Antennas

The GM3RVL 'Joiners Delight' loop antenna

PHOTO 1: The overall construction of the 'Joiners Delight' antenna. The element is made from a 3m length of 22mm copper tube bent into an approximate circle of approximately 950mm O/D.

REDUCING LOOP LOSSES. The description of my magnetic transmitting loop in September's Antennas resulted in some feedback. The most interesting of these was a description of a loop antenna designed and built by Harry Brash, GM3RVL. He has been fascinated by small transmitting and receiving loops for a long time and followed the controversy about them in *RadCom* and elsewhere. His view is that losses are the limiting factor and the trick is to make the loop as loss free as possible – and that has to include the immediate surrounding electrical environment.

As part of the investigation into loop losses, GM3RVL made some tests with loops constructed using standard plumbing angle joints, soldered and mechanical. As a rather primitive test, he passed significant DC currents across joints and was surprised at the poor electrical connections at DC. He assumed losses would be worse at RF but had no suitable test equipment to make the appropriate measurements (more about this later). He goes on to say, "The other obvious issue regarding loop Q was the connection to the tuning capacitor. I was surprised how some constructors put great effort into making a high performance loop and then used quite crude connections to a standard variable capacitor. I felt that the arrangement I finally chose was as close to the ideal as possible, apart from making the whole thing from silver. It would have been good to use copper capacitor plates and spot welding in place of soldering but soldering was my only option at that time."

CONSTRUCTION. The overall construction of the antenna is shown in **Photo 1**. The element is made from a 3m length of 22mm copper tube bent into an approximate circle of approximately 950mm O/D. The ends are flattened and soldered to two 8in square 1/16in thick brass plates, which form the capacitor. The rest of the structure is made of wood, apart from some Perspex insulators to mount the plates to the two long strips of hardwood.

The mechanical tuning arrangement is shown in **Photo 2**. There is a hinge at each point marked with an arrow. The offset arrangement of the hinges results in the two capacitor plates being moved closer together as point A is raised, and vice versa. Tuning is therefore accomplished by moving point A up and down using the hardwood dowel D. Rough adjustment (band change) is accomplished by releasing the clamp C and setting to marked positions of the dowel. Fine adjustment is by moving lever F.

The mechanism as illustrated in Photo 2 is set so that the capacitor plates are spread apart for the higher frequency bands. With the dowel raised, as shown in **Photo 3**, the capacitor plates are moved so that they are close together for the 30 and 40m bands. On the 40m, the plate spacing is only a few millimetres and GM3RVL reports that the tuning was very 'touchy', although he made some contacts. When the loop is mounted outside, any movement due to wind affects the tuning due to the small capacitor plate separation.

OTHER CONSTRUCTION ISSUES. To overcome the perceived losses due to joints in the loop element, GM3RVL made his loop out of a single section of 22mm copper tube as shown in the photos. He used a bending spring with a wire extension so that the spring could be placed anywhere along the 3m length of the tube. This worked well, provided the bending was done gradually. He avoided the temptation to bend too much at a time, which could cause the spring to jam in the tube. Be warned, bending the tube is hard work!

The first version of this loop used aluminium plates for the capacitor. These were tinned using so-called aluminium solder (possibly the Radiospares version). The solder appeared to tin the aluminium well enough but difficulty was experienced soldering this arrangement to the ends of the copper loop. The aluminium capacitor plates were replaced by brass plates at a later stage and fixed to the loop ends using conventional solder, which gave joints that looked more 'convincing'. No change in performance has been noted.

MATCHING. Various methods of matching the feeder to the loop were tried. GM3RVL notes, "The biggest SWR improvements occurred when I moved from loop coupling to a gamma match. It wasn't so much that the loop wouldn't match; it was that the gamma match was easier to tune. It didn't require so much critical adjustment. Additionally it was less sensitive to band changes."

GM3RVL has since reverted to loop coupling because he was unsure of the gamma match efficiency and he wanted to avoid coupling the feeder directly to the loop. He goes on to say, "I'd be interested in your comment on current loop coupling practice. The Faraday screened loop in Figure 15.55 on page 15.28 of the *RSGB Handbook* (later editions) is wrong, in my opinion. I have seen this arrangement described in several places. As I understand it, the broken braid on both sides at the top of the coupling loop should be unconnected and only joined to the other braid and the centre conductor at the bottom feed point.

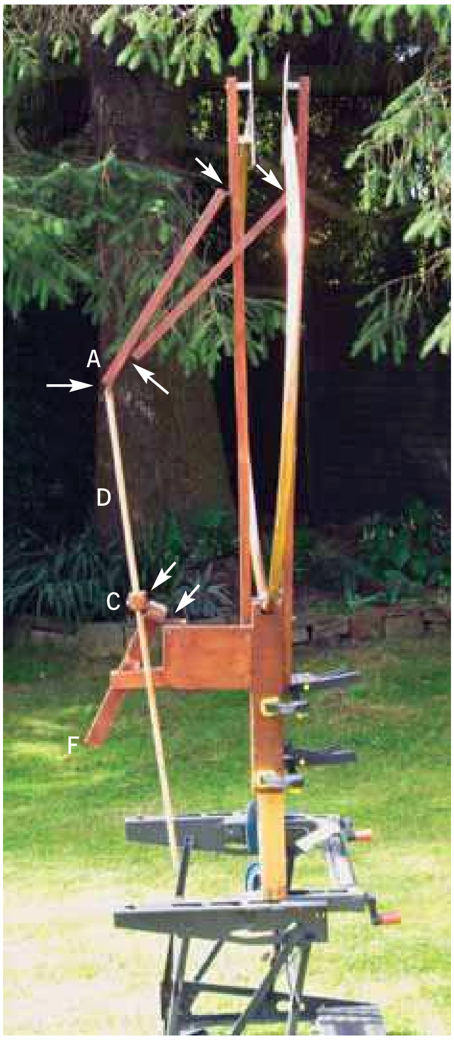

PHOTO 2: The mechanical tuning arrangement of the 'Joiners Delight' antenna.

Otherwise it is not a Faraday screen.

"I made a Faraday screened coupling loop (1/5 diameter of main loop) using RG213. Without adjustment, it tunes up on 20m (SWR ≈ 1.3:1), 15m (SWR ≈ 1.1:1) and 10m (SWR ≈ 1.1:1). The loop will tune up to 29.5MHz and down to 40m provided there is no wind. The very close spacing of the capacitor plates on that band makes the tuning quite critical, hence the wind 'interference'. The loop has not been tested on 30m at the time of writing."

Photo 4 shows the coupling coil and the fine-tuning lever in more detail. The adjustment at the end of the tuning lever is about 25mm to cover the 20m band, 35mm to cover the 15m band and about 100mm to cover the 10m band up to 29.5MHz. The tuning range on 40m is just a few mm. The tuning movement can of course be changed by altering the mechanics.

As I am responsible for the above-mentioned Faraday coupling loop appearing in the *RSGB Handbook* I feel that an explanation is in order. This coupling loop was included in a magnetic loop design 'Abstimmbare Magnetische Antennan (AMA)' by DL5CZ. Variations of this antenna have been manufactured by FunkTechnik Beese since 1983. Additionally, this type of coupling loop was included in the design by Roberto Craighero, I1ARZ so I had no hesitation of including it – although I must confess I was a little unsure of its Faraday status. Furthermore, I became aware of some disquiet about it so I included the proviso in **[1]**, **[2]** and **[3]**, "The coax inner and braid at the apex of the (coupling) loop (in the illustration) is shown to be joined, which would make it a Faraday half loop. The inner to braid connection should be removed but the gap in the braid should remain."

PHOTO 3: The mechanical tuning arrangement set so that capacitor plates are close together for the 30 and 40m bands.

TESTS. If you use copper pipe joints to make the loop as described in September's Antennas then some method of measuring the resistance of the joint is beneficial. GM3RVL fed 5A DC through the pipe from a current limited power supply and measured the voltage (in mV) across the joint with a digital multimeter. He then calculated the resistance using Ohm's law. He also made a measuring bridge designed for low resistance measurements. One side of the bridge is capacitive, powered by a signal generator, and uses a receiver as a detector. So far it is working correctly with test resistors down to about 0.1Ω but he thinks it needs to go down almost two orders of magnitude to test the pipe joints. Overcoming the mechanical layout for testing the pipes is a challenge, particularly the construction of reliable connections at the ends of the test pieces.

PHOTO 4: The Faraday coupling coil and the fine-tuning lever in more detail.

I used the high current DC method of measuring resistance of my loop by incorporating the pipe section under test in the circuit of high current 10A charger and a lead acid battery (not having a current limited power supply). This worked to a degree but was limited by the 0.1mV resolution of my digital multimeter. Most of the joints caused a voltage drop of 0.1mV although one joint was 0.2mV. This suspect joint was resoldered and further tested to give 0.1mV. The voltage drop of the whole copper loop including the variable capacitor hinges was 18.1mV at 10A, ie a total resistance of 1.81mΩ.

FINALLY. I often receive e-mail (and occasionally letters) requesting advice on certain problems regarding antennas, most of which is to do with fitting HF antennas within the confines of postage stamp locations. I am more than happy to continue doing this and the e-mail system provides a quick and easy way of communication when dealing with these queries. My main difficulty is sometimes trying to envisage the general situation from a plain description. It is much easier for me if a drawing or photograph (or both) of the antenna and layout is provided, bearing in mind the saying that a picture is worth a thousand words.

FINALLY FINALLY. I wish you all a happy Christmas and a pleasant ham radio New Year.

REFERENCES
[1] *RSGB Radio Communications Handbook*, later editions
[2] *Backyard Antennas* P85
[3] *Building Successful HF Antennas*, P108