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The 3 parallel loop/Adcock system

by Ben Peters

The loop system which I'm going to describe is based on one developed by Telefunken in 1937, known as the "polarization-error-free" if translated directly from the German. It consists of 3 similar loops mounted on a large flat board. Two are mounted parallel to each other (the sideloops), while the third (the middleloop) is mounted between these two, is rotatable, and is coupled to the receiver either through a coupling winding or amplifier. The entire system also rotates for improved nulls. I've been using wooden rotatable sculptor's stands as my rotation device, available here in Europe for about US$10-40, which turn smoothly, but are solid enough that a null won't be lost due to vibrations from loop and capacitor tweaking. The system was originally developed to give accurate direction finding on signals which were distorted by "night-effects", phase cancellation and so on. As I'm using unbalanced Martens loops, I've not experimented with the direction finding capabilities of the set-up, but have found it to be extremely useful in nulling stations otherwise un-nullable by a conventional loop, especially stations affected by "night-effect" distortions. An advantage is that the set-up can often be used for nulls without even determining which way the interfering signal is coming from.

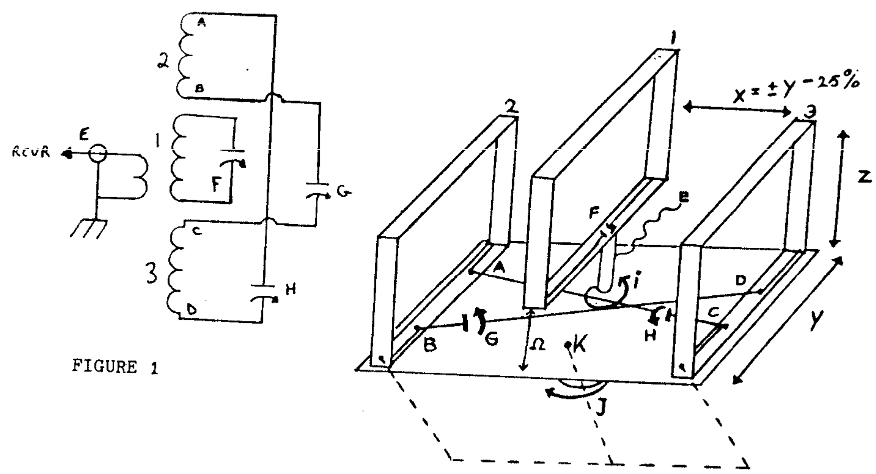

FIGURE 1

1. Middleloop, air-core, unbalanced possible (must be balanced for DF), about 40 to 50 cm. a side (the system becomes unworkable if much larger). Rotates independantly of wooden base plate K. Provision for tilting is optional, if this loop is ever used solo for example. Switchable amplifier is recommended but not essential. This loop connects to receiver and is inductively influenced by sideloops.
2. Sideloop, same size and winding as middleloop. Fixed on base K in a parallel position to other sideloop. Not connected to receiver.
3. Sideloop, same as 2

A,B, C,D Ends of sideloop windings

E Coax lead-in from middleloop to receiver

F Variable capacitor of middleloop, vernier recommended.

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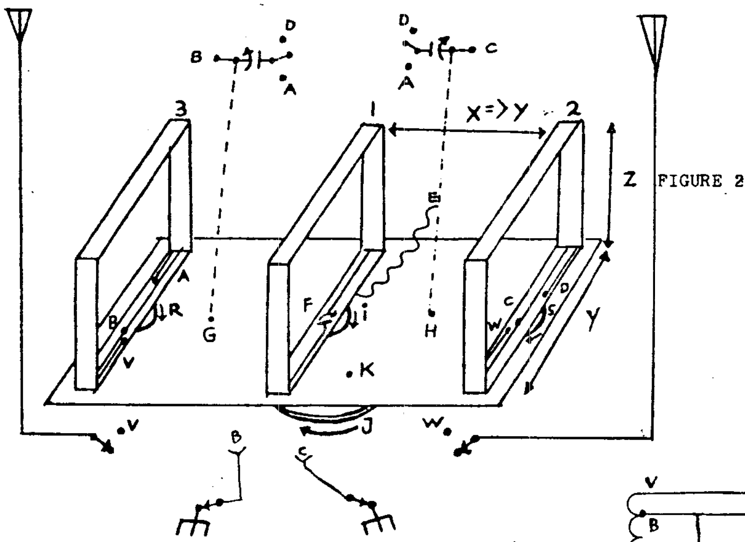
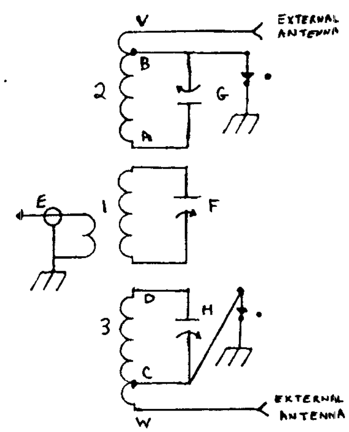


FIGURE 2



G
H Variable capacitors of sideloops, vernier recommended. Value of each capacitor same as F.
Connecting the capacitors as diagrammed in Figure 1 results in a "clover-leaf" reception pattern by sideloops. Nulling etc. is much easier this way than when G is connected between A and B, and when H is connected between C and D, like two normal loops.
Nulling with sideloop capacitors as diagrammed in Figure 1 often needs only one capacitor to be adjusted.
When sideloop capacitors are connected as in normal loops, both need to be adjusted for best result, and nulls are sometimes harder to find.

i Rotating stand of middle loop.

J Rotating stand of K

K Wooden base plate for all 3 loops. Must not warp! Size depends on loop sizes chosen and whether the middle loop is raised half its height to reduce distance X (e.g. when loops of 40 cm a side are used, the base must be about 80 x 40 cm, but when middle loop raised half its height, the base can be about 60 x 40 cm)

Y
Z Loop dimensions, Y=Z recommended.

X Distance between middleloop and sideloops (center to center). Can best be found experimentally, but will be about one loop diameter.
Find as follows: Place middleloop in the clear, no other loops around, connect to receiver, tune receiver to a well-known frequency, midday preferably, tune middleloop and rotate for best null. Leave middleloop alone for rest of procedure. Now move a same sized loop parallel to middleloop at about one loop diameter distance, tune second loop for a further dip in signal strength. Slightly rotate second loop, at the same time varying the distance to middleloop for DX/null improvement. When DX/null cannot be improved anymore even after readjusting the second loop's capacitor, the distance between loop centers will be X.
If tuning the second loop peaks rather than attenuates the signal, rotate second loop out of parallel position to about 45 degrees to middleloop, or possibly to slightly less than 90 degrees. If null is not improved this way, slightly pass 90 degrees, to 45 degrees, and even parallel again. Probably a DX/null improvement will be noticed by now. (Note: if middleloop is unbalanced and no null improvement is found with above, rotate middleloop 180 degrees and start procedure with second loop again). Do not forget to vary the distance between the two loops slightly when looking for null deepening and readjust second loop's capacitor for better dip. Final distance between loop centers will be X.
(Reference to: Helmholtz Coils--see electronics dictionary
Mike Levintow's IRCA reprint A12: "Generating asymmetrical receiving patterns using two loops")

Distance X can be reduced about 25% with only a very slight loss of gain but without impairing the nulling/phasing capabilities. If the middleloop is to be raised half its height related to the sideloops, find exact distance as above, but now have middleloop raised half its height related to the second loop.
This reduction in loop spacing is possible only in the unmodified 3 parallel loop system (Figure 1). If the sideloops are also to be rotated, e.g. for phasing two random wires, then X must be slightly greater than Y (see Figure 2).

V
W Floating ends of additional turn(s) of winding AB and winding DC; only needed when used to phase two random wires; the wires connect to V and W and B and C become taps on windings AV and DW. Length of wire between B and V (or C and W) is about 1/10 of total wire length between AB (or DC), not critical; it only slightly interacts with the tuning range of the capacitors. (see Figure 2)

R
S Rotating stands for sideloops, only need for optional phasing of two random wires, or a 3 loop "series" system.

Ω Distance between K and bottom winding of middleloop when size reduction of assembly is wanted, e.g. loop side = 40 cm, then this distance = 20 cm.

Nulling/DXing with the 3 parallel loop system:

When sideloops are capacitely connected against each other (Figure 1):

1. Position whole system convenient to receiver.
2. Rotate middleloop to a) approximately parallel to; b) 45° from; c) approximately 90° from sideloops
3. Tune middleloop to resonance
4. Tune one sideloop capacitor, G or H, for dip (if it peaks: try one of the other middleloop positions, or (if the middleloop is unbalanced) rotate it 180°. When at the low end of the MW band, start with G or H in maximum capacitance position and adjust one only for null/peak. When at the high end, start with both in the minimum position and also adjust only one for null/peak. In some situations, e.g. when hand-capacity effects are a problem, playing with both G and H may be needed.
5. Rotate middleloop slightly for better null.
6. Repeat 4 and 5
7. Rotate the whole set-up for best DX/null.
8. If not satisfied try another one of the positions of the middleloop mentioned in section 2 above, or tune middleloop to resonance, rotate to null unwanted station, and proceed to step 4.
9. Sometimes one needs to adjust the other sideloop capacitor to get the best stable, hand-capacity free null. Both capacitors interact: a peak of one can be nulled again with the other and then be peaked again by the first, nulled again by the second until you've hit the maximum or minimum positions of the capacitors. Keep cool!
10. When, while DXing, middleloop is rotated from about parallel to say, less than 90° (exactly 90 is a position with almost no coupling between the middle and sideloops), be sure to retune middleloop, especially when it's amplified. This is because resonance may have shifted due to inductive interaction with the sideloops; this may result, if not corrected, in spurs.

When each sideloop is connected to its own capacitor:

1. Position whole system convenient to receiver.
2. Rotate middleloop to about about parallel (or 45° from etc.) to sideloop.
3. Tune middleloop to resonance.
4. Tune one sideloop for dip (if it peaks, rotate middleloop to 45° etc.)
5. Tune other sideloop for peak; it it dips also, that's even better.
6. Slightly rotate middleloop for better null.

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7. Repeat 4, 5 and 6
8. Rotate whole set-up for best DX/null.
9. Same as 10 above (retuning of middleloop etc.)

With sideloops rotatable (Figure 2):

1. Tune middleloop to resonance.
2. Rotate this loop for best null.
3. Tune one of the sideloops for dip/peak (eventually rotate this sideloop to achieve a dip/peak.
4. If a dip: leave this sideloop and rotate middleloop for a better null. If a peak: rotate this sideloop for better null.
5. Tune other sideloop for dip/peak (eventually rotate this loop etc.)
6. If a dip: leave this loop and rotate middleloop and first sideloop slightly for null improvement (eventually readjust first sideloop's capacitor.) If a peak: rotate this sideloop for a better null.
7. Make final small adjustments to rotation and capacitor setting of all three.

** Experimental suggestion: worked very well when I tried it. Connect signal leads of all 3 loops together/ connect 3 ground leads together. i.e. all loops are fed to receiver, and must be similar design. Null action is much more pronounced then. Also, try "criss-crossing" antenna and chassis leads of the 3 loops and choose what is best in your set-up.

Phasing two (or one vs. loop) random wires with 3 small independantly rotatable loops placed next to each other was done as follows:

1. Connect two randoms to the the 2 sideloops (as described in figure 2). Have all capacitors at maximum. May need to ground points B and C for best results.
2. Tune the middleloop to resonance and rotate for null; when null is hard to find, skip it and tune one sideloop etc.
3. Tune one sideloop for peak and then rotate for better null.
4. Tune other sideloop for peak and then rotate for better null.
5. Slightly rotate middleloop for best DX/null.
6. Make final adjustments to rotation and capacitor setting of sideloops, and finally of middleloop.

** If while doing steps 3 or 4 a dip occurs, leave that loop and rotate middleloop for best null.

Nulling with this system (especially as shown in Figure 1) is always an improvement over using the middleloop on its own.

Daytime---noisy, poorly readable DX is transformed into clean readable DX. Shallow nulls are transformed into deep nulls with DX audio coming through. Best position to start from for daytime is probably approximately 90° because highest DX gain seems to be in this position. And there is not usually much polarization effect on signals to make nulls unstable during the day. Although DX gain is higher in this 90° position, one of the other middleloop positions may yield a better quality null, though with lower DX signal level.

Nighttime-----On a crowded channel, with no one station readable, one can find 2 or 3 readable stations with the middleloop approximately parallel to the sideloop; often yet another readable station is in the approximately 45° or 90° positions. Stations which cannot be nulled with the loop alone, due to short skip and groundwave mixing, can be nulled deeply yielding DX with the 3 loop system. Local signals can be deeply nulled to yield DX on the same bearing as the local.

This system is comparable in its nulling abilities to the much larger wall loop system described in the January 14/84 DX Monitor, at least when a smaller rotatable loop near the wall loops feeds the receiver (the wall loop system is in effect a big goniometer, with the small loop as a sense coil). Both systems use 3 loops, and necessitate 3 handed tuning/rotating/switching, at least in some circumstances.

The advantage of these systems is in superior nulling possibilities over a single loop. There are a couple of disadvantages (beyond relative complexity) particularly when an amplified loop is used to feed the receiver. Hand capacity effects can be a problem with deep nulls when using the parallel loop system, though careful tuning of sideloops and rotation of the whole set-up can eliminate it. Amplification of the middleloop is often necessary on weak signals, and care must then be taken in tuning all three loops as spurious responses may result. In strong signal areas, an unamplified set-up would be preferable, but would involve larger loops for better signal strength. This would make the system unwieldly. The 3 parallel loop system could also be used in conjunction with the wall loops for better signal strength without amplification. In high signal strength areas, the wall loops with a smaller unamplified loop feeding the receiver may be preferred.

I would like to hear from those who experiment with both the 3 parallel and the wall loop systems. Write to Ben Peters, Lynbaansgr. 318, 1017WZ Amsterdam, Holland.

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