Reducing a dish's gain for easier aiming

by

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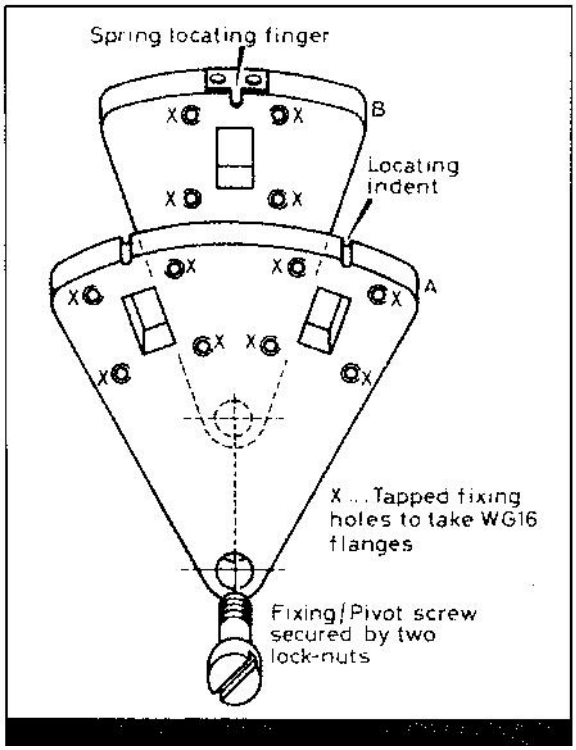
Several years ago or longer Knadle (K2RIW) suggested it would be handy for the microwave operator to cut the gain of a dish for easier signal locating. He suggested that defocusing the dish by moving the feed horn away from the focus would work. In 2009 Paul Wade (W1GHZ) showed in the MUD proceedings that didn't work. That while the defocused feed did reduce the gain, it didn't leave it centered, it turned a pencil beam into a hollow cone.

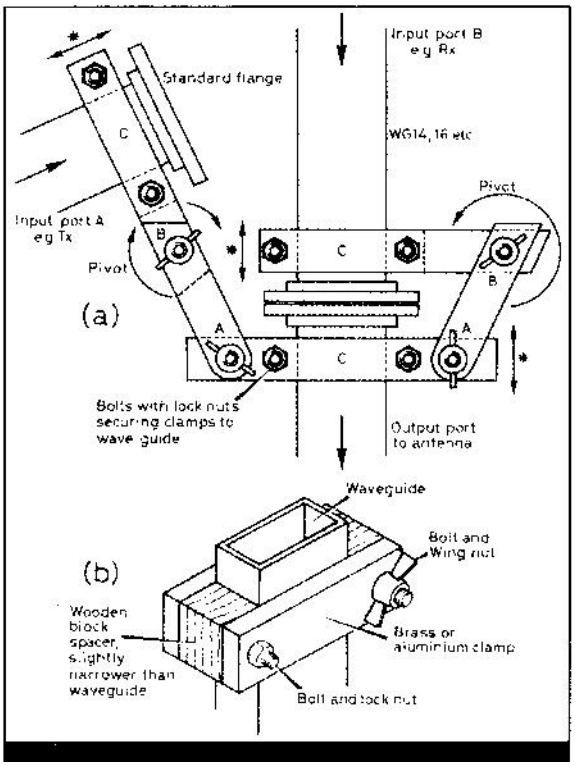
I suggest there are techniques that will work, probably none as mechanically simple as moving the feed towards or away from the dish. But what needs to be done is to increase the gain of the feed, and so underfeed the reflector. The feed must remain at the reflector focal point. In concept, increase the aperture of the feed when its a simple horn, maybe take off Chaperral or VE4MA ring.

I propose that a pair of feeds on a rotating turret (best for an offset dish) would work. One set for 10dB down at the reflector edge (optimum for gain, not necessarily for G/T), and the other set for 10 dB down at some fraction of the dish diameter, perhaps ½ the diameter for doubling the dish beamwidth at the cost of 6 dB gain if symmetrical. As in this drawing from the current International Microwave Handbook, figure 13.34 on page 399. Same whether sliding, spinning 180 degrees or just enough

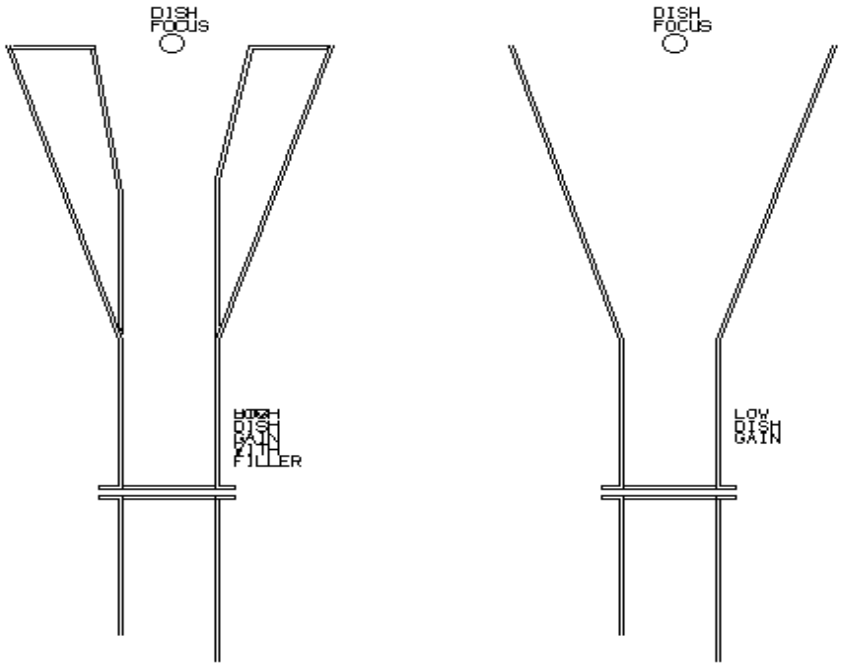


to clear each other. Using feeds instead of the Rx and Tx as in this drawing.

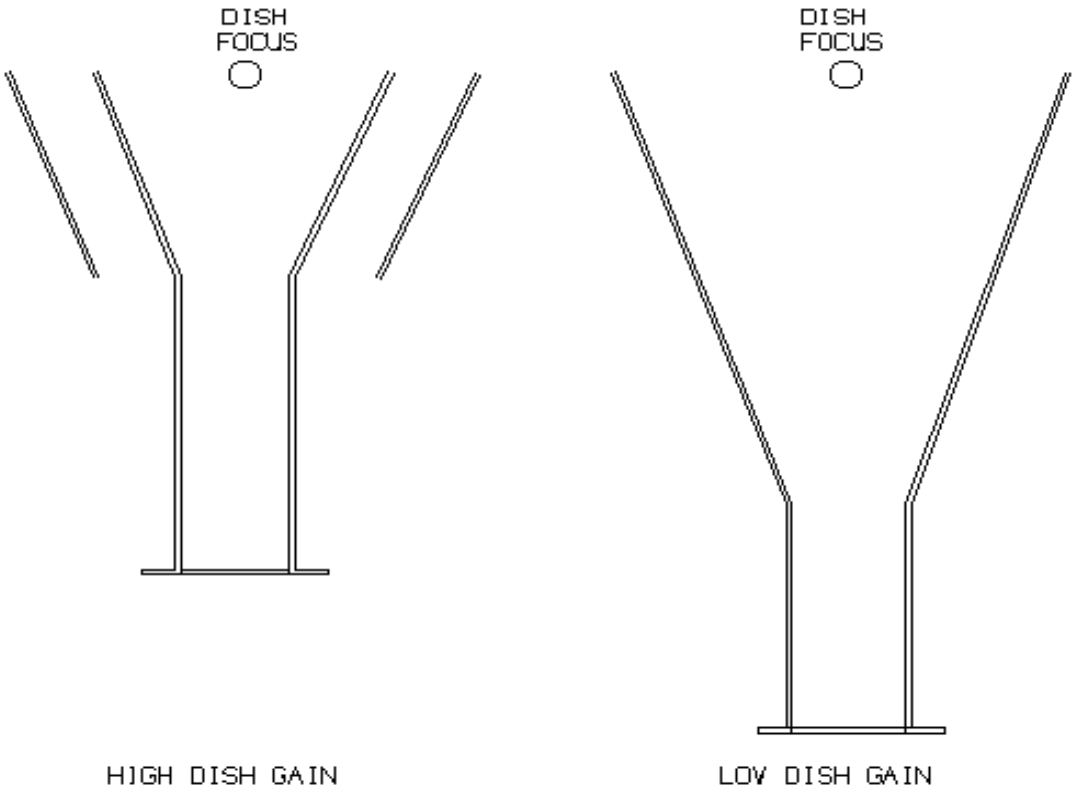
Perhaps a pair of flopping feeds as in a vintage RSGB Microwave handbook, or swinging feeds. Same thing again, low and high gain horns in place of Rx and Tx. Same handbook and page, figure 13.35.



A large aperture feed horn could be modified by a drop in filler with smaller aperture, though the open end of that may need special treatment to prevent strong side lobes that miss the reflector. It might not want to be a flat plane.

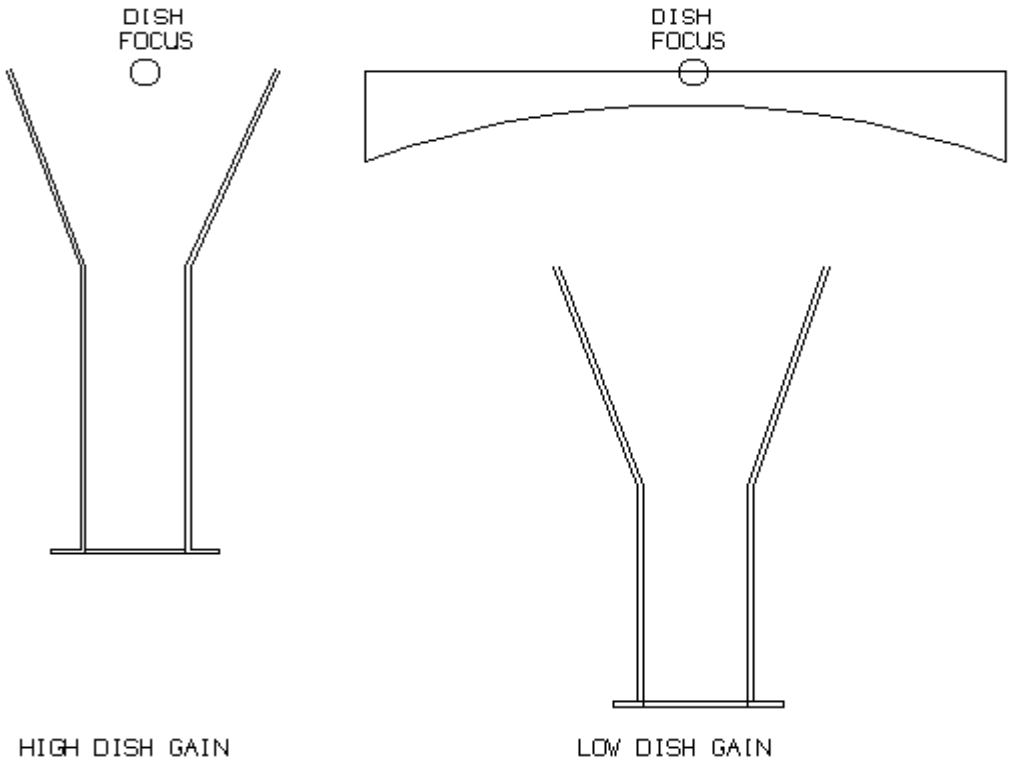


A horn feed could be made of two pieces. The basic horn with proper aperture for the dish and an aperture extension horn. With the aperture extension horn fixed in place, the basic horn would move its aperture to the focal point for normal gain, or back to feed the extension horn for reduced reflector gain. I'm not sure what that open back ring horn would do for the normal gain position. Something to be modeled.



At least in one plane, walls of the horn could swing like barn doors on a theater spotlight, maybe even all four, except that gaps at the corners will probably mess up the pattern of the horn adding 45 degree lobes with significant energy.

One could move the feed horn back from the focal point, replacing it with a lens having that twice sized aperture and set the feed horn to illuminate the lens fully. Probably the lens focal length should be created for that feed horn distance. The lens could be metal, solid dielectric, or Fresnel as described in DUBUS 2/2011. Suitable metal lenses were described by Paul Wade and Matt Reilly, in DUBUS 2/1993.



Then there have been multiband coaxial radiator feeds made with concentric radiators as used at Jodrell Banks as described by Marvin Livingston, “Multifrequency Coaxial Cavity Apex Feeds,” on pages 51-54 of Microwave Journal for October 1979. I'd use a larger diameter feed for lower dish gain though the complete excitation seems more complicated than the modern septum feeds for circular polarization. Livingston includes a chart of feed 10 dB beamwidth vs coaxial waveguide cut off frequency. I have found several more references and plan to study coaxial waveguide feeds more in the near future.

All of these schemes should work better on a prime focus dish with f/D less than about ½ because good feed horn designs are around for f/D from about 0.3 to 0.9. Where the typical offset dish is f/D of 0.7, it will take a substantial feed horn to get the f/D up to 1.4 because we are changing the effective diameter without changing the focal length.

More destructively, one could shade the outer quarter radius of the reflector with microwave absorber to eliminate its reflection to and from the feed. Gain loss would be greater than simply reducing the portion of the dish fed by increasing the feed horn aperture because signal would absorbed and dissipated as heat. However the beamwidth increase would be based on the working area of the reflector.

One might apply a ring to intercept horn energy headed for the rim of the dish, much like some of the shrouded commercial dishes that hope to reduce side lobes, but with a substantial portion of the feed energy being intercepted and bounced around the system side lobes surely will increase unreasonably.

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