Shortwave Receiving Antennas

Here are a number of antennas for shortwave-listening enthusiasts that are inexpensive and simple to erect.

SALES OF GOOD QUALITY 'general coverage' receivers with tuning ranges that cover the HF spectrum from 3 MHz to 30 MHz have boomed in recent years, bringing about an upsurge of interest in shortwave listening.

The price of receivers with good 'slow' tuning rates, dial readout to 5 kHz or better, excellent sensitivity and selectivity as well as good stability has decreased to the point where many enthusiasts can afford a 'communications quality' receiver.

Examples are the Yaesu FRG-7, the Drake SSR-1 and the Barlow-Wadley XCR-30 – all of which use the Wadley-Loop frequency selection system which provides coverage of any 1 MHz band between 500 kHz and 30 MHz.

However, judging from the letters received from readers of Electronics Today, there remains a problem with antennas to suit such wide frequency coverage.

The Long Wire

No discussion or description of wide coverage receiving antennas is complete without mention of the ubiquitous 'long wire'. The time-honoured long wire is simply what is says – any 'random' length of wire that it is possible to erect in a given space.

Theoretically it is 'long' when its length is one wavelength or more at the lowest frequency of interest. The other way of looking at it is that the wire you erect is no longer 'long' below that frequency where it is one wavelength long.

No matter, modern receivers are sufficiently sensitive that they only need a whisker of an antenna to pull in plenty of stations at good strength. It's for the weak ones that you need the big antennas.

A typical long wire installation is illustrated in figure 1. The actual height and length depend entirely on your circumstances. A piece of 50 mm by 100 mm oregon is painted (the new external wood paints such as 'Timber-colour' etc are very good) and bolted to a fence post or other support, as far from your receiver installation as you can reasonably manage it. A pulley, obtainable at almost any hardware store, is fixed to the top and a loop of good quality hemp rope threaded through it, before erection.

An egg or strain insulator is attached to one end of the antenna which is also tied. The other end of the antenna is erected near the receiver installation. An insulator is also attached at this end and the lead-in taken down from it to the receiver installation. The antenna is then supported from this end by tying it off to a chimney, as illustrated, or to a screw-eye in the barge-board of the house. Having one end of the antenna higher than the other is of little consequence. It'll still work!

The lead-in should be taken in such that it clears the house guttering and may be fed through a ventilator opening or over a window sill – whatever is convenient. Avoid running it for any distance clammped to a wall or parallel to metal guttering, pipes or wiring. The more direct, the better.

Once your long wire is up, you're ready to go! The end of the lead-in can simply be attached directly to the antenna terminal of your receiver or it can be connected to your receiver via an 'antenna tuner' – more on that subject later though.

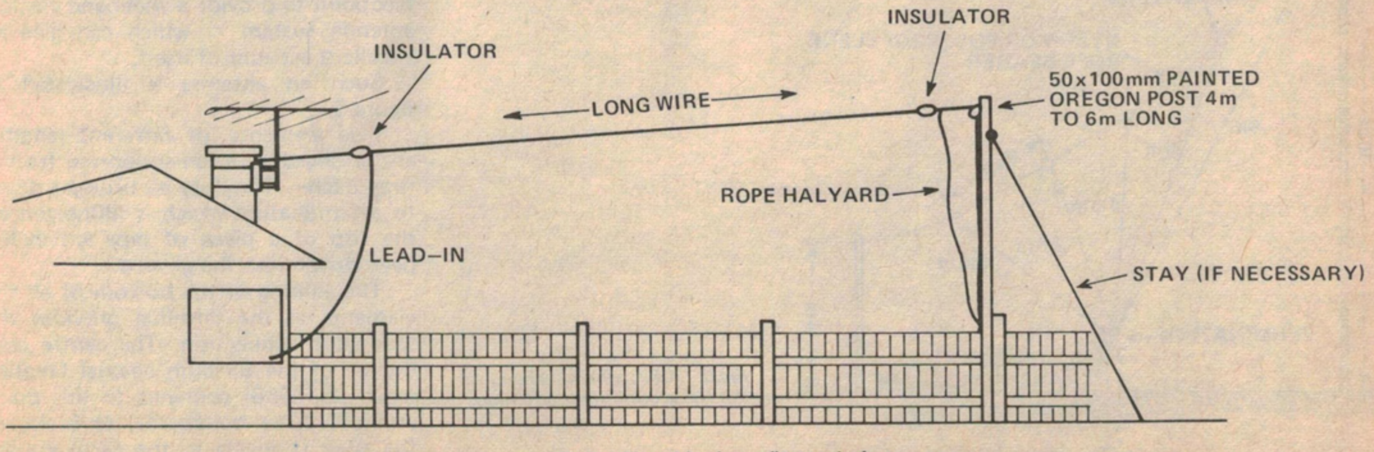

Fig.1. The ubiquitous 'long wire' antenna.

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Inverted-Vee

A wideband "inverted-vee" style of antenna is illustrated in figure 2. This works extremely well across the range from about 5 MHz up to 30 MHz and uses ordinary TV ribbon for a feedline. However, a balun or an antenna tuner is necessary. A balun is simple but an antenna tuner will give better results.

Good signals will be picked up by this antenna right down to 2 MHz, but at these low frequencies, there's no substitute for size and different antennas, designed to operate in these regions, usually provide better performance.

Beggers can't be choosers though, in many circumstances!

Construction is quite simple. Again, a 4m or 6m length of 50 x 100 mm oregon, painted, is erected against a suitable support — shown here as the side of a house. A fence or garage is just as good.

If you can attach a length of aluminium pipe to a chimney mount or to your house gable — well and good. Just get the centre up as high as you reasonably can.

Each leg of the inverted-vee should be six metres long. However, they can be shorter — whatever you can fit, but the performance at low frequencies suffers.

The TV ribbon is connected where the opposite legs of the antenna join at the apex. Support the ribbon with standard screw-in TV ribbon insulator standoffs. These are obtainable from many electronic component suppliers, such as Davred and Dick Smiths.

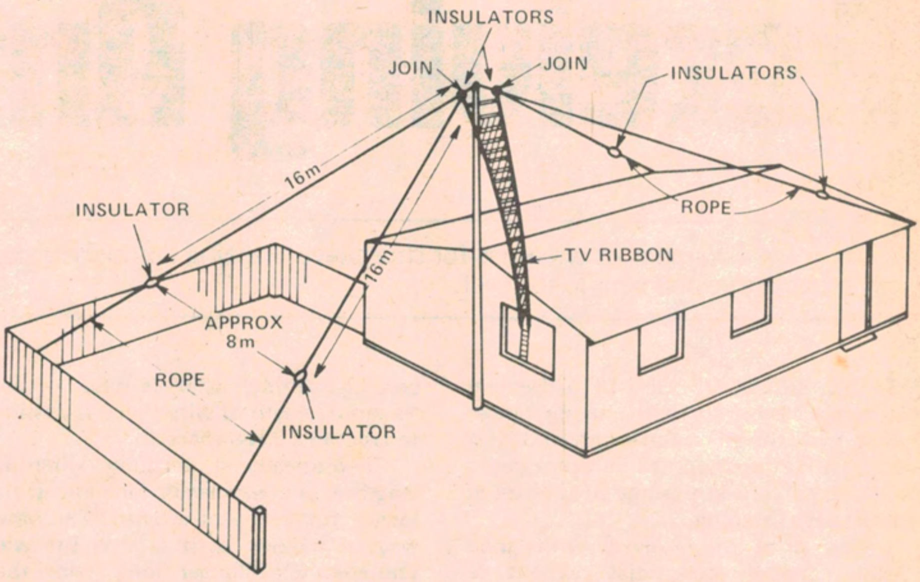

Fig.2. The 'inverted-vee' antenna. This is a wideband version.

Each leg should be individually tensioned with the rope strainers indicated in figure 2. Large screw-eyes, obtainable from most hardware stores, screwed into the supports as illustrated serve as excellent anchor points and allow the rope to be tightened using an appropriate slip knot (a round turn and two half-hitches is excellent).

Balun and antenna tuner construction, whichever you choose, to suit the inverted-vee antenna are described later.

Vertical

The familiar groundplane antenna, much used in commercial VHF two-way communications systems as base-station antennas, becomes somewhat cumbersome at the frequencies that interest hams and shortwave listeners, although they are manageable above 14 MHz.

Loaded verticals, short verticals and other forms of the vertical antenna are popular for a variety of reasons, one good one being they have a low impedance, unbalanced feedpoint which suits most receivers on the market today.

If the *actual* ground is utilised as the ground plane for a HF groundplane antenna, a series of vertical elements can be connected in parallel at the feedpoint to provide a wideband vertical antenna system — which can give an excellent account of itself.

Such an antenna is illustrated in figure 3.

Five elements, of different lengths, are arranged in a fan supported from a rope bearer. They are all brought down to a termination which is supported on the top of a piece of pipe which has been driven into the ground.

The joining of the bottom of all the elements at the terminal provides the feedpoint connection. The centre conductor of the 50 ohm coaxial feedline (such as RG58) connects to this point and the outer conductor, or braid, of the coax connects to the earth via the pipe supporting the termination.

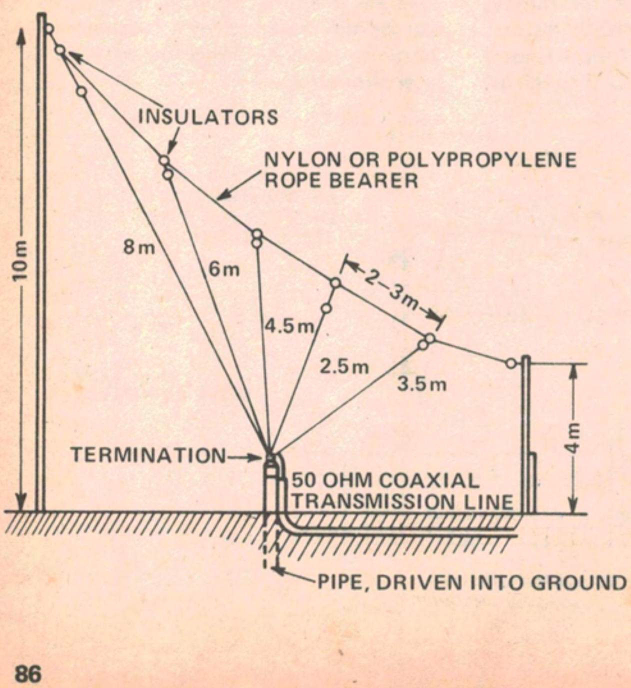

Fig.3. A broadband version of the HF groundplane antenna.

Details of the termination are shown in figure 4. The use of a coax socket is recommended as it is a simple matter to waterproof a coax connector, however, an alternative method is indicated.

Waterproofing of the coax plug and cable will see that it has a long useful life. Use Silastic or some other sealing and waterproofing compound. Silastic is excellent as it sets to plastic consistency and is easily removed at a later time if necessary.

The antenna dimensions indicated in figure 3 need not be strictly adhered to – some latitude is possible.

Construction is easy if you follow this procedure: lay out the bearer rope first. Insert the insulator ties at intervals of two to three metres as indicated. Attach the insulators that go at the top of each element to these points on the bearer rope using short lengths of rope or wire. These will have to be subsequently adjusted, so don't tie the insulators on in a permanent fashion yet.

Next, lay out all the elements, using the lengths as a guide and allow at least one metre at the termination end of each wire so that they can be individually tightened from the termination end when the antenna is erected.

Hoist the bearer rope into position and adjust the termination ends of the elements so that they come together with the termination insulator about 300 mm above the ground.

Drive the pipe into the ground below this point. Finish everything off as illustrated in figure 4. If using a coax socket for the coax connection, mount it on a small aluminium or galvanised steel plate which is mounted to the pipe via a long bolt passed through the pipe, as illustrated.

If you wish, the coax may be buried. However, it is advisable to pass it through some flexible plastic conduit and bury the whole assembly. This will prevent damage to the cable (from enthusiastic or ignorant gardeners, dogs, small brothers etc) as well as reducing the ingress of moisture.

If you want the ultimate in performance, a series of ground wires can be buried about 200 - 300 mm below the soil surface radiating out from the pipe for a distance of six to ten metres. They should all be connected together at the centre and bonded to the pipe.

However, keeping the area surrounding the pipe well-watered should satisfy most requirements.

Biconical Monopole

Yes I know it sounds funny – looks funny too, (except to the died-in-the-wool enthusiast!) but this antenna really performs as is attested by the fact that many professional and military receiving installations throughout the world use them.

The biconical antenna is mentioned in all the classic textbooks – so I won't go into it here. Suffice to say that it will readily cover a 4:1 bandwidth and has a low impedance, unbalanced feed. Low frequency performance is reduced of course but it still works sufficiently well to provide reasonable signals well below the low frequency design limit.

A biconical monopole suitable for home-construction (for the enthusiastic!) is illustrated in figure 5. A central pole has two cross-arms located low down around which is passed a length of rope. Twelve wires run from the top termination to the bottom termination, all wires being connected together at the termination points. The four wires which pass over the ends of the cross-arms are arranged to act as guys so that the whole assembly is self-supporting.

The most practical height for the central pole is about six metres, although if you can manage something higher, so much the better. The cross-arms are located about 40% of the pole height above the ground. Each cross-arm is about 40% of the pole height long.

Dimensions are given in figure 6 for a biconical monopole that will cover the 7 to 30 MHz range.

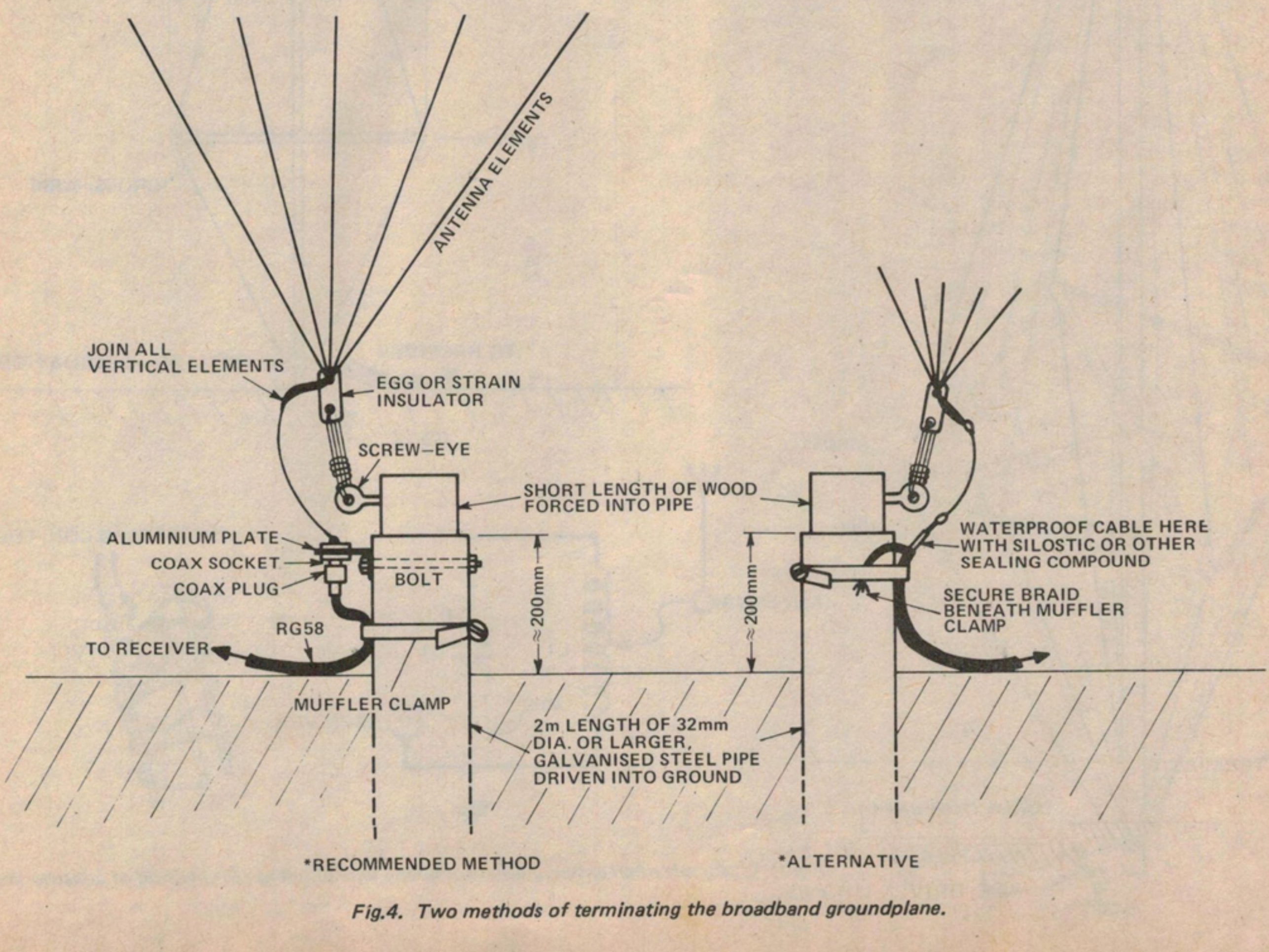

Fig.4. Two methods of terminating the broadband groundplane.

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Specific construction details are left up to the individual constructor. However, the following points should be noted.

All the wires should be insulated from the pole and cross-arms. Wooden cross-arms are recommended (paint them though). Nylon or polypropylene rope is recommended to go around between the ends of the cross arms to support the eight wires not used as the guys. Simply tie them with short lengths of wire to the rope to secure them, after tensioning.

All the wires should be joined together at the top and bottom terminations. The bottom termination is the feedpoint. An arrangement similar to that in figure 4 should be used to connect the coax feedline. A good ground stake should be used, or better still a ground radial system, as previously described.

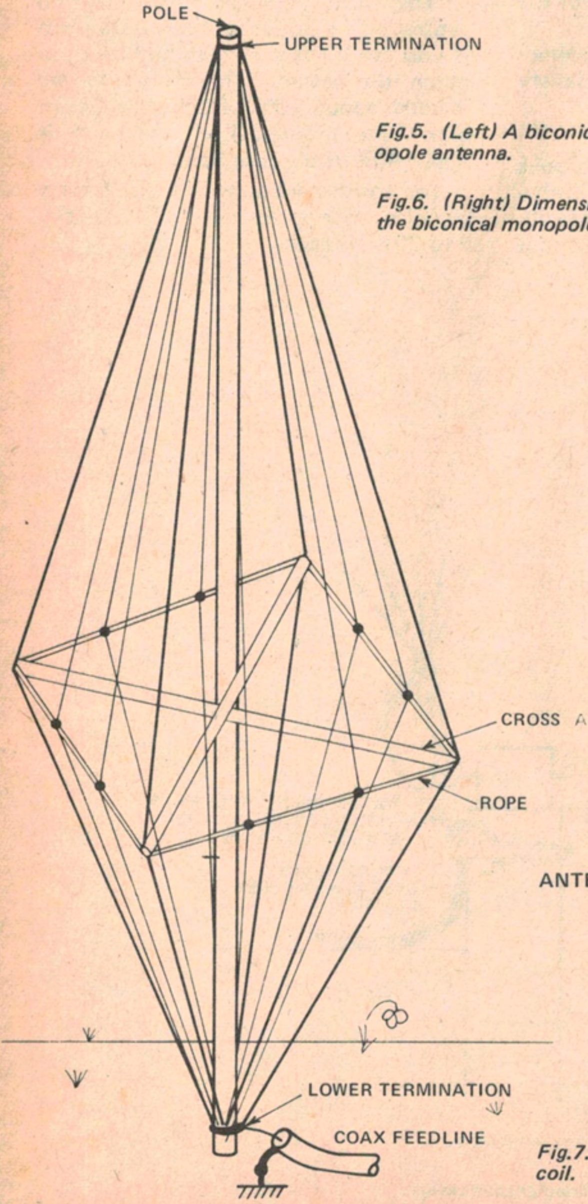
Antenna Tuners

Two basic types are really all that is necessary for most SWL applications: the unbalanced type for long-wire antennas and the balanced type for balanced-to-unbalanced conversion as well as tuning the antenna-feedline system.

Circuit and construction details for a long wire antenna system are illustrated in figure 7. The coil L1 consists of a length of "air-wound" coil stock – such as supplied by William Willis & Co. or Dick Smith.

A portion of every second turn is depressed, using the blade of a small screwdriver and moderate pressure, so that the remaining turns stand proud and allow a standard small crocodile clip to be attached, forming a tapping point on the coil.

The tuning capacitor, C1, can be anything suitable, providing it has a maximum capacitance greater than 200 pF. A broadcast tuning gang, such as one of the Roblan RMG series, would be suitable – these generally have a maximum capacitance of about 350



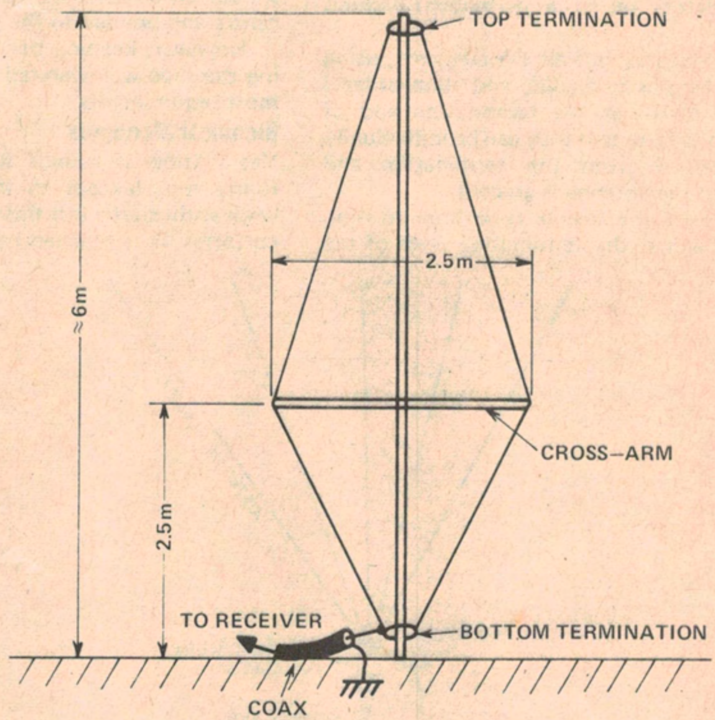


Fig.5. (Left) A biconical monopole antenna.

Fig.6. (Right) Dimensions for the biconical monopole.

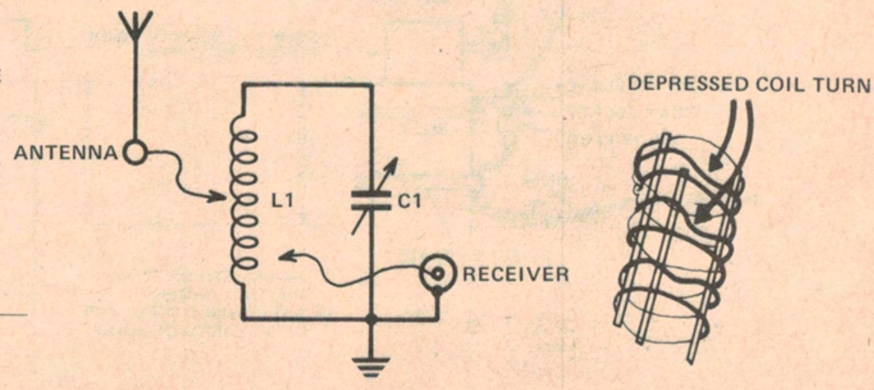


Fig.7. (a) Circuit of an antenna tuner for a long wire antenna. (b) Method of constructing the coil.

to 450 pF.

The receiver tap is generally best at a point only several turns from the grounded end of the coil. Tune in a signal near or in the frequency band of interest and commence with the antenna tapped about ¼ to 1/3 the way up the coil from the grounded end. Tune C1 for maximum signal strength.

Move the tap higher and retune for maximum signal. If it increases, you're headed in the right direction. If it decreases, move the tap the other way.

A balanced tuner is illustrated in figure 8. Coil taps are made in the same fashion as illustrated in figure 7. The tuning capacitor is a double-gang broadcast type, which must have identical gangs. This item can be salvaged from old valve-type mantle radios, or bought in electronic disposals stores. Some component suppliers stock such items also.

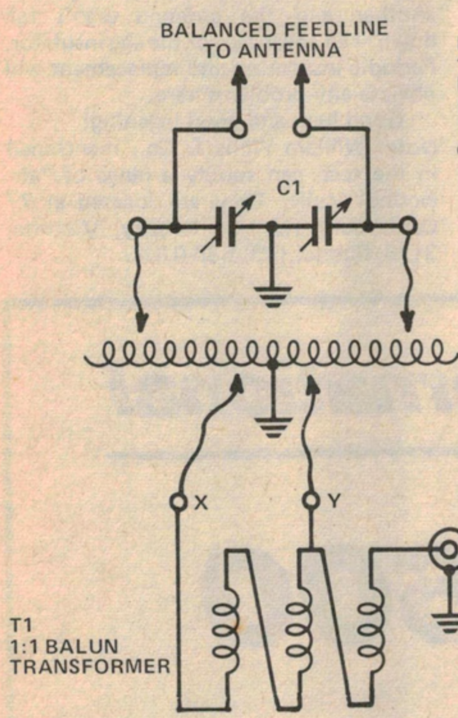
Balun

The balun, T1, is a wideband type and is constructed as follows: A dual-hole ferrite core such as the Philips 4322-020-3150 or the Neosid 1050/2/F29 is required.

Take three 180 mm lengths of light gauge hookup wire or 26 gauge enamelled copper wire and twist them together at about two twists per 10 mm. Wind three turns of the twisted strands through the holes of the core as illustrated in figure 9. Identify and mark the three separate wires. Having done this, connect them as shown in figure 10. Use a small tagstrip or terminal block to support the joints.

When using the tuner, taps are made symmetrically about the centre-tap of the coil, L1.

The antenna tuners can be constructed in any suitable metal or plastic box. However, if using a metal box, choose one of such a size that the air-wound coil stock can be mounted at least its own diameter away from any side.



L1 in both tuners is a 'Willis' air-wound inductor No. 5.08, 32mm dia. (1¼"), 8 turns per inch, 102mm long. (B & W equivalent No. 3018).

Fig.8. A balanced antenna tuner.

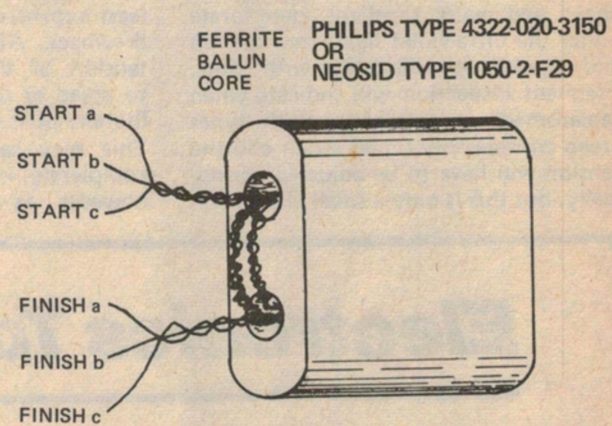


Fig.9. Construction of the 1:1 balun transformer.

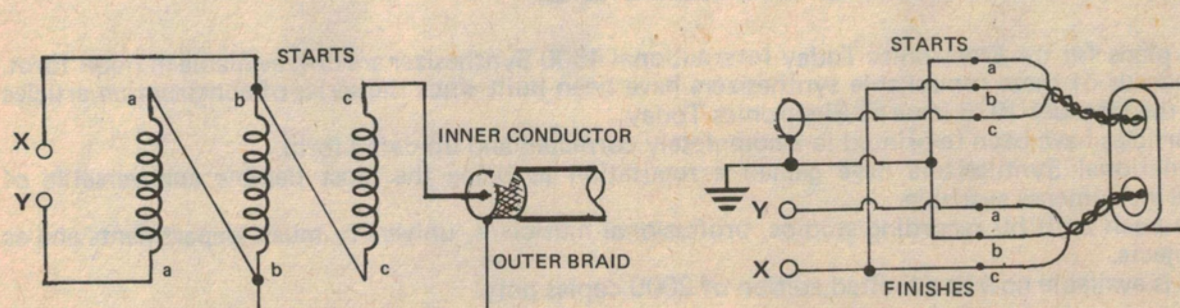


Fig.10. (a) and (b) Connections for 1:1 wideband balun transformer.

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Insulator Hints

The antennas described call for the use of insulators at various critical points to insulate the antenna elements from any support or tension rope.

There are two types generally available, the 'egg' insulator and the 'strain' insulator – both illustrated in figure 11. Using them is very simple. However, the rope or antenna wire must be firmly secured where it ties on to the insulator.

Where heavy, standard wire is used, simply wrapping the wire around itself a number of times is usually sufficient. If flexible hookup wire, such as 7/0026 or 10/010 PVC covered, is used then it will have to be knotted to be properly secured. Usually a number of half-hitches following several turns through the insulator eye are sufficient.

Nylon and propylene rope, while cheap and water repellent, deteriorate under the ultra-violet light from the sun and weaken considerably with time. Frequent inspection will indicate when replacement is necessary. Both types creep considerably under strain and the tension will have to be adjusted periodically, but this is only a small chore.

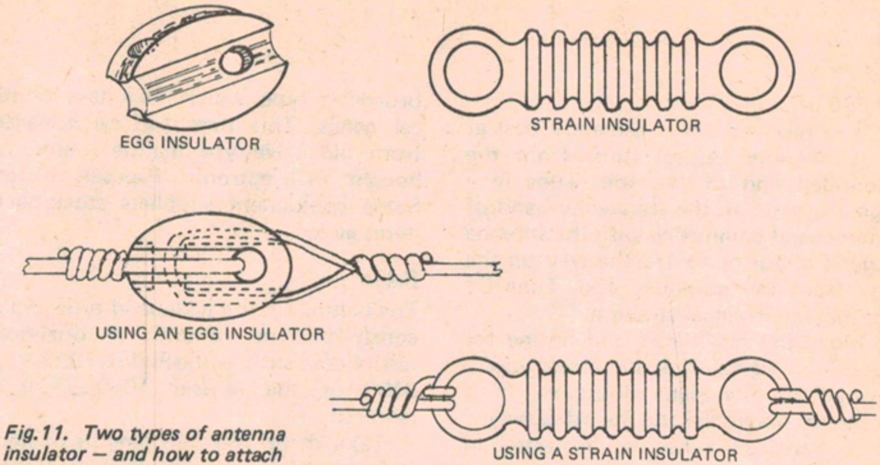

Fig.11. Two types of antenna insulator – and how to attach them.

The insulators illustrated are available in porcelain, nylon and glass. The nylon type egg insulator is usually the least expensive – but they do have one drawback. After some time in use, the tension of the wire causes the nylon to creep or remould itself and the wire literally pulls itself through the insulator. This may cause the insulator to fail completely. It isn't so much of a disaster however as the antenna wire and support rope are looped through one another and the antenna won't fall down – an advantage of the egg insulator. Periodic inspection and replacement will obviate any problems here.

Good luck and good listening!

Note: William Willis & Co., mentioned in the test, can supply a range of "air-wound" coils. They are located at 77 Canterbury Rd., Canterbury, Victoria, 3126. Phone: (03) 836-0707.