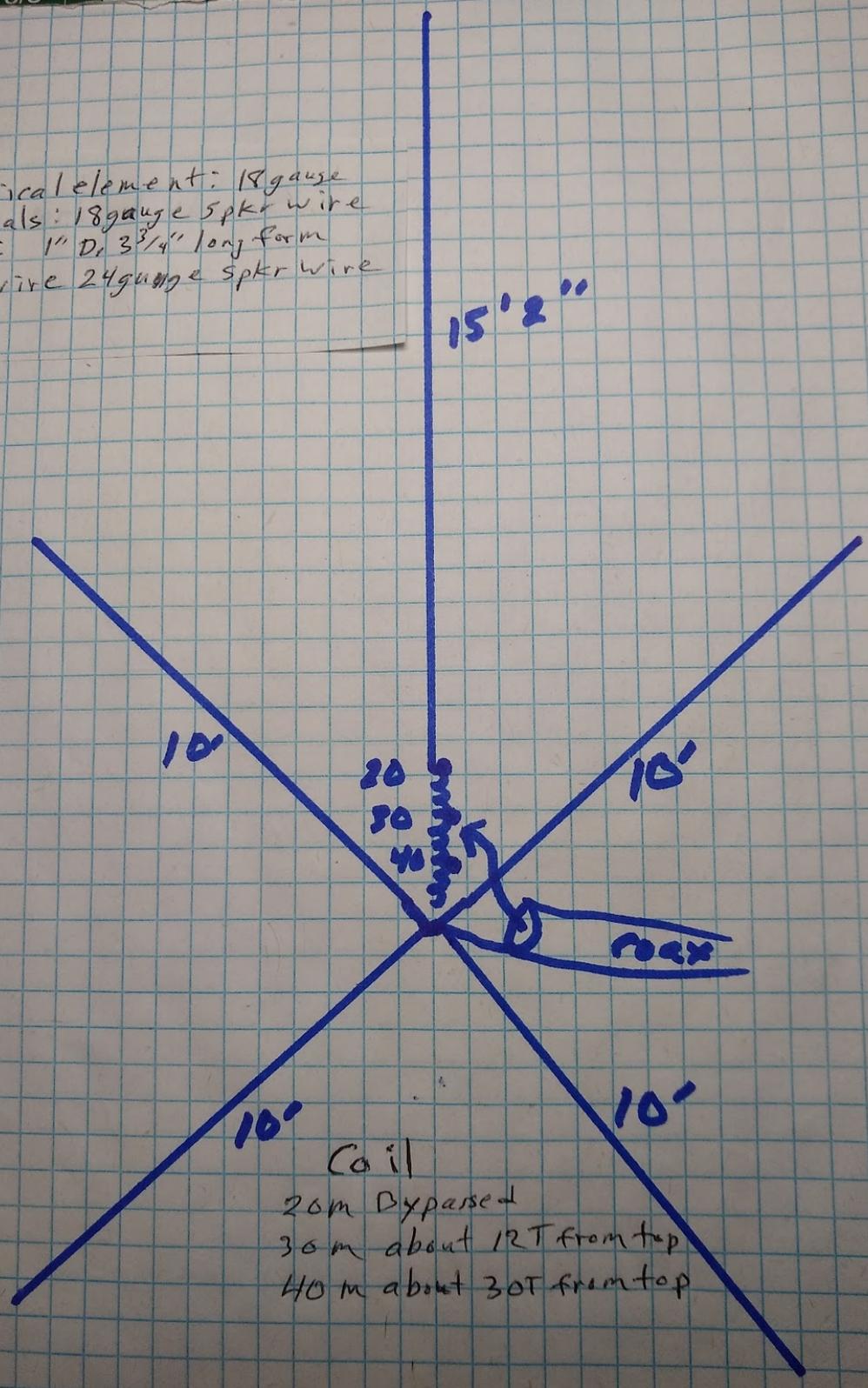


DIY Linked Vertical 40, 30, 20, 18, 15 and 12 meters
2020-12-04 Draft
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Overview

The antenna described here is a $\frac{1}{4}$ wavelength vertical cut to resonate in the 20 meter band without a loading coil. A tapped loading coil is added to its lower end with taps for 20 meters (the coil is bypassed), 30 meters and 40 meters. As described it provides a low SWR across all of 20, 30 and 40 meters without need for a tuner.

Vertical element: 18 gauge
Radials: 18 gauge spkr wire
Coil: 1" D, 3 3/4" long form
wire 24 gauge spkr wire



Coil
20m Dyparsed
30m about 12T from top
40m about 30T from top

(Schematic)

The antenna consists of a 15' 9" vertical radiator, four 10' counterpoise wires and the tapped coil. All the components are inexpensive and between your local home or hardware store and your local radio store or the Internet are readily available.

The completed antenna alone is a small bundle and weights just 6 ounces. Add 25' of RG174 coax and it weighs 10 ounces. So it is highly portable/packable.



Picture with RG-174 coax.



Picture with and without coax

The tools needed are a hand drill, screwdriver, wire cutters and strippers, solder and a soldering iron. A pair of pliers and a needle nose plier will also be needed. You'll need a ruler or tape measure along with a felt tip marker and a couple straight pins and a push pin. Some small heat shrink tubing is useful though not essential along with some electrical tape.

It will be helpful to have an antenna analyzer though with patience and persistence you should be able to get by with a rig that indicates SWR. If you stick fairly close to the measurements given, the SWR should be close to 1:1 on all three bands.

Materials

For the loading coil you'll need



Fig 1

1. a 1-½ inch coil form 3-½ inches long. I used a plastic 1-½” sink tailpiece,
2. about 15 feet of RCA 24 gauge speaker wire (one strand of the pair),
3. a female BNC connector with ring terminal for the ground side,
4. three small screw eyes,
5. a small machine screw with a nut and a couple washers,
6. two banana jacks,
7. a solder lug that will fit the machine screw, and
8. a small alligator clip.

For the radiator and counterpoise wires you'll need

1. about 65 feet of RCA 18 gauge speaker wire (one strand of the pair),
2. two banana plugs.

Thoughts about construction

I'll give specific construction details but there is a lot of room for “doing it your way.” Some things to keep in mind. If you use a larger or smaller diameter coil form, you'll need to add turns, if the form is smaller, or use fewer turns if the diameter is larger. If you use a larger or smaller wire for the coil, that will also impact the number of turns needed. Note that the bottom end of the coil is not connected to anything. It simply floats free electrically. You may choose something other

than banana connectors which is fine. In fact you could permanently attach both the counterpoise wires and the vertical radiator. You may also want to permanently attach a length of coax with a connector for your radio on it rather than fuss with the BNC connector. I also specify quite a few turns beyond what is needed on the coil. You can wind five or so fewer, just don't take off so many that you can't "tune" the coil when done.

Making the Coil



Fig 1a

1. Cut a couple inches off the tapered end of the 1- $\frac{1}{2}$ " sink tailpiece and throw it away. Then cut off 3- $\frac{1}{2}$ inches of the remaining tailpiece which will be your form.
2. Using a felt tip marker, put four dots on the form. One $\frac{3}{8}$ " from each end and one $\frac{3}{4}$ " from each end. The two inner ones will form the ends of the winding itself. One of the outer ones will be for mounting the BNC connector and the other for inserting the machine screw which will hold the banana plug for the vertical radiator. Then 1/2 inch to the side of the BNC connector mark, place a fifth dot, the hole where the band change pigtail will pass through to the BNC connector center pin.
3. Drill holes where you marked the two inner marks for the ends of the winding. Choose a drill bit that will just pass the 24 gauge speaker wire for the coil. Larger won't hurt but will make it a bit more difficult to keep the winding tight.
4. Drill a hole where you marked the fifth dot. Choose a drill bit that will snugly pass the 18 gauge speaker wire pigtail.
5. Drill the upper end outer hole so your machine screw fits through freely.
6. For the lower end hole where the BNC connector will be installed, choose a drill bit just smaller than the threads on the BNC connector. You want the BNC connector to thread tightly into the hole.
7. Wind the coil itself. Start with your 15' piece of 24 Gauge speaker wire and push about an inch through the lower hole next to where the BNC connector will be installed.



Fig 2

8. Fold the wire inside the form flat against the form toward the top and firmly tape it in place with electrical tape.



Fig 3

9. Now carefully but snugly wind the wire onto the form by turning the form in your hand and using your finger keep the windings firmly against one another. When you have wound the form full pushe the loose end through the inner of the two holes at the top of the form and carefully pull it through until the winding itself is snug and tight.



Fig 4

10. Then sharply bend the wire protruding through to the inside and firmly press it against the inside of the form and tape it securely in place with electrical tape,

11. Now trim the loose end of the wire leaving two inches or so free to attach to the banana jack.
12. Now, install the BNC connector.

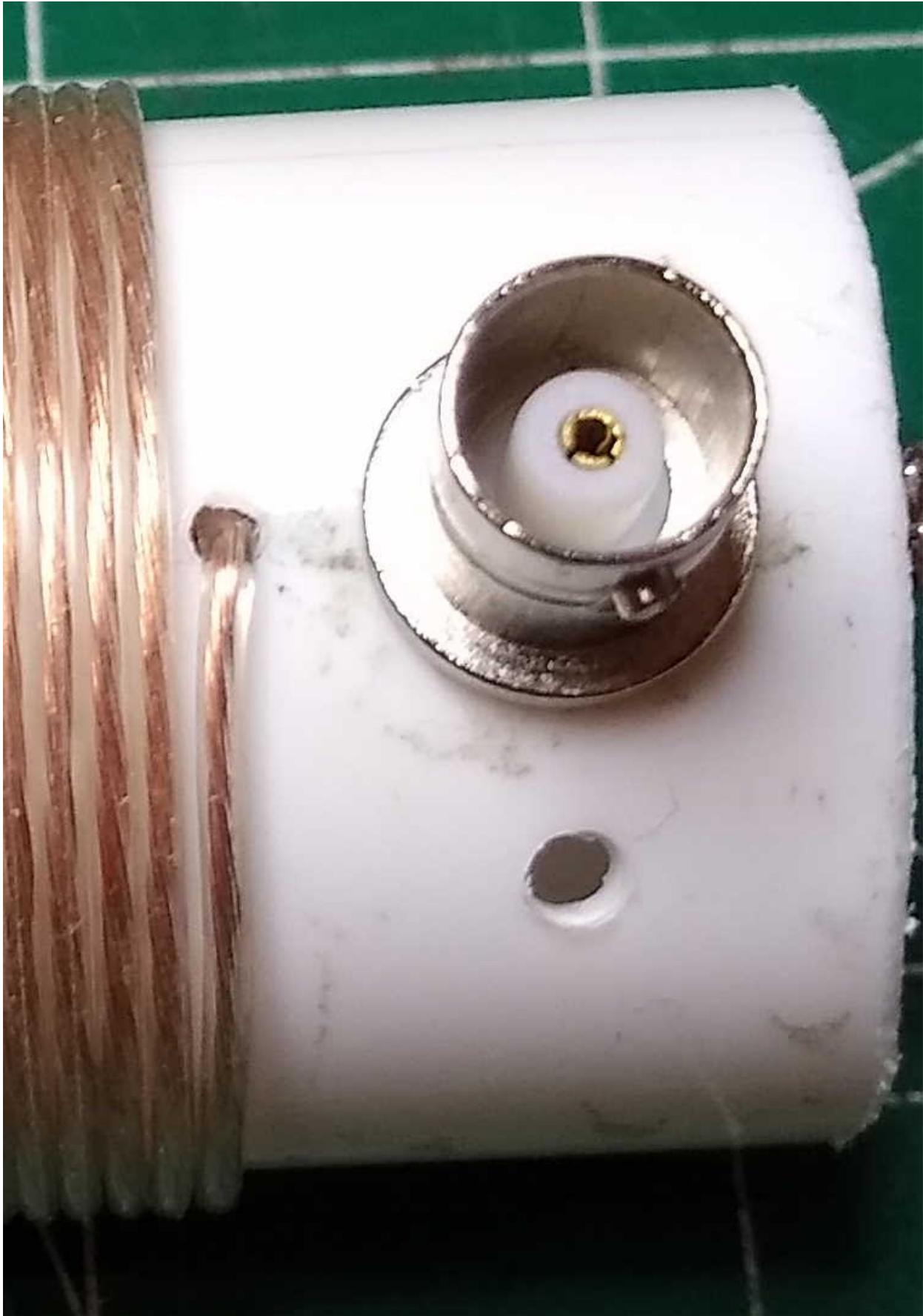


Fig 5

13. You can carefully file the hole out a bit if needed but not too much. As mentioned above, the objective is that the BNC connector will be very firm in the whole. To help screw the BNC connector into the hole connect the end of a short BNC cable to it using the knurled male connector as a wrench. Screw it all the way in, as tightly as possible.
14. Before you put the solder terminal and nut on the BNC connector decide how you will make the connection between the ground or shield side of the BNC and your counterpoise wires. I used two solder terminals (because one was too flimsy) and soldered my banana jack to the solder terminals. Then I installed the solder terminals and tightened the nut on the back of the BNC connector. So I have a banana jack protruding out the bottom of the form where I can plug in the counterpoise wire bundle.
15. Next, tin the center pin of your BNC connector to make it easy to connect the pigtail to it. Cut a piece of 18 gauge speaker wire about five inches long and strip about $\frac{1}{8}$ " from one end and tin it. Pass an inch or so of the tinned end through the fifth hole from the outside and shape it so it lines up with the tinned center pin of the BNC connector. Holding it in place, heat the wire and center pin until the solder fuses. Now work some of the pigtail back through the hole keeping enough inside to avoid any stress on the connection when the pigtail is moved from tap to tap.

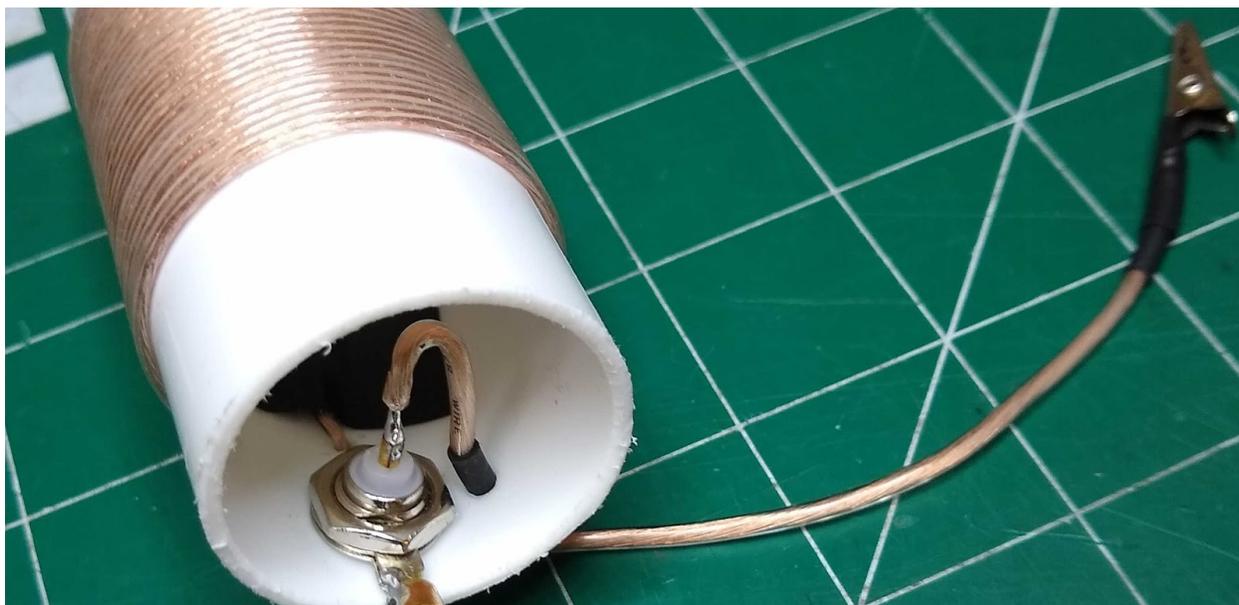


Fig 6

16. Cut the pigtail so when the alligator clip is attached it will easily reach the top of the winding where a screw eye will be inserted to select the 20 meter band. Now strip and solder the alligator clip onto the pigtail. To make it a bit more robust and look nicer you may want to slip a piece of heat sink tubing onto the wire prior to soldering the alligator clip in place. Chose a piece that will shrink over the back of the alligator clip and a half inch or so of the pigtail.

17. Now turn to the top of the coil where you will attach the banana jack for the vertical radiator.



Fig 7

18. I used a similar technique to what I did at the bottom. I soldered a banana jack onto a solder terminal, then carefully trimmed, stripped and soldered the wire from the top of the winding to the terminal. Finally I attached the banana jack assembly to the form with the machine screw and nut.
19. To complete the pre-tuning assembly of the coil, screw one of the screw eyes through the top turn of the winding just ahead of where it pass through the form to the inside.



Fig 8

20. To do this use some sharply pointed device such as a push pin and press it through the center of the wire and into the form. Be very careful not to damage the winding itself but simply pass it through the bundle of wires. Get the push pin as far into the coil form itself as possible to make starting the screw eye as easy as possible. Use the smallest screw eye you can find. A good source is a jewelry supplier. On Amazon they are called “screw eye pins for jewelry making.” you can get 500 for about six dollars! Remove the push pin and carefully screw the screw eye into the hole left by the push pin. This is probably the most difficult step of the entire build! So proceed with care and caution. A good pair of pliers helps.

This completes the initial assembly of the coil. After you do the tuning you will install the final two screw eyes completing the whole project.

Preparing the vertical radiator and counterpoise wires.

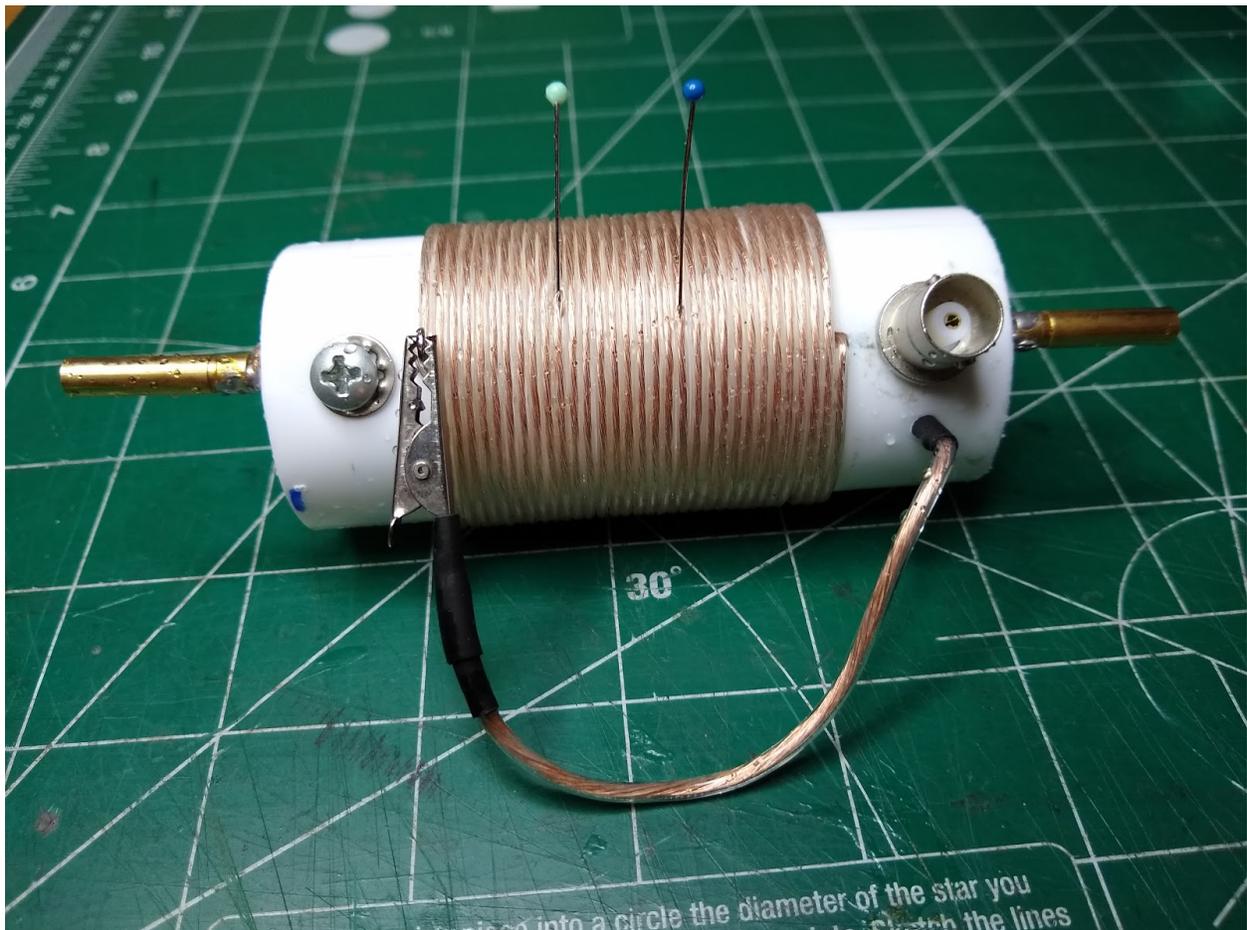
1. Cut about 16 feet of one strand of 18 gauge speaker wire.
2. Solder a banana plug to one end.
3. Fold about six inches of the other end back over itself and tape it, leaving a loop at the top.
4. Cut four 10' pieces of a single strand of 18 gauge speaker wire.
5. Strip about $\frac{3}{4}$ inch from one end of each and then carefully twist and solder them together, forming a bundle. Solder a banana plug to the bundle..

Initial Tuning of the antenna.

1. Suspend the vertical radiator from a tree or the top end of a fiberglass push up pole so the lower end is about a foot off the ground.
2. Plug the top end of the coil banana jack onto the hanging end of the radiating element.

3. Plug the bundle of counterpoise wires into the lower banana jack and fan them out on the ground evenly from the coil.
4. Attach a coax to the BNC connector and to your analyzer or rig.
5. Clip the pigtail alligator clip onto the screw eye at the top of the coil.
6. Hold your breath and turn on your analyzer. Or if using your rig, set the power to one watt or so, tune to 14.03mhz. and key the transmitter. Jot down the SWR. Now tune about 14.347mhz and once again key the transmitter. Jot down the SWR.
7. If the SWR is lower at 14.03mhz than at 14.345mhz, the radiator is too long. Fold back more of the tip by a couple inches or so and recheck. If the SWR is lower at 14.345mhz than at 14.03mhz. The radiator is too short. Unfold a couple inches of the folded tip and recheck. Final length of the radiator will be about 15ft, 9in.
8. Repeat this until the SWR is about the same at both frequencies. Also it should be near 1:1 at both ends. I suggest you go make some contacts with it at this point just to get a bit of reward for your hard work!

Final tuning and completion of the antenna



(Fig 9)

1. Count down 10 turns from the top end of the coil and carefully push a straight pin through the insulation and along inside the insulation among the strands a quarter inch or so.

2. Count down a further 9 turns and insert another straight pin.
3. Use a multimeter to make sure you have continuity between each pin and the 20 meter screw eye. If not, reinsert the pin and try again.
4. With the antenna suspended and assembled as above but with the pins into the 10th and 19th turns, clip the alligator clip to the 20 meter screw eye and verify that the antenna is resonant in the 20 meter band. You will not change the length of the radiator from this point on, only move the straight pins up or down a turn or to as needed to achieve resonance on the 40 and 30 meter bands.
5. Carefully clip the alligator clip to the 30 meter straight pin (the top one). Be careful not to dislodge the pin.
6. Tune your rig to 10.105mhz and key the transmitter. Jot down the SWR. Then tune to 10.144mhz and check and jot down the SWR again. If SWR is lower at the bottom of the band, move the pin up a turn and check again. If SWR is lower at the top of the band, move the pin down a turn and recheck. This band is so narrow that both readings are likely to be very close and hopefully below 1.5:1 or so in which case your a good to go.
7. Use a felt tipped marker to carefully mark the point where you pin is inserted.
8. Repeat the above procedure but clipped to the 40 meter pin. 40 meters is wide enough that you will need to favor the end of the band you use most. You should have a usable SWR across the whole band though.

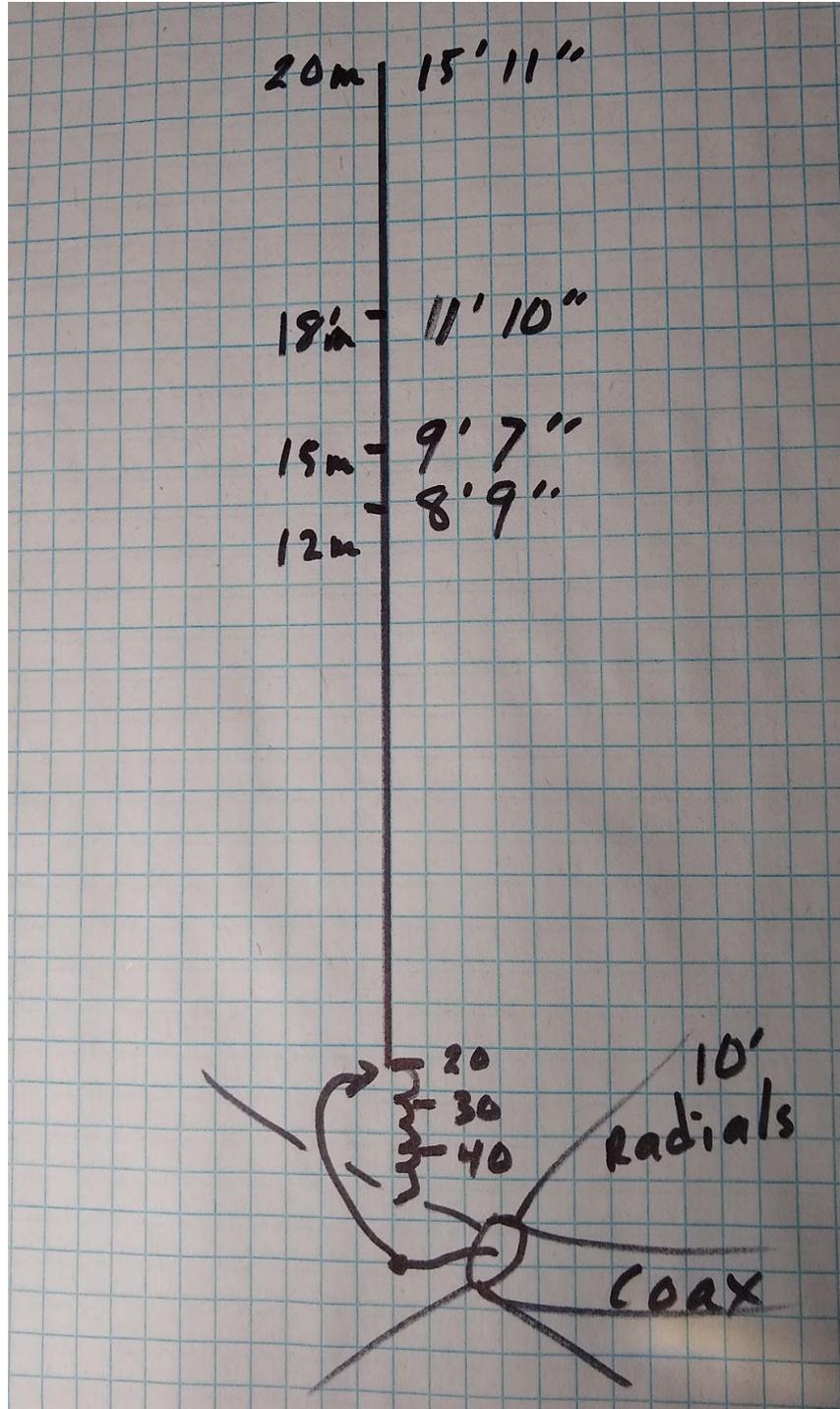


Fig 10 Finished Coil with taps.

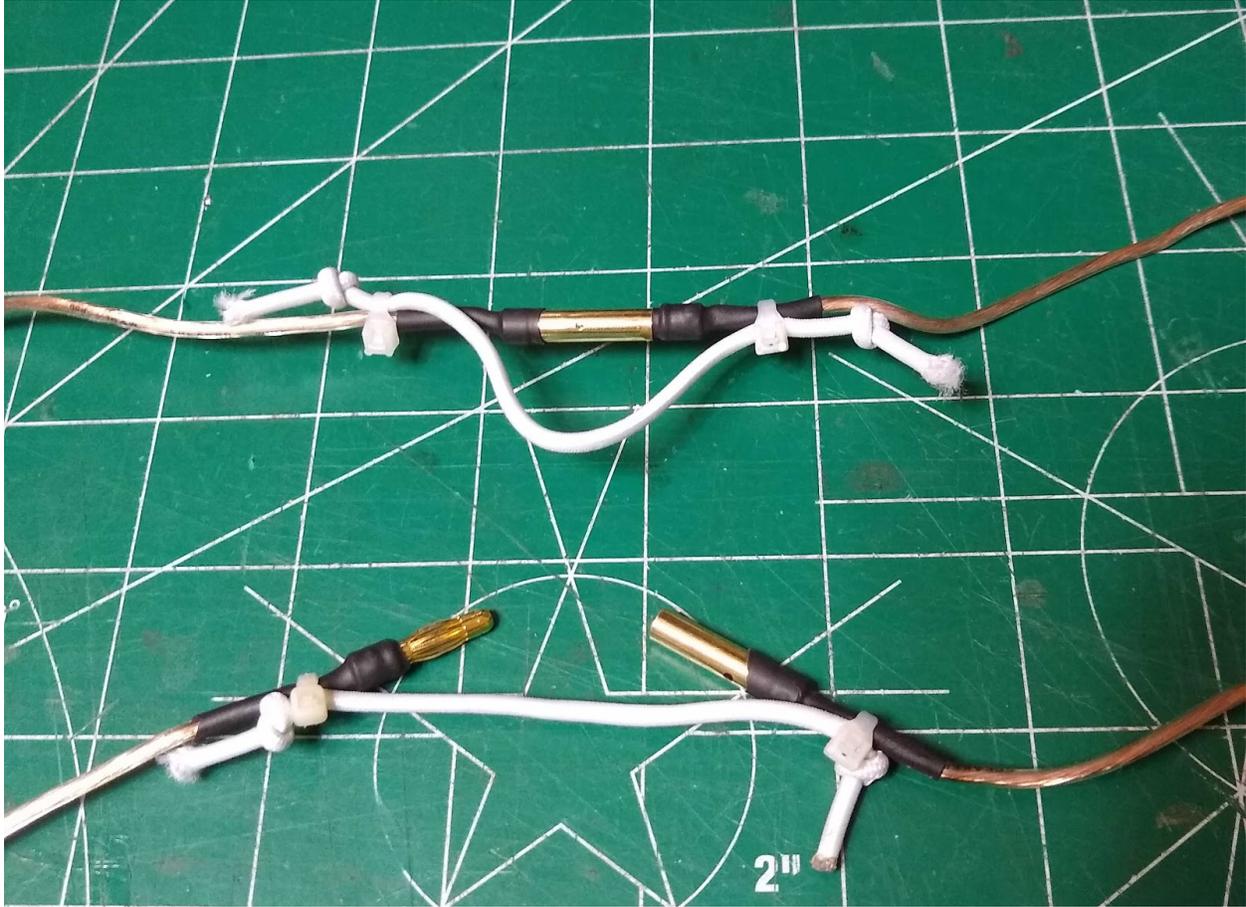
Addendum

The antenna can also be modified to be a $\frac{1}{4}$ wavelength on 15 meters, 18 meters and 12 meters. To make the antenna modification I cut and installed links made with banana plug/jack (bullet connectors) pairs at each band position noted in the picture below. A short piece of $\frac{1}{8}$ in bungee cord tied across the junction keeps the antenna suspended when a link is opened.

To select these one of these bands, clip the pigtail on the 20 meter coil tap and then open the link for the band you wish to use.



Schematic of the 6 band vertical antenna.



Link detail.