Economical Mobile HF Antenna

Modify a CB antenna for the ham bands.

by John Portune AA6NG

When you think "mobile HF antenna," what comes to mind? Big and ugly? If so, you're normal. Little wonder so many hams have turned, in just the last three decades, to the convenience of VHF and UHF repeaters. Yet mobile HF still offers many advantages. On long trips and in remote areas, it is unequalled for fun and safety.

I couldn't bear the thought of a gigantic loading coil, a ball and a spring, on my new, small car. Fortunately, I found an answer. This article describes that solution—a modified commercially-built, base-loaded CB antenna. It has proven itself remarkably efficient, as well as an attractive partner to my diminutive new car and modern mobile transceiver.

Perfect for Modification

The current model Radio Shack 21-908A Trunk Lid Mobile CB antenna ($26.95) is ideally suited for conversion to HF. It has a loading coil that comes apart, making it easy to rewind, and is shunt-fed, making it easy to match. This second feature is very important.

In the past, HF rigs had output tuning networks which could match the low impedance of a mobile whip. Today, however, many mobile rigs are "no tune." They must see a 50 ohm load to function correctly. An antenna, therefore, must not only be tuned, but also impedance-matched, before it can accept power from such a rig. The preferred way is to add an additional small shunt coil from the feedpoint to ground. The Radio Shack antenna has this feature built in. A ball-and-spring setup does not.

Since modifying the first of several of these antennas, I have operated them on most of the ham HF bands, and have rarely been disappointed by an unanswered CQ. The little antenna has proven to be a winner.

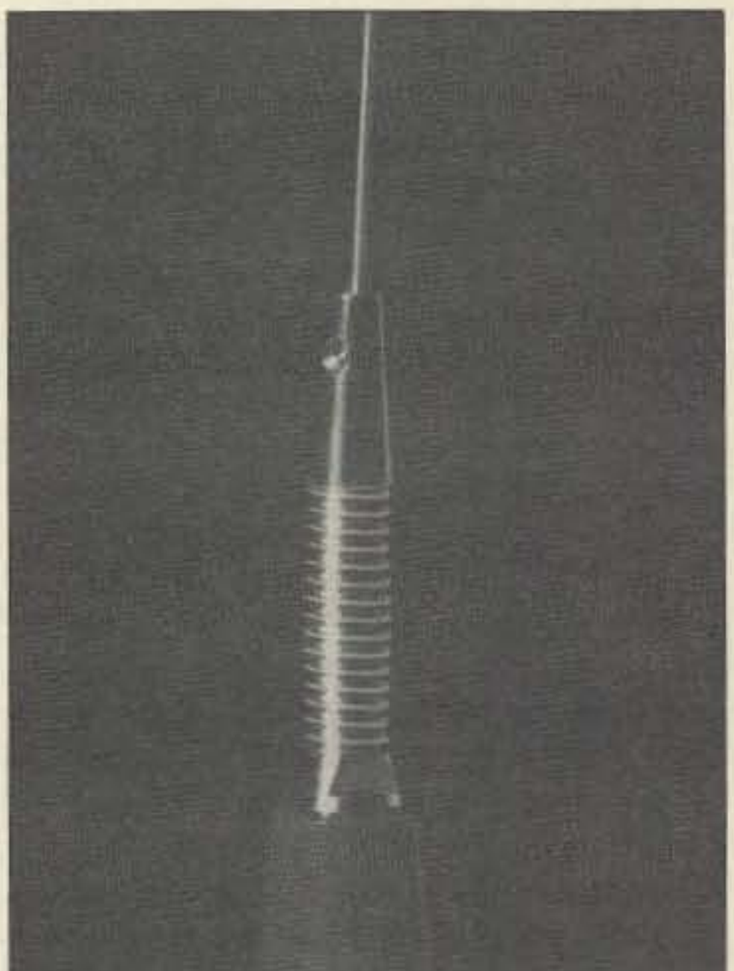

Photo A. This antenna is rugged, attractive, and easily mounted on the trunk lid. The whip may be adjusted in length by loosening the set-screw.

A Magnetic Mount Version

This same antenna also comes in a magnetic version, model 21-940. I had originally hoped to use it. But there is a problem. A magnetic mount relies on capacitive coupling to the car's metal body. It effectively adds (see Figure 1) a capacitor (Cm) in series with the antenna.

For 20 meters and higher, this is not a problem. But as the frequency gets lower, the reactance of this capacitor will eventually exceed 50 ohms. When it does, there is no 50 ohm tap point on the loading coil.

The trunk lid mount, with a real electrical ground, eliminates the problem. But if you are content with 20 meters and above, you

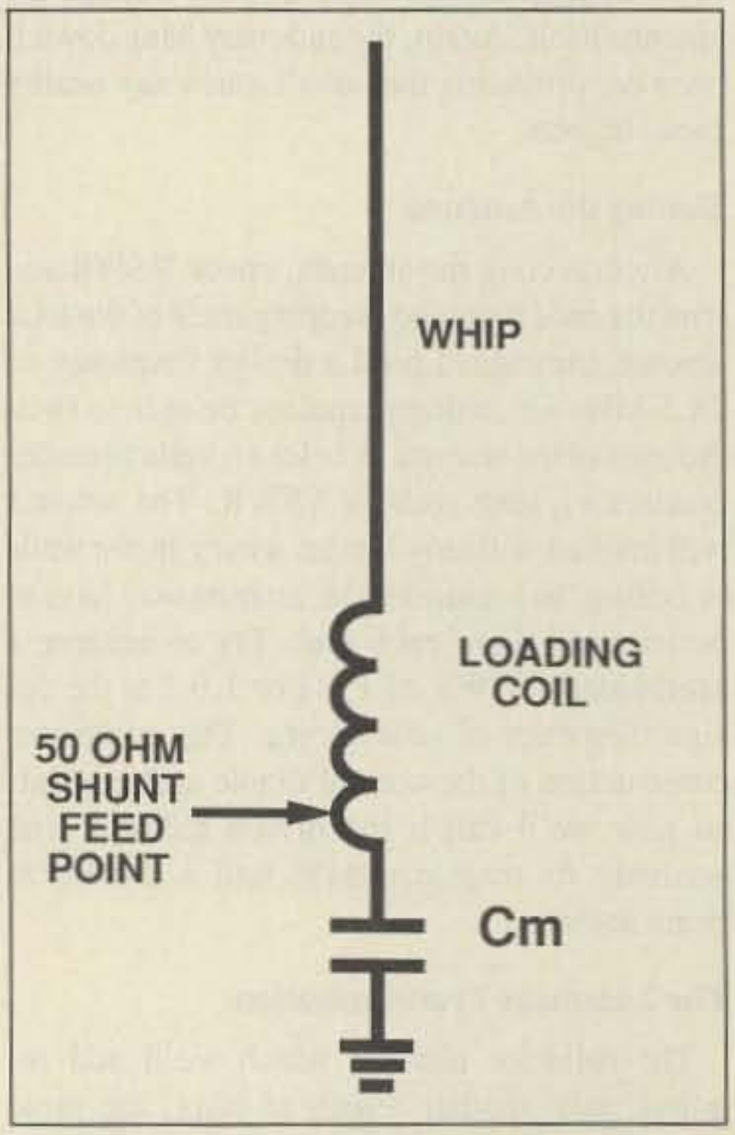

Figure 1. The circuit of the antenna on a magnetic mount. "Cm" is the effective capacity of the mount. At lower frequencies, the reactance of "C" exceeds 50 ohms, and impedance matching is not possible.

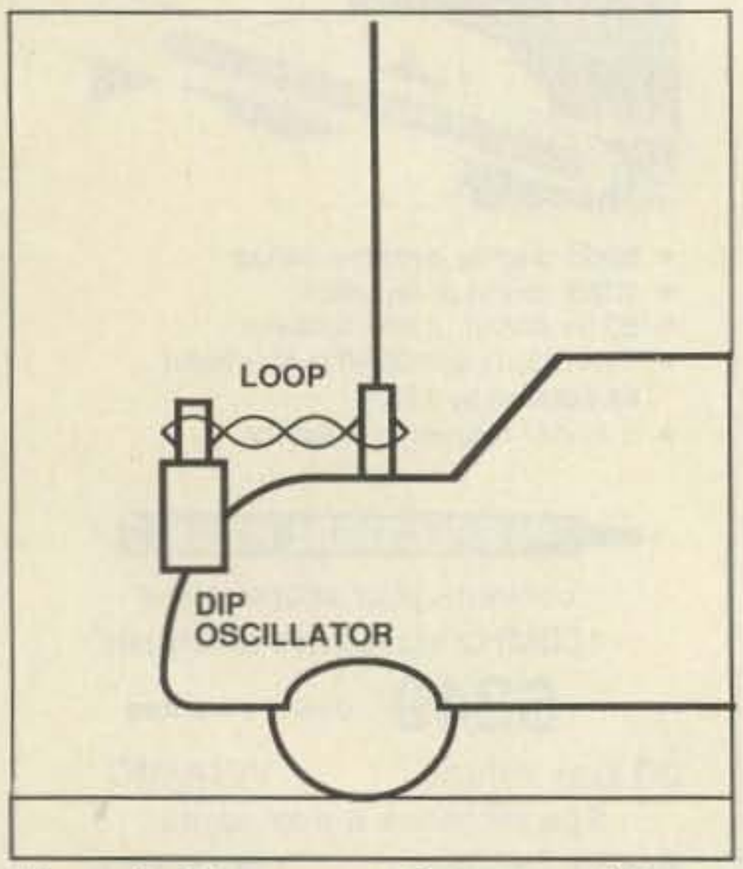

Figure 2. The resonant frequency of the antenna may easily be determined with a dip oscillator coupled to the antenna by a loop of twisted hook-up wire. Keep away from the antenna when dipping. The antenna feedline should be connected to the transceiver during the measurement.

may wish to use the magnetic mount. Some additional turns will have to be added to the coils, however, to counteract for the series capacity of the mount.

Modifying the Loading Coil

The loading coil is easily pushed out of the gray plastic housing for rewinding by pressing the threaded stud against a firm surface. Two well-placed O-rings protect the assembly from the weather. Be careful of these during modification, as they are easy to damage.

Notice that the coil has two sections. Tuning of the antenna is accomplished mostly by the upper coil, the impedance match by the lower. The feed from the center conductor of the coax is a shunt tap between the two coils.

The correct number of turns and wire gauge for each band is given in the table. The values are for the center of the band. Operation on 80 meters with this antenna is impractical due to the small diameter of the wire that is required.

You will also have to perform minor surgery on the plastic coil form. It comes with molded ridges to space the windings of the CB coil. For all but 10 meters, these should be removed with a coarse file or a hobby knife. A slight touch of the soldering iron will secure the new windings. Be sure to use the wire size listed. Also, wind all turns tightly together at the bottom. Different sizes of wire, or spaces between turns, will significantly change the number of turns required.

Tuning the Antenna

Once the completed antenna is assembled and installed on the car, tuning may be accomplished. This is not difficult, but it is touchy, owing to the size of the antenna. The smaller a loaded mobile whip, the narrower its operating bandwidth. Also, the bandwidth becomes more critical as the frequency goes down. On 10 meters the bandwidth is quite broad, but on 40 meters it is very narrow.

You will, therefore, have to slightly alter the number of turns on the loading coil for the specific spot on the band where you operate, especially on the lower bands.

A small amount of tuning is also possible during operation by adjusting the length of the whip. Use a turn or two less on the coil than for the frequency where you operate, with the whip all the way in. Then, by extending the whip, you will be able to lower the frequency to your precise operating point.

I leave a small SWR bridge in the feedline mounted near the transceiver. On low-power tune position, it is easy to find where the antenna is tuned—it's where the SWR is at a minimum. I then adjust the length of the whip until the antenna is perfectly tuned for my operating spot.

More Energetic Changes

If you wish to depart from the listed values more than a little, such as to build a version for a band not shown, you can use the help of a dip oscillator.

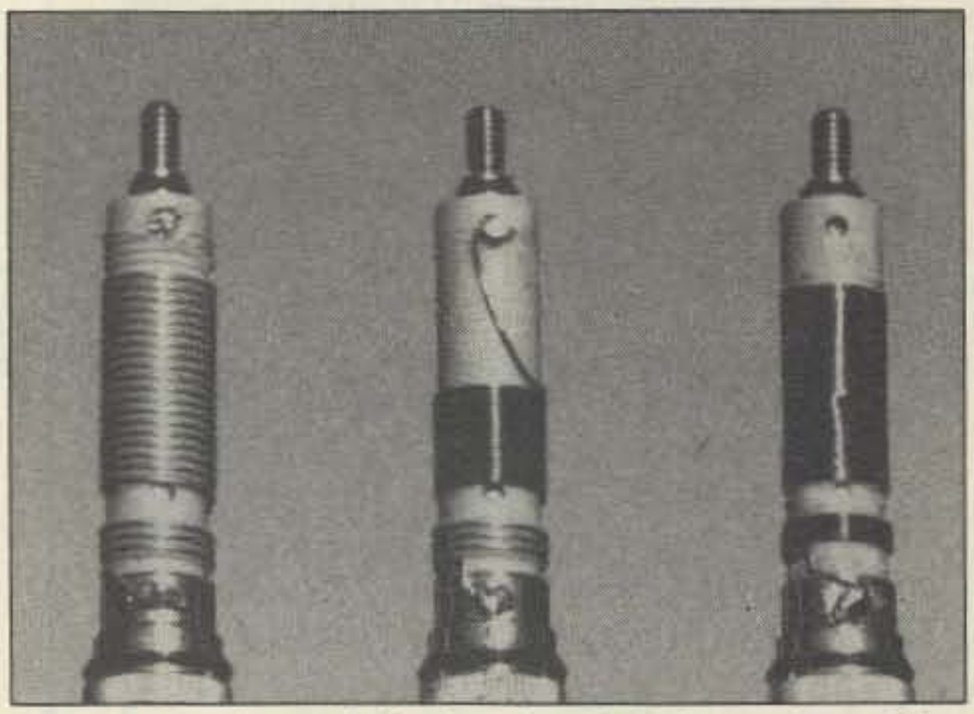

Photo B. Loading coils for three bands. Left to right are 10m, 20m, and 40m. Notice the spacing ridges on the 10m coil. Revolve these, and close wind coils for all other bands.

To do so, mount the antenna on the car and connect it to your transceiver (an open feedline will alter the operating frequency). Leave the gray plastic cover off of the loading coil during tuning.

Make a temporary coupling loop out of solid-conductor insulated hook-up wire, or from wire-wrap wire. See Figure 2. This loop will let you "dip" the antenna, to find its resonant frequency, without being too near it and changing its resonant frequency by body capacitance.

It is also a good idea to check out the test setup first with a known antenna, such as the stock CB version, before removing or adding turns.

First use your transceiver's receiver to verify the calibration of the dip oscillator on 10 meters. Then see if the stock antenna dips in the CB band (Channel 19 = 27.185 MHz). Then make a small modification to the coil. The dip oscillator will give you a fair indication of how far you have moved the resonant frequency. Repeat this process until you are inside the desired band.

You will then be able, using your transceiver and an SWR bridge, to locate the exact frequency that the antenna is resonant to. The SWR will be lowest at this frequency.

The necessary number of turns for the matching section of the loading coil is found by noticing how low you are able to get the SWR as you cross the band with a brief test transmission. Add or subtract a turn at a time until the SWR is near 1:1 at the resonant frequency of the antenna.

A Word About Power

Finally, be cautious about power. I use the antenna satisfactorily with an average 100 watt SSB mobile radio. But it is possible to exceed the power limitations of the antenna (the steady carrier power limit is 25 watts). The RF current in a short mobile antenna can be quite high, especially on the lower frequencies. Therefore, avoid more than brief key-down steady carrier situations. The loading coil could melt. Normal SSB voice transmissions will not be a problem.

An Attractive Compromise

Admittedly, from the purist's point of view, this little antenna lacks some in theoretical efficiency. A longer whip, a larger loading coil, or a capacitive hat would technically improve performance. But getting away from these is the object of the design.

By actual measurement, these changes would only offer minor improvement. To me, it's a small price to pay for the fact that I am one of the few in my ham circle who continues to enjoy HF mobiling in the days of tiny modern cars. The only drawback I've encountered is snide remarks from ham friends about a "good buddy" antenna on my car. They think I'm a traitor. I just smile and leave them in ignorance. 73

You may contact John Portune AA6NG at 724 Celestial Lane, Foster City CA 94404. If you request info, please include an SASE.

Turns Required on Loading Coil

Band	Upper Coil Turns (AWG)	Lower Coil Turns (AWG)
10m**	18 (*)	3.5 (*)
15m	21 (21)	3.5 (*)
20m	42 (21)	3.5 (*)
40m	82 (28)	5.5 (21)

*Existing AWG.
**Radio Shack recommends cutting the whip for 10m operation. However, the antenna will be more efficient if you rewind the coils according to this chart.