RADIOACTIVITIES

NEWSLETTER OF THE ARGONNE AMATEUR RADIO CLUB

Volume XLVIII, Number 6 **June 2007**

Club Meeting

Unless otherwise noted, AARC general meetings are the second Tuesday of the month at the Argonne cafeteria at a table on the north end of the room. Any club member is welcome. To arrange for a gate pass contact Bruce Epperson at epperson@aps.anl.gov phone 630-252-3495 or Chuck Doose at doose@aps.anl.gov phone 630-252-6037.

The Treasurer's Report

by Chuck KB9UMF

Nothing received.

REMINDERS

CLUB BREAKFAST: Always the 2nd Saturday of each month, 8:30 AM at:

Old◆Country Buffet◆

59th Street and LaGrange Road in LaGrange

CLUB NETS: Thru our Club Repeater 145.19.
SKYWARN NET: Mondays in season at 7 PM with Deni, W9DS.
THE CLUB'S 9PM NET: every Monday with Jack WA9FVP.
THE NIGHT PATROL: every night at 10:30 PM with Paul, W9FNM.
THE BREAKFAST CLUB: every morning at 8 AM.
THE NOONTIME NET: every weekday at noon.

Mil's Corner for June

13	N9SHE	Elizabeth	Willowbrook, IL

Another Small Loop Using Lots Capacitance

by Deni W9DS

Here go again, but an interesting attempt. Seems Ted Hart, W5QJR, has interest in small single loop coil he authored his piece of study via QST June 1986. We know small aerials have low impedance and follow the sassy capacitor and leave coils to rust. We have a large capacitor and add it to a loop and bring it to resonance, thus if the loop has no losses then we have high efficiency marks with small space.

Oh boy, what are the losses? We do the math. A jungle of calculations is a sure thing. Define small loop. A conductor length less than ⅓ of a wavelength that radiates a doughnut pattern. That radiates in the plane of the loop and parallel to a line tangent to the loop at that point. So, if the plane of the loop is horizontal, polarization everywhere is horizontal. Look no vertical component nor any horizontal polarization component exists outside the plane of the loop.

But, if the plane of loop is vertical we get vertical polarization at the 90 degree elevation yields horizontal polarization. Then at 30 degrees elevation the polarized angle is 60 degrees; at 45 degrees the polarization is at 45 degrees. The fact that it radiates at vertical and horizontal angles allows vertical and horizontal dipoles to exist. Define the loop:

Eq1: Radiation resistance RR = 3.38 x 10-8 * (F2 * A)2
Eq2: Loss resistance RL = 9.9 x 10-4 * sqrt(F * (S / D))
Eq3: Efficiency N = RR / (RR + RL)
Eq4: L = 1.9 * 10-8 * S * (7.353 * log10 * 96S / (π * D)) – 6.386
Eq5: Inductive reactance XL = 2 * π * F * L * 106
Eq6: Tuning capacitor CT = 1 / (2 * π * F * XL * 106)
Eq7: Quality Factor Q = F / ΔF = XL / (2 * (RR + R1))
Eq8: Bandwidth ΔF = F / Q
: Distributed capacitance CP = 0.82 * S
Eq9: Capacitor voltage VC = sqrt(P * XL * Q)

Where A = area of loop (sq ft)
S = length of conductor (ft)
F = operating frequency (MHz)
D = diameter of conductor (in)
P = transmit power (W)

Define efficiency: The power radiated by our aerial divided by the power applied to the aerial. Power goes to radiation resistance power lost turns into heat. Radiation resistance is a function of loop area and higher impedance than any other shape. The octagon loop is the preferred shape. The highest operating frequency of a small loop is determined by self-resonance and circumference must be less than ¼ wavelength. A 2:1 frequency range is usual for a loop.

Define bandwidth: A high Q tuned circuit has a narrow bandwidth. The instantaneous will be low. The Q may be 1,000 and the bandwidth in Kilohertz you need a variable capacitor to tune or shift frequencies. You are trading bandwidth for aerial size. Any metal close by will absorb the aerial radiation and kill the efficiency. This is found by the bandwidth measurement.

Tuning capacitor: High Q, high voltage, an air gap of one inch in air, power of 75,000V will arc across plates of capacitor. Power input 500 watts changes into 30,000 volts so capacitor plate spacing must be ½ inch and ¼ inch for 100 watts. Best very costly capacitor is high voltage vacuum variable. The regular losses are from wiper contacts, but split-stator has no wiper contacts and now you must weld the plates together no mechanical spacers they must be bonded between plates it must be electronically welded to bond all plates together the RF coupling is through the rotor, spacing is doubled no wiper contacts thus plates are welded together. To use mechanical plates they must be welded to a conductor to electricity bond the plates. A welding shop can do it for you. You need a fixed capacitor in parallel with your split-stator capacitor.

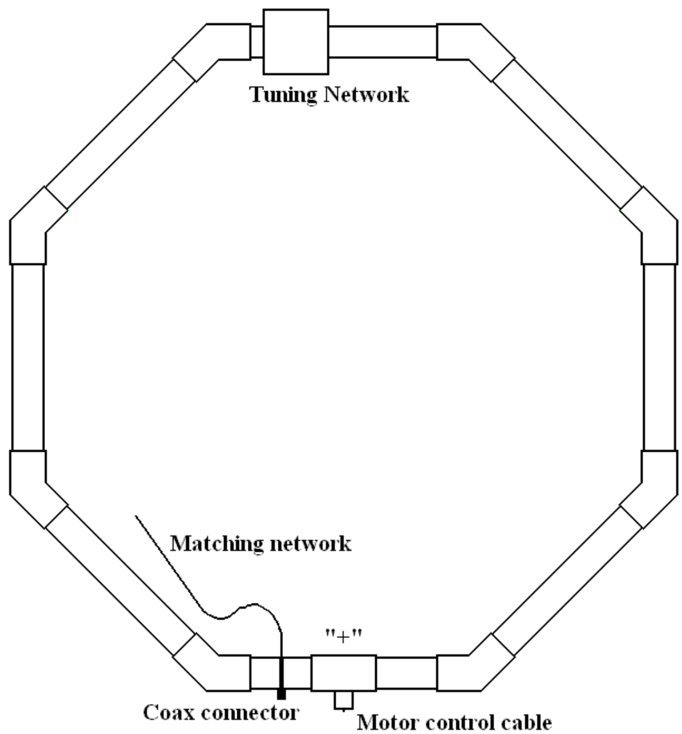
Made from printed circuit board material, its value is $C = 0.225 * (N - 1) * A / D$. N = number of plates, A = the plate area in sq inches, and D is the spacing in inches. You need ½ inch for 30,000 volts for 2KW. Which reminds me of a 160 meter ham who lived in Berwyn South, now raised to glory, owned a broadcast bread slicer. He cranked it spacing 6 inches or my foot size between the plates. The problem he had was that at night neighbors saw arcing off the hustler tip 160 vertical on his garage. He had complaints. I told him to cut a #12 copper wire 1 foot soldier an alligator clip on one end climb up on the roof and put the clip wire at very tip of the hustler as a capacitor hat the aerial didn't sizzle any longer.

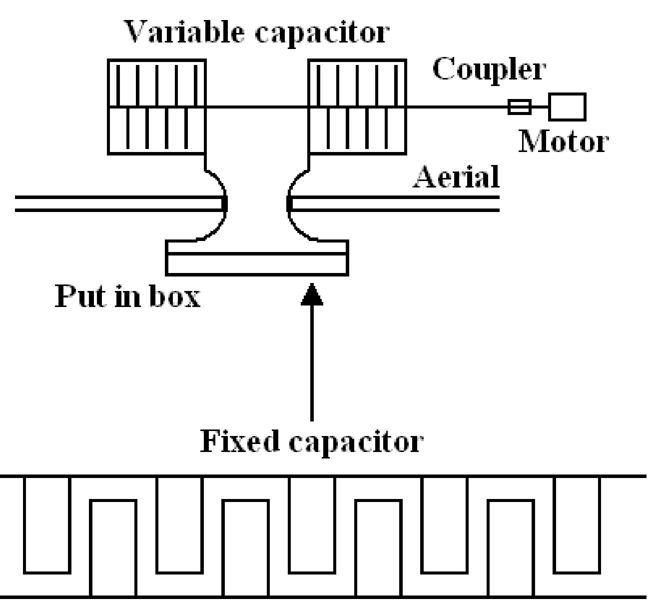
Broadband matching network: A simple gama match no reactive components. A piece of copper ¼ tubing soldered to the loop and a coaxial cable connector. A match can be achieved by bending the tubing and match is made at the center frequency of the loop; SWR will be 2:1 or less over a 2 to 1 frequency range.

Motor drive: You need a stepper motor with gear drive to get adequate tuning resolution. Computations are left to you. (Hint: A 10 foot loop at 14MHz has a 14KHz bandwidth. A 50pf capacitor can tune over a 16MHz range with 180º rotation. Author obtained motor and controller from Hurst Manufacturing Co., Princeton, IN, T986, price $90. The controller is a circuit that needs a potentiometer, control switches, and a 12 volt source.

Once the loop is completed, place it vertical away from all metal. To find resonant frequency by listening for a noise peak in the receiver. Tuning up. Hook up SWR bridge at the loop base its metal so use judgment. Apply power now adjust matching network for lowest SWR, but if high you loose efficiency and bandwidth. Get away from metal MOVE AERIAL.

The large capacitance range allows coverage of all ldF bands from 3.5 to 30 MHz with 2 loops. Capacitor from W5QJR antenna products P.O. Box 334, Melbourne, FL 32902 from 1986 QST.





More Coaxial Trap Design

by Deni W9DS

This type of aerial trap is electrically equal to a parallel LC circuit having inductance of shield and total capacitance of the coax. The flux, 0 and its time are the same in all turns. Voltage is the same as the voltage across every other turn. Thus voltage varies linearly with position along the windings. (The dots are indicating wind sense) In Fig 1A, I1 = EWL (L is the inductance of the shield), and I2 = 0. In Fig 1B, a capacitor is connected between opposite points on the windings. A current I2 flows as shown. Because current through Z changes, voltage across the shield changes to a new value E' and the flux to a new value Ø. Since the coils are unity coupled, voltage ratios and phase cannot change. Thus, voltage across the capacitor is always equal to E'.

The voltage across the shield winding, whatever the value of E' maybe I1 changes to I1' = E'WL; I2' = E'WC. I2' flows in opposite directions through the coils, so net flux produced by I2' is zero. We can move the capacitor down to the bottom of the coils so the net flux made by I2' is zero. We may move the capacitor down to the bottom of the coils with no change anywhere.

We end up with a resonant circuit with shield inductance in parallel with total capacitance of the coax. As such, a coax trap is the same as an ordinary trap with same Q and component values. Differences in aerial loading are caused by variations in Q and reactance, rather than any other trap property.

EQ1: Design coax trap capacitance. C = E (π*d) * N, where E = capacitance per cable inch. d = diameter (to center conductor) of coil in inches. N = number of turns.
EQ2: Inductance of shield. L(uH) = (d2 * n2) / (18*d + 40*b*N). For close wound coils where b is the cable diameter in inches and the other variables are defined for EQ1.
EQ3: f = MHz, L = uH, C = pf, F = 159 / (sqrt(L*C)).
EQ4: f = 127 * sqrt((9*d + 20*b*N) / (E*d3 * N3)), where E is in pf. For RG58U, b = 0.195", E = 2.375pf /inch.
EQ5: f = 127 * sqrt((15.26 + 3.9*N) / (11.57*N3))

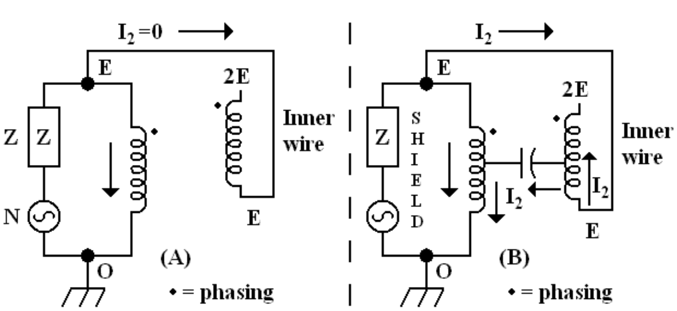


Fig.1

Coax trap as a coil with no cable capacitance (A). With a capacitor connected across opposite points on the coil (B).

Table one turns

MHz	EQ5	John's coil
28	4.1	3.75
21	5.2	5
14	6.8	6.75
10	8.8	4.75
7	12.2	12.75

75 T-Hunt

by Deni W9DS

W6PZV came up with 2 different loops the handheld aerial uses a copper tube, which forms a circle. His article June QST 1958 shows 2 different aerials. The first has 5 turns of wire with a 140pf variable capacitor in a box used as a handle and a single loop placed in the tube ties to coax and a receiver. The tubing is cut at top and the ends insulated from each other by plastic tape. A grid dip meter is used along with variable capacitor to get it on frequency.

Operation consists of turning the loop; it has 2 nulls when loop is turned until signal is at minimum the loop gives the line of the hidden xmiter but not its direction. Take bearings from 2 places, draw 2 lines on a map note they intersect then this must be repeated until you find the fox.

The second aerial uses loop stick out of radio. Old wiring cut off and new wiring placed over the ferrite core this loop can function best with use of a "sense aerial" and the sense aerial is combined in proper phase relationship A 2 turn loop is used for output to be obtained 15 inch whip is the sense aerial adjust the 15 inch whip to resonate. A switch disconnects the sense aerial during tuneup. Whip, loopstick, coil L1, potentiometer R1, and switch and capacitor C1 are mounted on a 2 x 3 x 4 inch box chassis. Loopstick is mounted protected by a piece ½ inch thick plastic and length of fiber tubing, which fits over loopstick.

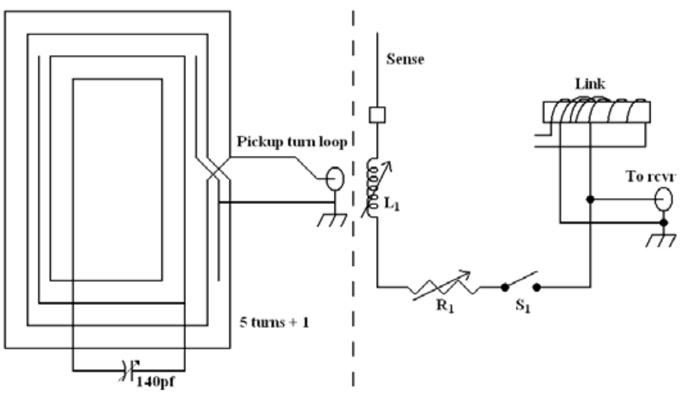
To get a null output via loop and sense be combined we must have a 90 degree phase difference between them and a phase shift is done by tuning the sense aerial slightly off frequency by means of slug L1. Since sensitivity of the whip aerial is larger than the loop. The output is reduced by using potentiometer R1.

Ham radio is used to tune up the direction finder. All aerials are removed using the loop.

With the xmitr on frequency and low power, use switch to disconnect sense aerial. Turn C1 watch S meter on receiver the loopstick is peaked. C1 is set. Turn on sense aerial and turn pot to lowest resistance. Adjust slug L1 for maximum S meter reading. It may require turning d.f. a bit to get higher reading than the loopstick! The last slug turn is critical watch stay capacitance from hand. Now turn d.f. so one side of loop is to xmitr. Turn R1 complete revolution to get null on S meter for one position on R1. If not, turn d.f. 180 degrees. Try again. Leave R1 at setting which shows lowest reading. Adjust L1 slow to reduce reading further. Repeat first R1 then L1 all minimum readings.

Have xmiter move around and d.f. and follow it turning d.f. The null should be broadside to loopstick. Make record of which side the d.f. null is on. Finished.

Keep the d.f. nulled. As hidden xmitr is getting closer to xmiter d.f. must turn in order to get null. At this point xmiter is at right angle line of travel. At this point a right angle turn to xmitr and go ahead watch strength of signal you catch him and say now it's my turn.



C1 140pf, L1 140mh adjustable, R1 1,000 ohm carbon pot, S1 spst, loopstick Miller 705A cut off windings. New winding 20 turns #22 enamel link is at center. Wire ends Scotch tape em.

Dimensions of a 40 Meter V Beam and 2 Quads 20/15 Meters

by Deni W9DS

The 40 meter beam is in an inverted Vee. Elements are 50 to 60 feet up and the elements slope down 35 degrees. All elements are #16 copper insulated. All aerials fed by 50 ohm coax. Are fixed not rotatable.

40 meter V reflector: 67' 1 ½" spaced 26 ft from driven element 64' 10" spaced 21' 6" from first director 62' 5" spaced 22' from second director 61'.

20 meter 5 element quad fixed: reflector 70' spaced 13' 4" from driven element 67' 2" spaced 12' 6" from first director 64' 8 ½" spaced 13' 1" from second director 62' 2 ½" spaced 14' from third director 62' 5".

15 meter 8 element wire quad fixed: reflector 47' 4 ½" spaced 7' 3" from driven element 45' 10" spaced 4' 1" from first director 44' 5" spaced 4' 10" from second director 44' ½" spaced 10' 8" from third director 43' spaced 12' 5" from fourth director 43' 6" spaced 14' 6" from fifth director 44' 2" spaced 15' 3" from sixth director 43' 6".

Now your aerial height 40 meter driven 50' 2nd director 62' the 20 meter fifty feet for 150 feet forward 15 meter driven element 10' off ground then is 50' high the land drops off. It's 69 ½ feet long 1 ½ wave length. The author, K1GZL, published Sep/Nov 1990 rest unknown.

Helical Wound Mobile Aerial

by Deni W9DS

From Rhodesia ZE6JP, H.L. Booth, gives us his work with coil wound whips. His aerial has flat resonant response and frequencies above resonance. With fall-off below the desing frequency. He has a 1-150mHz or a 4 bander covering 10 to 80 meters in his 1972 Dec Ham Radio article.

ZE6JP warns that construction procedures, dimensions, and winding instructions must be followed exactly or the aerial won't perform as claimed. Details are given to copy the aerial either mono band design (1-150mHz) or as a 4 band covering 10-80 meters. After you've built the aerial from instructions provided here, then try your own variations, but "stick to the script" to start with. He has made many single band helical wound whips. A second resonance was found around 18-19 mHz on most aerials using rod ⅜ inch in diameter for the dielectric. The technique to wind single band whips for 3.5 to 100mHz trends were noted. After rewinding and making adjustments the aerial whip worked on 40 and 20 meters, so he tried 10 meters & it loaded and worked. Then 15 meters was tied and it worked on that band too. The tests on 20 meters showed 3db gain over a hustler at a distance of 14,500 miles.

A single band design formula resulted in determining length of wire for a one frequency helically wound aerial. The formula guesses the shape, dielectric rod length, and wire gauge, which affect the formula. The formula now is $L = 840 / \text{freq MHz}$, where L = wire length in feet. This formula results in a little more wire than required if the top third of the aerial length is close wound. If less than ⅓ is close wound, more wire will be required; if more is close wound, less wire will be needed.

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MEMBERSHIP is open to all who are interested in amateur radio. This club is sponsored by Argonne National Laboratory. Employees of ANL or DOE-Chicago are eligible for full membership. Auxiliary membership is available to non-employees.

W9ANL/R is an open repeater, coordinated on 145.19 MHz (-600 input). The AARC repeater has been in operation on this frequency pair continuously since February 5, 1982.

CLUB NETS: 2 meter fm 1) Regular, every Monday evening at 9:00 and 2) the Night Patrol every night at 10:30, both on W9ANL/R. The Peanut Whistle Net (PWN) every Sunday at 1:30 p.m., and many evenings at 8:30 p.m. on 1932 kHz (cw/am/ssb), QRP.

RADIOACTIVITIES is published monthly by the Argonne Amateur Radio Club as a nonprofit newsletter intended only for the use of its membership. Material appearing here does not represent the official position of Argonne National Laboratory or the U. S. Department of Energy. Please give credit to the author and to Radioactivities or the Argonne Amateur Radio Club, when using original material published here. Deadline for submissions normally is the 20th of the preceding month.

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Please send club and editorial correspondence to the club address, or to travisdj@bigfoot.com Please include "AARC" in the subject.