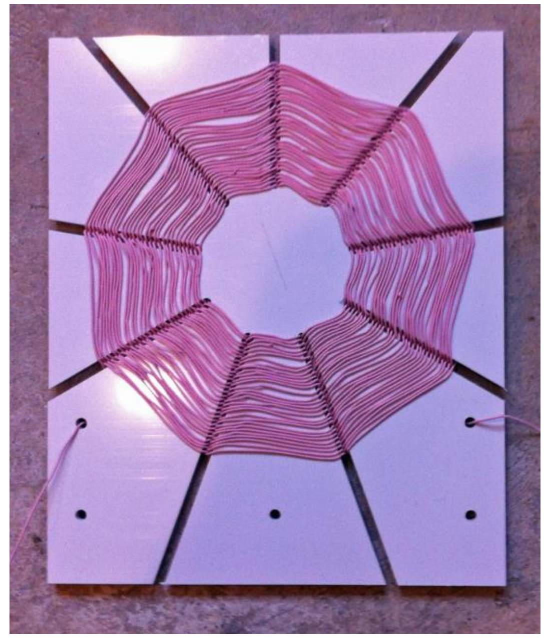
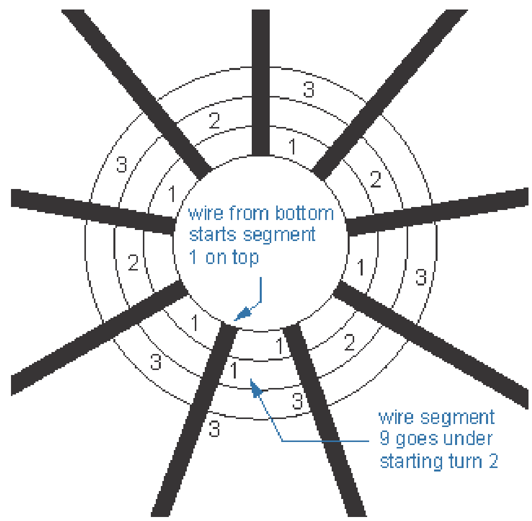
THE SPIDER WEB (or SPIRAL) COIL
by WØXI (112613) (update 080614)



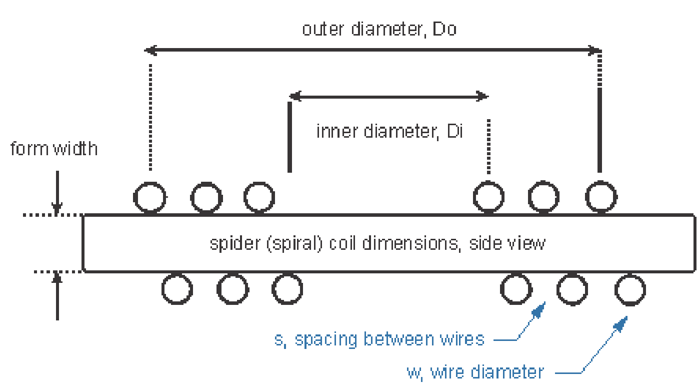
When winding coils you have a number of form choices: standard cylindrical, basket weave, spider or donut (on a ferrite core). Any one of the first three forms works nicely in pairs when you want to add an antenna tuner to your crystal set. In this piece our focus is the spider web coil. A 250 uH spider web coil using 150/45 Litz wire wound on an ABS plastic form is shown in picture 1. Why use the spider? We think it's easy to wind and works as good as a basket weave.

Spider web and basket weave coils will produce a stronger signal than their cousin, the standard close wound cylindrical, for a given input signal. This is accomplished by separating adjacent windings by the thickness of one winding. This separation reduces the proximity effect between wires, wherein the closer they are a current in one will increase the resistance of the other.



The separation of adjacent turns is accomplished by breaking up each full turn into an odd number of segments wherein each additional segment is wound on the opposite side of a thin flat form. This is enabled by cutting an odd-number of radial slits extending outward from the outer edge of the internal circular center.

Windings of the first few turns are displayed in picture 2. The winding starts from the back of the interior center; hence the first and all odd segments of the first turn will show on the top side as noted by "1." The last segment of turn 1, segment 9, comes out on top and zig-zags over to become turn 2, where it goes underneath the form again. The following segment of turn 2 is then on the top as noted, and so on.



The inductance of the spider coil is determined by its inner and outer diameters and the diameter and spacing of the wire, as defined in picture 3. The picture displays what you would see if you cut all the wires in one of the radial slits and removed one of the segments of the form. From this side view, you would see the turns alternately wound on top and bottom of the form as the coil builds up from the inner radius. Note that a flat spiral would have the same dimensions but all the wires would be on top of the form. Given that the width (thickness) of the form is generally a bit greater than the diameter of the wire but much less than the outer diameter of the coil, the spider coil approaches the same dimensions as a flat spiral coil wound on one side of the form. Thus, the equation for the spiral coil can be used when winding the spider coil.

The equation for the spider coil is

$$L(uH) = \frac{N^2 A^2}{30A - 11D_I} \text{ and A} = \frac{D_I + N(w+s)}{2}$$

$$\textit{where } D_I = \text{ inner diameter in inches, w = wire diameter,}$$

$$\text{s = distance between windings, N = no. of turns, } D_O = \text{ outer diameter.}$$

Please note that A defines the average diameter of the windings in inches.

The total length of the wire needed to wind the coil is thus the average diameter (A) times the number of turns, times pi. Or,

LEN" (length in inches) = A*N*3.14.

If you wish to use an on-line calculator go here: http://www.deepfriedneon.com/tesla_f_calcspiral.html, assuming that it is still posted there.

Table 1 below lists our calculation results for four 250 uH coils using different sizes & types of wire. The results for the 150/45 Litz wire coil, also shown in picture 1 above, specify that given that wire, that form with 9 slits, an inner diameter of 1.6 inches, an outer diameter of 4.2 inches and 56 turns, the inductance should be 254 uH. We tested the coil on the bench and the results matched another 250 uH cylindrical coil on hand. ☺

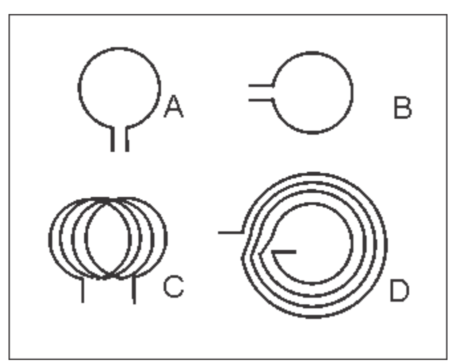
Starting with 250 uH spiral coils,

wire type	inner Dia D1	N turns N	wire Dia w	turn Spacing S	outer Dia Do	length Wire LEN"	L uH	wire Feet LEN'
hookup	1.6	51	0.03	0.02	6.7	664	251	55
#22	1.6	56	0.025	0	4.4	527	257	44
150/45 L	1.6	56	0.023	0	4.176	508	254	42
#26	1.6	51	0.016	0	3.4	439	246	37

Happy winding!

Appendix:

Some may be curious about the origin of the spider/spiral equation. It has been said that it is derived – a better word might be rearranged – from Harold Wheeler's equation for a cylindrical coil. That idea seems plausible given the following. Ask yourself this question, "When is a coil both a cylindrical and a spider?" The answer is a single loop of wire as noted by coils A & B in picture 4. Second, what might the inductance be of coils C and D be, given that they have the same number of turns and the diameter of C is



equal to the average diameter of the turns of D? It would seem that the total flux produced by each would be the same!