Low-cost Trap Dipole

After a long absence from the h.f. bands John Davies G3LJD was persuaded to return. His antenna array of five dipoles didn't impress his neighbours however, so some compromise was needed.

How Much? & How Difficult? £3.50 Beginner

With a garden some 40 metres long the antenna system would seem to be no problem and five dipoles covering 3·5 to 28MHz were cut and erected, fed with 75Ω coaxial feeder. However, the neighbours didn't see eye to eye with the beauty of such a system and so the development and construction of a trap dipole was started.

The breakthrough came with the suggestion by Geoff Myatt G3FRN that double-sided, copper-clad board could be used for the capacitor and that its size could be decreased to reduce the capacitance and resonate the trap assembly to 7·1MHz.

Twelve of the traps described here have been made and have proved to be cheap and easy to construct as well as performing well.

Construction

Two traps will be needed and the first stage is to prepare a suitable former on which to wind the coils. The former can be made from a short length of plastics or cardboard tube of 50mm outside diameter. Plastics waste pipe could be used but the thick cardboard tubes used to send drawings through the post are equally suitable. The length of tube required is about 75mm, and two holes about 4mm diameter are made in the wall of the tube about 50mm apart and centrally disposed along the axis of the tube.

A length of pvc insulation tape is wound around the tube, covering the space between the two holes, **adhesive side outermost.** Strips of the tape, about 12mm wide and 70mm long are next placed along the axis of the tube, **adhesive side outermost** (1). The pvc covered copper wire is passed through one of the holes in the former with about 75mm inside the tube. The wire is then wound around the tube **tightly** and close-spaced, over the adhesive tape for nine complete turns (2). The adhesive strips can now be folded over the windings to hold them firmly and closely together, ensuring that only the nine turns are so bound and that the ends can be pulled out of the holes and left free (3). The coil is now slipped off the former and the rest of the tape slit and wrapped around the coil, finishing with a length of tape, **adhesive side innermost,** around the outside of the coil (4). You should now have two coils each with nine complete turns and with long enough ends to make up the turns to nine and a half.

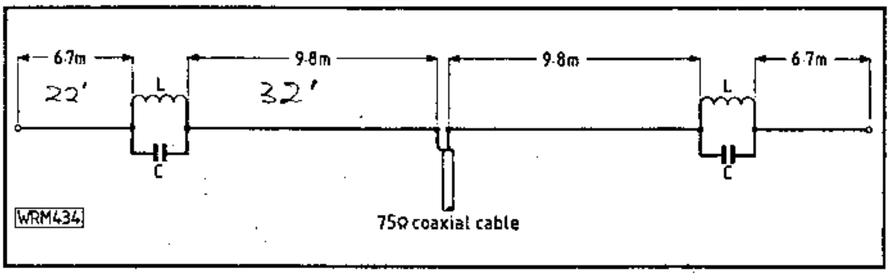
The double-sided p.c.b. material, which should be of the glass fibre variety both for its strength and its moisture-resistant properties, is now prepared as the drawings show with the two holes fitted with plastics eyelets of the snap-together type as sold by camping shops and boat chandlers. Obviously metal eyelets cannot be used as they would short out the capacitor and coil! It is better to make the board oversize than undersize as it is easy to trim the length to reduce the capacitance but very, very difficult to make it larger to increase the capacitance!

The p.c.b. is slipped inside the coil, and it should be a reasonably tight fit, with the coil ends positioned as shown in the drawings. Note that if the tube used for the former is not exactly 50mm outside diameter then the p.c.b. should be cut to suit the former.

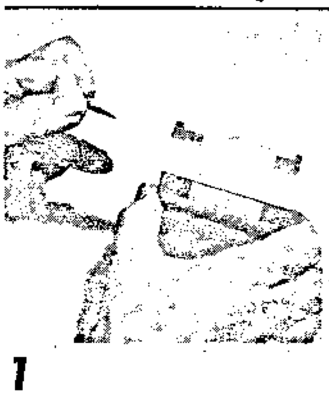
The coil ends are made off and soldered to opposite sides of the p.c.b. ensuring that you end up with the required extra half turn over the full nine turns.

Tuning

The two traps are now ready to be resonated to the desired trap frequency, suggested at 7·1MHz. For this operation you will need a g.d.o., or



Picture Sequence for Construction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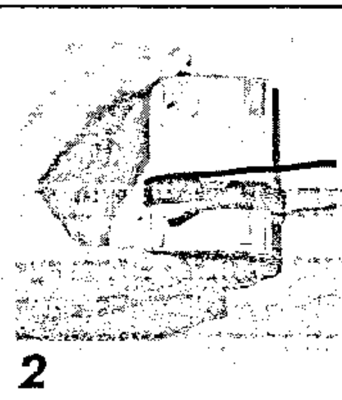
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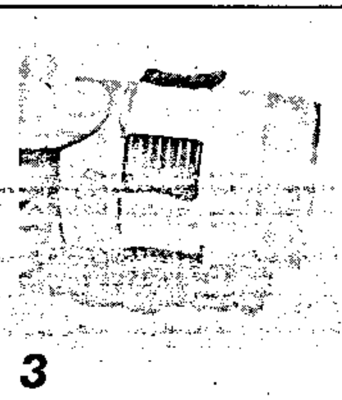
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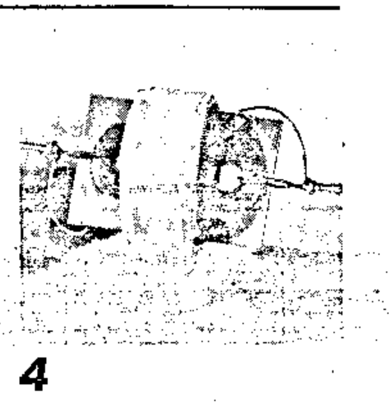
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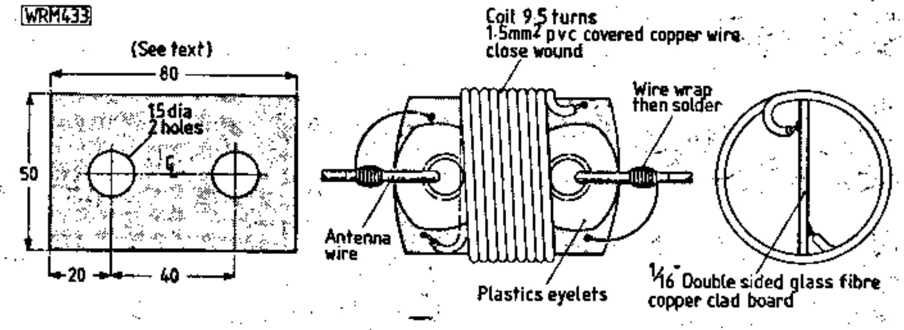
f.e.t.d.o. such as the one described in the October 1985 issue of *PW*, and a means of cutting the p.c.b. or removing areas of the copper.

Using the g.d.o. to measure the resonant frequency of the trap, carefully either remove the copper or cut away the corners of the board, as indicated in the drawings until the trap is resonant at 7·1MHz.



Finishing and Installation

The antenna wires can now be fastened to the traps ensuring that the overlap of the wire ends are securely bound and completely soldered, again as shown in the drawings so that you have a good electrical and strong mechanical joint. The other ends of the copper wire used to bind the joints are soldered to opposite sides of the p.c.b. to connect the trap to the antenna wires. The completed traps must be weatherproofed using either a proprietary antenna sealing compound or car body sealant underseal, ensuring that every bit of the trap assembly is sealed. **PW**

SHOPPING LIST

Cardboard or plastics tube 50mm outside diameter, 75mm long; PVC-covered copper wire 1·5mm² x 4m long (suggested source is a 2m length of 1·5mm² twin and earth electrical cable); Double-sided glass fibre p.c.b. material 80 x 50mm x 1/16in (2); Plastics "snap and fix" Arro eyelets (2); PVC insulating tape; Waterproofing material.

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25 ▶ lutely still air, the only forces acting on the tower are due to the weight of the antenna and its own weight. These are transferred down through the structure and end up as a simple vertical load. When a wind blows on the tower and antenna, the stays are called upon to resist this force. Ideally, stays should come out horizontally from the tower, and in such a situation the wind force would be resisted by the stays, and the only forces transferred down through the tower would be the original vertical load.

In practice however, we have to bring the stays down to anchorages at ground level so we get involved in calculations of a triangle of forces, since a stay inclined at an angle below the horizontal introduces additional vertical loads in the tower. If we assume that the stay is inclined at an angle A° to the vertical, then:

$$\sin A = \frac{\text{wind force}}{\text{stay force}} \text{ and}$$

$$\tan A = \frac{\text{wind force}}{\text{tower load}}$$

If for example we installed a stay an an angle A = 45°, and if the wind force was 100kg then:

$$\sin 45° = \frac{1}{2} = \frac{100}{\text{stay force}}$$

$$\text{Stay Force} = 100 \times 2 = 141\text{kg}$$

$$\tan 45° = 1 = \frac{100}{\text{tower load}}$$

$$\text{Tower load} = 100\text{kg}.$$

If the stay was at an angle of 30° to the vertical then sin A = 0·5 and tan A = 0·58. Thus for a wind force of 100kg the stay force would be 200kg and the tower load would be 172kg.

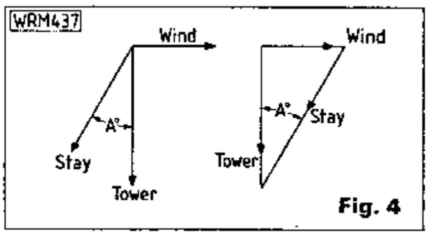


Fig. 4

So we see that a horizontal stay takes a pull equal to the wind force and exerts no additional load on the tower, a 45° stay takes 1·41 times the wind force and imposes a tower load equal to the wind force, and a 30° stay takes twice the wind force and imposes a tower load 1·72 times the wind force.

If we refer back to the first example we see that the 160km wind load on a 6-element beam is 61kg. If we assume a wind load of 30kg acting on the top section of the tower body itself, we have a total wind load of 91kg.

With 45° stays, the corresponding stay force would be 128kg, and the tower load would be 91kg.

With 30° stays, the corresponding stay force would be 182kg, and the tower load would be 157kg.

From a practical point of view, we should try to have the highest stay on a tower at 45° inclination, if possible. In cases of space restriction we could reduce this to 30°, but doing so introduces quite severe loads in the stay and in the tower.

To determine the size of wire necessary for a given installation, the wind forces acting on the antenna and tower can be calculated as before and a suitable wire selected from the makers data for safe loadings. It is important that staywires are terminated on suitable galvanised steel or plastics thimbles available from builders providers and ships chandlers to ensure that excessive bends are not made which would weaken the wire. Turnbuckles are recommended for adjusting the tension in the stays. They should not be over-tightened, merely made secure enough to resist the wind forces without pre-stressing.

In regard to the foundation, a massive block of concrete of 1 cubic metre (such as was called for in the case of the free-standing tower) is not necessary. For a typical installation, say two 6m lengths of triangular TV antenna tower, assuming that the ground is solid, not boggy or waterlogged, a pad of concrete 0·6m square by 0·25m thick on a base of gravel would be ample. A few bolts may be embedded in the concrete to provide an anchorage for the tower which simply sits on the concrete, the bolts serving merely to resist any tendency for the tower to skid sideways. The nuts on these bolts need only be hand-tight. Large commercial towers, such as for TV broadcast stations, very often have the tower coming to a point at the bottom, with provision for a large ball-bearing on which the tower rests (Fig. 3).

Three stays are sufficient at any one level; do not attempt to install four or more stays since it can be very difficult to tension them equally. In the case of the 12m tower mentioned, stays would be required at the 6m and 12m levels. If short sections were used, such as 3m sections, it would be advisable to install stays at each joint. **PW**

29/7/91 ARRL ANT HANDBOOK.

TWIN LEAD ANT

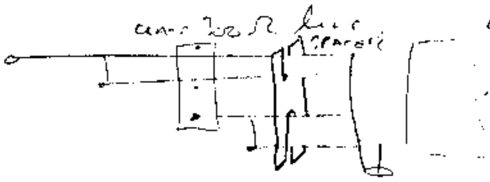
7.1	40	9.95m
14.1	20	4.60m
21.2	15	3.44m
28.2	10	2.34m

ea side.

NORMAL FORMULA

$\frac{143}{f_{(MHz)}}$ made → But since 50/2 x .99 approx for this design

feed with 50/75 Ω coax direct



4/5 BAND TRAP DIPOLE

— 7.2MHz

8.2μH
60pF

(5) 3.5 7 14 21 28 — 22' 32' 32' 22'

(4) 7 14 21 28. — 10'6" 27p 4N7 16'8" 16'8" 10'6"

7200/14.140/21.150/28.400

14.1 MHz