Mike Jones's

antenna workshop

Mike Jones G3UED describes his low profile vertical antenna design, suitable for use either at home or for portable operating.

A Low Profile HF Multi-Band Vertical Antenna

So low profile – the antenna almost disappears in the Wisteria bush!

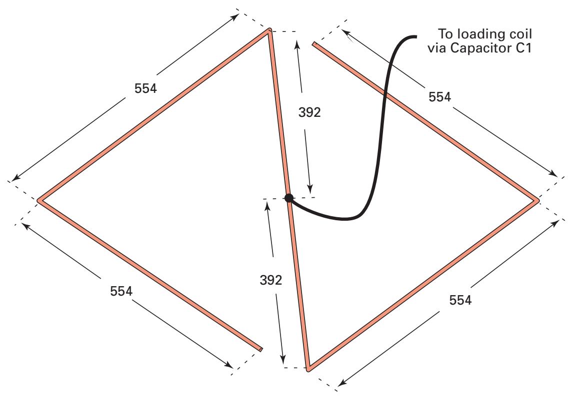

Fig. 1: Fold the counterpoise end-plate, made from 10mm diameter copper pipe or stout wire on a wooden frame, into this shape.

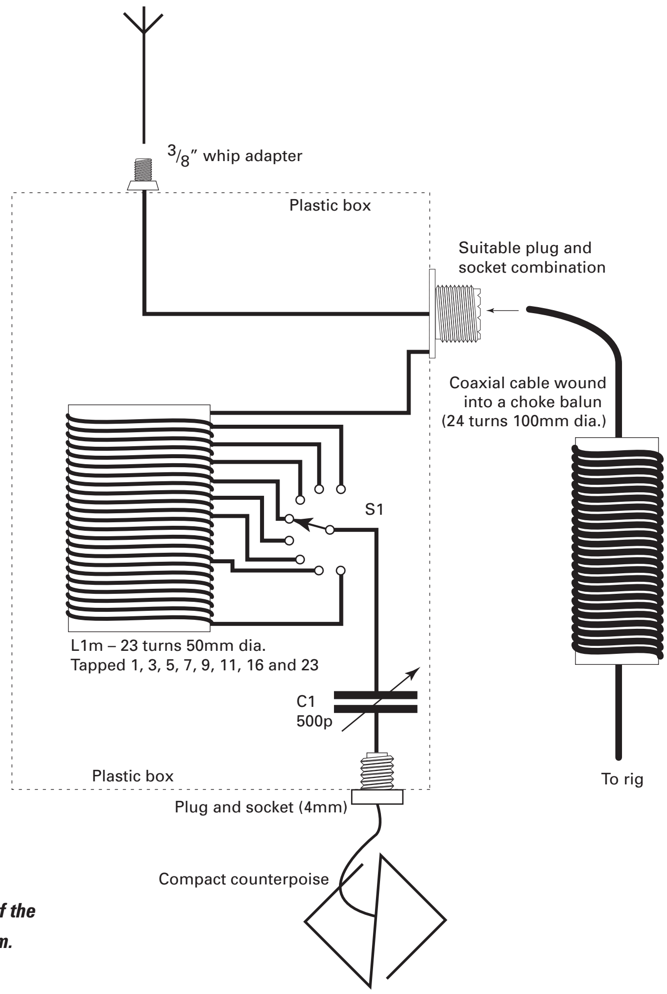

Fig. 2: Overall arrangement of the antenna system.

My problem was how to operate on more than one high frequency (h.f.) band using a cost effective antenna system with a very low visual impact. My aspiration was to be able to operate on 14MHz (20m) particularly, but also on 18 to 24MHz (17, 15, and 12) and, maybe, 28MHz (10m) when the next sun-spot cycle progresses. Working long distance (DX) was not a priority, but Europe and maybe a little beyond was my hope!

A Vertical Solution?

My thoughts were that a vertical antenna of some sort might be an ideal solution. This conjured up images of ¼ wavelength (λ/4) vertical rods and a multitude of buried earth wires for the ground-plane. So, more research was needed.

A short loaded vertical radiator would be visually acceptable, omni-directional and have the potential for low-angle radiation. So, I decided to investigate even further!

Mobile whips sprang to mind as they offer the advantages of being commercially available and readily brought to resonance on their respective bands. Designed for use on vehicles, they normally use the vehicle structure as the ground plane.

However, reference to *HF Antennas for All Locations* (by the late **Les Moxon G6XN**) suggested that a compact loaded counterpoise might be effective.

I purchased a set of six 2.25m-long whips, for 3.5, 7, 14, 18, 21, 24MHz, for about £80 and, although hopeful that I could do something useful for 14 to 24MHz, I didn't expect good results on 3.5 or 7MHz.

My wife **Peggy** and I have a pergola just outside our house and this supports a Wisteria. This seemed like a good position to mount my whips as it offered a mounting height of about 2m (approx 6ft 6in) and was readily accessible using a short step-ladder.

Compact Counterpoise

Next, I set about making the compact counterpoise and to minimise losses, I made my counterpoise out of a 3m length of 10mm diameter copper tubing. Following G6XN's suggestion, I bent the tubing into the shape shown in **Fig 1**. **Note:** An alternative form of counterpoise might be a wooden cross-piece supporting stout wire bent into the same shape.

Because I expected different values of loading coil to be required for each band, I used a coil of 23 turns on a 50mm diameter former out of the junk box. I also incorporated a switch to enable a fairly wide range of inductance values to be selected. In addition, I included a variable capacitor in series with the loading coil to allow precise loading for each whip.

The diagram, **Fig 2**, shows the overall arrangement with photograph, **Fig. 3,** showing the finished article, minus a whip.

Waterproof Box

The coil, switch and variable capacitor were installed in a waterproof ABS plastic box. I then fitted a 3/8in coupler for the whips, to the top lid using a small (approx 100mm x 30mm) strengthening plate.

To minimise hand capacity when making fine adjustments, I think that the variable capacitor is best mounted towards the rear of the box, with a plastic extension shaft to reach the front panel. I used a brass bush (taken from a scrapped light fitting) for the shaft and lubricated it with plenty of petroleum jelly to prevent water ingress.

Installation of the items within the box depends upon the actual items used. In my case, a piece of copper clad board secured to the base of the box provided a mounting platform for the coil and an off-cut, drilled to take the variable capacitor and was soldered to this platform providing a rigid installation.

A lead from C1 to a 4mm socket located on the rear panel of the box provides for the final connection to the counterpoise. Switch positions were marked on the box using a waterproof marker and a similar scale marked in 5° steps using a protractor for C1. The photograph, **Fig. 5**, shows the completed installation of the components within the box.

The counterpoise was secured to the top of the box using 10mm cable clips and a fly-lead soldered to its centre taken via a 4mm plug to the socket on the rear of the box. The whole assembly was secured to one of the cross members of the pergola (**Fig. 4**) embedded in the Wisteria – with no ill-effect to the vine-like plant! A height of about 2m seemed to be optimum, bearing in mind the need to easily replace whips to change bands and to make adjustments to **S1** and **C1**.

Testing Time

Then it was time to test the system and initially, there was unacceptable r.f. coupling from the antenna to the feeder cable screen, giving erratic results. Some experimentation proved that the best solution was a choke of 24 turns (cable is 6m in length) of RG213 coaxial cable, close wound on a 300mm length of 70mm diameter plastic drain pipe inserted between the plastic box socket and the feed cable.

I installed the choke horizontally from the box, running the feeder cable down one of the vertical posts and then to my ground-floor shack and the photograph, **Fig. 5**, shows the choke in-situ. This completely resolved the coupling problem on all bands.

Whip Adjustment

The whips are adjusted simply by loosening grub screws at the base of the top whip section and moving this in and out as necessary to bring the antenna to resonance. Although I used my main standing wave ratio (s.w.r.) meter for specific measurements at my transceiver, I temporarily connected an old ex-CB radio s.w.r. meter in line between the feeder cable and the choke to enable adjustments to be made.

Initial adjustment was carried out using the instructions accompanying the whips. With a **low** level r.f. output from the transceiver, I adjusted **S1** and **C1** for the lowest s.w.r. reading on the meter outside. then, by adjusting the frequency from one end of each band to the other, it was possible to identify whether the whip should be shortened

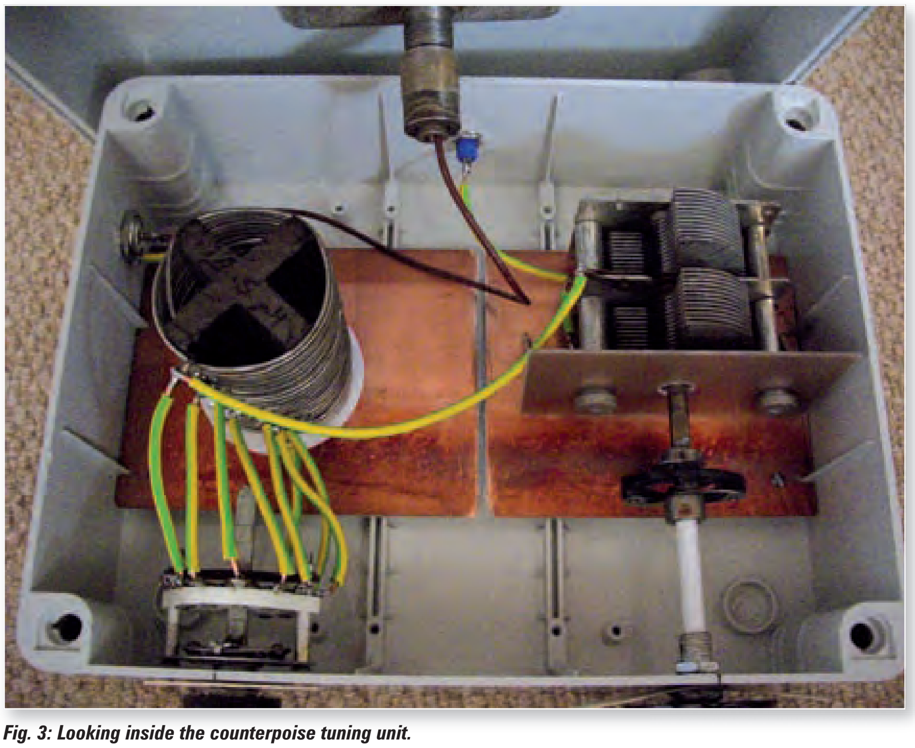

Fig. 3: Looking inside the counterpoise tuning unit.

Mike Jones G3UED
PW Publishing Ltd.,
Arrowsmith Court,
Station Approach,
Broadstone,
Dorset BH18 8PW
E-mail: antennas@pwpublishing.ltd.uk

Fig. 4: The tuner and counterpoise at the top of a pergola, and hidden in a Wisteria!

or lengthened to achieve resonance. An alternative approach is to use a 1-turn link at the shack-end of the feeder cable and couple this to a grid (or gate) dip oscillator (g.d.o.), then adjust whip lengths accordingly and adjust S1 and C1 for the lowest s.w.r. reading.

The adjustment procedure was quite time demanding and tedious – but the results were very rewarding! In fact, I have achieved s.w.r. readings of less than 1.5:1 across all bands except 7MHz.

Bandwidth on 7MHz was limited (approximately 65kHz) and adjustment of C1 was required as I moved from one end of the band to the other. However, on the higher-frequencies, adjustment at the band centre provides a low s.w.r. across the entire band.

Unfortunately, 3.5MHz was not so successful, even with two additional 6m long wire radials attached. However, I think my arrangement should operate just as well on 28MHz as on the other h.f. bands.

Contrary to my expectations, only slight variation was found between summer and winter. This was despite the fact that the Wisteria produces abundant foliage in the summer and sheds it all in the autumn!

Resistive Losses

Resistive losses can be reduced by the use of copper tubing for the ground plane and stout wires for the coil and connections within the matching box. My coil was wound with 2mm bare tinned copper wire and I used 1.5mm copper wire for all internal connections.

Because the feed point is at low impedance, r.f. currents here are high and voltages low. Consequently, C1 can be any good quality air-spaced capacitor without the need for wide spacing. Switch S1 also needs to be of good quality with low losses. I used an eight-way ceramic wafer switch.

My final results suggest that for 14 to 24MHz, only 2-tap positions are required and therefore it should be possible to use a coil of only six turns and a three or four-way switch. In fact, because these switches are now difficult to come by, a 4mm wander plug and three or four matching sockets could be used thus reducing cost. The illustration, **Fig. 6**, shows how this could be done. (For 7MHz, all 23 turns were required).

On 14MHz, received signal strengths are generally comparable with my 20m sloping dipole installed in the attic of my two-storey house. Using the 14MHz whip, signals are often stronger and never more than two S-points down! Interestingly, the noise level is lower when using the vertical whip.

Pleasing Results

I've been very pleased with the results using 100W from my Icom IC-718 transceiver. On 14MHz, my best DX was **3B8CF** in Mauritius and I've also received good reports from North American stations. Interestingly, 7MHz gave unexpectedly good results, my first call to a Norwegian station **LA0HK** resulting in a very pleasing R5 and S9 report. Numerous European contacts on the 7 to 24MHz bands have given me great satisfaction – with a low visual impact antenna that causes no domestic conflict!

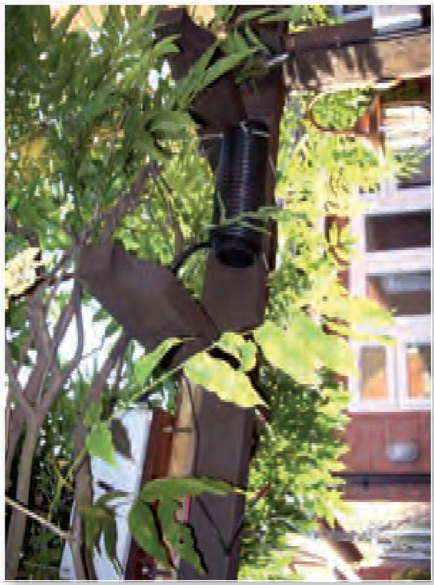

Fig. 5: The choke balun runs down, and is attached to a leg of the pergola.

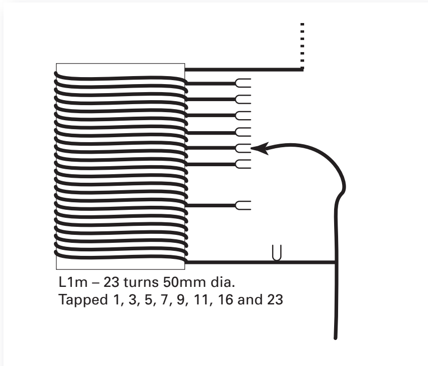

Fig. 6: An alternative to using a switch for band-changing, is to use a 4mm plug and sockets.

As well as making a useful main-station h.f. multi-band antenna system, this design would also be ideal for temporary or portable operation. It could also be installed in a loft, but don't forget the need to make adjustments and change whips, if multi-band operation is planned. I'm hoping my new antenna system will prove very effective, particularly on the higher bands, as the next sun-spot cycle progresses. ●