See also the Notes at the end

Townsman 2m / 70cm aerial

Two-band design with no ground plane.

by **B. J. P. Howlett,** G3JAM

The continued witholding of the citizen's band by the Home Office has caused vastly increased occupancy of the amateur 2m and 70cm bands for everyday purposes of mutual communication between friends, and most of them use commercially-made private mobile radio equipment tailored for these frequencies, and for the 80 or so automatic/unattended repeater stations dotted about the UK.

Several years ago, the author foresaw the need for a somewhat tidier aerial for the average householder than the too-prevalent, quarter-wave, ground-plane, vertical aerial; an aerial which would be stick-like, with no ground-plane, and operating on both bands without switching. It should be weather-proof and cheap, and easily clamped to a short stub-mast with Jubilee clips from the local garage. It wasn't an easy job!

The first design, a half-wave rod driven from a quarter-wave concentric transformer, did work, but the thinness of the centre wire to match 50 ohms to 1200 ohms (the end resistance of a 12mm, half-wavelength rod at 145 MHz), relegated the design to the roof-space.

However, in the aerial shown diagrammatically in Fig. 1, the wire is 0.7mm and the inductor can be 127mm of p.v.c.-covered wire, fashioned into a hairpin shape and soldered on in parallel to the feeder cable at the point of entry. Very careful tests disclosed the interesting fact that the transformer needed to be about 0.185 wavelength long when the insulator/spacer S was 0.015 wavelength. With 12mm tubing, v.s.w.r. could easily be made 1:1, *and the feeder did not radiate.* Pro rata scaling from the 2m band to the 70cm band proved that the hairpin needed to be, not one third, but $(1/3)^{1/2}$ (= 0.5774) × 127 = 73mm long at three times the frequency. The *inductance* changed inversely as the frequency.

Already it was felt that enough was known about the aerial to go ahead with a full patent for the matching features, and this has now been obtained (British Patent No 1527800).

From a practical viewpoint, the aerial suffered in rain and high winds. It had to be precision-made and sealed if water was to be kept out of the two joints, either side of the precision-turned insulator/separator. The solution, shown in Fig. 2, was to build the aerial flat, from off-cut strips about 1 cm wide, with a flat drilled strip insulator (of Perspex, in the author's case), the whole lot being pushed into ¾in plastic conduit and put on a high stub mast so that it would rattle, and keep the author awake at night.

Quite right! That is exactly what the kinks are for; to stop the assembly rattling in a high wind. The kinks have no electrical purpose whatsoever. The two end-plugs, one drilled for the feeder, were actually cast from body-repair (the automobile kind) resin, but could be turned from solid material, of course.

Gone is the taut centre wire in the transformer, T. Instead (see construction diagram), the centre core of the feeder itself, UR43, (F) with the braiding stripped back, forms the "centre" wire. Actually, an insulated wire taped on to a wide strip is not unlike a coaxial line, except that there is the added advantage that, for fine matching adjustment, it can be flared away from the strip as shown.

So what about 70 centimetres? Well, around the outside of the plastic conduit, and directly over the middle of the 2m radiating element, a "cooking foil" (actually aluminium Silglas glazing strip), cylinder is glued, resonant at the third harmonic of 2m. This prevents radiation from the centre current maximum when the aerial is used at its third harmonic on 70cm, and leaves just the upper and lower half wavelengths (which are in phase) operating as a two-element colinear at 70cm.

The author is, perhaps, lucky to have discovered a matching and radiating system that can be adjusted to give very good matching at both frequencies at once. It did take four years, of course, and quite a bit of help along the way was given by other radio amateur

Item	2m	70cm	Red	Yel.	Brn.	Grn.
Dipole A	96.5	30	27.4	24.5	22.2	19.9
Transf. T	40.64	13	10.55	9.43	8.55	7.67
Space S	2.0	0.8	0.6	0.6	0.6	0.6
Hairpin L, total wire length	12.7	7.24	-	-	-	-
Harmonic shield	29.3					

Dimensions are given in cm for 1cm wide material, as cut. Hairpin loop made of p.v.c. insulated hook-up wire.

18swg

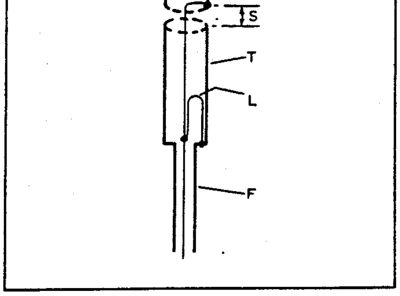
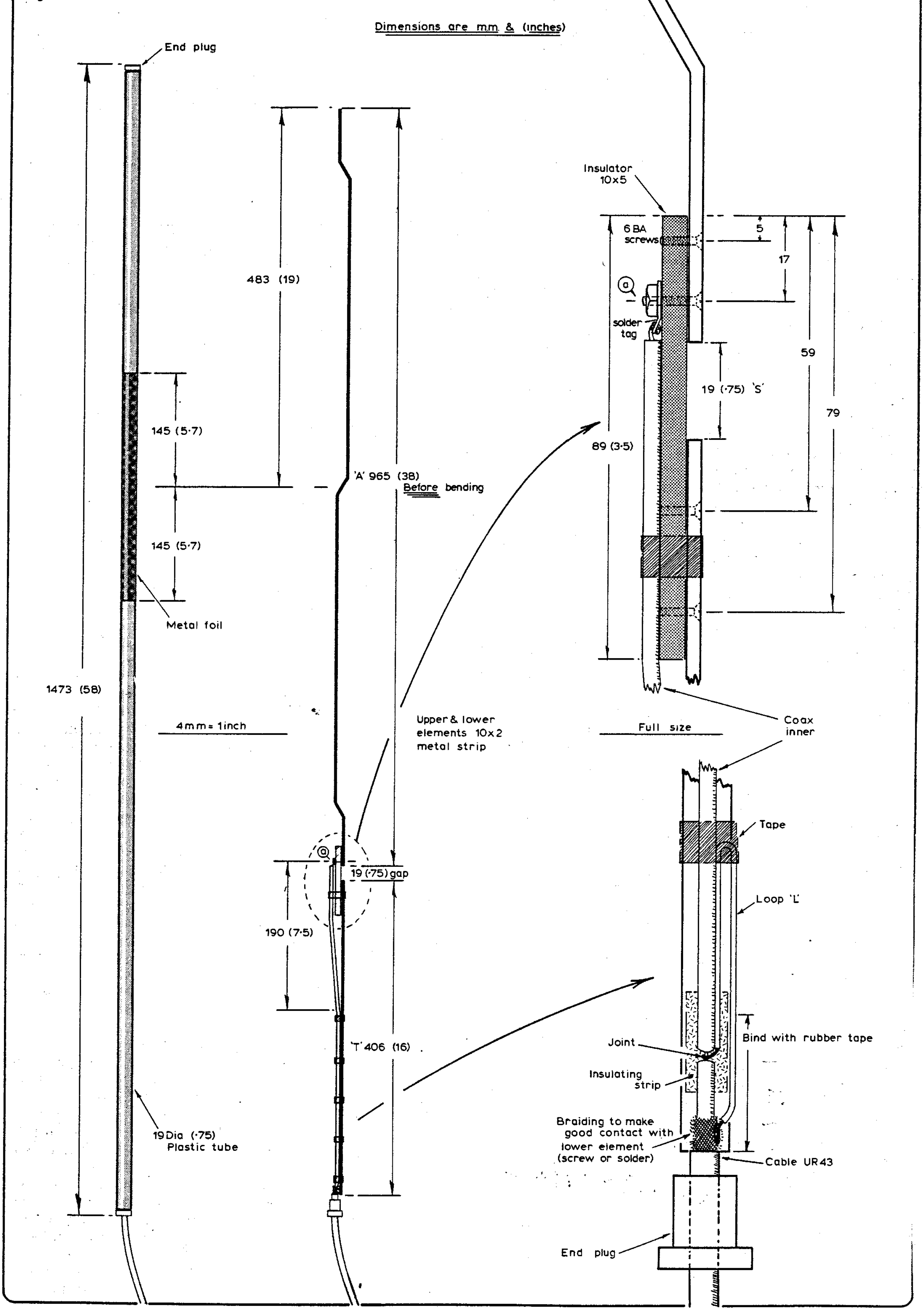


Fig. 1. Basic aerial, a half-wave element A and coaxial impedance transformer T. Loop inductor to augment impedance ratio obtainable.

Fig. 2. Construction of 2m / 70cm aerial.



friends. None of them ever saw the final model, except from a considerable distance, but a number of the early models were made by the author and farmed out for reports. G8NCW, G3PCA, G3IMC, G8LWA, G8BAM, G3YNC (callsigns given in a random order) were early users of the aerial, and some went on to build their own. Thanks are due to all of them for the assistance they gave.

Scaling the aerial to Band V television, proved a very pleasant surprise. With short, fat dipoles, and 75 ohm feeder, the inductor L is not needed. This helped the bandwidth problem. Red zone is particularly difficult in this respect, though it must be admitted that even 1cm wide material does quite a good job, and the feeder is absolutely 'dead', allowing one to pin up the feeder after setting the aerial to the best position, without upsetting the picture again. Some users have been known to get quite light-headed about this particular feature, only rarely encountered, apparently.

No dark plans are afoot to manufacture the aerial. No doubt, however, some character will make one or other of the suggested models and sell huge quantities in a clandestine manner. Good luck.

To others, I would say, please build one with my compliments. It was a challenge to make exactly the aerial I wanted; it was a challenge, in this day and age, to invent a virtually new aerial which turned out to *be* a new aerial, at least within the definition of the patents law, whatever that is.

The table shows the dimensions of aerials for single-frequency use in other bands. □

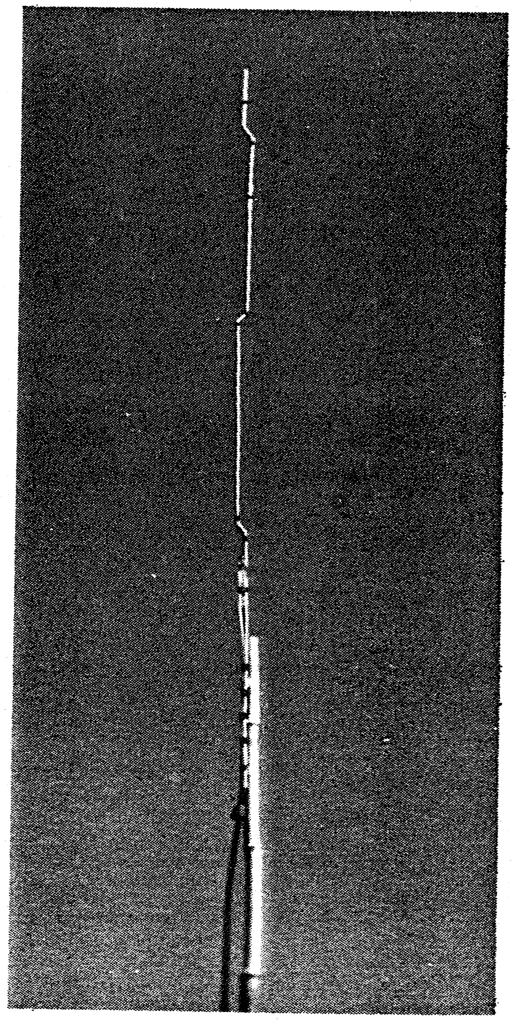


Fig. 3. Townsman without plastic tube cover.

TOWNSMAN AERIAL

Since the publication of my article the "Townsman 2m/70cm aerial" in the February issue, a few queries have arisen, mainly as a result of conversations over the air on the 2-metre and 70 centimetre amateur bands. Further experience with the aerial since the article was written enables me to answer most of these, although the obvious one, "Where can I obtain flat metal strip 1 cm wide?" must remain open at present.

The first question concerns a certain confusion about the tabular data. Column No. 1 is the data for the two-band 2m/70cm aerial. Columns 2, 3, 4, 5 and 6 give details of single band "simple" models for 70cm, and for indoor television reception.

In the two-band model, I can now be very precise about the positioning of the cooking-foil suppression sleeve as a result of on-air tests carried out recently since the commissioning of more 70cm repeater stations near my home. The centre of the sleeve should be 3 inches (7½cm) *below* the centre of the dipole element, and not exactly as shown in the drawing, level with it. This makes its manner of operation rather obscure, but results show that this is the best position.

Tests using a variety of different hook-up wire for the hair-pin matching loop disclose the fact (originally overlooked!) that thin wire with thin insulation bends into a tighter hair-pin than thick wire with thick insulation, and that the influence of the metal of the transformer strip is far greater with the thin wire than with the thick wire. The length shown is for thin wire with thin insulation; a possible minimum length for wire extracted from ten-amp mains flex would be in the region of 3 inches (7½cm), rather than the five inches (12.7cm) shown.

The conductor wire is taped lightly along the metal of the transformer until it flares away for 7½ inches (19cm). The shape of the flare adjusts the matching rather critically, particularly on 2m. It is helpful, to permit accurate adjustment and to maintain long-term stability, to brace this free section of the conductor wire with a strip of thin Formica and fit a grub-screw through the metal about 2cm above the last strapping, for the purpose of fine-adjusting the rate of flare. With such a screw adjustment, v.s.w.r. can be brought to unity with almost 'factory-test' rapidity.

The aerial is necessarily a compromise. It is recommended that adjustment be made to be correct on 2m, and some v.s.w.r.accepted on 70cm. This need not be worse than 1.5:1.

I used plastic tubing coloured white. I suspect that black coloured tubing may include a carbon content which would make it unsuitable for these purposes.

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Additional Notes:

The radiating element does not have to be flat; it was just that he had some available. A piece of long tube does quite well, using grommets to prevent rattling.

It might be worth reminding USA readers that the UK 2m band is 144-146MHz, and the 70cm band 430-440 MHz. Using this aerial outside the UK may involve a little re-sizing.

Mounting this aerial as show can be tricky. A longer length of plastic pipe will permit a short length of metal tube at the bottom; it must be well below the 'feed-matching' section.

Use only white plastic pipe.

The feed-matching section may be best made of flat brass or copper strip. If this is done, a BNC socket can by soldered to the end.

The coaxial cable used is UR43. RG58 may also be employed.

The Bandwidth on the dual-band version has to be optimised, and it is very difficult to get a good match on both bands. You have ot pick the best part of the band for your needs (in the UK, around 145/ 435 MHz).