Antenna Workshop

Short of space? Don't have a garden at all? Want to work from the beach hut? - You need the 'Quick-fix' bulletin board loop as described by Richard Marris G2BZQ.

During a period, many years ago, I was living and working in Minnesota USA. Pressure of business and much travel throughout the USA and Canada meant that a quickly erected structure would have to suffice until time allowed little more thought for more permanent antenna affairs.

Many of the apartments that I lived in had 'No outside antennas here policies' which meant I was unable to put up even an effective long wire. So, to enable me to continue with my radio hobby, I had to come up with a suitable antenna to overcome all the above problems.

First Answer

My first answer to the various difficulties was to wind a horizontal loop of medium to thick copper wire around the operating room. Then, with both a loading coil and a variable capacitor I brought the single turn loop to resonance in the 3.5MHz band.

In an effort to reduce the size and losses of the loading coil, the loop would have to be made bigger. But I had a limitation on the size of the room. Luckily the room door was at the opposite end of the room from the operating position and the tuning capacitor.

So, I quickly cut the loop wire at the door and attached more wire, which I took down the long hallway and back up to connect to the other cut end of the loop. Then I began the task of bringing the loop to resonance again.

The results of my experiments were interesting! The whole contraption had taken around two hours to make, check, modify and recheck. Amazingly the resulting loop could be loaded up with 15W of c.w. transmissions on 3.5MHz without producing any TVI at all.

My new large around-the-apartment loop worked well, with many QSOs throughout the USA and Canada, although the bandwidth was rather narrow at around 18kHz wide. The point is however, that I had an effective antenna that worked, even though it was a bit of a monstrosity.

My loop gave good service, in a first floor apartment until time allowed for a more permanent affair consisting of a vertical wooden frame on a stout wooden base. Onto this frame I wound a few turns of wire to form the main loop.

Brought To Resonance

Then I added a loading coil fed with 50Ω coaxial cable and brought the loop to resonance with a variable capacitor. The main layout of this antenna is shown in **Fig. 1**. To keep loop tuning changes, due to hand capacity, to a minimum, I fitted the shaft of the tuning capacitor with an extended insulated spindle before fitting the tuning knob.

As the loop was mounted vertically, I could turn it to take advantage of the directional properties of the antenna. This way I got around the apparent limitations of the 'No outside antennas here' rules. But in the interest of domestic safety and to keep the chances of TVI to a minimum, I'd recommend keeping down to no more than 15-20W maximum.

Despite living in what is often called 'central southern England' we're not exactly blessed with an inspiring local shopping experience. However, we have, apart from the motley collection of shops, a small local Woolworth's and on a recent visit, I came across an absolute bargain of a cork based message board reduced to £2.99.

Finding this message board coincided with a loop project I had in mind so, I decided that it would make a good basis for the frame to hold the loop itself, which consisted of six turns of wire. This board has a pseudo wooden frame around a stout cork sheet, with an overall size of 600x400mm. It also weighs very little!

The board also proved strong enough to support the loading coil and the tuning capacitor, which I also mounted on a small section of Paxolin. You could, though, use almost any other insulated material for the purpose or even small piece of p.c.b. material

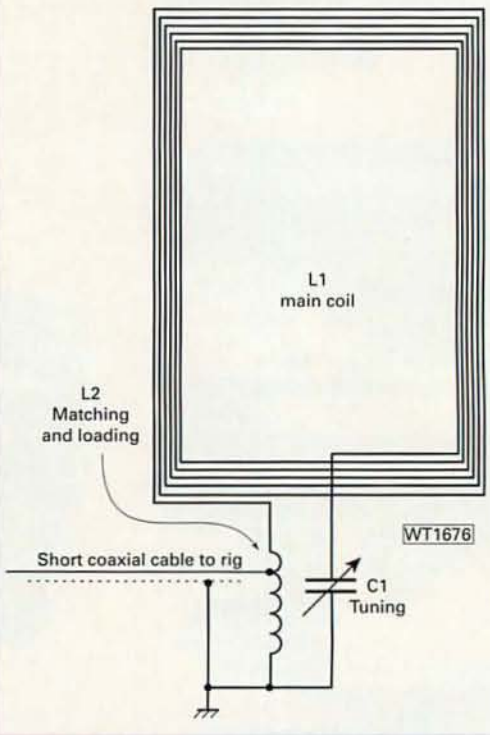

Fig. 1: I've produced several tuned loop antennas in this form, all of them work with slight modifications to the number of turns and sizes of both coils.

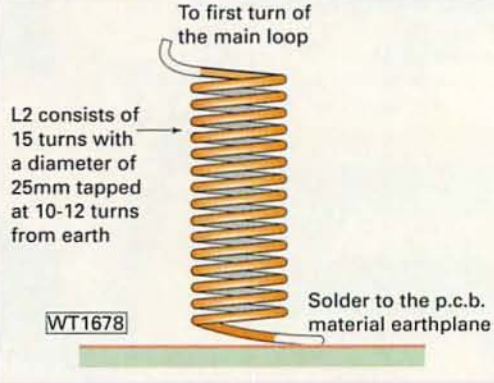

Fig. 2: The 15-turn matching and loading coil L2 has the lower point soldered to the p.c.b. earth plane close to the point that the coaxial screen is also soldered.

Older Jackson

The tuning capacitor is an older Jackson 150pF unit with a metal frame and mounting feet making attaching it to a chassis, or mounting board much easier. The matching coil, L2 (shown diagrammatically in **Fig. 2**) consists of 15 turns of 2mm dia (14 or 16s.w.g.) tinned copper wire wound on a length of plastic tubing. The turns should be spaced one wire diameter apart.

Leave some excess length at each end of the coil for connections to be made later. This matching and loading coil is to be mounted vertically and near the tuning capacitor on the insulated plate that holds the tuning capacitor. Connect the bottom end of the coil to the frame of the tuning capacitor.

In each corner of the board is mounted a six-way terminal block with a screw into the frame and a bolt through the cork on the inner (make sure you put a large washer under the nut to protect the cork from the pressure).

Now let's begin wiring the main coil onto the board. Arrange the board as shown in **Fig. 3**. Start from the outer hole of the bottom left hand terminal block. I used pvc covered hook-up wire, pass the loop wire through the hole and solder it to the top connection of L2.

Clockwise & Inwards

Feed the wire through around in a clockwise and inwards direction around the board, to make the main coil. Then when all runs are in place, gently tension the wire and lock each turn in place with the screws of the terminal blocks. When the final turn is in place, continue winding the wire to the stator plate of the main tuning capacitor.

Now to attach the coaxial cable feed to the antenna, I used a two metre length of RG58U coaxial cable for this purpose. Strip a short length of the outer insulation from the cable and carefully separate the screen from around the inner insulated conductor.

I mounted the coaxial cable on the reverse side of the board with 'P' clips in a position so that the twisted together screen could be fastened securely to the frame of the tuning capacitor via one of the fastening bolts.

A short length of wire is used to extend the inner conductor to a temporary tapping point 10 turns from the bottom of L2. After making sure the wiring follows the plans shown here, it's ready for initial tests.

Simpleton Approach

The simpleton approach to testing a loop antenna is the best method in my opinion! This is a method of carrying out tests in a series of steps, checking at each stage before proceeding to the next, and potentially more disastrous level. So, begin with checking the tuning range of your particular loop with a receiver.

If your antenna is as described here, then it should tune from just below the 1.8MHz band to just above the 3.5MHz band. Firstly set your receiver to somewhere in the middle of this range and attach the antenna via the coaxial cable to the receiver.

Slowly swing the antenna's tuning capacitor from maximum to minimum capacitance and back again. There should have been two peaks of received noise, hopefully at the same capacitance positions. Now tune both the loop and the receiver in synchronism, maximising received noise, to check the tuning range.

At several points within its range and after tuning the loop, adjust the tapping point on L2 to maximise the received noise at that point. If the tapping point alters over the range, choose the tapping point best suited to the band and area that you intend using most.

Now it's time to move on to low power transmit tests, for which you will ideally need some form of field strength indicator. Set the receiver to the frequency of interest and tune to loop to maximise noise. Now apply a few watts of r.f. at the same frequency to the loop by transmitting.

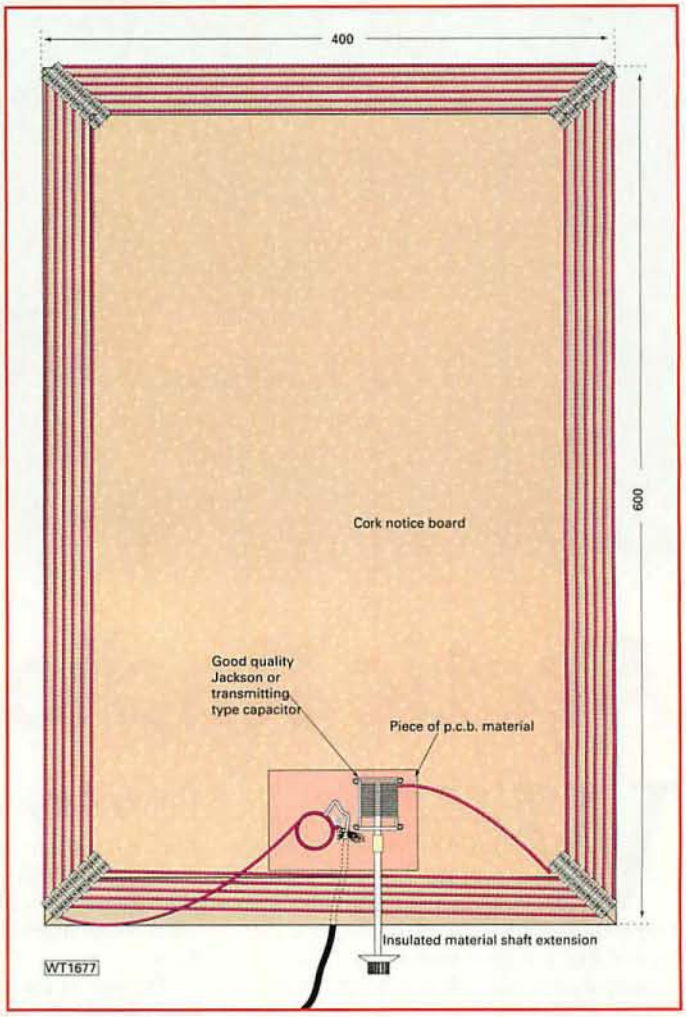

Fig. 3: The general layout of the message board loop antenna for 3.5MHz. this gives bandwidth that is rather narrow (about 20kHz) but does match quite well over the whole band.

Field Strength

Watch the field strength generated by the loop and carefully adjust the loop's tuning capacitor to maximise the transmitted field strength. Then, after dropping carrier, adjust the L2 tapping point and again check to see if this gives any improvement on the transmitted field strength.

You may note that at the maximum field strength, the s.w.r. (if you're measuring it) should have dropped very near to unity. You're now ready for on-air tests at that frequency - **but do remember not to use more than 20W for safety reasons**!

In operation the loop may be operated in either the horizontal or vertical plane (giving a degree of directional capability) **but must be kept clear of metallic objects**. If hung vertically on a wall, try to make sure that it's clear of house wiring. Another point to remember is that fluorescent lights or lights on dimmer controls are both horrific sources of r.f. noise!

Early one morning, just before dawn, I set the loop and transmitter up on 3.555MHz and with some 10-12W of r.f., I made a tentative CQ call using c.w. I had an answer, with a good signal report, from a German station, which was rather unexpected but proved that the loop antenna can be effective, even when as small as this example.

Final Comments

My final comments about this loop antenna, is that as an exercise to find a small, but effective loop antenna that was both quick and above all cheap to produce - it was a great success. I used the smallest available bulletin board, with all other items from the junk box. When not in use, the loop stays in a black plastic bin bag on the wall of the garage.

There are some thoughts to bear in mind when building this and indeed any other indoor loop antenna. The most important is to keep the operating power down to no more than around 15-20W maximum and to make sure that there are no exposed metal points near any hand controls. If possible, try to extend all tuning controls through a length of insulating rod or similar material.

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