The quest for a high voltage variable capacitor for magnetic loops.

Henry Chamberlain
ZS1AAZ

We in South Africa are a long way away from just about all other countries in the world except those African countries to the North of us. This has advantages as well as disadvantages but when you want to get hold of a high voltage variable capacitor for your home constructed magnetic loop, you have a problem. You can order it from wherever you can find it on the web, but often postage is way more than the cost of the item. And then we have to deal with a poor exchange rate that makes such items expensive.

And so we look for alternatives. I have built a square loop using 22mm copper pipe with a T-piece in one top corner and a gap in the loop half way in the top part of the loop. I slid a polyethylene irrigation pipe into the open end of the T-piece right through the gap in the top horizontal section. Inside this pipe I slid a 15mm copper pipe, through the gap, thus forming two capacitors in series across the gap, and so I could tune the loop to 40M, 20M and so on. I had to do the adjusting by hand which was fine while I was experimenting with it but it did not lend itself to remote controlled tuning.

Then some students from the university wanted to build a magnetic loop and I suggested a trombone shaped tuning capacitor. They came back to me after a while to report that it did not work too well because you had to slide the trombone out to reduce capacity and thus increase frequency but in the process you lengthened the loop, reducing the frequency.

I then thought about using a trombone with an insulating material with high dielectric constant in order to make a shorter capacitor. Window pane glass has a dielectric constant of 8, I read on the web, but I needed glass in tubular form and so I bought test tubes made from Borosilicate glass, also called Pyrex, with a constant of 4.6. They were 20mm outside diameter and 150mm long and quite cheap. Wall thickness about 1.3mm and a dielectric strength of 30kV/mm. Nice!

I bought some aluminium tubing of 25mm and 19mm diameter to make the trombone. The diameters were wrong of course but I had bought a small circular table saw from the Chinese with three blades, one of

them Tungsten, and with this I cut pieces of aluminium tube lengthwise and by squeezing the tubes in a vice, I managed to reduce the diameters so that a test tube fitted snugly inside the aluminium tube. In the same way I constructed an aluminium tube that could slide inside the test tube making a tubular capacitor. I calculated that I should get around 200pF but it seems like it is impossible to have such a capacitor without air gaps and in practice I got around 100pF.

A trombone capacitor has two capacitors in series like with a butterfly capacitor, and so I got 50pF which was too little. I then made two more capacitors to connect in parallel but in the end with my limited facilities to do precision construction work in my garage, it was just not a success. I tended to break the test tubes at their mouths, due to side forces. Glass is strong under compression, and no damaged was caused by forcing test tubes inside tight fitting aluminium tubes, but the slightest forces from the inside broke the tubes.

The answer to this is to make a trombone that is short and fat to give you the needed change in capactance without changing the dimensions of the loop too much. Alex, PY1AHD has a video on Youtube showing a loop tuned by a trombone capacitor constructed of two Coca Cola tins of different diameters that slide into each other. He uses a novel way to do the sliding, he uses two syringes filled with water, connected to each other with a thin plastic tube and by pushing the plunger into the one syringe, the other one moves the trombone. So I went shopping for suitable tins but it seems like just about all locally made tins are the same diameter.

There is anothe idea that I saw on Youtube. Thomas Hillard, WB9TH uses glass bottles and attaches metal sheet to the ouside of a bottle, and rotating plates on the inside of the bottles to make a tuning capacitor. The shaft passes through the lid. This method means that sliding contacts are used that could be lossy in a magnetic loop and should be avoided, but it is a workable solution.

So far the only option that is left to me is to make my own butterfly capacitor and there are local companies that will cut aluminium sheet by laser or on a CNC machine to produce plates that can be stacked and bolted together to make a butterfly capacitor.

There is a website called Etsy.com where they advertise sets of plates and all other components for butterfly capacitors, 3D printed end

plates, threaded rods, ball bearings, etc. The costs are very reasonable but the postage alone is three times the cost of the plates. I will wait for the quotes for the butterfly capacitor plates!