
Personal Articles and Stories by John Achor

Copyright notice. This story is copyrighted and may not be reproduced, copied, distributed, or reproduced by any means in any media without the express written permission of the author.

ADCOCK RADIO RANGE ORIENTATION AND INSTRUMENT APPROACHES

I hadn't even thought of this type of flying in years. When I did, I searched the Internet for the details of flying a range orientation. I got dozens of hits on "Adcock" and "radio range," which mentioned the subject. But none gave me any details I was trying to pull out of my memory banks. I found just enough in a manual a friend gave me (which quadrants were "N" and which were "A") and worked out the rest from memory and deduction. I started this monograph but didn't think it would extend to six pages. It was fun though.

Radio range low frequency, 200 to 450 kHz beacons provided a means of navigating and instrument approaches in the days before long Automatic Direction Finding (ADF) equipment was available.

The beacons broadcast into quadrants with four legs approximately NE, SE, SW and NW. In the V's, one of two letters, "A" or "N" was broadcast in Morse Code. Dit, Dah (dot, dash) forms an "A" while Dah, Dit (dash, dot) represents an "N." Where the signals melded, on the legs or beams, the "A" and "N" codes are superimposed and the dot, dash, dash, dot became a solid tone.

Here's an example (Figure 1) of how a Radio Range looked showing the inbound headings for each leg and the "A" and "N" quadrants with the Morse Code equivalents shown in parentheses. The dot is "pronounced" dit and the dash, dah - the code is easier to learn that way.

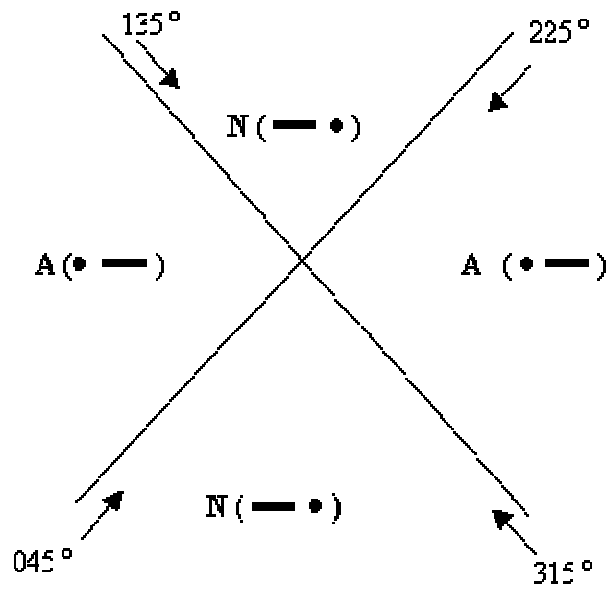


Figure 1

In Figure 2, we have our orientation problem. We're heading East:

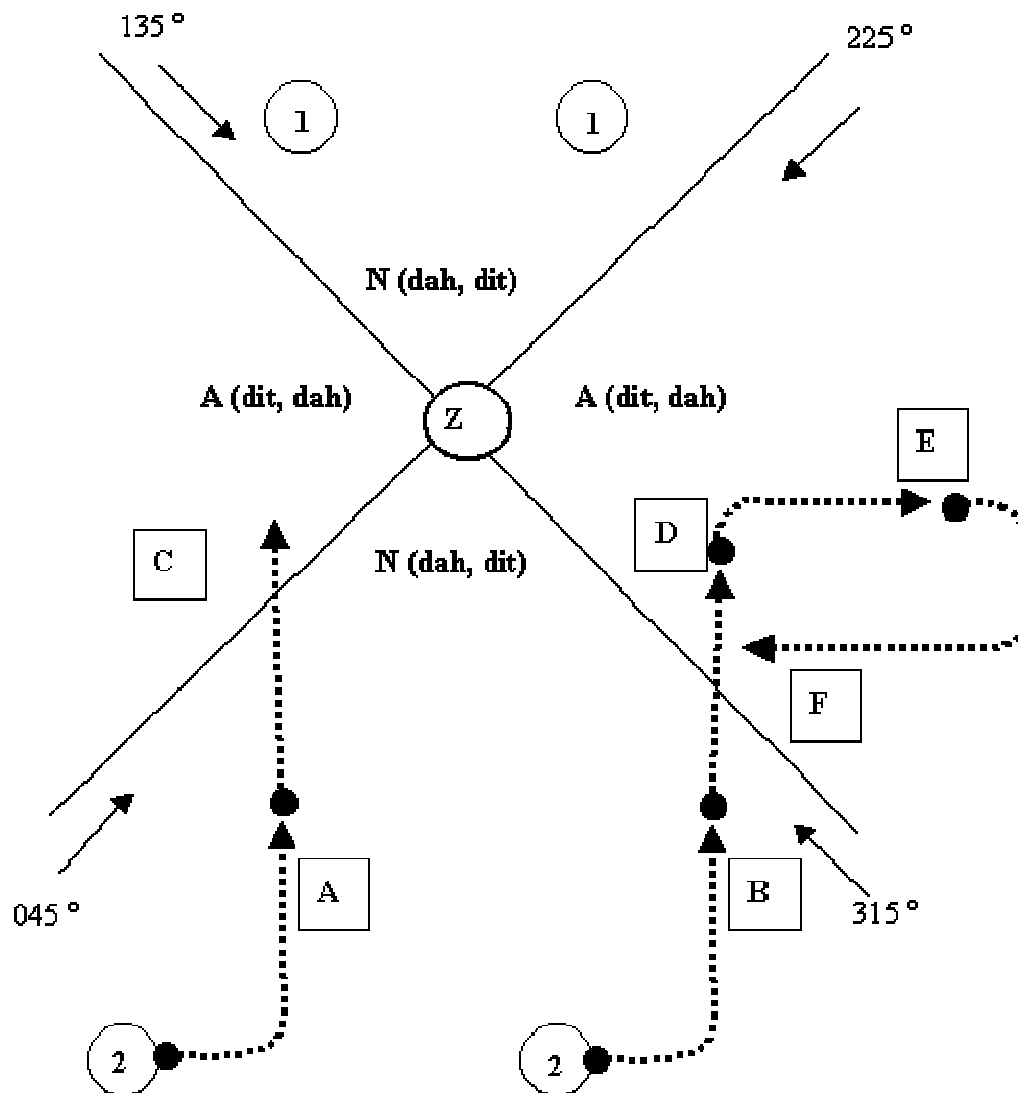


Figure 2

When you tune the proper frequency, you hear an "N" (dah, dit). Four circled numbers (1 and 2) represent possible initial locations. Letters refer to subsequent positions based on your assumptions and the turns you make.

Let's go through the assumptions and see how we orient ourselves on a radio range.

Let's review the Rules of the Road: The Adcock Radio Range broadcasts two different signals. Don't ask me how - that's the magic only Electrical Engineers understand. One signal is the "A" in Morse Code, which is a dot-dash (dit, dah) combination. The other signal, a dash-dot (dah, dit) represents the letter "N." The "N" quadrants are North and South leaving the East and West quadrants for the "A." Each of the four legs is identified by a solid tone. What produces the solid tone when we're on a

leg? When the dit, dah (A) and the dah, dit (N) signals combine or overlap, they become a solid tone.

We are approaching the station, south of it we think, and on an easterly heading. We assume we are still south of the fix. Therefore, in navigational terms, our Most Probable Position is either of the two spots marked "2."

Since we felt we were south of the fix, we decide to turn north and listen to the signal. The station's signal strength increases -- we made the correct decision. If we had turned south assuming we were in the northern "N" quadrant, the signal would have decreased and we would have to make a 180-degree turn to the north. We've solved the problem of whether the station is north or south of our current position.

Now we have to solve the East / West ambiguity. As we turn north, we could be at either "A" or "B." We wait until the N (dah, dit) signal becomes a solid tone indicating that we are crossing a range leg. But it could still be either the SW or the SE leg.

We decide that we are most likely going to cross the SW leg (a best guess) of the range, and are at position "C" going north. As we pass through a leg, and we wait until we are in the clear zone and hear the "A" (dit, dah) - we are at either "C" or "D" and we turn right based on our earlier assumption.

If we actually passed through the SW leg, a right turn would almost immediately give us a solid tone again. At that point we would turn inbound to the station on heading of 045 degrees. Instead of returning to a solid tone, the signal remains an "A" and begins to fade. We know that we intercepted the SE leg and we are actually at position "D" and heading toward "E." Make a right hand 180 degree turn toward "F."

Why the right turn? Because if you're close in, a left turn could take you across the NE leg instead of the SE. That's going to toss in a real confusion factor.

As you intercept the SE leg (solid tone), turn inbound to the station on a heading of 315 degrees.

Station passage ("Z") is indicated by the Z-Marker Beacon or you entered the Cone of Silence (shades of Maxwell Smart secret agent in the TV show "Get Smart"). This tone is broadcast straight up only (another one of those magic things :-)) and has a different tone than the solid tone of a leg. I don't remember what it sounded like. Maybe some other old-timers can jog my memory. If the site didn't have a Z-Marker, the sound in your headset faded to nothing as you passed directly over the station.

Well, there you have it. We now know where the station is located, we are heading towards it heading 315 degrees - so, what do we do now. In Figure 3, let's assume there is a runway located on the NE leg and that we want to make an instrument approach to that runway which is 23/05. The approach plate is set up to land on runway 05.

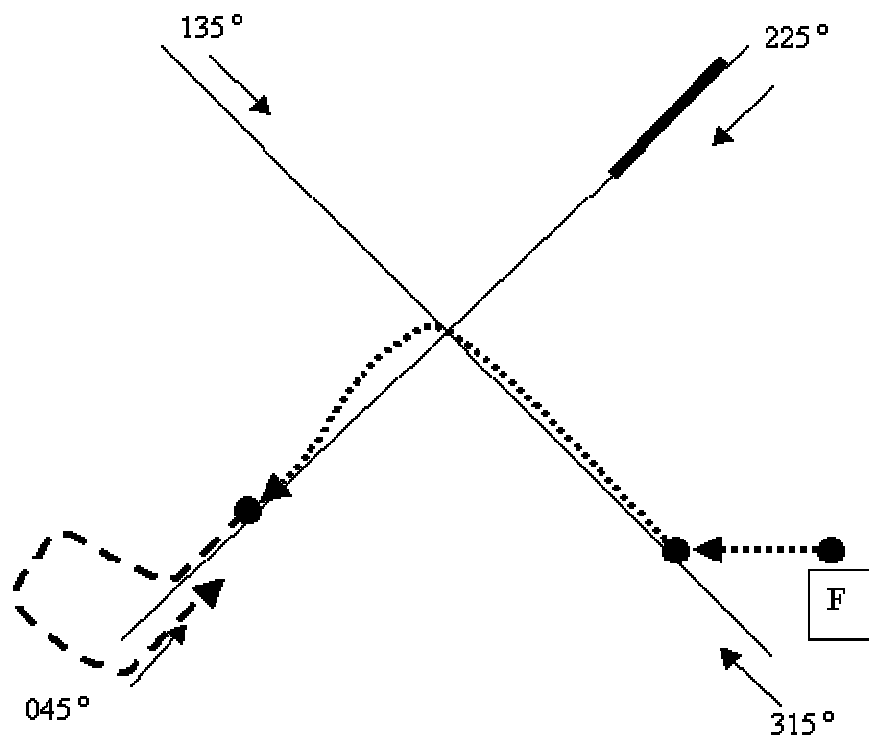


Figure 3

From point "F," we intercept the SE beam. Turn inbound heading 315 degrees. How do we stay on the leg or beam? If we drift right, we'll hear an "A" (dit, dah) and if we drift left, the "N" (dah, dit) is heard. As long as we hear the solid tone, we're "on the beam" or "flying the beam."

At Station Passage, we turn left and track outbound on the SW leg (heading 215 degrees). Follow the procedure turn (- - >) as published. Back in the olden days, we called these "greasy engine letdowns."

Track inbound on heading 045 degrees and listen for station passage again. Track outbound on the same heading and follow the letdown plate to find the runway. Generally that consisted of timing the distance (based on airspeed) from the station to the runway and descending to the minimum published altitude.

If you think this is an imprecise method of navigating and finding an airport in bad weather, you're right. I doubt that anyone busted a hundred foot ceiling with minimum visibility on a radio range. Most likely, they were good for five hundred to one thousand feet ceilings - with few or no terrain obstructions. Never know though, some of those intrepid open-cockpit, air-mail pilots pulled off some amazing feats.

I've also given you a simple range layout using cardinal points of the compass where it's simple to compute 45, 90, and 180 degree turns. In real life, it was usually

tougher. Here's an example (Figure 4) of an actual radio range at Fresno, California, USA.

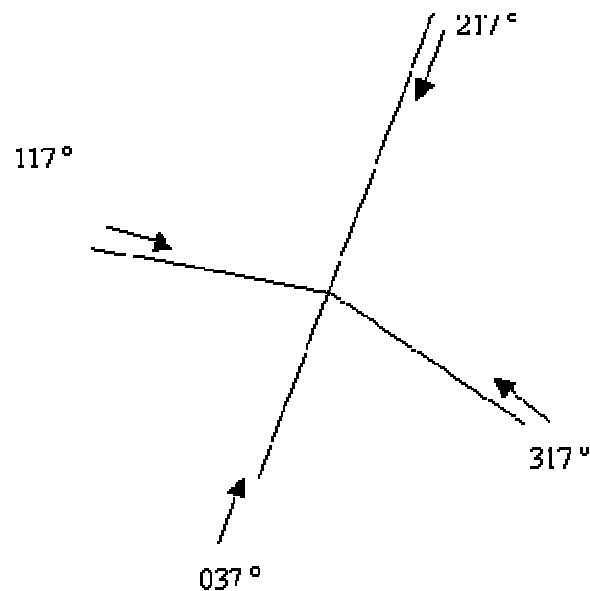


Figure 4

As you can see, the legs don't fall on cardinal points and one pair is skewed (117 / 317). On top of all this: listening for aural signals, Morse Code for A and N, signals fading or growing stronger, computing headings for turns (probably using a Directional Gyro and no compass rose type instrument), locating the station and flying the approach - keep this in mind. Besides all those chores, you are hand flying an airplane in actual weather conditions - that's IFR (Instrument Flight Rules) folks.

When I learned to fly in the USAF (1956-1957), radio ranges were on their way out, however we still had to demonstrate the ability to orient ourselves on a radio range under an IFR hood. We tuned the radio ranges on what we called the "coffee grinder." The tuning knob was actually a crank, hence the name. That same receiver also could be used for RDF, Radio Direction Finder. The Left / Right switch rotated a loop antenna that was synchronized to the instrument needle in the cockpit. The strongest signal was heard when the plane of the loop was parallel to the signal. When the plane of the loop was perpendicular to the signal, you received the weakest signal. I seem to remember that we tuned for the null (minimum strength) because it's easier to identify a minimum signal as opposed to deciding what a maximum signal sounded like. Easier than radio ranges, but still not very automated.

The ADF was an amazing step up - a needle that actually pointed to the station without listening for a signal or slewing a loop left and right. Just don't trust them too far around thunderstorms. They had a nasty habit of aiming the needle at the strongest storm in the neighborhood and trying to sucker you into it.

VORs (VHF Omni Range) were well established in the mid '50s. Another step up. And, when that VOR also included DME (Distance Measuring Equipment), we thought we were in hog heaven. Unless the stupid let down plate called for a circling approach holding a DME arc until near the final approach heading. ILSs (Instrument Landing System) were another blessing. Today, automatic approaches to touchdown are available. I flew KC-135s (military equivalent of the Boeing 707) into the early 70's. Autopilot coupled ILS approaches were possible, but seldom used. I remember demonstrating them to new copilots a couple of times in CAVU (clear and visibility unlimited) conditions, but I never flew one in poor weather. We just didn't trust the equipment that much.

Today, the only stick time I get is in a computer flight simulator. That's okay, in real life I had enough of what that WWII RAF pilot called, hours of boredom, interspersed with moments of stark terror.