The Helical Whip for RV and Mobile Use

By: J. T. McCullough, W0BHG

When I retired I found I needed to reduce the complexity of my antennas for several bands, and simplify their mounting and connections. I needed to cut down on the time I spent setting up and disassembling antennas for recreational vehicle (RV) and motor home use.

Advantages

The antennas presented here will also work well for ordinary mobile operations. They can be adapted easily for home use in tight space situation in an attic, on a porch roof, or on a small lot. While it is quite likely that the helical vertical will perform any better that a full quarter – wave vertical in the same situation, the difference can be rather negligible. Helicals can also be used back to back for a one half wave dipole or horizontal dipole. They will work as radials for a ground plane antenna too.

For temporary or permanent use on one WARC band, attach the helical vertically to the framework of a metal beam assembly near feedpoint. Then connect the base directly to the coax feed. The framework and elements of the beam provide the ground plane. By mounting the helicals at slight angle from each other, you could use two or three new bands in the same way.

It appears that at certain times of day, especially in the early evening, stronger DX signals may be obtained from 10, 15, and 20-meter helicals atop a metal-covered RV than from much more sophisticated antennas in the same location. This may be because the metal covering of an RV makes an almost perfect ground plane.

Development

I started using helical whips with a large magnet mount about two years ago. My first was a CB antenna, modified for 20 meters. It was fantastic! I used it atop my pickup truck while traveling, and on my trailer or motor home at campsites.

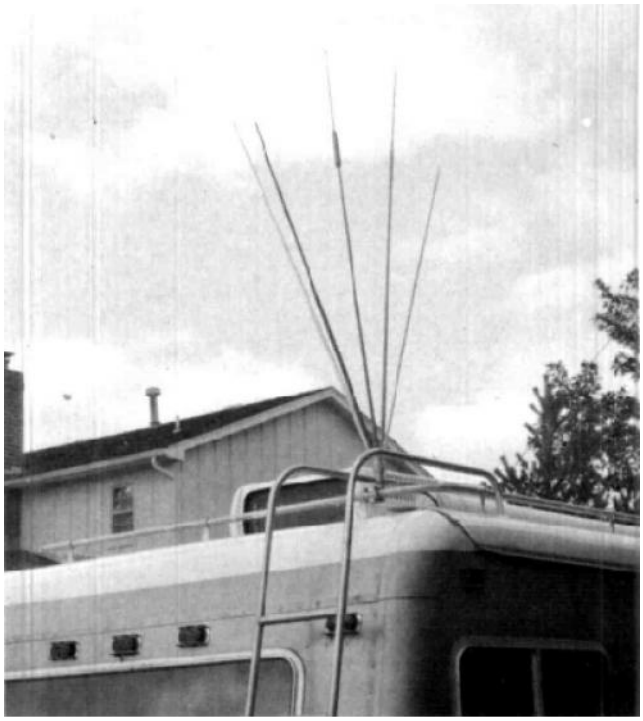


Photo A Five-band helical antenna on single spring mount

I worked a lot of DX, including all continents. (More about modifying the CB antenna later)

I wanted to work five bands: 10, 12, 15, 17, and 20 meters. To do this I tied all five helicals together near the feedpoint. I started with a heavy 4- inch spring mount. Then I made a 2-1/4 inch square plate out of 1/16 inch thick aluminum and drilled five 3/8-inch holes- one in the middle and one in each corner.. I bent each corner down about 15 degrees. I installed on antenna in the center hole to hold the plate in place on the top of a spring mount. Next I put one antenna in each of the other four holes, using lock washers and 3/8-24 nuts. See **Photo A** and **Figure 1** for details.

Performance Comments

There appears to be no significant interaction between the five antennas, with the positive exception of the center unit. Each was developed individually using a method I will be describe later, so that VSWR was lowest in the center of the desired band.

When attached to the common spring mount on the top of the motor home, four of the antennas had low VSWR (less than 1.5:1) without retuning.

The center unit (20 meters) was affected slightly, and I needed to shorten the tip ½ inch to obtain the best VSWR for the phone band. The 20 meter antenna also had narrow bandwidth, although it still covered the phone band. For this reason, it might be better to put one of the narrow band antenna (12 or 17 meters) in the center.

While traveling, tilting the assembly about 45 degrees or more to the rear should help you avoid losing some of it to an underpass or bridge. You will encounter another hazard in residential areas, where large trees often overhang the streets. Mobile operation is still quite feasible, even at a 45 degree tilt, if you mount the assembly on a rear luggage rail or ladder.

Testing Procedure

I used the test setup in **Figure 2** to check all the antennas during construction. If you do not plan to go into heavy production, the steel top of a car or pick up truc should work quite well as a base for the magnet mount. Take precautions to protect the top of the vehicle. A thin sheet of plastic should work, as capacitance between the magnet mount and car top will serve as an effective RF ground connection.

I consider a grid- dip meter a must for checking antenna resonant frequency, but an RX noise bridge may work if you are proficient in its use. Checking VSWR is useless for initial testing unless the resonant frequency happens to be in or very near the band in question. If you have a BNC fitting in the magnet mount, you can easily attach a small loop for grid- dip meter readings, exchanging it for coax for testing VSWR or on- the- air use.

After you adjust an antenna roughly to the correct frequency with the grid- dip meter, make the adjustments by connecting the antenna to a transceiver and finding the frequency of lowest VSWR with a VSWR meter. An adjustments of as little ¼ inch to the tip of the antenna may be necessary to bring lowest VSWR point to the center of the desired band.

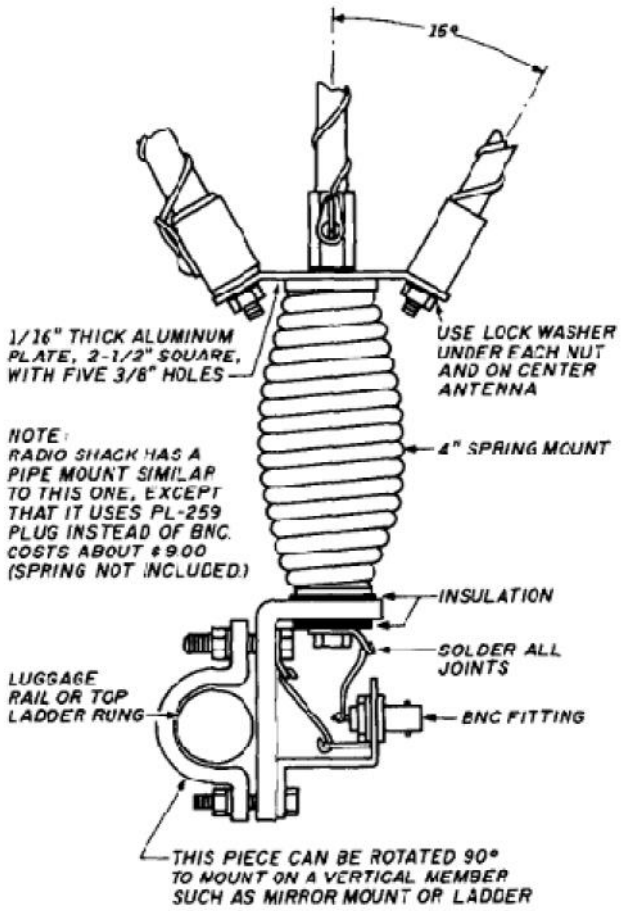


Figure 1

It is usually sufficient to check the VSWR every 100 kHz to find the low point. A dual needle VSWR meter is a real time saver here.

It is better to start with an antenna that is too long; you can find the correct length with careful plunging. If you have not found a low VSWR point after your first check with a grid- dip meter, recheck the meter frequency. Don not be concerned with other higher frequency dips. Some may be harmonic dips and some may not. Depending on the length of the wire up the point, the loading coil may act as a trap or a choke, creating a much higher frequency dip.

Construction of the Modified CB Antenna

The modified CB antenna requires the least work and is very efficient. I recommend using a top- loaded type with short tuning stubs at the very top, just above the loading coil. The one I used had about 3 feet of helical winding spaced evenly on constant diameter fiber glass rod,

followed by a close- spaced loading coil several inches long, and topped by a metal tuning tip with a set screw and 2 or 3 inches of 1/8- inch steel rod. I replaced this rod with one the same diameter about 24 inches long, and cut and adjusted it unit it resonated at the proper point of the 20- meter band.

It is important not to extend this rod into loading coil, as it will likely heat up if much power is applied. Your local hardware store is a good source of brass brazing rod. While I did not try this antenna on other bands, it should work on 12, 15, or 17 meters if you use different lengths of pre-adjusted rod. For 10 meters, it will probably be necessary to remove a few turns from the loading coil.

Neighborhood garage sales and flea markets are good, inexpensive sources for CB antennas. Because most late model, top loaded CB antennas do not have tuning tip, you may need to improve one (details on how to do this later).

Building Fiber Glass Rod Helicals

The light weight of fiber glass fishing rods makes them useful in helical antenna construction. Weight can be important when four or five antennas are placed on one spring mount.

Choosing a Fiber Glass Rod

You can find fiber glass rod at garage sales and flea markets. Poles with broken or missed guides and handles can often be bought for almost nothing. Look for hollow rods at least 4 or 5 feet long with a 3/8 to ½- inch diameter near the handle. You can use smaller, solid rods, but they require heavier, larger loading coils. Use one- piece rods with no metal ferrules or joints. It is possible to use larger rods with metal ferrules if you cut them out and rejoin the rod pieces with epoxy.

One way to do this is to slide one end into the other, or use a tight – fitting piece from a solid rod as an internal splint. Refer to **Figure 3** for construction details.

Base

Remove all windings, wire, and thread, along with the tip, guides, and any foil of metal bands.

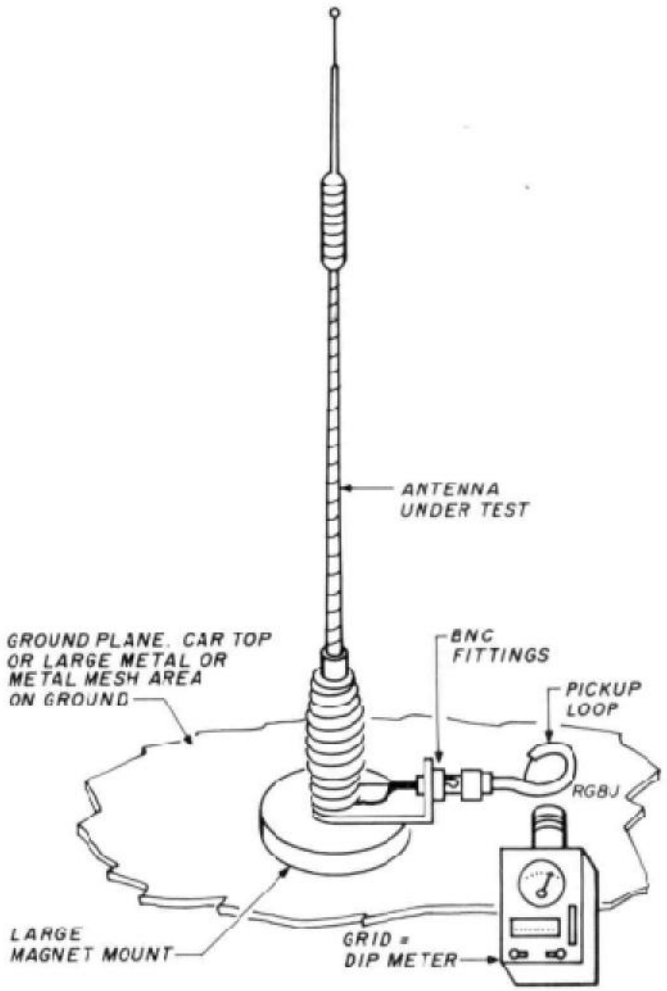


Figure 2

Remove the entire handle, unless it appears that an inch or two would make a good base mount. There are so many different types of handle attachments that it is difficult to prescribe a standard of construction. Keep in mind the cross- section drawing of **Figure 3**. You need to mount a 3/8- inch diameter steel or brass bolt with no. 24 thread 1-1/2 to 2 inches long in the base after cutting off the head of the bolt. Use two-part epoxy to hold this bolt in place. The 5 minute kind will save construction time.

How drill and tap through the bolt and handle to provide an electrical connection. Brass bolt (8- 32) are ideal. Use a solder lug to attach the antenna wire, soldering to both the lug and the screw head. You should cover the complete base with shrink or several coats of good enamel, or both.

Stem

Cut a length of wire, preferably no. 18 copper enameled (no. 20 or 16 will do), for frequency desired.

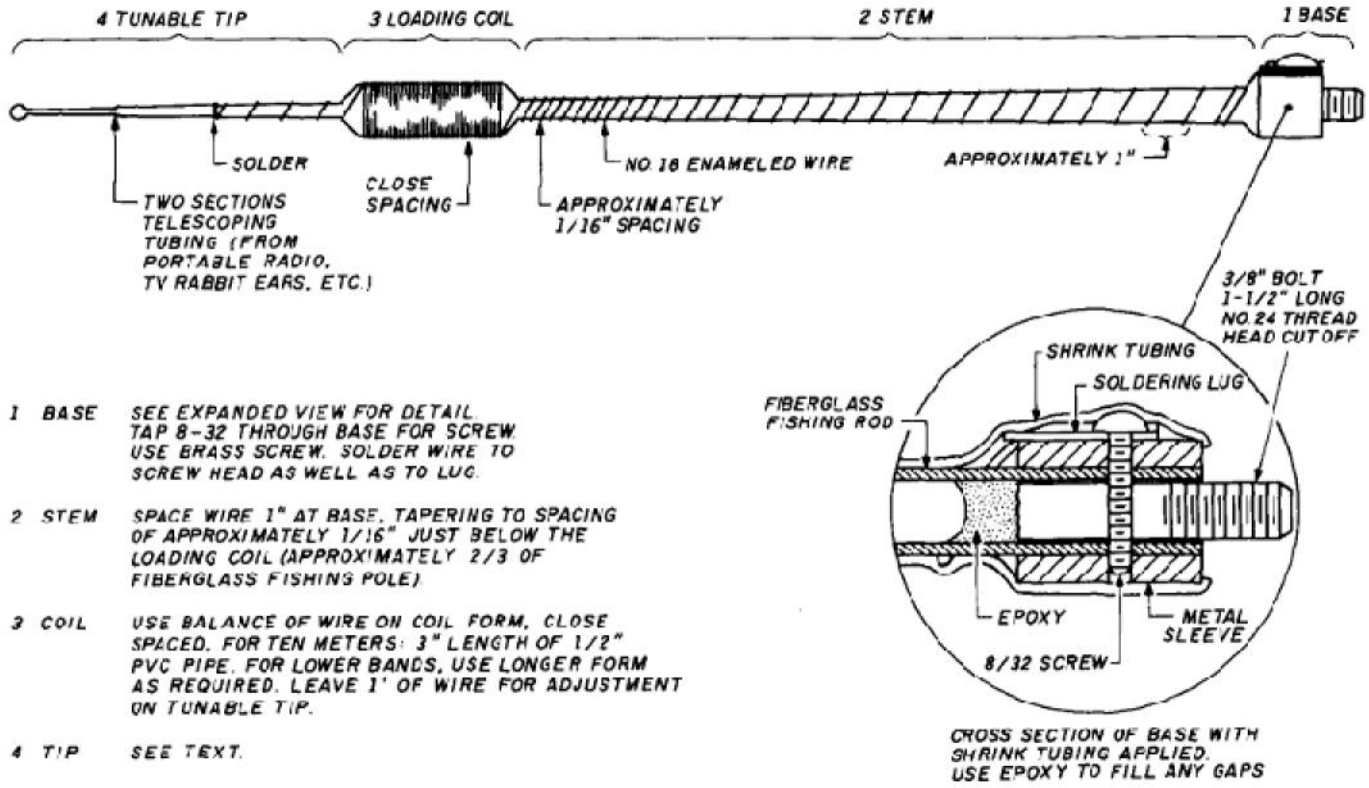


Figure 3

The length should be one half wavelength plus approximately 12 inches. To find the length for one-half wavelength in feet, divide 468by the desired frequency in MHz. You can do the winding by hand, with help of another person, or by improvising a jig like that in **Figure 4**. If you have access to a 0 to 120- V Variac, you can use a 3/8-inch or larger electric drill (see **Figure 4**). If necessary, use a handle with 3/8-inch or larger drill chuck mounted on it, instead of the electric drill setup shown.

With the shaft turning slowly, wind on about one – half or a little more of the wire allotted, starting with spacing of about 1 inch.

As you reach the loading coil position, gradually reduce until the turns are barely separated. The bottom of the loading coil should be roughly 12 inches from the top of the pole.

Loading Coil

The loading coil offers several variations. You are, of course, dealing with low power here- in the area of 100 watts or less.

This is definitely not a high powered linear amplifier.

If you are using a “fat” pole (5/16- inch or larger diameter at the loading coil position), you can wind the loading coil directly on the pole- especially for 10 or 12 meter antenna. However, VSWR usually seems to be better with larger diameter. A loading coil of ½- inch PVC pipe works well, but if fiber glass poles with larger ends are available (say1/2 inch or slightly larger) a short section cut from the larger end would be lighter and better.

You will have to improvise when mounting the coil form. Corks with a hole in the center and some epoxy will do the trick.

Cut or grind off the excess part. The small mushroom shaped wooden buttons used for covering screw holes in furniture work nicely for ½- inch PVC by enlarging the hole in the end of the pipe. These buttons usually cost a dime or less at most hardware stores.

If the loading coil is approximately ½- inch in diameter, it should be about 3 inches long for 10 and 12 meters, 4 inches long for 15 and 17 meters, and about 5 inches long for 20 meters.

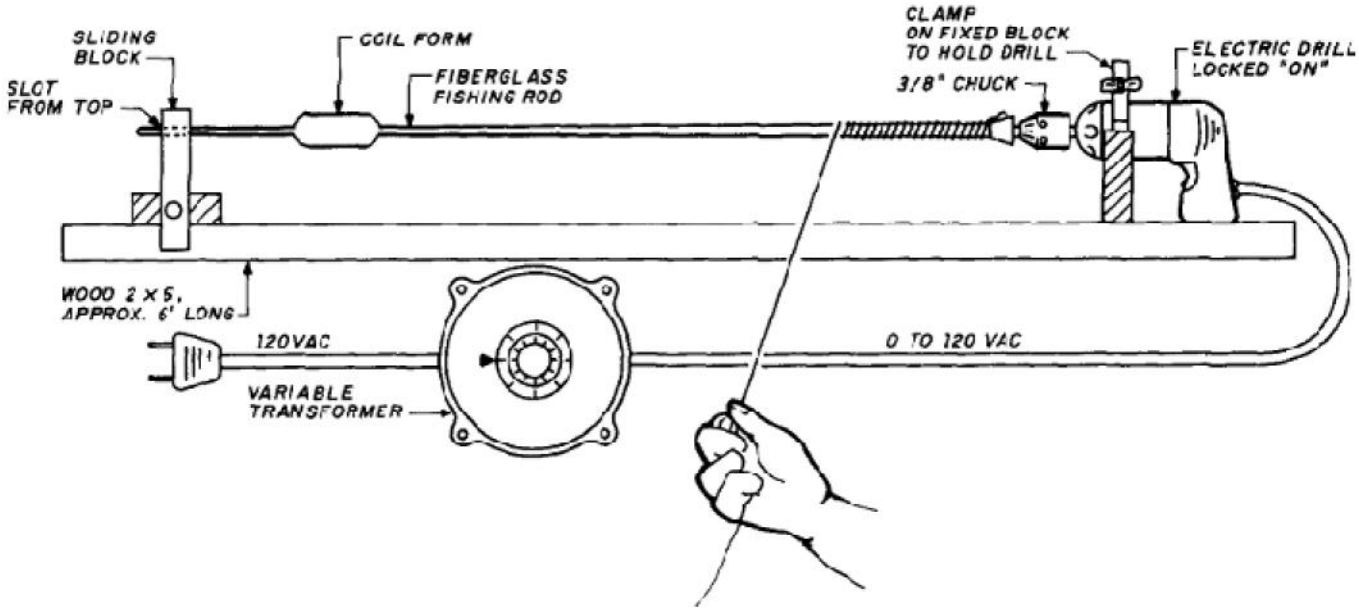


Figure 4

Wind all the remaining wire, except for the last 12 or 14 inches, close spaced on the loading coil form. The remaining 12 inches or so of the wire can be loosely spiraled up the pole to hold the wire steady for testing. You can use tape or epoxy to hold turns in place where needed, like the beginning and end of the loading coil.

Noe you are ready to screw the assembly onto the spring magnet mount. Place the antenna on the ground plane in the yard or on top of the vehicle. Use a grid – dip meter and VSWR test equipment as described in the section on testing.

It may be necessary to cut off half or more of the last 12 inches of wire. If, after cutting it all off, the resonant frequency is too low, remove a few turns from the top of the loading coil and extend the last 12 inches as before. Then recheck the resonance with a grid- dip meter. This may all sounds like a lot guesswork, but it seems that you have used a prescribed amount of wire, the antenna will almost always work out when vary last 12 inches.

All the bands can have nearly the same pole length of about 5 feet, if you desire. The big variable is loading coil. Removing 1 inch from the tip will make a rather large difference in resonant frequency, but you have need remove several inches from the loading coil to make a similar difference.

Tunable Tip

You can make the tip adjustable if you wish by using telescoping sections from TV rabbit ears, old auto or portable radio antennas, and so forth. Use only two sections; choose that that will fit the rod above the loading coil after cutting off excess fiber glass rod Epoxy the tip onto the rod after sanding of spot of chrome to allow for easy soldering of the wire end. The total midadjustment length of the telescoping section will be a little shorter than the length of wire it replaces because of greater capacitance of the tubing. Recheck the VSWR, and if the midrange setting hits the desired VSWR at the frequency selected, the section is ready for completion – after you plug the hole in the end of the tip.

With the exception of the sliding tip, you can use heat-shrink tubing over the length of the antenna. This can be a bit difficult because of the larger diameter of the loading coil, and possibly the base. It may be expedient to shrink tubing over the steam area before sliding on the loading coil form. Have two or three sizes of heat- shrink tubing on hand. If places remain where the tubing does not fit closely, fill the gap with epoxy and sand smooth.

To shrink the tubing on long items like antenna, try a toaster oven. This is another easy to find garage sale item, you can often find one for $ 3 to $ 5. You can dedicate your oven to this type of service by cutting a 3 or 4 inch diameter hole in the back.

Finally, spray the antenna with two or three coats of good enamel.

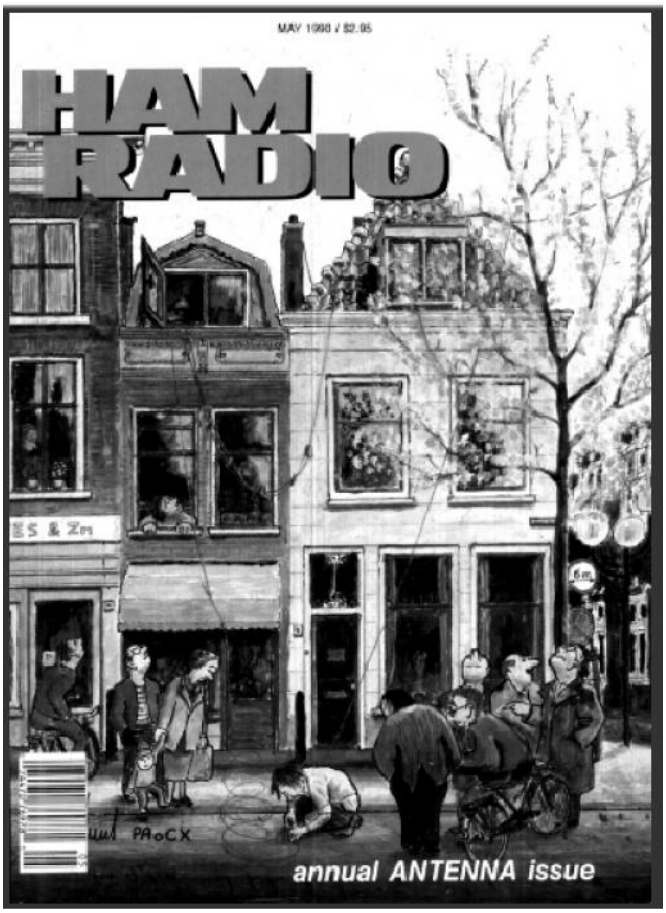
If you are not particular about its bulky appearance, ½-inch PVC pipe makes quite satisfactory antennas. Using PVC eliminates the need for a form for loading coils. Otherwise, follow the procedure for col winding and use the same amount of wire. The tunable tip will require some kind of cap or plug with a hole on it. Seal the tip well to keep water out.

Conclusion

Anyone who likes to experiment will surely enjoy using some combination on the antennas described. On a recent trip to southern Missouri, I made contacts on all five bands using the antennas in **Photo** and Yaesu FT101E modified for WARC bands. I also worked 17 stations in Europe and Asia in 2 hours operating time. I made contacts on 40 meters by attach a 33- foot wire to a common feedpoint and throwing the other end up into a three. Attaching the 40- meter wire did not affect the operation of the five helicals on the spring mount. Your result can be equal to those obtained with expensive commercial products.

The features I have tried to stress here are:

- Top loading has an advantage over middle or bottom loading.
- Top of vehicle mount is superior to bumper mounting.
- Multiband operation is possible with one lead.
- Good efficiency occurs at low power.



Front Cover of the
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But in the final analysis, great economy and the fun of building ones own equipment are probably the best features of all.

Credit Line: Ham Radio/May/1990/pp.: 24-29

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