Wing Tips

A CAP Aerospace Education Moment

Did you know?

Before there was GPS, there was VOR (short for **V**ery high frequency **O**mni-directional **R**adio range) and before there was VOR, there was the four-course radio range. The four-course radio range stations operated on frequencies between 200 and 400 kilohertz (called kilocycles in their heyday). Because they used low power, the signals could only be heard within a radius of 150 to 200 miles. Four 120 foot towers with directional antennas were used. Two of the antennas, which were opposite to each other, broadcast the letter **A** (dit dah) while the other two towers, also opposite to each other, broadcast the letter **N** (dah dit). In the center of this electronic square-dance, there was a "cone" of silence. The result was two quadrants where the letter **A** was heard and two quadrants where the letter **N** was heard. For various practical reasons, the quadrants were generally not equal size "pie slices."

A characteristic of Morse code is that it is not just dits and dahs, but the silences are important, too. The silence between the dits and dahs that make up a letter is equal in length to a dit and the silence between the individual letters that make up a word is equal in length to a dah. Therefore, where the quadrants slightly overlap, the dit dah dit dah dit dah of the **A** quadrant mesh with the dah dit dah dit dah dit of the **N** quadrant resulting in a continuous tone called the "beam." To use this nav-aid, the pilot tunes his radio to the frequency of the desired station. He could tell if he tuned to the right station because every thirty seconds, all this clatter of dits and dahs stopped. Then the **N** antennas would broadcast the three letter station identifier in Morse code twice and shut up. Next the **A** antennas would broadcast the same three letter station identifier twice. Having accomplished this little chore, the antennas get back to their normal business of broadcasting their respective **A** or **N** for the next thirty seconds.

The pilot knew that if the signal grew stronger, he was flying toward the station but, if the signal grew weaker, he was flying away from it. He also knew that an imaginary line from the station heading true North passed through the **N** quadrant that was north of the station.

Flying in a quadrant, however, was flying "off the beam" and it was generally desirable to be flying "on the beam." Let's say that the pilot is in an **A** quadrant (in this case the **A** to the east of the station) and tuned to the correct station. The dit dah signal is getting stronger. If it had been getting weaker and he wanted to go toward the station, he would have to make a 180 degree turn. He flies along until he hears the tell-tale tone that indicates he is crossing a beam and finds himself in an **N** quadrant. He now turns to the left in order to get back to the beam and, when he hears the continuous tone, turns toward the right in order to fly on the beam. Because he wants to fly on the right hand side of the beam, he occasionally turns slightly to the right in order to pick up the **N** signal, then makes a slight turn back toward the beam in order to be sure he was staying near the right hand edge of the beam.

Let's suppose that another pilot had been in the same **A** quadrant and flying the same compass heading as the first pilot but happened to be southeast of the station whereas the first pilot had been northeast of the station. The second pilot proceeds the same way, hearing the **A** signal get stronger, crossing the beam, hearing the **N** signal, and making a turn to the left. (Actually, he got into the **N** quadrant south of the one that the first pilot had gotten into.) He reaches the beam, then turns right to fly on the beam being careful to keep to the right hand side of the beam as the other pilot had done. However, the signal begins to fade. He is flying away from the station and must make a 180 degree turn if he wants to fly toward it.

The sectional charts, of the day, were clearly marked with all the information needed to make long cross country flights. The beams were even marked with an arrow with the magnetic heading pointing toward the station and an arrow with the magnetic heading pointing away from the station. There were around 400 four course radio range stations in the U.S. and the system was adopted around the world. VOR began to be used in the 1950's and for about 20 years both systems appeared on sectional charts.