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The Fishtail Antenna

Roy Walker G0TAK, writing from his eyrie high in the Lake District, takes a look at a practical antenna developed by John Heys G3BDQ, a long-time *PW* author.

I'll start by looking at the history behind this article. It started a number of years ago when I got hold of a copy of an excellent book written by John Heys G3BDQ entitled *Practical Wire Antennas (PWAs)*, which was published by the Radio Society of Great Britain (RSGB). John Heys G3BDQ is well known to readers of *PW* as he's been one of the magazine's specialist antenna authors for many years.

I have read the *PWAs* from cover to cover many times and it really does give what it tells you on the cover *Effective HF Designs for the Radio Amateur*. What a pity it's no longer published.

One of the small items towards the end of the book, in the chapter *A Gallimaufry of Antennas* fascinated me, it entails a fish-tailed five band antenna made from aluminium foil! I actually made an example of this antenna as a demo at the **Thornton Cleveleys Amateur Radio Society** (TCARS) and it worked – giving an acceptable 'tune up' throughout the stated range.

We didn't have time to run a full set of tests on the antenna, which was pinned up on the Scout hut wall – but we did have a QSO into Moscow on 14MHz. Unfortunately because of its rather flimsy nature of the aluminium foil, it didn't survive for very long.

To be completely fair to John G3BDQ, the item was designed to be used tacked to the inside of the rafters in a house and was never intended to be a 'take it anywhere' multi-band antenna!

Triangular Shaped Radiators

The antenna, **Fig. 1**, consists of two triangular shaped radiators (dipole elements), each 4.5m in length and 450mm wide at the broadest end. Each broad end is 'notched' to a depth of 2.1m giving the distinctive fish tail appearance.

Because of the 'broad' shape of the dipole sections the antenna is itself broad banded and, although it is considerably shorter than a $\lambda/2$ on 20m, (10.68m) is useable from 14MHz to 30MHz with a low v.s.w.r. and without the use of an antenna tuning unit.

It's quite possible to make the antenna from rolls of kitchen foil, (at least 450mm in width). Heavy duty rolls up to 20m in length can be obtained. I decided to re-build the Fishtail and mount it in the loft. This time I considered opting for a more durable construction, not because it would need to withstand the weather – but because my triangular loft space 'crawl-way' measures 1.20m across, 610mm high and is 11.5 metres long.

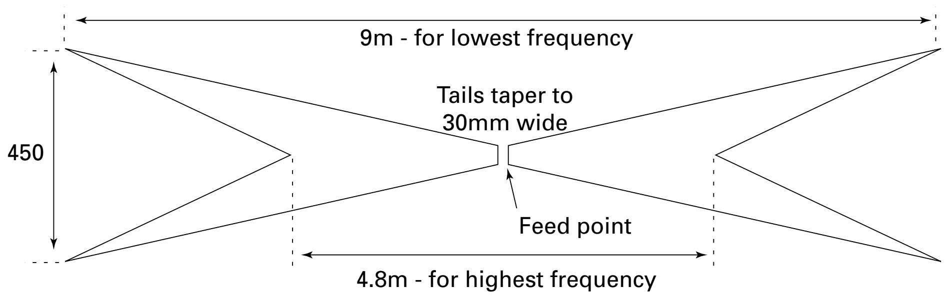

Fig. 1: The original Fishtail antenna as shown in John Heys G3BDQ's book *Practical Wire Antennas*.

The Theory

The theory behind this antenna is not very complicated – it's merely a 'Fat Dipole'. You'll probably have seen designs in this magazine and in other antenna theory books where a 'Nest' (in some books it's called a Spider's Web) of dipoles that are fed from a single coaxial feeder.

Typically, three dipoles are suspended from the same masts with a common feeder. The upper dipole is cut for the lowest of the three frequencies (it's the longest one), the second to the middle frequency and the highest frequency is the lowest of the set (**Fig. 2**)

In this manner, antennas (for example the 7, 14 and 21MHz Amateur bands can occupy the same masts, footprint and feeder. The antennas are 'self switching', so nothing more than a band change and a tweak of the tuner is required to get the lowest v.s.w.r. on one or other of the bands.

However, the Fishtail takes the design one step further. The 'points' of the dipole are cut for the lowest frequency your space can accommodate. The inset 'Vee' point is calculated for the highest frequency of interest.

The clever bit is, of course, that an infinite number of frequencies between those two 'spots on the dial' are included at two points on the Fishtail. The device is therefore, in theory, capable of resonance at any frequency between (in this case) 14 to 30MHz).

Discussed With G3BDQ

I discussed the design of the antenna with G3BDQ and resolved to take things a little further with a view to ease of construction and a reduction in production cost. The final design was, at John's suggestion, to be a 'Half Fishtail', each side of the dipole comprising a triangle of metal, **Fig. 3**, mimicking the overall shape of the elements, in the Nest of dipoles in Fig 2.

My idea was to source the manufacture of the 'tails' from a supplier of aluminium foil or thin sheet. After a discussion with a supplier I modified my requirements to a 5m roll of 0.5mm aluminium foil with a width of 500mm and do the cutting myself but it turned out to be expensive.

The cooking foil option suddenly became interesting again, although I had to be able to 'beef it up' merely to survive the installation process. The fact that a local supplier of kitchen goods advertised 'Turkey Foil at £6.99 a roll helped in the decision process! I opted for a roll of foil at least 450mm wide of a sufficient length to fabricate the two parts of a Half Fishtail dipole from double thickness foil – with the excess folded over rather than cut off.

The Construction Process

Choose yourself a construction area not too far away from the loft where you are going to place the antenna. Lay out a double layer of the foil just over 4.88m long. From one corner of the sheet measure and lightly indent a folding line to the other edge of the foil sandwich 2.44m away from the top corner. This will give you the dimension of the highest frequency dipole. Fold back the two layers of foil to form the first angle of the triangle.

At this stage you can adopt one of two measures to improve the rigidity of the element. The first is to fold the whole of the spare material back, and where it overlaps the long side of the foil trim it back or simply fold it over. My preferred choice is to trim back the foil a few centimetres and carefully 'Duct Tape' the flap to the main body of the radiating element. This holds the two cut sides together and gives rigidity to the short side. Be careful to leave 200mm at the point of the triangle clear of tape as this is where you will attach the feeder.

Next, measure the lowest frequency dipole dimension (4.88m) along the top edge of the fishtail and fold back to that length. Tape up the top of the element as you have done with the shorter side. Lightly score a line from top of the longest dimension down to the end of the shortest dimension, again trim back, fold over and apply the tape.

You'll end up with a taped up element of the required shape with an element of rigidity but still fairly fragile. To increase the survivability – put a few lengths of tape from top to bottom edges, turn the whole construction over, tape the edges on the other side and staple the two sides together at fairly regular intervals. The tape will ensure that the staples don't tear the foil.

Theoretical Dipole

A theoretical dipole erected in free space is said to have an impedance of 73Ω. A practical wire dipole in the real world will have an impedance of about 65Ω. A dipole made of tubing will have an impedance of between 50 and 60Ω.

A thicker 'wire' will lower the *Q* of an antenna making it less susceptible to changes in frequency. I guess that the fishtail and the Half Fishtail are something like tubing or 'thick wire'.

All impedance characteristics are affected by the height above ground and the amount of 'free space' around the elements. The impedance of the 'half fishtail' dipole erected in your loft will

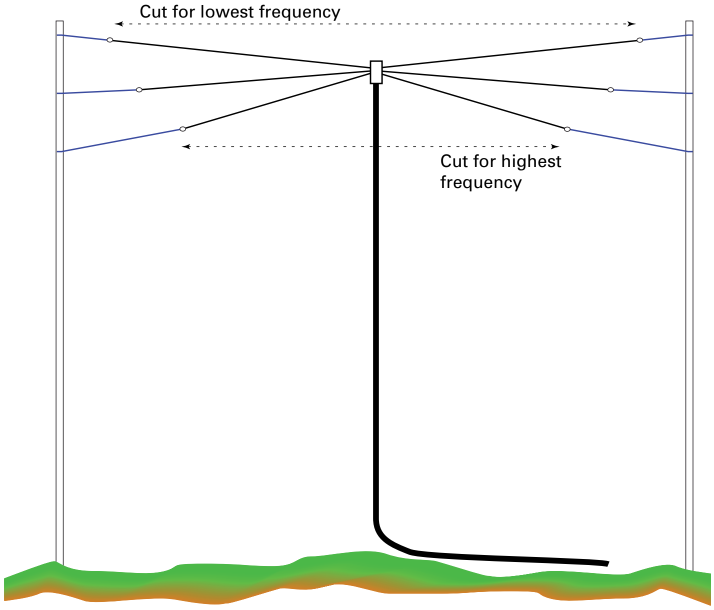

Fig. 2: A 'traditional' nest (or spider's web) of dipoles, that allows coverage of several bands using just one feeder.

certainly vary from that in my loft space because of their different situations.

Don't forget that the measured impedance of any dipole will vary with the amount of 'droop' in the elements; decreasing the internal angle of the dipole elements from 180° will progressively reduce the impedance. This is one way of optimising the matching of a dipole, enabling it to be used on a selected frequency without additional tuning equipment.

If the Fishtail antenna is erected with both 'long' elements at the top then the impedance will change as you progressively tune h.f., effectively decreasing the angle between the elements. It will probably be beneficial if the 'long' element is at the top on one side and the 'short' element is at the top on the other, maintaining a more regular balance of impedance and less need to use the tuner.

The Installation

The installation is the easy part, once you have the materials almost in place. Start at the end where the longest element is uppermost; holding it horizontal staple-gun the element to the inside of the rafters.

If you have the choice, make sure that the feeder is in a location that will allow it to be secured to something firm. Work along the element, top and bottom, towards the feed point. Position and secure the feeder and, this time with the 'shorter' element uppermost, secure the second half of the dipole. Then install the 50Ω coaxial cable into your shack.

Feeding The Fishtail

Feeding the antenna is simple although I would however recommend that you use a 1:1 balanced-to-unbalanced (balun) at the centre. Try to eliminate copper to aluminium junctions that are exposed to the air.

I prefer punching a hole in the foil and placing the contacts to the balun through those holes. I also recommend that you use stainless steel washers either side of the foil to protect and support it. I also recommend that you don't let the foil support the weight of the balun. If you have no option I suggest that you should then put some of the duct tape on one side of the foil and secure the coaxial cable to the rafters as 'early' as possible.

Tests To Come

The final tests must remain uncompleted for the time being as I's still evaluating the antenna. So, I cannot show you a list of impedance readings and bands to work although what worked for me may not work for you anyway. Despite this the antenna will load (somewhere on the Amateur bands) **and it will work**. But remember it is, at the end of the day, a simple antenna – although it's well worth trying out yourself. **PW**

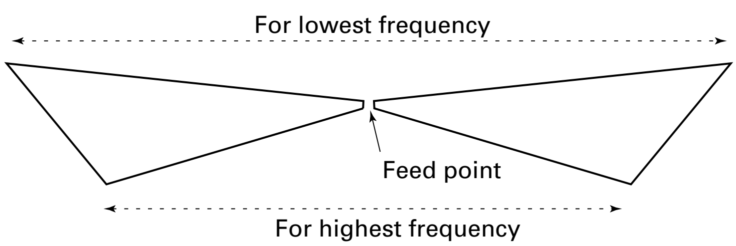

Fig. 3: Roy opted for a rather modified shape for his version of the fishtail antenna to put up in his loft crawl-space.