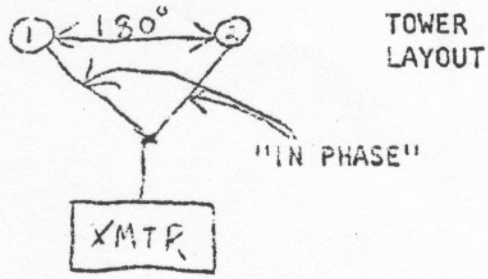
T19-1-1

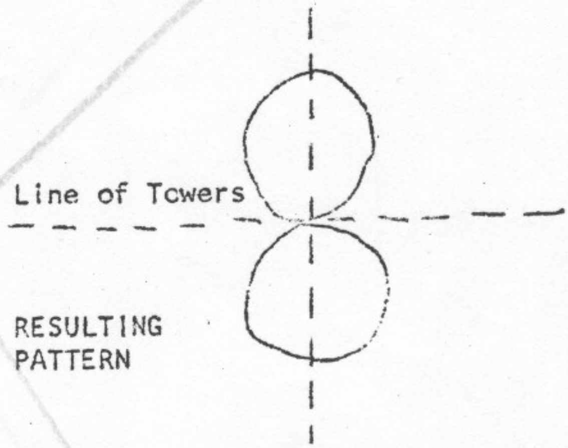
DIRECTIONAL ANTENNA PATTERNS

Few DXers realize the extent to which directional antennas are used by BCB ations in the U.S.; some of us may not even be aware of them. The fact remains nat over 1,200 stations are now using Directional Antenna (DA) during at least part of their broadcast day, including the vast majority of fulltime regionals and clears. Whether we know it or not, DA's are responsible for bringing us at least a few of our prized catches, and, in much more numerous instances, are to blame for denying us our most sought-after stations.

Why use DA? There are two main reasons: 1) A few of the nationally cleared Class I stations have constructed arrays which provide a "gain" (effective power greater than the input) over most of the U.S. Continent, while reducing power which was formerly wasted over the ocean or a foreign country. WBZ in Boston, for example, beams west in such a way that they enjoy an effective power greater than 50kw over the entire U.S., except for the small areas lying east of the transmitter. 2) A much more common use of DA's is for mutual protection of the service areas of stations which operate on the same or adjacent frequencies.

How do DA's operate? While some of the more intimate mathematics behind DA operation is reputed to be rather involved, the basic theory is quite simple and logical. All directional arrays (DA can mean this also) consist of two or more vertical radiators (towers). Two factors determine where the transmitter's power will go: Tower spacing and tower phasing.





Referring to the diagrams above, it should be noticed that in either of the two directions which are in line with the towers, the r.f. sine wave from one tower will have travelled 180 electrical degrees (one-half of the station's wavelength) farther than that of the other, making the sine waves out-of-phase. Thus, assuming the r.f. amplitude in Tower 1 to be equal to that in Tower 2, the r.f. energy is effectively cancelled to zero in these directions. In the two directions which are broadside to thearray, the r.f. sine waves will add in a similar manner. The familiar "figure 8" pattern has now been formed. Cardioids (patterns having only one null), "four-leaf-clovers", and other even more complex patterns are common.

In the example shown, phase relationships have been achieved wholly by means of tower spacing. In actual practice, a combination of tower spacing and artificial variable r.f. delay networks interposed between transmitter and towers is employed. Use of the delay network (called a phasing unit) carries two big advantages: It can artificially compensate for less controllable variables (such as a necessary change in xmission line lengths), and, more importantly, it permits more complex patterns using a minimum number of towers. The phasing unit's usual place in a broadcast station is right next to the transmitter. Once its controls have been set for the desired pattern, they are strictly taboo to meddlers. This is one of the best reasons why a directional radio station may not be legally operated unless a First Class FCC Broadcast license holder is on the premises!

--Jim Korn