AERIALS FOR SHORT-WAVE RECEPTION

NATION SHALL SPEAK PEACE UNTO NATION

BRITISH BROADCASTING CORPORATION

AERIALS FOR SHORT-WAVE RECEPTION

How clearly you can hear the broadcast programmes depends very much on the sort of aerial you use, for the simple reason that your receiver relies solely on the aerial to pick up the programme that you want to hear. Unless the aerial does this job properly, the receiver has to work at a disadvantage and cannot do either itself or the programmes full justice. This point is often overlooked, because modern receivers are so sensitive that they will work after a fashion even with a poor aerial. But if you want to get the maximum enjoyment from the programmes and the best out of your receiver, whether it is an old one or the very latest and most sensitive model, you should have a proper aerial.

This pamphlet describes various kinds of aerial that are especially suitable for short-wave reception, ranging from simple wire aerials to the more elaborate rhombic with its high gain and directivity. Between these two extremes there are several types which will meet most people's needs. They are not difficult to erect, nor are they expensive. The resulting improvement in reception will more than repay the initial outlay and the small amount of effort needed for their installation.

MATERIALS

The wire used to make an aerial must be strong enough to carry its own weight plus any additional stresses to which wind and weather may subject it. 7/.029 copper wire, which consists of seven strands of wire, each .029 inch in diameter, twisted together to form a single conductor, is very suitable for the purpose. It is flexible, less liable to kink than single-strand wire, and is easily twisted securely around insulators. Any other available wire can, however, be used provided that it is strong enough. Insulated wire will give the same performance as bare wire and has a slight advantage in that the insulation affords some protection against atmospheric corrosion.

Insulators are generally made from glass or ceramic material. Two kinds which are usually to be found in radio shops are illustrated in Figure 1. If there is any difficulty in getting these locally, a suitably shaped piece of wood or other insulating material can be drilled and used as a temporary expedient.

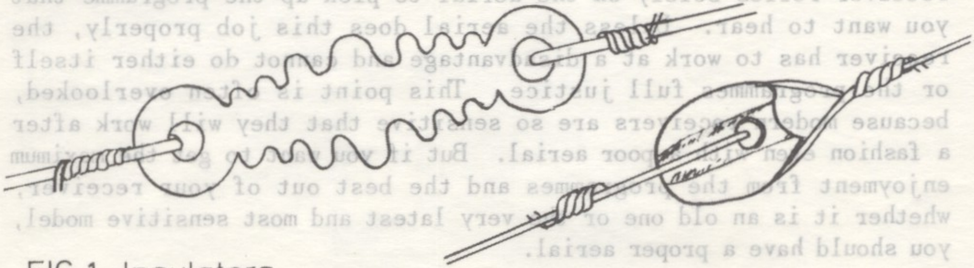

FIG. 1 Insulators

AERIAL-RECEIVER CONNECTION

The lead-in connecting the aerial to the receiver can take various forms, the most straightforward being a single insulated wire. This kind of lead-in is particularly suitable for simple aerials such as the vertical rod, T, and inverted L. Being unscreened, it acts as if it were part of the aerial and contributes to the input to the receiver.

An alternative to the single wire lead-in is coaxial cable, illustrated in Figure 2. It consists of an inner conductor surrounded by an insulator, usually of polythene; this in turn is surrounded by a metal screen, which also acts as the outer conductor, and the whole is covered by insulating material.

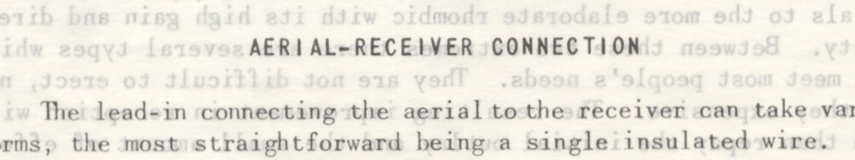

FIG. 2 Coaxial Cable

Coaxial cable may be used as a screened lead-in for any of the simple aerials, such as the horizontal wire and the vertical rod, by connecting one end of the inner conductor to the aerial, and the other end to the receiver aerial terminal (generally marked AE). The outer conductor should be earthed at the receiver end and left unconnected at the aerial end. It is also very suitable as a lead-in for dipole aerials. The inner conductor is connected to one side of the dipole, and the outer to the other side; at the receiver end, the inner is connected to the aerial terminal, and outer to the earth terminal. If the receiver has aerial terminals marked "dipole", then the inner conductor goes to one of these terminals and the outer conductor to the other. The great advantage of coaxial cable as a lead-in is that it picks up less electrical interference than an unscreened wire, and hence improves reception if there is much local interference. The use of excessively long lengths of coaxial cable may however seriously reduce signals at some wavelengths except in the case of dipole aerials.

Another kind of lead-in consists of parallel wires insulated from one another. This is suitable for rhombic aerials, and may also be used for dipoles when coaxial cable is not available. An alternative to the parallel-wire arrangement is twisted flex.

The lead-in should always be kept as short and direct as possible and should be well insulated from intervening objects. In particular it should be insulated from all parts of the building and from the earth. The connection at the aerial should be soldered after the wire has been twisted tightly round in order to make a good mechanical joint. Where an unscreened lead-in is used, it should be kept as far away as possible from all electrical wiring.

Some of these lead-in arrangements do not take full account of the problems of matching and of balanced and unbalanced terminations, which are really beyond the scope of this pamphlet. They will nevertheless, be found to give generally satisfactory results in practice. Some manufacturers who supply special aerials in ready made or kit form include matching transformers, or other devices, as part of this equipment. In these cases their instructions should be followed.

SIMPLE AERIALS

The simplest kind of aerial is a horizontal or sloping wire, or a vertical rod, as shown in Figures 3, 4, and 5. Variants of this are the T and inverted L aerial (Figures 6 and 7).

The main point to watch in rigging these aerials is to make them reasonably long and also to get them as high as possible above the ground and surrounding objects. A length of about thirty feet will suffice for a sloping or horizontal wire aerial, but something approaching a hundred feet would be better. A vertical rod aerial should be about fifteen feet long. For the lead-in from these aerials a single insulated wire or coaxial cable is equally suitable.

For simplicity, the aerials in Figures 3 to 7 are shown suspended between poles. Where suitable supports exist on the site, for instance a tree or a chimney stack, they can of course be used instead.

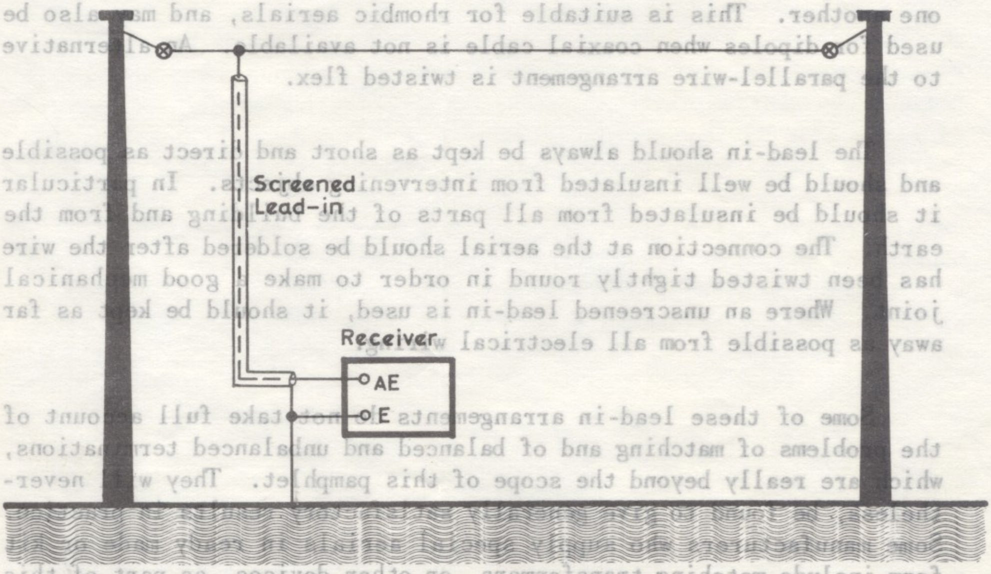

FIG. 3 Horizontal Wire Aerial

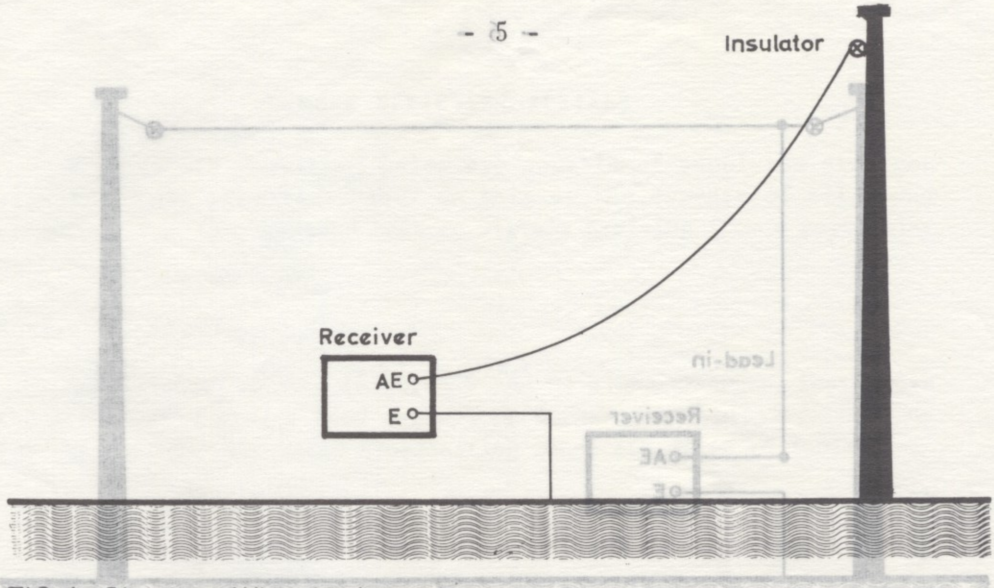

FIG. 4 Sloping Wire Aerial

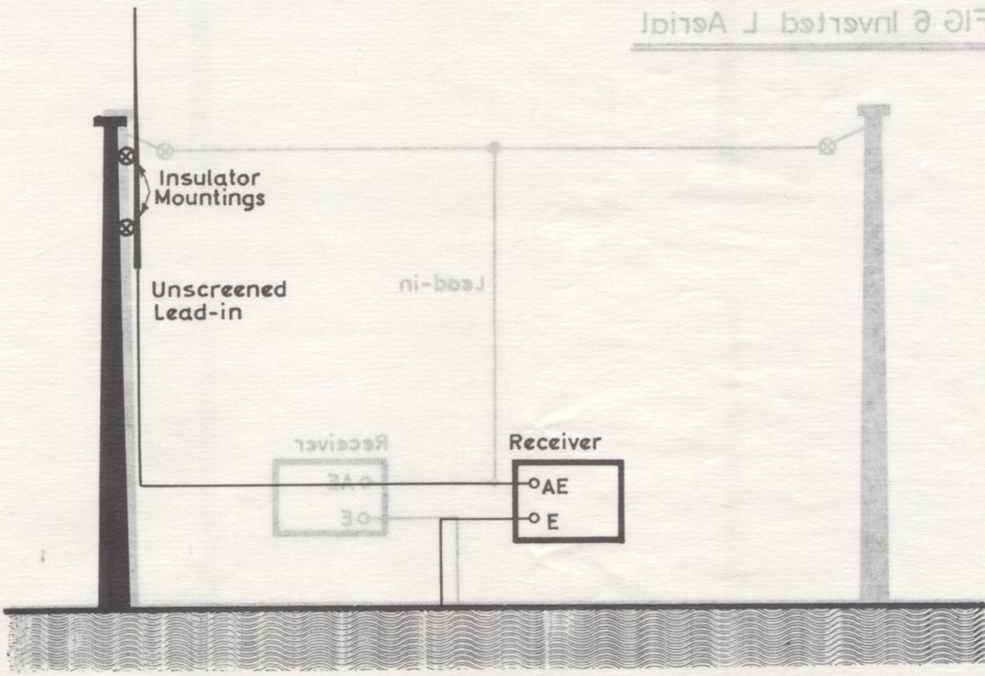

FIG. 5 Vertical Rod Aerial

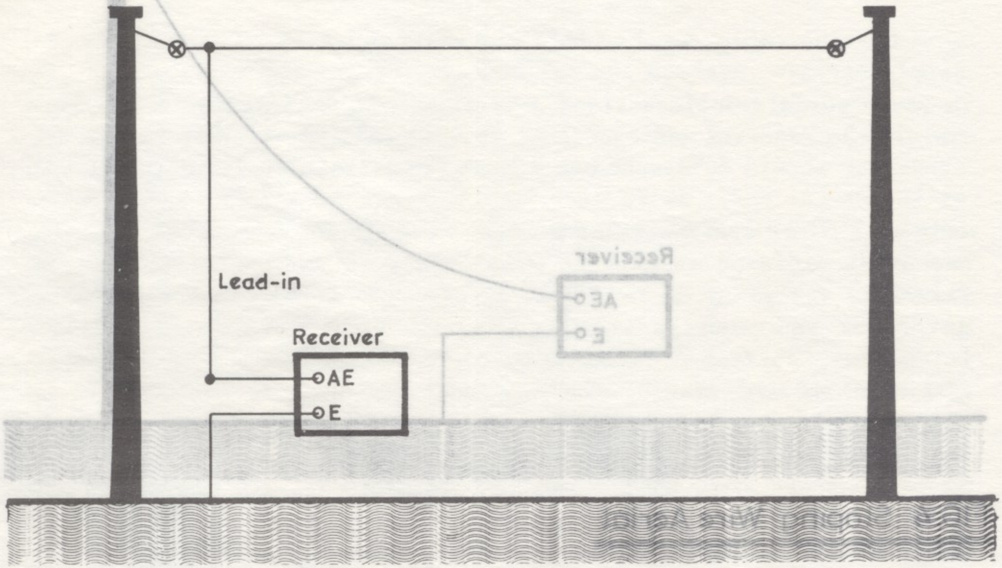

FIG 6 Inverted L Aerial

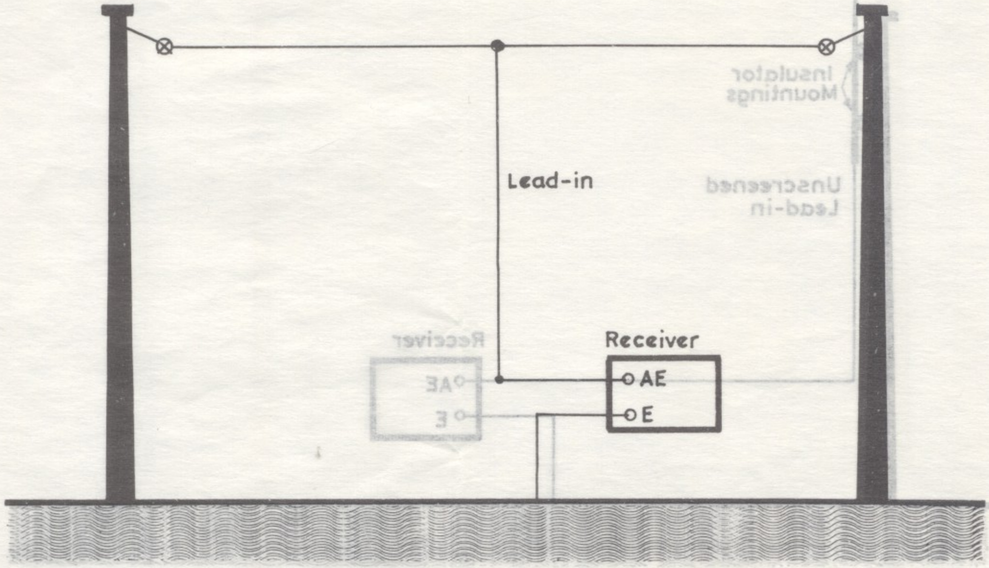

FIG.7 T Aerial

MORE EFFICIENT AERIALS

The aerials described below are capable of supplying stronger signals to the receiver. They do this at the expense of all-round reception, i.e. they respond best to signals arriving from a particular direction.

Horizontal Dipole

A horizontal dipole (Figures 8 and 9) slung about 30 feet above the ground will give a good average performance. Typical dimensions for the various short-wave broadcasting bands are given in Table 1.

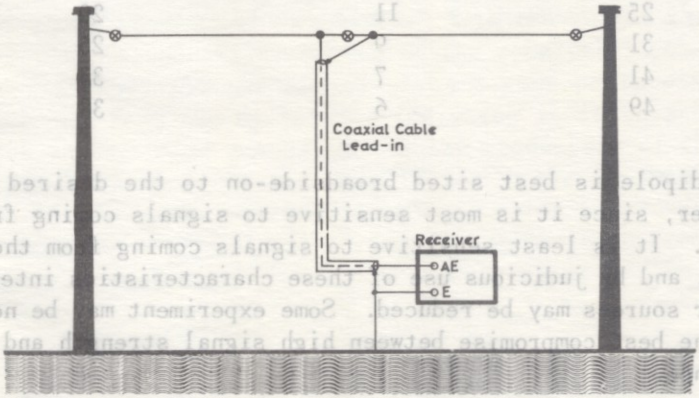

FIG. 8 Horizontal Dipole With Coaxial Cable Lead-in

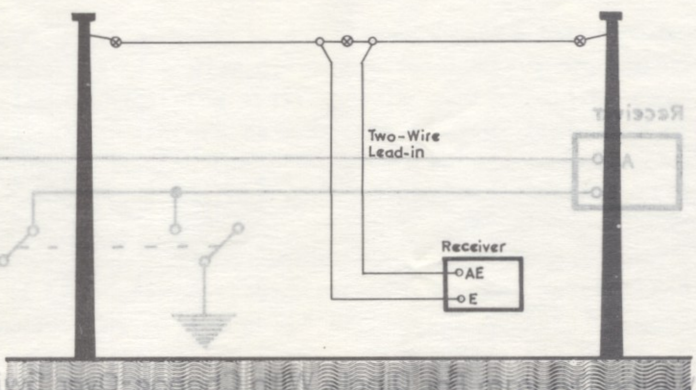

FIG.9 Horizontal Dipole With Two-Wire Lead-in

TABLE I

TYPICAL DIPOLE DIMENSIONS

Waveband metres	Frequency Band Mc/s	Length of each half of dipole feet
11	26	9
13	21	11
16	17	13
19	15	15
25	11	20
31	9	25
41	7	33
49	6	38

The dipole is best sited broadside-on to the desired distant transmitter, since it is most sensitive to signals coming from that direction. It is least sensitive to signals coming from the end-on direction, and by judicious use of these characteristics interference from other sources may be reduced. Some experiment may be necessary to find the best compromise between high signal strength and minimum interference.

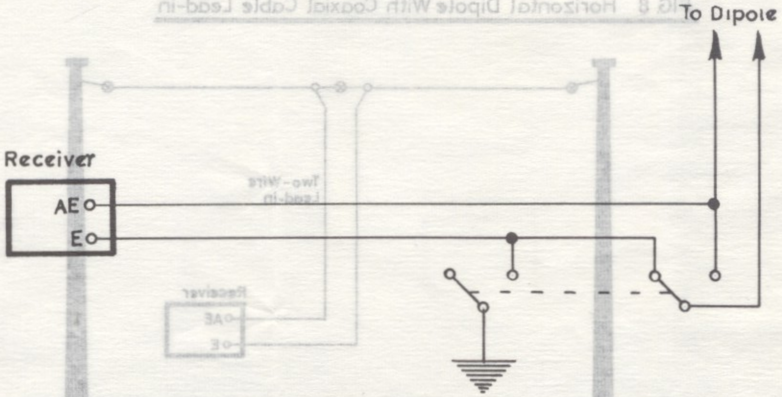

FIG 10 Wiring Diagram For Dipole With Change-Over Switch

Dipole Aerial Switch

The disadvantages of the dipole aerial just described are that its performance is poor for signals coming from the end-on directions, and that it is less effective on wavebands widely different from that for which it is designed. For general purpose reception it must be possible to receive signals from all directions on any wavelength. The following modification will make fairly good all-round reception possible.

As shown in Figure 10, a double-pole double-throw change-over switch is added close to the receiver. With the switch in the position shown, the dipole is connected to the receiver input terminals in the normal way, and the aerial gives a good performance on the wavelength and from the directions for which it is intended. With the switch in the other position, the two conductors of the lead-in are connected together, so that they form with the dipole a T aerial. In addition, the earth terminal of the receiver is grounded. This position provides a good aerial performance on medium waves and a fair performance on most other wavelengths, regardless of the direction from which the transmission comes.

Long Wire Aerial

The long wire aerial, sometimes called the Beverage or wave aerial, consists of a wire several wavelengths long, pointing towards the required transmitting station. The wire should be supported above the ground on insulators at a height of 5-10 feet, and should be at least 250 feet long. The remote end should be connected to earth through a 600 ohm resistor, and the near end to the aerial terminal of the receiver by either a single-wire or screened lead-in. The 600 ohm resistor absorbs radio energy coming from directions opposite to that of the desired transmitter, and hence makes the aerial unidirectional. One of the chief advantages of this type of aerial is that it works quite well over all the broadcasting bands.

Inverted V Aerial

Another form of directional receiving aerial is the inverted V, which is shown in Figure 11. Only one mast is required to support it, and the higher this can be made, the better. For the best results on a given waveband, the length L of each of the two limbs should be half a wavelength longer than the distance A. An inverted V provides a better signal gain in the direction for which it is erected than a dipole, and has a fair front-to-back ratio. The impedance is substantially constant at about 400 ohms over a wide frequency range. The terminating resistor of approximately 400 ohms absorbs radio energy coming from directions opposite to that of the required transmitter, and may consist of a small carbon resistor connected to a well-buried earth plate.

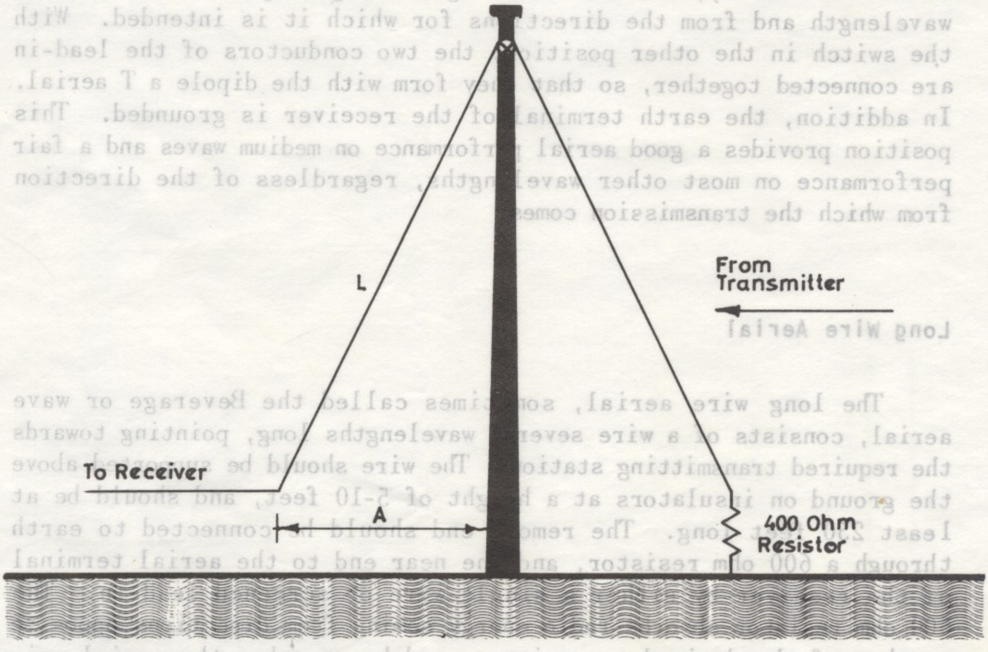

FIG 11 Inverted V Aerial

Typical dimensions for a wavelength of 19 metres are as follows:-

Mast height	65 feet
Length (L)	80 feet
Half base line (A)	50 feet

An aerial with these dimensions should also give satisfactory results on the other short-wave broadcasting bands.

Rhombic Aerial

For uni-directional reception over a wide frequency range, the rhombic (Figure 12) is probably the best aerial of all, but it is costly to erect and requires a lot of space, and so is not a practical proposition for most people. Dimensions for a rhombic of fairly modest size are given in Table 2.

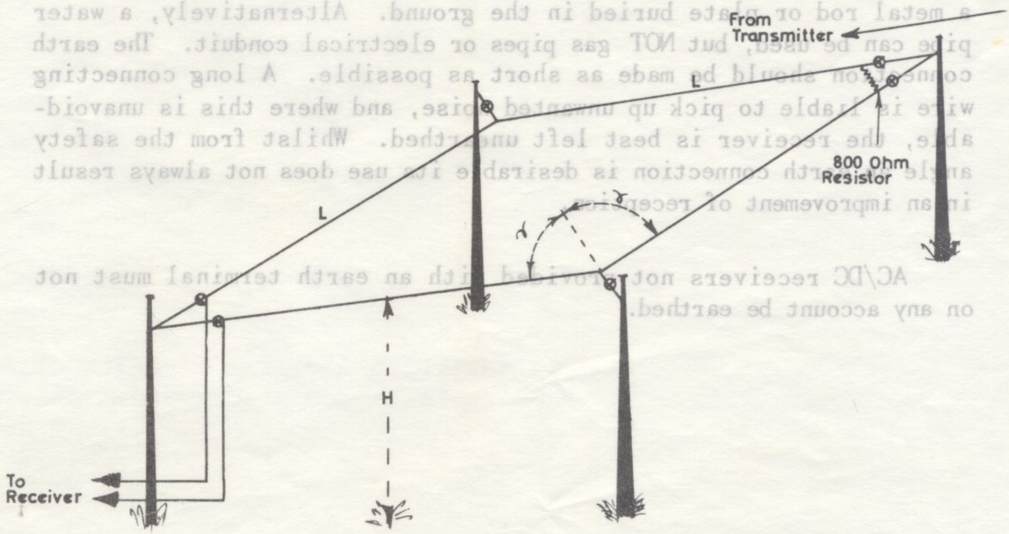

FIG 12 Rhombic Aerial

TABLE 2

RHOMBIC AERIAL DIMENSIONS

Design wavelength	19.75 metres
Height above ground	50 feet
Side Length (L)	230 feet
Half interior side angle (γ)	70°

EARTHING

Battery-operated and AC receivers are generally provided with an earth terminal, and where practicable this should be connected to a metal rod or plate buried in the ground. Alternatively, a water pipe can be used, but NOT gas pipes or electrical conduit. The earth connection should be made as short as possible. A long connecting wire is liable to pick up unwanted noise, and where this is unavoidable, the receiver is best left unearthed. Whilst from the safety angle an earth connection is desirable its use does not always result in an improvement of reception.

AC/DC receivers not provided with an earth terminal must not on any account be earthed.

Chief Engineer, External Broadcasting,
British Broadcasting Corporation,
Bush House,
Strand,
LONDON, W.C.2.

OCTOBER 1967