have. ■