LF/MF Antenna Tuner

Since I had already completed construction of my variometer, I was close to completing my LF/MF antenna system. All I needed to do was to was to install the LF loading coil and connect it to the antenna tuner. Since I wanted the antenna to be able to operate over the frequency range of 150 to 500 KHz, I knew that this would require a fairly complex tuning system.

Since I already had the variometer constructed, and had split it into two parts when I found that it would not fit into the antenna tuning cabinet I had already acquired, I figured that this would make a good antenna tuning system. Some more calculations told me that I could simply switch the additional 5-gallon loading coil in the circuit for the 150 KHz band, and switch it out for operation in the 400-500 KHz band. The variometer unit has a number of taps on the coil, and I had already calculated that by using a combination of these taps and the variometer itself, I could cover all the frequencies I wanted to cover.

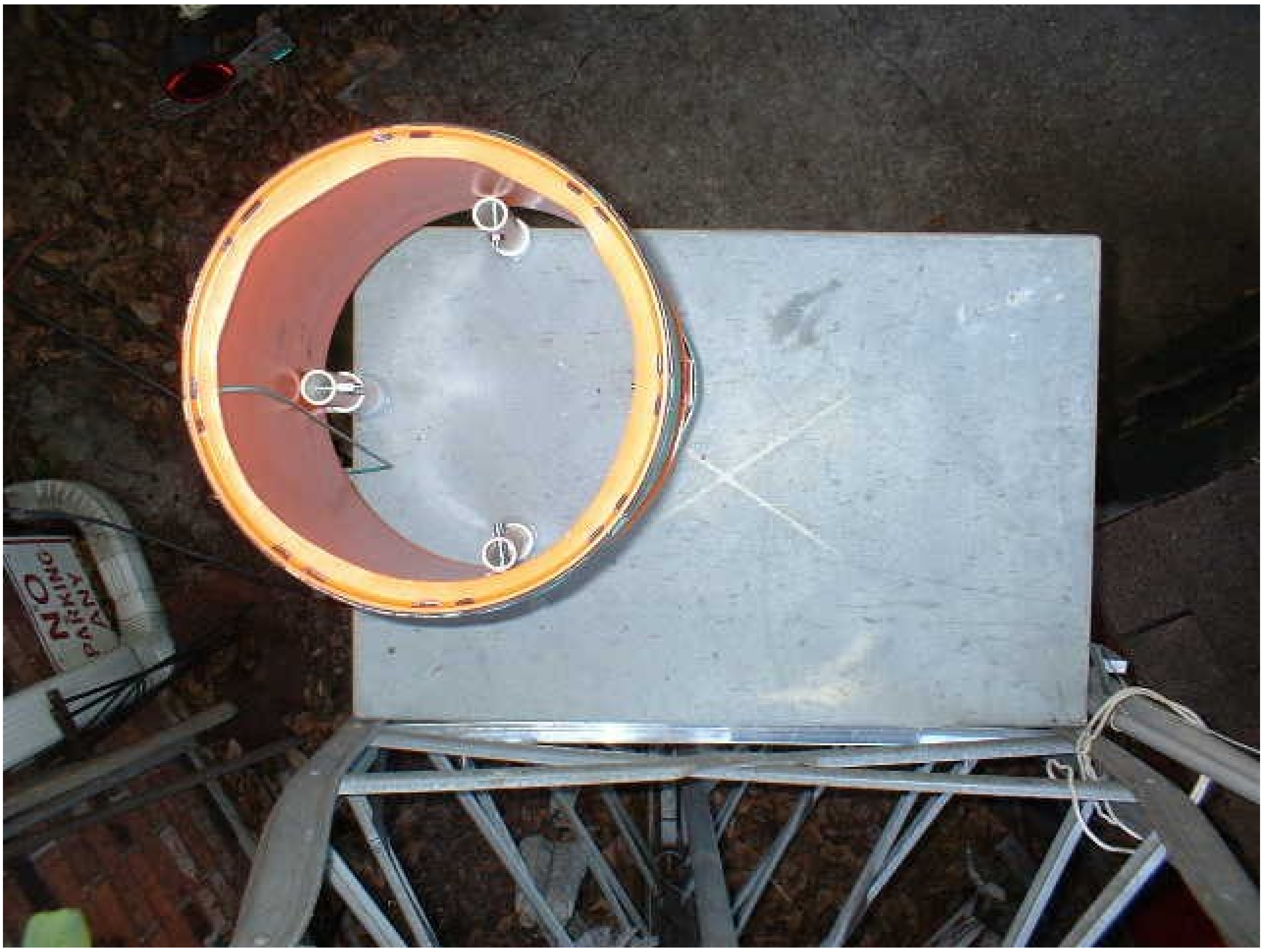
Since I knew that the operating voltages appearing on the antenna system would be quite high even at fairly low RF power levels, I decided to build my own coil tap switches. I designed them to be able to handle about 30 KV. They are designed to be operated cold only, i.e., with all the power removed. This simplified construction. To prevent anyone from coming into contact with the circuitry, the door to the tuning cabinet is locked at all times other than when making adjustments.

I decided to build a new loading coil instead of using the existing tapped coil which resulted when I split the original double-bucket variometer into two parts. I wanted to keep the tapped coil unit for other tests, and I did not need any taps on the "final version", shown here. Note that I added another 14 turns of wire on the lower end of the bucket. I figured that I could use a little more inductance in this coil.

Since the bucket is tapered, the windings tend to slip off the end of the bucket unless you hold them in place. What I decided on was to install eight short sections of #14 wire on the narrow end of the bucket. These lengths of wire are simply passed through the bucket wall and bent back a short ways over themselves to fasten them in place. You can see the stub ends of the wires in the picture above. Note that the end of the winding passes through the bucket wall into the inside of the bucket and then goes to the antenna tuner. The wire is kept about two inches away from the inside wall of the bucket to prevent possible arcing and to reduce capacity across the coil.

A top view of one of the wire support sections.

This view shows the LF loading coil mounted on top of the antenna tuner. The loading coil is supported about 6 inches away from the tuning cabinet and the tower. The presence of the cabinet and the tower do not materially affect the operation of the loading coil.



Looking down at the top of the LF loading coil and the antenna tuner cabinet. I have cut the end out of the bucket. Here in south Louisiana, any nice, dry place, such as under an upturned loading coil bucket, tends to collect wasp nests in abundance. Hence, cutting the end out of the bucket may be regarded as an operator safety precaution! Notice that the top coil wire which eventually connects to the antenna, is spaced away from the bucket wall by several inches.

Did you notice that the top ends of the PVC pipe coil support legs were open? That means that they will catch rainwater and may cause leaks into the tuning cabinet. If you use this mounting method, be sure to drill 3/8 inch drain holes in the bottom of the legs, as shown here. Note that I have also applied RTV Silicone sealant under the legs where the mounting bolts pass through the tuning cabinet roof. Water and high voltage RF don't mix well!

Another view of the LF loading coil mounted on top of the tuning cabinet. Look at the cheap but effective "T" insulator on the right hand leg. This insulator holds both the leads from the loading coil firmly in place.

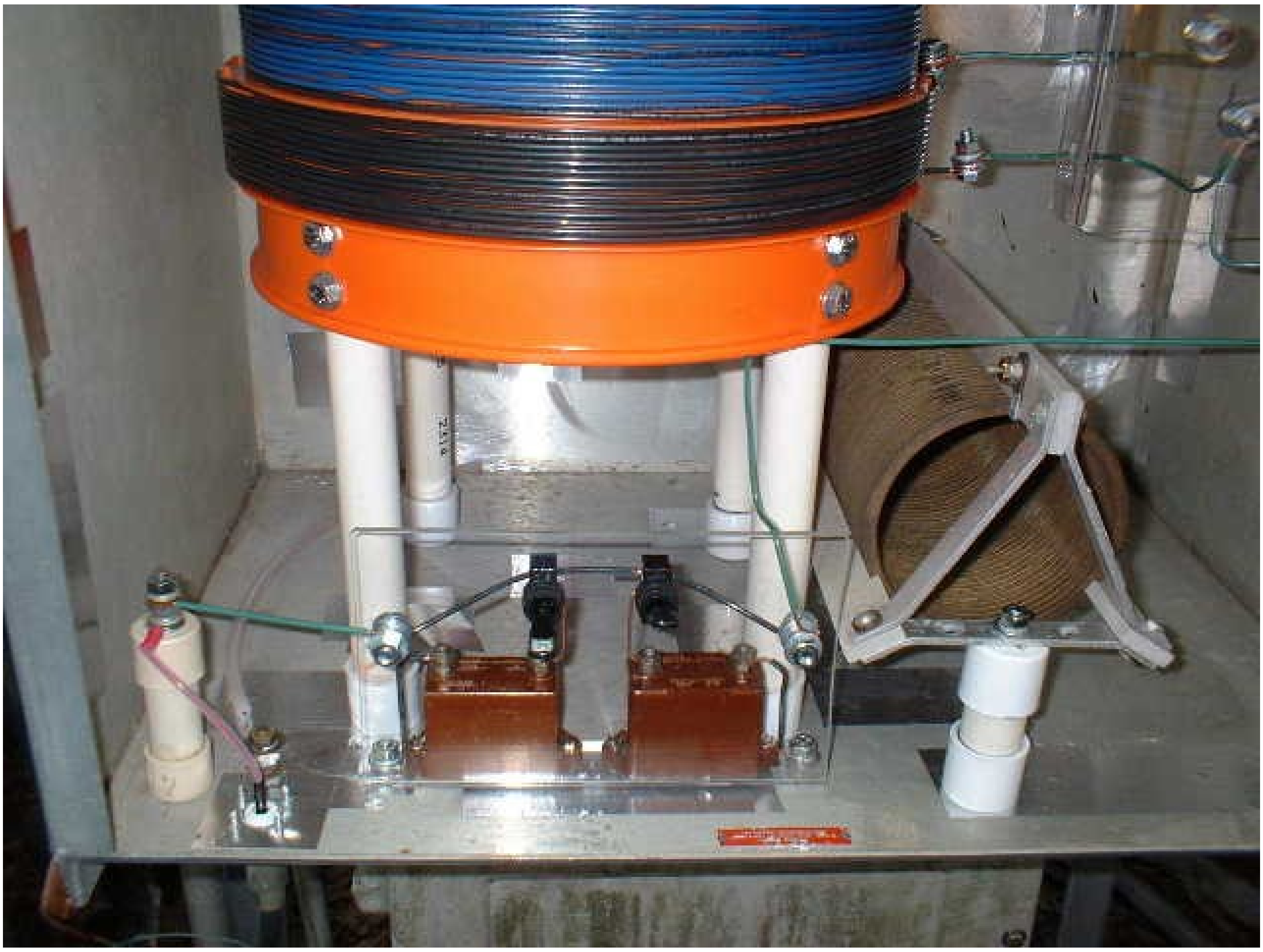
A close up view of the "T" insulator. It's made from a couple of 3/4" PVC pipe tees and a few 2" long sections of PVC pipe, all glued together. Be sure to put the bolts through the pipe caps on the end of the insulator BEFORE you glue the sections together.

The business end of the tuner and loading coil. Note that there are two drip loops visible. One is in the green wire running from the smaller ceramic insulator to the input side of the loading coil, and the other is in the clear Polyethylene insulated wire (RG-8 center lead) running from the output side of the loading coil through the center bolt of the large ceramic bowl insulator. A short length of #14 wire (love that stuff!) is twisted around the poly wire to keep the drip loop in shape. Note the spark gap across the bowl insulator. The black wire leading up from the spark gap on the bowl insulator is the antenna lead in wire.

This is what the guts of the completed antenna tuner looks like. The variometer coil itself is inside of the blue and black coil on the orange drum. Note the variometer adjustment handle which passes through the left side wall of the tuning cabinet. The large brown colored coil to the bottom right of the variometer is not used at the present time.

The coax cable feedline connector is visible at the lower left front of the cabinet. The center lead of the coax goes to the white standoff insulator just to the left of the coax connector. From there, the lead goes across the two black switches directly below the variometer. These switches allow me to add either one or both fixed capacitors across the coax line to ground. They are used at various frequencies to bring the impedance of the tuner closer to 50 ohms to match the coax cable.

After leaving the capacitors, the line goes to the center wiper of the home made rotary tap switch shown to the right of the variometer. This switch is assembled of stainless steel nuts and bolts and washers. It is built on a salvaged sheet of Plexiglas plastic. All the wires running from the coil to the switch are bolted to the switch contacts from the rear of the switch. There are several open positions available on the switch for future use. Above the switch are several standoff insulators, which support a cutout switch for the LF loading coil and a position for an RF ammeter (to be installed) and space for the RF ammeter bypass switch (to be installed).

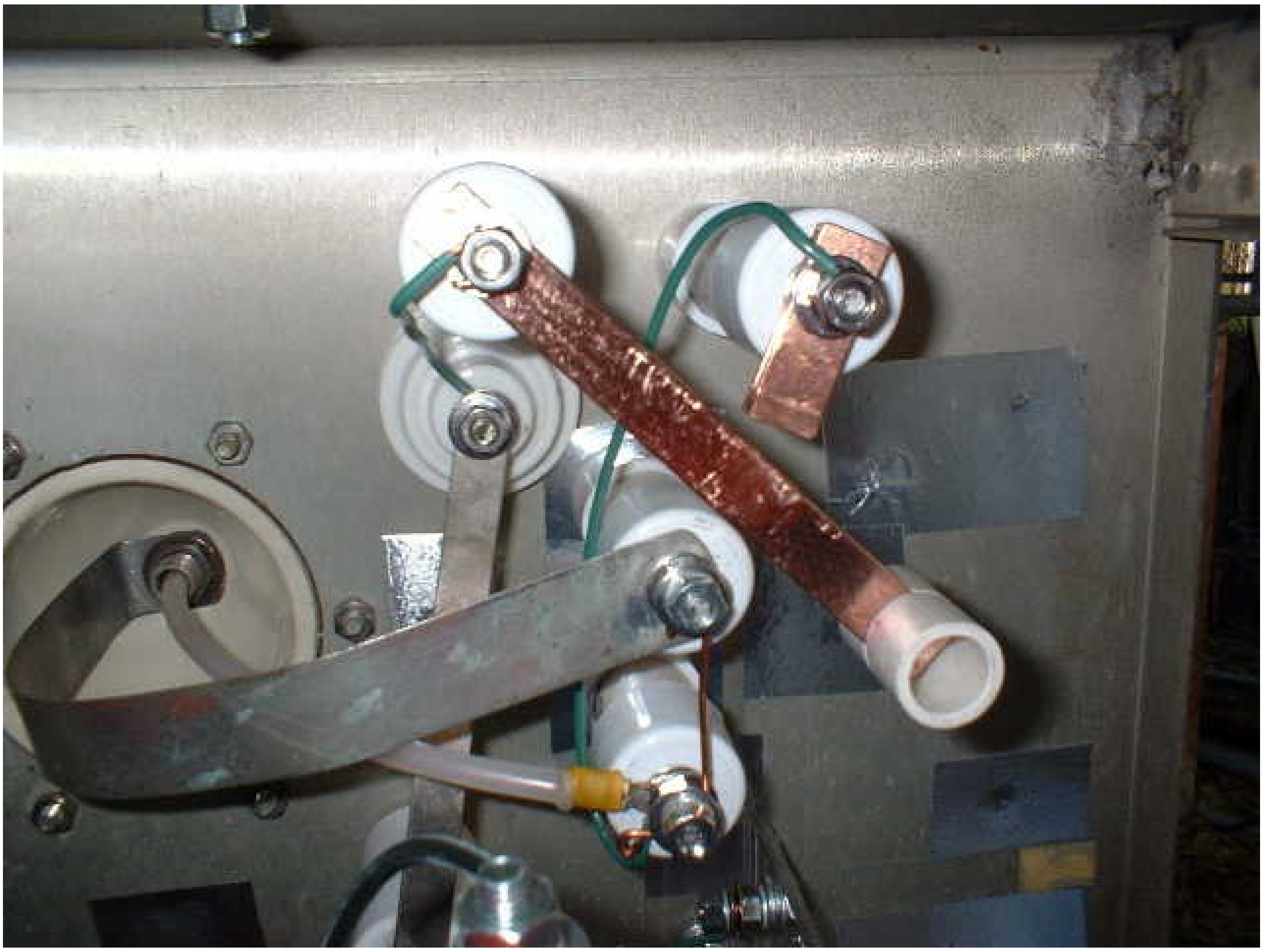


A closer view of the capacitor switching assembly. The capacitors are surplus Mica capacitors rated at 5000 volts. They were made in about 1946, and still work perfectly. The switches came from Radio Shack, and are rated at 12 volts DC, but I tested them at 300 volts RF and they worked fine. No, I did not hot switch them, but the insulation handles the open circuit voltage OK.

A better view of the coil tap switch. Cheap and simple! The springy wiper strip is sandwiched between two stainless steel flat washers and tensioned by a lock washer and an adjustable nut. The nut is locked in place by another lock washer and another nut. A little oil on the washers prevents binding. The contacts of the switch are the head of the stainless steel bolts. I used stainless hardware because in our damp Louisiana climate, anything else corrodes badly. I did find that stainless-to-stainless seems to make a more intermittent contact than does stainless-to-brass or stainless-to-copper. I may change the wiper arm contact to a brass or copper bolt.

Notice all the lovely bolted connections! I chose to do it this way instead of soldering everything, because it was very easy to assemble, and it is also very easy to make changes later on. Since this is an experimental system, change is one thing I am sure WILL happen!

Looking from the bottom of the tuning cabinet behind the coil tap switch, showing the bolted MF loading coil tap connections and the wires running from the MF loading coil to the tap switch. Note the black Variometer coil wires exiting the black shaft pipe near the middle of the blue winding on the loading coil.



Inside the tuning cabinet, looking at the right side wall. The large bowl insulator is to the left of the picture. I pulled an interesting design trick here. Since I wanted to have the antenna current ammeter located inside the tuning cabinet, that meant that I would have to run the output lead of the LF loading coil back into the cabinet, through the RF ammeter, and the back out of the cabinet.

Since both the input and output leads from the RF ammeter are at the same RF voltage, I simply ran the Polyethylene insulated lead from the LF loading coil into the cabinet through the hollow tube in the center of the bowl insulator. This tube is actually the output connection terminal of the tuner. Note that the Poly lead comes in the cabinet, over to a standoff insulator, then via a copper wire jumper (this is where the RF ammeter will be connected) to another standoff insulator, then it exits the cabinet on the wide copper strap connected to the bowl insulator pipe connection.

Note the home made RF switch shown on the upper two standoff insulators. Here, it is shown in the open position. This switch is used to bypass the LF loading coil when operating on the MF band.

A view inside the cabinet from a different angle. Here you see the LF loading coil bypass switch in the closed position for MF work. The switch is made from sections of flattened 3/8" diameter soft copper tubing. I hammered it flat and pounded it to work harden it.

The PVC pipe handle for the switch is made by slitting the side of a short length of pipe and driving the flattened copper into the slot. The knife switch jaws are made from three pieces if the same flattened copper tube. A little Vasoline provides sufficient lubrication to prevent metal-to-metal galling.

There are two black flexible wires from the Variometer coil visible. One lead is connected to the top connection of the blue loading coil, and the other lead is connected via a standoff and strap to the smaller feed through insulator on the right wall of the cabinet. from there, the lead goes to the input side of the LF loading coil.

CIRCUIT DIAGRAM OF MF/LF ANTENNA TUNER

(NOTE: 20 Kc Loading coil not installed)

LF - MF Antenna Tuner