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Antennas

Beat the declining sunspot cycle with this small beam design for 40 metres.

Although there are a few who are able to put up beam antennas for the lower frequencies, for most of us it is out of the question. Most designs for reducing the size of an antenna use loading coils. Other designs achieve a reduced turning circle by folding the ends of the elements.

In recent correspondence, Andy Göens, YS1AG/G5AYU, said "...several years ago in 'TT', Pat Hawker described a 'VK2ABQ Mini-Beam' ('TT', May 87). I made one, but it had a very low Q and, with the first heavy rain, the wooden frame bent and it looked like a dead octopus. Now I have made a different one, a parasitic Yagi, which is much easier to tame".

THE YS1AG 40m TWO-ELEMENT BEAM

This design achieves a small element size by folding the ends of the elements back on themselves. The antenna is shown in **Fig 1** and, as you can, see the turning circle is only one third the size of a conventional 40m beam. But how does it perform? YS1AG claims "...on the air I have received consistent 2-3 S-unit reports over a local ham using a vertical. The front-to-back ratio is about 12dB. It is not the best antenna in the world, but it is much better than a dipole and very small indeed. The height of the antenna is only 14m until I can get a taller tower to obtain a lower angle of radiation."

Analysis of the antenna using *EZNEC3* indicates a maximum free-space gain of just over 4dBi and a front-to-back ratio of around 10dB, which agrees closely with the measured performance of the real antenna. Increasing the boom length from 0.078λ to 0.1λ results in an increase in gain to 5dBi and a front-to-back ratio of around 12dB. This would mean an increase of boom length from 3m (10.8ft) to 4.26m (14ft).

The feed impedance of such a small antenna is, as you might expect, very low, and *EZNEC* indicates a value of around 4 to 5Ω. The feed arrangement used by YS1AG utilises a gamma match, in which the gamma rod is 1.3m long made from 5 or 6mm OD tubing and spaced 180mm from the driven element. The series compensating capacitor comprises two tubes, one sliding inside the other to make up a variable capacitor with a maximum value of 180pF. A 100pF doorknob capacitor is connected in parallel to make up the required total capacitance. The measured SWR, using such an arrangement with 50Ω feeder, is 1.8:1 at 7MHz, less than 1.2:1 over the range 7.04 to 7.1MHz and 1.8:1 at 7.2MHz. For European use, the driven element could be tuned slightly lower.

CONSTRUCTION

The centre supports for the antenna were constructed by welding four lengths of 20mm OD aluminium tubes to a centre ring made from a short length of larger diameter tube (the diameter selected to fit the boom). The construction is not unlike a quad 'spider' except that the angles are 60°/120° rather than 90°/90°. The 12mm diameter elements were fitted to the 20mm tube of the spider at the feed-point end using reducers machined from aluminium bar. The high-voltage ends are insulated from the spider using hardwood dowelling and reinforced with fibreglass.

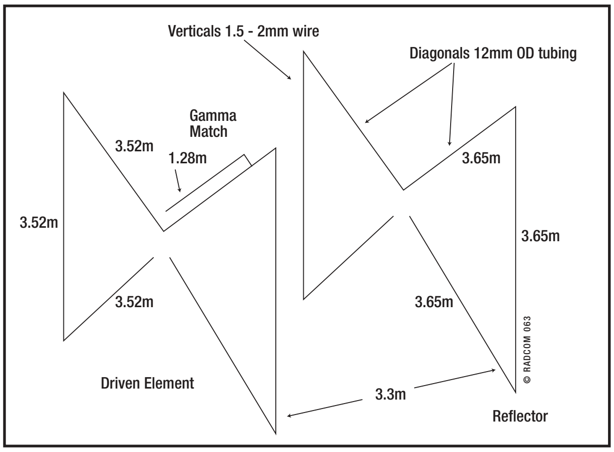
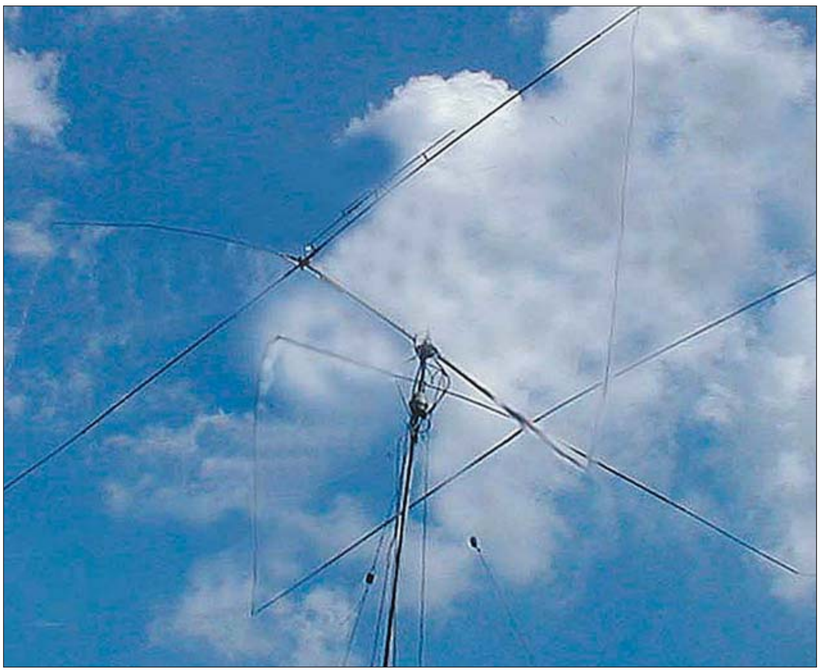


Fig 1: Diagram of the YS1AG 40m minibeam.

Below left: The YS1AG beam in position.



For those of us without access to aluminium welding equipment or a lathe, I suggest a method of construction that uses one-metre lengths of aluminium angle stock. This material has two holes drilled in the centre to take a U-clamp, the size of which has been selected to fit the boom as shown in [1]. Two lengths of angle material are clamped to one end of the boom so that they form a 60°/120° spider. A further two lengths of angle are then clamped to the other end of the boom. When the angle sections are correctly aligned, the feed-point end of the elements can then be fixed to the angle material with hose clamps (the antenna experimenter's friend!). The high-voltage end of the elements can be supported using hardwood dowelling, which is fixed to the angle material. The wires forming the vertical part of the elements can be fixed to the ends of the 12mm elements using hose clamps.

I find that trying to waterproof a Gamma-match variable capacitor is difficult. I prefer to insert a temporary variable capacitor, make all the adjustments necessary to match the element to the feeder, then remove the capacitor. I then measure the capacitance of the setting of the variable capacitor and replace it with a fixed capacitor of the same value (you may need two or more capacitors in parallel to get the correct value). Fixed capacitors are normally inherently waterproof, although a coat of grease prevents degradation of the outside insulation of the capacitor due to prolonged exposure to our weather. ◆

REFERENCE

[1] *Backyard Antennas*, RSGB books, Fig 8.9