RADIOACTIVITIES

NEWSLETTER OF THE ARGONNE AMATEUR RADIO CLUB

W9ANL

Volume XLVIII, Number 12 **December 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

Members: East 18; Associate 40; Newsletter 6; Retired 13
Balances: Checking $3,610.62; Cash $0.00; ANL fund $30.00
Distributed as: Club $2,978.74; Repeater $594.88, Newsline $37.00
For the period August 1, 2007 thru October 31, 2007:
Income: Dividend $5.64; Rptr $1.11
Expenses: None

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 November

10	W9DS	Dennis	Burr Ridge, IL
25	N9UEB	Timothy	Lockport, IL
26	KB9FUR	Robert	Addison, IL
27	W9ZEW	Rudolf	Cicero, IL
29	N9AFK	Doug	Plainfield, IL

A 40 meter Discone Aerial

by Deni W9DS

Well, why not? A little less real estate is needed for the horizontal dipole and the 90 degree pyramid wire below the horizontal. The lower wire point is a point angle which one attaches one leg of the feed line. This aerial dates from an article by Kandoian "3 New Antenna Types and Their Applications." Proceedings of the IRE, Feb 1946. It was DJ4GA, Mike Wintzer, who brought it to QST in 1974.

Mike wanted more than just a simple dipole. He was looking for an aerial to work mobiles DX and locals on field day. Along with the idea of long haul DX as well. He goes through a complex stage of wires lots of wire including verticals with many wires were tried. He felt something better was to be used.

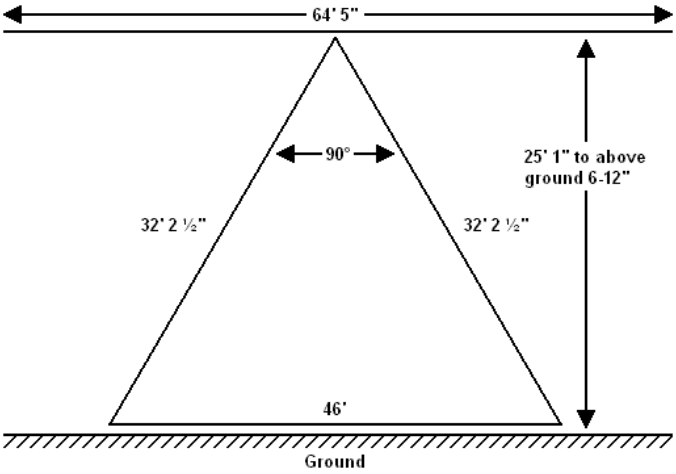
To him the major goal is to move the current maximum upward and also do away with the necessity of a ground reference. So he built a vertical upside down with 4 radials. Oops, not a good idea. He discovers Mr. Kandoihn paper as referenced earlier. Now he is on track, but I just glanced to see how he hooked the coax to the upside down vertical and he tied the center conductor to the vertical. That was wrong. The ground should have tied to the vertical and those 4 wires would have radiated a better signal, but degraded by dividing current into four parts. Alas, we won't know if any improvement would have taken place.

The aerial is a cone section ¼ wave long below a disc top. Both sections are made of conducting materials and fed like a ground plane. The bandwidth is large with SWR 2 to 1; the frequency is ten to one. It radiates a horizontal pattern. A single support is all that is needed. However, no one would waste their time putting up one for 40 meters. They are used at higher frequencies Radio Shack used to sell something just like it for TV.

Mike took this idea and built himself a different wave-guide horn. It took him a little time to figure the higher-mode resonances in the structure are hard to predict. Looking at SWR curves showed him the uselessness of using it as a multi-band aerial.

Coming to his senses he decided to place a horizontal wire, replacing the top hat, the length of a ½ wave dipole soldered at its center and the cone point. Now it has the properties of an ordinary linear aerial with resonances at the odd harmonics and still the bandwidth is broader than a dipoles range. It is useful for 40 and 15 meters. He was using 4 wires under the dipole and then only two

radials are used mounted so that they are in the same plane as the half dipole. The two radials form a right 90 degree isosceles triangle and at the top point the one leg of feed line ties in here and the feed line other leg ties into the center of the overhead dipole center. Thus, the ground shield goes to the 2 ¼ wave radials meeting point.



This aerial is superior to a ground plane, and considerable improvement of performance observed for ground wave and long distance (skip) contacts and DXing. Remember, there are methods for multi-band use via traps. Here is a good choice for field day.

It just might knock their socks off!

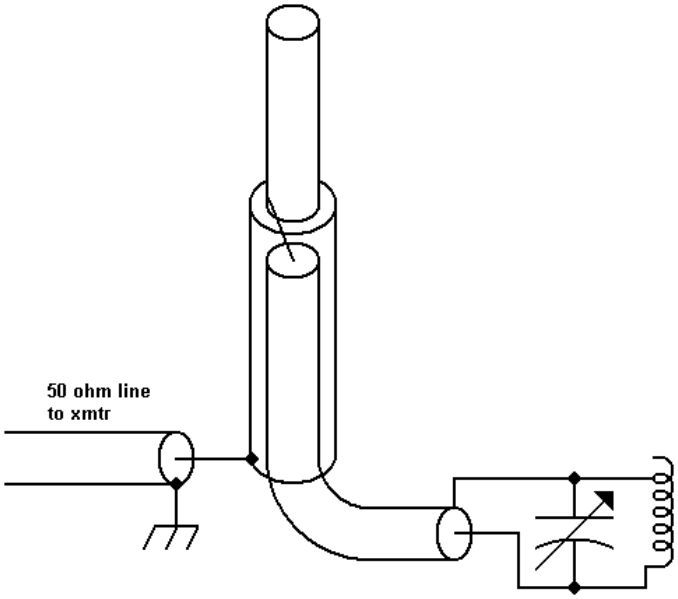
Coax Base Tuned Center-Loaded Aerial

by Deni W9DS

It was John Schultz, W1EEY, who experimented with idea found in January 1970 73 Magazine. He uses transmission line (coax) to transfer the reactive element to aerial center. Base inductive loading verticals have low efficiency when radiator is short under ¼ l at operating frequencies. High base current flow through the coil small size creates losses, but solutions are found to get current flow distributed in a way reactive elements brings resonance without high losses. Using a helical coil wound the length of the aerial reduces base section high current using inductive load along whole length.

Center loading popular method allows base radiation of high current for mobiles, but not good for fixed stations using verticals on various bands. A method to improve efficiency. A form of center loading using transmission line to change the reactance of a loading element nested at the base to the center electrically. The inductive reactance makes the electrical length of the aerial equal to ¼ l so that the base impedance will match a coaxial line and aerial accept a power transfer from transmission line.

Coax lines can transfer reactance and simulate like stub matching simulates inductance or capacitance to correct mis-matches. Combined lump reactance at stub end and effect of the stub itself can be any value. What's produced could have high Q and low power factor. Using certain lengths and/or termination for coax line could reflect an open or short circuit and be used as a remote switch to boot.



Coax line is placed inside lower aerial element to effect reactance transfer from base to junction of upper and lower aerial elements.

A shorted stub can act like a coil until it is ¼ l long and then has a capacitive reactance beyond ¼ l. If the stub is open-circuited, the capacitive reactance takes place until stub reaches ¼ l then it acts like a short circuit. The math goes like this: reactance XL (short circuited stub) = Z * tan(2p * L / l). XC (open circuit stub) = Z * tan(2p * L / l). Z equals the transmission line to make the stub and L/l is line length in wavelengths. The real coax line length has a velocity factor usually 0.66 and thus shorter by that value than a free-space wavelength. Avoid lengths longer than ¼ l because highest Q will be found when stub length is less than ¼ l. Knowing the reactance of the stub, we calculate how many millihenries or picofarads are made at any frequency. Now we look for best Q, for lowest possible cable loss use RG58, RG14. Replacing the short or open-ended termination with lumped reactance will extend the range to any desired value.

By using the right value of loading reactance, the overall aerial is resonated as a ¼ l or ¾ l vertical. Feed point now matches 50 ohm impedance coax. The coaxial line use to transfer the base reactance is shoved into the lower vertical element. Dimensioning of aerial sections and the coaxial length transfer line must all match to get proper aerial operation on various bands and locating of base reactive elements. Tuning using SWR meter one should try both inductive and capacitive element at the base on each band, varying their value to get closest to 1 to 1 SWR. Use field strength meter to determine which reactance value gets the best radiated signal. A good ground connection must be provided for ¼ l and ¾ l mode for 50 ohm coax match.

A Cardioid Beam QRM Killer

by Deni W9DS

Webster's dictionary states cardioid means heart-shaped. In mathematics, it is the one-cusped epilycloid traced by any point on the circumference of a circle that rolls all around on an equal circle. Wow! What a word to describe an aerial.

I would call it QRM Killer that's why it appeared in QST August 1947 authored by Ed Harris, W9KNK, a resident of North Ashland Avenue in Chicago. Looking for minimum QRM and not maximum gain. You see, he saw the future with bands crowded to capacity by the tremendous expansion of the ham fraternity. Boy, he was right then. AM was 6Kc wide and overloaded front ends of receivers with not wanted heterodynes. Well, don't we have that today? Wait for the bands to come back again. Every local and hams across the country will be chasing DX and islands.

Ed produced a simple beam with a novel way to approach this subject. Having used a ½ wave doublet over seas in Japan, Ed came home, put up a doublet, and after hours of listening on his receiver (which was as broad as a barn door), and several attempts at QSOing, no sooner would a station be called and contact made, the QRM would set in and that was the QSO end. He had to lick this terrific QRM. So, he put into his receiver all the latest gadgets of selectivity afforded by various crystal and IF band pass to no avail. All signals were S9 on any frequency at any time.

Ed went to work on the aerial. His doublet had its day. Now he found hams using parasitic arrays usually close spaced on 20, 15, and 10 meters. It is easy to adjust aerials for more gain with good front to back ratio, but one failing point is that in no direction is there an absolute null and particularly in the case of 2 or 3 element beams.

The problem is it is possible to discriminate against an unwanted signal and be able to eliminate it completely on reception. If our null is sharp, say ten to twenty degrees, it is possible to work either of (2) S9 signals on the same frequency as long as the signals are coming with an azimuth differential of more than 20 degrees. Orientation of aerial to put strong signals into the null pattern will allow QSOs in the remainder of the pattern.

I, W9DS, was thinking of using something like this along with another aerial to transit on. Using this aerial strictly for reception separate from our transmitting beam put on a sliding sleeve rotatable around the same pole. The catch is that this described aerial is vertically polarized vs the upper rotatable beam being horizontal. I can see the tangled up elements all ready. But we could use this vertical by itself without very much forward gain. QRM killing will be a must in the future.

It seems hams all around the world have this harassing carrier QRM. Some times it is on a heading you must hold in order to make that single contact with QRM db's stronger than the weak one you are interested in talking with for a very short QSO, like a DX contact.

Ed's aerial is one of several types of arrays with radiation pattern of a null. Ed' array uses two half waves with quarter wave spacing and fed 90 degrees in phase.

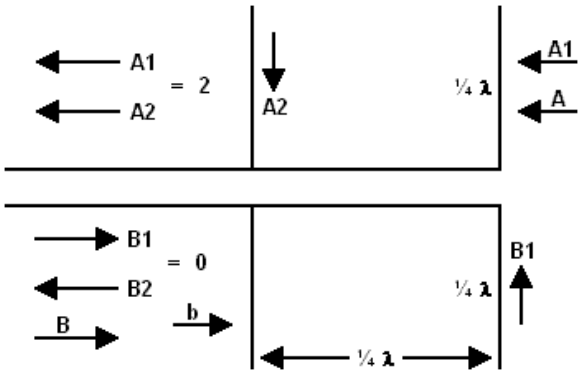
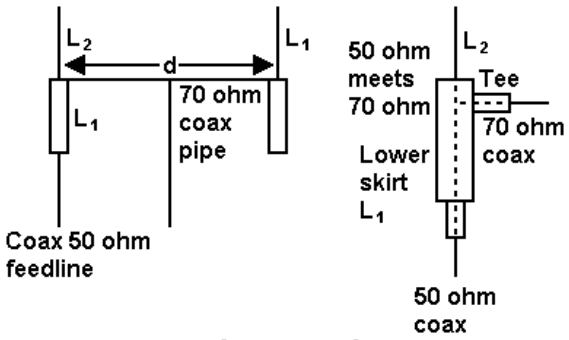


Fig. 1



Radiator Details

	20 mtr	10 mtr	f MHz
d	16' 9"	8.3'	240/f
L1	16' 5"	8.1'	234/f
L2	16' 5"	8.1'	234/f

Theory of cardioid beam, W9KNK, 1947
Spaced ¼ fed with $l_2 = l_1 < 90°$
$E = 2*E_1*\cos((\pi*d*\cos(\theta)+d)/2)$
$E = 2*E_1*\cos((\pi/2*\cos(\theta)+\pi/2)/2)$

Horizontal Radiation pattern from two vertical half-wave elements with ¼ wave length spaced and fed 90° in phase as compared to radiation pattern of vertical dipole.

Let $E_1 = l$, then:

θ	E	θ	E	θ	E
0	0	120	1.85	240	1.85
30	0.221	150	1.99	270	1.41
60	0.758	180	2.00	300	0.758
90	1.41	210	1.99	330	0.221

Reference to fig.1, the theory of the array is shown. A signal coming from direction A will induce voltages A1 and A2 in elements 1 and 2. In traveling the ¼ wave from element 1 to element 2, A1 goes through a 90 degree rotation, and getting to element 2, it is in phase with A2 and the 2 voltages add. Now A arrival signal from direction B induces voltages B1 and B2 in the respective elements, but B1 has gone along the transmission line to combine with voltage B2, the 90 degree phase rotation places it 180 degrees out of phase with B2 and the voltages cancel, thus we get a null in this direction. Radio waves coming from intermediate angles suffer different phase differentials in the two elements, but there always the 90 degree rotation of the vector from element 1 to 2 where the voltages combine. The pattern from this is the well known cardioid, and is the same on transmitting and receiving. Fig.2 shows the development for obtaining the pattern in mathematical terms.

The broad pattern of radiation is a disadvantage but we want to combat QRM on the band. The extreme value of the null factor alone is responsible for successful operation when strong signals may be expected from any direction.

If 2 signals arrive at opposite directions on the same frequency, both of them having the same signal strength. Using your parasitic array with a ratio of front to back 20db you will still have trouble. An absolute null means we have a ratio of infinity. With proper use of null the infinite ration exists between directions separated much less than 180 degrees. There is a theoretical gain in forward direction of 2 on the front of the beam. It is better to suppress the unwanted signal. The beam should be up at least ½ wave. Use of ground screen is helpful.

It is imperative that currents in each element be the same. 70 ohm coax cable is used to connect the 2 elements. Since the coax line, which feeds the 2 elements, is terminated in two 70 ohm resistances in parallel it is characteristic impedance should be 35 ohms. 50 ohm coax is used for the main feeder line.

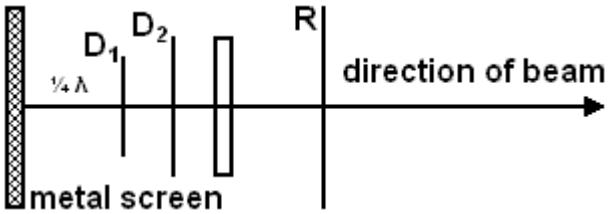
In order to lesson trouble the first element is fed as a vertical coaxial aerial using 50 ohm line and 70 ohm line connected between this and the second element. The line below the bottom of the first element is isolate from the aerial and this improves the balance of the fed dipoles. Happy hamming.

Reverse Beam Aerial

by Deni W9DS

In September 1962, 73 Magazine had a short column about European radio magazines describing a VHF reverse beam adding 5db due to narrowing of the beam (about twice) compared to a regular dipole director reflector arrangement.

Done by pointing a regular yagi toward a large 2 x 2 wavelength reflected surface and away from the station you are in contact with. The reflecting surface (it can be solid metal or screening) is located ¼ wave from the nearest director. The same idea can be used with stacked beams and then larger screens are needed it is successful on 144MHz, but no information on how the screen effects the input impedance.



An Old Farmer's Advice

- Your fences need to be horse-high, pig-tight, & bull-strong.
- Life is simpler when you plow around the stump.
- A bumblebee is considerably faster than a John Deere tractor.
- Words that soak into your ears are whispered…not yelled.

ARGONNE AMATEUR RADIO CLUB
P.O. Box 741
Lemont, IL 60439

Officers

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e-mail: w9anl@bigfoot.com
www.bigfoot.com/~w9anl

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.

EDITOR Dale Travis AG9H
EVENTS
SKYWARN ACTIVITIES Deni Lamoreaux W9DS

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