25p

HOW TO MAKE AERIALS FOR T.V.

(BAND I and 3)

and V.H.F. (BAND 2)

FREQUENCY MODULATED TRANSMISSIONS

Data for all Channels

10 DIFFERENT DESIGNS FOR LOCAL and FRINGE AREAS

Full Constructional Details and Diagrams

BERNARDS RADIO

MANUALS

138

HOW TO MAKE YOUR OWN T.V. (Band 1 and Band 3) AND V.H.F. (F.M.) AERIALS

BY

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BERNARDS(publishers)LTD

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London W6 7NF

SOME SIMPLE AERIALS FOR BAND I

THE DIPOLE

Let us start with the simplest of the aerials the two element Dipole which is quite useful at close range to the transmitter. The simple Dipole is the basis for all types of aerial arrays.

The construction of such an aerial can be completed in a relatively short space of time. All that is needed is an electrician's aluminium junction box, two lengths of 3/8″ or ½″ O.D. Duralumin tubing cut to length for the channel desired. Three holes are then drilled into the circumference of the junction box, two suitable for the diameter of the Duralumin tube used and diametrically opposite, the third one at 90° to these to take the co-axial cable (Fig. 1). One of the diametrically opposite holes should be made a trifle larger than the other to take an insulating bush or grommet, to prevent the high potential or upper limb of the dipole from shorting to the lower, which would be the case if the two rods were screwed into the junction box. The other hole can now be threaded to accept the lower limb.

A 2BA tapping size hole is drilled into each aerial rod about a quarter of an inch from the ends which are inside the box. Tap these holes to take a 2BA aluminium bolt. One of the rods should now be threaded approximately 1.5″ in length. Screw on a suitable aluminium nut, and screw the rod into the junction box to a suitable distance to allow for an 0.5 inch gap between the upper and lower limbs when both are fitted into the box. Screw on a second aluminium nut and clamp down tightly on to the inside of the box (Fig. 2). Screw both nuts up firmly.

The upper limb can now be fitted, and a piece of insulating sleeving is suggested to be fitted on the end entering the box as an added protection, clear of the 2BA hole in the end of the rod.

Now screw a 2BA aluminium bolt with a 2BA solder tag under, into the holes made in the ends of each rod. The upper limb will perhaps be rather "wobbly". This can easily be made rigid by a bracket which can be screwed to the support arm and the dipole. To do this, drill a hole to take a 4BA aluminium bolt through an insulating bush on each side of the upper limb, approximately 6 inches above where it enters the box and fit a stout aluminium bracket. Bolting to the horizontal support through another bush fitting.

A co-axial downlead can now be fixed to the aerial. The P.V.C. sleeving should be cut away to expose about one inch of braiding, which can be unravelled to make a "tail", for soldering on to the tag of the lower limb, while the centre conductor is soldered on to the tag of the upper limb.

The length of the horizontal aerial support arm should be at least a quarter wavelength in length, according to the channel being received.

The aerial can now be fitted to the wall of the house or on the chimney stack and it is left to the reader to achieve this in the best way possible for his type of house.

It will be noticed that aluminium construction has been stressed throughout, to prevent corrosion taking place between dissimilar metals when exposed to the weather. The co-axial cable should be taped to the bracket and cleated to the wall up to a point where it enters the house.

This type of aerial can be used as a loft aerial where it can take on the shape of an "L" type or as an "inverted V", and is useful up to a radius of about 25 miles from the transmitter.

Fig. 3 shows a method of fixing the finished aerial to the wall of the house. Lengths of tubing required are shown in Table I at the back of the book. A face plate, if not already bought with the junction box, can be made to fit over the open side of the box to prevent the weather from affecting the connections.

THE "H" TYPE AERIAL

Should the reader be living in an area where the signal from the transmitter is rather weak, the "H" aerial may make marked improvement in the reception.

The construction is the same as for the dipole, but with a reflector added to make the aerial more directive, placed a quarter wavelength behind the dipole. This is made from a duralumin rod a little over eleven feet in length.

For convenience the tubing can be cut in half, and screwed into another junction box, in the same manner as the lower limb of the dipole, but neither of the sections need be insulated from each other.

The dipole and the reflector are mounted at each end of a cross-bar of approximately 4 ft. 6 inches in length; with the mast coupled to the centre of the cross-bar.

To prevent the reflector from "whipping" too much in the wind, a small supporting bracket may be used, above and below the crossbar, similar to that used on the dipole.

The cross-bar and the mast are sometimes made of a hardwood such as pitch pine. More often the cross-bar is made of Duralumin tubing about 1 inch to 1.25 inches diameter while the mast can be between 1.5 inches and 2 inches diameter depending upon the height above the rooftop.

With a wooden cross-bar, and mast the construction is fairly simple and it can be taken that the reader has the "know-how". In the case of the metal construction, unless the necessary tools are at hand, it would be as well to get an electrician to thread the tubing. Then fit the cross-bar in two halves into a "T" piece together with the mast.

Fig. 4 shows a suggested idea how this could be done.

With this type of aerial good reception up to about 50 miles from the transmitter can be obtained.

"H" AERIALS AND DIRECTORS

This is a type of aerial which can be used at a still greater distance, up to 80 miles from the transmitter with reliable reception, and is usually a folded dipole. Similar construction is used as is shown for the Band III and F.M. dipoles. The overall construction is much the same as for the previous "H" aerial with an extension to the cross-bar of 0.1 of a wavelength for the director to be fitted in front of the dipole. For a single director the length of Duralumin tubing would vary between about 7 feet and 10 ft. 6 inches in length according to the frequency of the channel being received.

Fig. 5 shows the aerial when constructed.

Two aerials with two directors spaced about six feet apart, and connected in parallel are quite useful where severe ghosting is prevalent. This then becomes rather bulky for one person to handle and can be quite a problem to erect, especially on a windy day.

Another director could be added if neces-

Drilling and tapping Junction Box.

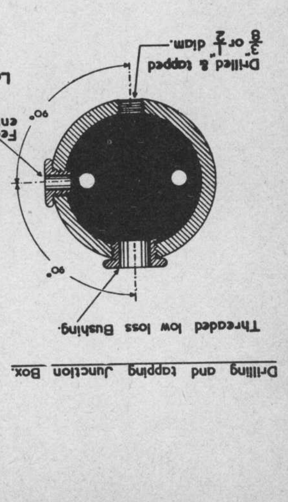


Fig. 1.

Fitting the Dipole.

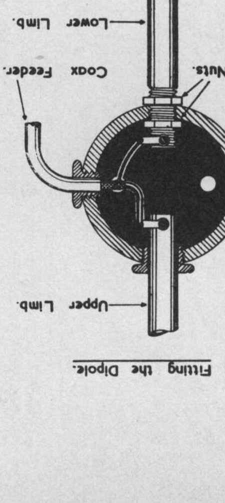


Fig. 2.

Mounting Aerial to Wall.

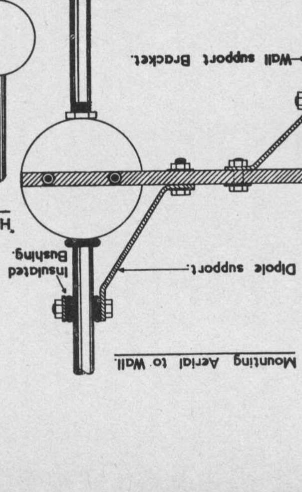


Fig. 3.

"H" Aerial using threaded Tubing.

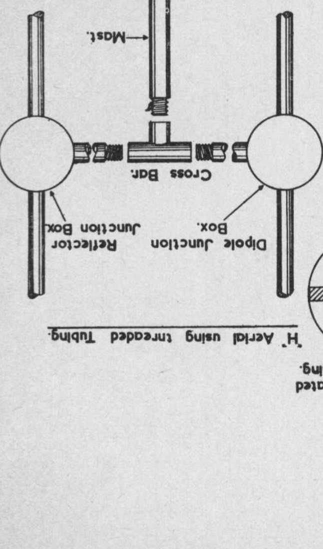


Fig. 4.

Dipole with one Director and Reflector.

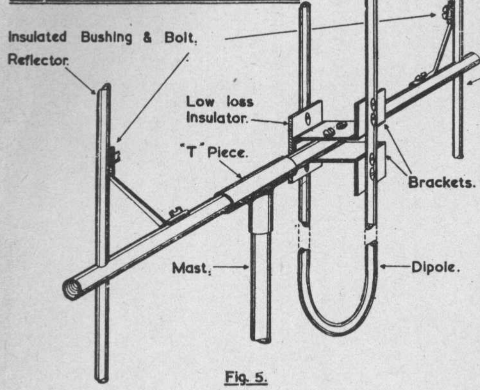


Fig. 5.

Showing completed Aerial.

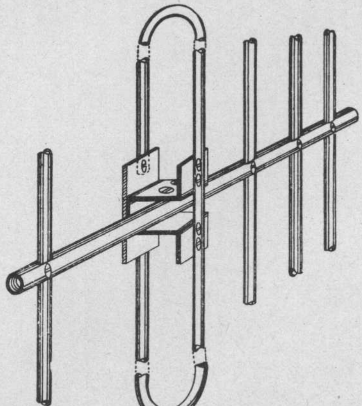


Fig. 6.

Showing the method for fixing Elements.

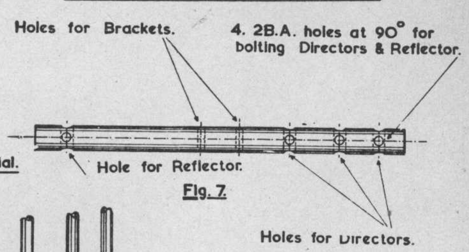


Fig. 7.

sary making the aerial still more sensitive, the length of Duralumin tubing varying between 6 ft. 6 inches and 10 feet, spaced again 0.1 in front of the existing director.

BAND III

Many viewers will want to receive the alternative T/V programmes, but unless a fairly powerful transmitter is near, it will be of no use trying to receive the signals in a haphazard fashion by "stringing up" a piece of wire in a convenient corner.

To receive the signals, whether near or distant to the transmitter, it is far better to "go about" the job in a sensible manner and have a respectable aerial capable of giving good results.

Band III frequencies are such, that a compact, light and neat aerial can be made, but the constructor must keep as near as possible to the given dimensions, than in the case of Band I.

The constructional details which follow, are to act as guide to the constructor, and it is left to his own ingenuity to make a good finished article.

All aluminium construction is recommended again, because of lightness and ease of handling.

CONSTRUCTION

Aluminium or Duralumin tubing of 1 inch diameter is required for the support to the aerial, cut to length to build the array desired. For the dipole, reflector and directors 3/8 inch or ½ inch diameter aluminium tubing is cut to the lengths required for the frequency of the local transmitter.

The diagram (Fig. 6), shows a five element array, having three directors, a folded dipole and reflector.

Preparing the aluminium crossbar for drilling is the first working. Mark off along the centre length of the tube (Fig. 7) the positions for the holes necessary for holding the reflector and one, two or three directors, including the holes above and below for fixing the dipole bracket.

The holes for the reflector and directors should be made a fraction larger than the outside diameter of the rod used, so that the rods can slip through but not be "sloppy". Make sure that when drilling the holes are absolutely diametrically opposite. The holes for holding the dipole bracket need be 2BA clearing size, as two long bolts hold the bracket in position.

At right angles to each of the large holes, drill other holes 2BA clearing to hold the rods in position.

Cut off lengths required for the reflector and directors from the 3/8″ or ½″ rod, and drill 2BA clearing holes in the centre of each length.

The dipole support brackets are made from two pieces of heavy gauge aluminium (16 S.W.6). Mark out, drill the holes and bend to shape (Fig. 8), allowing for, on the one which is to be fixed to the lower side of the support arm, the thickness of the metal used as the two flanges overlap.

Fit these two brackets. To the small flange bolt a piece of low loss insulating material for clamping the open ends of the dipole. Making the dipole is a fairly simple matter, if care is taken.

The remaining piece of aluminium tubing is cut to length. Mark the centre of the rod and at 12 inches either side two other marks these are where the bending starts for making the dipole.

Bending radius is about 1¼ inches, measuring inside the bend. It is left to the discretion of the constructor how best to achieve this as a piece of 3¼ inch diameter iron is not always available.
(A piece of standard rainwater piping could be used). When bending is completed at the appropriate points, two 4BA holes are drilled to correspond with those on the supporting bracket, also a 4BA hole in each of the free ends, ½ inch in from the ends.

The dipole can now be fitted and clamped rigidly to the bracket.

Two fly nuts are screwed on the bolts retaining the open ends of the dipole for attaching the "lead in" cable.

The down lead is kept away from metallic guttering and wall by "stand off" support posts to a convenient point where the cable enters the house. Recommended lengths for the tubing required are shown in Table II.

AN AERIAL FOR F.M. RECEPTION

Unless a powerful transmitter is near for the reception of F.M., to make full use of the quality transmission, a good aerial must be used.
An aerial such as the one shown (Fig. 9) will give good results at long distances from the transmitter.

Again all aluminium construction is suggested, and can be made with tubing of ½ inch outside diameter, the lengths of the director and reflector cut so that when fitted into "T" junctions the measurements overall are correct.
The junctions should have inside diameters of ½ inch and be threaded. By threading the ends of the tubes to fit these a rigid construction is made. A supporting mast of the same material can be made to screw into the lower limb of the "T".

The dipole itself can be made in a similar manner as that described for Band III and mounted in a similar fashion. Remembering that the completed aerial should be mounted horizontal instead of vertical.

Recommended lengths are shown in Table 3.

THE "X" AERIAL

An aerial such as this is extremely efficient and has good electrical characteristics.

As this type is of a patented design the actual constructional details cannot be given.

The following details will most likely be of use to the constructor who would like to build an aerial such as this.

Aluminium rod or tubing is used for the elements, as in the case of the previous aerials, and a wooden structure is made to carry the aerial. The dimensions for each element are given later in the book.

For the construction a block of hardwood such as a piece of oak 6″ x 6″ x ½″ is needed to carry the elements. Eight "U" clamps made from a strip of 16 S.W.G. aluminium ½ inch wide for clamping the tubing or rod to the block, and a connecting strip of the same gauge aluminium for joining the ends of the director.
At approximately a ¼ inch from the ends of the elements to be clamped to the block a 4BA tapping size hole is drilled in each element to carry the connecting strip and the co-axial feeder.

Tap the 4BA holes, and then fix the elements to the wooden block by the clamps using ½ inch No. 6 wood screws. The elements to be at 90° to each other. Join the ends of one pair with the connecting strip and on the other pair bolt two 4BA solder tags for connecting the feeder cable.
A wooden or aluminium mast can now be screwed on to the reverse side of the block. This must be about 1½ inches to 2 inches in diameter, and its length sufficient to raise the aerial clear of the roof or chimney stack to which it is to be rigged.

With this type of aerial good signal strength is received up to 50 miles from the transmitter, with the director elements facing the transmitting station.

Fig. 10 shows the suggested construction.

THE CONICAL AERIAL

This is perhaps one of the most difficult aerials to construct, but it has the advantage

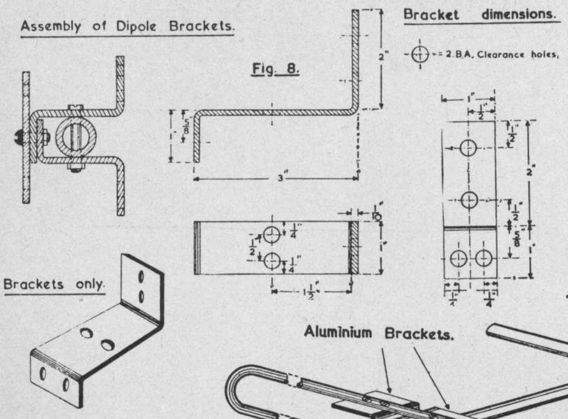


Fig. 8.

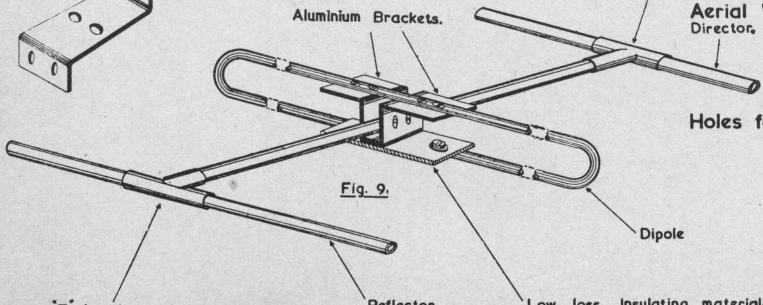


Fig. 9.

Showing constructional method of Cone Aerial.

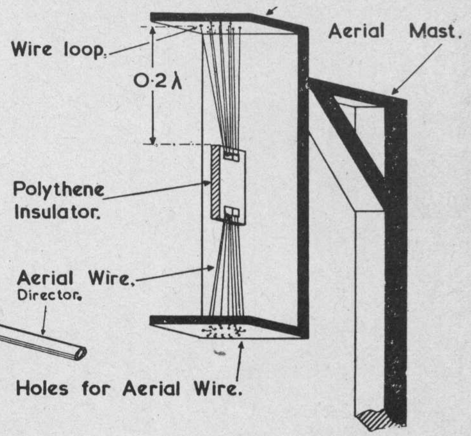
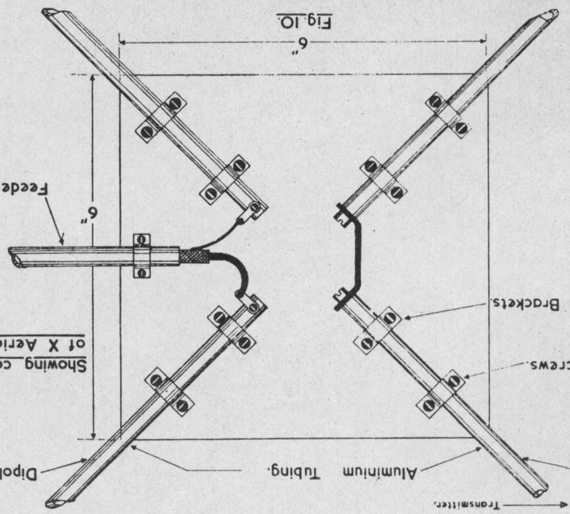


Fig. 11.



Showing construction of X Aerial.

Fig. 10.

Polythene Spacer dimensions.

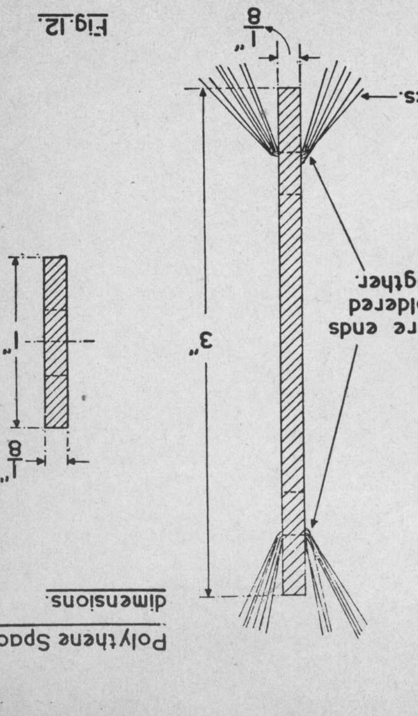


Fig. 12.

that it has a broad frequency response and possesses characteristics similar to those of the dipole.

A wooden framework must be made to support the aerial and two loops of wire to the diameter of the frequency to be received.

The upright ends of the framework have two circles of holes drilled, one inner and one outer, each hole equidistant from its neighbour. Somewhat like the figures on a clockface.

Twenty-four pieces of 18 S.W.G. copper enamelled wire are cut to a length of a few inches over 0.2 of a wavelength of the frequency required. One end of each is cleaned and then six are taken and the clean ends soldered together in a neat pack so that all six are lying side by side. Do the same with the remaining wires, so that there are four packs of six. The soldered ends of these packs are then bent at right angles to the wire and passed through slots made in a piece of Polythene 3" x 1" x ½", six either side at each end, these are then carefully soldered together to make twelve wires at each end.

The wire loops are clamped with staples to each of the uprights of the wooden frame and the enamel cleaned off. The wire ends are then threaded through the lower set of holes and bent back through the corresponding holes above to make soldered contact with the loops. These wires must be pulled taut to prevent sagging.

A co-axial feeder can be fitted to the centre of the cones, and the whole then mounted on a mast.

The length of the copper wires from the insulator to the loop should be approximately 0.2 of a wavelength for the frequency to be received.

The overall length of the aerial can be found from the formula below at mid frequencies.

$$\text{Length (ft.)} = \frac{936 \times 0.73}{\text{frequency (mc/s)}}$$

while the diameter of the wire loops can be calculated from :

$$\text{Diameter (ft.)} = \frac{114}{\text{frequency (mc/s)}}$$

Diagrams 11 and 12 give details of the construction.

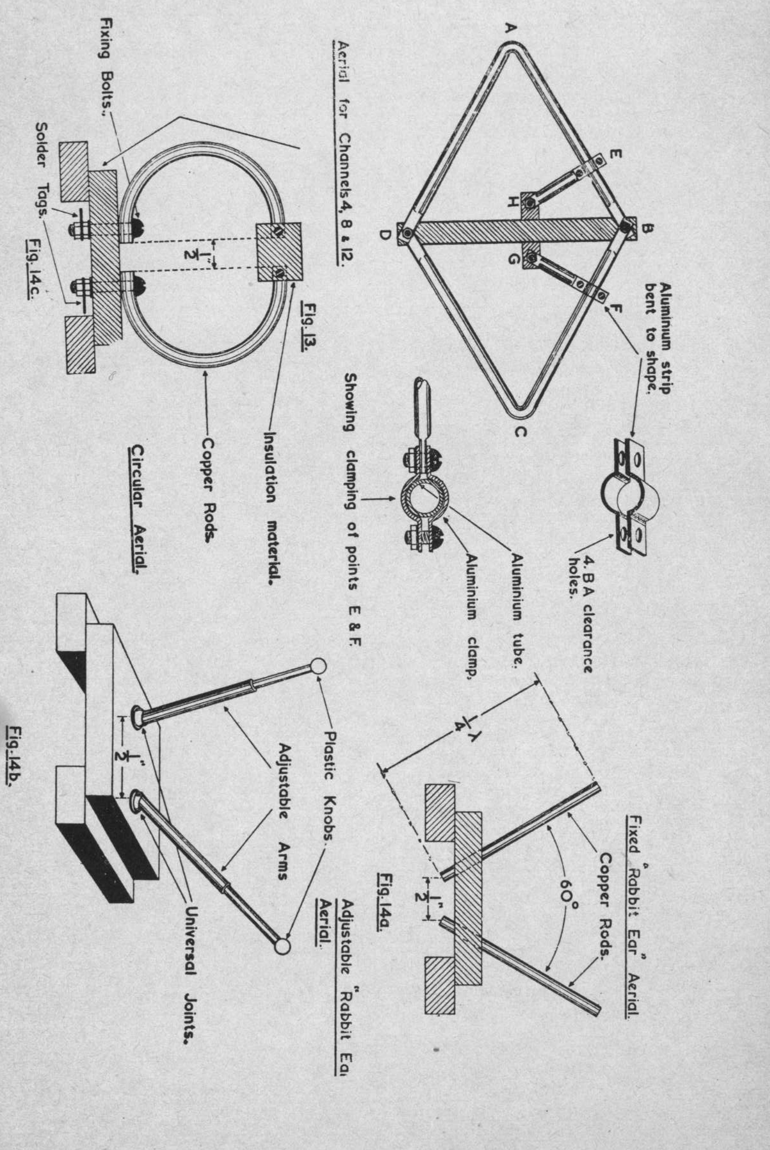
SIMPLE F.M. or T/V AERIAL COVERING CHANNELS 4 - 8 - 12

Here is a type of aerial which is not often seen, it would appear at first sight to be a rhombic, but looking closer shows two expanded dipoles.

The elements AB. BC. CD. DA. are three-quarters of a wavelength for channel 12, and together equal one wavelength for channel 4, while EB. BF. FG. and HE. are one quarter wavelength for channel 8. A 300Ω feeder cable is used and together gives a good coverage over a wide band.

The aerial is all aluminium construction and the dimensions of sides AB. BC. CD. DA. and EB. BF. FG. and HE. can be calculated from the formula below, also the boom length from B to D. The spacing between GH. is approximately 3 inches. This aerial can be mounted in a loft for indoor use and can be made of stout gauge wire. For use outdoors 3/8 inch aluminium tubing is used.

The elements DA. and AB. as well as BC. and CD. can be made in one length bent at points A and C. B and D are bolted directly on to this cross boom, which also carries a strip of Polythene for bolting elements HE. and FG. A cross boom of wood will be quite suitable and points B and D are flattened, also points EF. and HG. to make bolting easier. Aluminium clamps, made from strip aluminium and bent to shape, to hold HE. and FG. in position on the longer sides, H.G. are bolted to the insulator. A simple mast can be made to carry the aerial from a piece of wood or aluminium tubing. Fig. 13 shows the constructional method. Excellent F.M. reception can be obtained from this type of



aerial with sides AB. and CD. 28¼ inches long and a cross boom of 23¼ inches.

To obtain the element lengths for any given frequency the formula

$$\frac{1}{4}\text{ wavelength (in inches)} = \frac{2{,}770}{\text{f (in Mc/s)}}$$

is used.

The length of the cross boom is equal to 0.825 times one element length.

AERIALS FOR INDOOR USE ON BAND III

Though not always capable of producing superb results, the indoor aerial has its uses. The signal developed in them is rather poor, and any interference caused by house-wiring is much more likely to be picked up.

These aerials should be placed as far away from the receiver as possible, preferably in a loft, but where the case demands in a room away from the receiver. This again may not be possible, and here it should be mounted fairly high in the room so that any person walking about causes least possible effect on the aerial.

Two types of aerials can be mentioned here, one is the "Rabbit's Ear" and the other "The Circular".

The "Rabbit's Ear" can be made from a block of wood either square or circular, mounted on runners to raise the block. Two pieces of copper rod are fitted into holes drilled at an angle of about 30° from the vertical, so that the copper rods when fitted make an angle of 60° to each other, their ends when protruding through the wood base are half an inch apart. These copper rods should be a quarter wavelength long.

The co-axial cable can be fitted to the short stubs protruding through the wood and taken to the receiver.

As quite a number of T/V chassis are now "live", it is advantageous to isolate the aerial from the set by a small capacitor in each lead, say about 50 pf - 75 pf each.

Fig. 14a shows the "Rabbit's Ear" aerial.

Perhaps the "Rabbit's Ear" aerial could be made somewhat more versatile by an enthusiastic constructor, in so far as fitting the rods into universal joints and making the aerial rods capable of being lengthened or shortened at will (Fig. 14b).

Quite often a "Rabbit's Ear" will give a better result than an outdoor type of aerial, and by placing the elements at various angles "ghosting" can often be overcome rather more easily, although it must be remembered that the signal pick-up is considerably less.

The constructor can, when the aerial is connected to the receiver, experiment to find the best positions by rotating the aerial, adjusting the length of the elements and by placing them at various angles. Maybe the final result will not look anything like it should do, but if good results are obtained that is all that matters.

These refinements can be made by purchasing two small universal joints, such as are used for mounting cameras at any angle for the elements. Copper tubing of two different diameters comprise the aerial. The narrower gauge being rubbed down with emery cloth to make a snug fit into the larger for length adjustment purposes. One end of each of the smaller gauge copper rods can be threaded to take a knob, cut from a very large plastic knitting needle for ease of handling when adjustments are made. This can be drilled and tapped to match the rod.

The two sections can then be mounted on to a wooden block. On completion, the co-axial cable can be connected.

A Circular Aerial (Fig. 14c) has an advantage over the "Rabbit's Ear" in the fact that it does possess a directive property and can be rotated to obtain best results.

The construction of such an aerial is very similar to the one previously described.

A block of wood is mounted on runners to carry the rods of ¼ inch or ⅛ inch copper. The rods are bent in a semi-circle, and fitted to the block by either small "U" shaped clamps or perhaps better still by bolts, sufficiently long to pass through the rods and the block to allow the co-axial cable to be connected below the block.

Small holes are drilled in each end of the rods, the lower pair fix the aerial to the base and the upper pair are bolted to a piece of

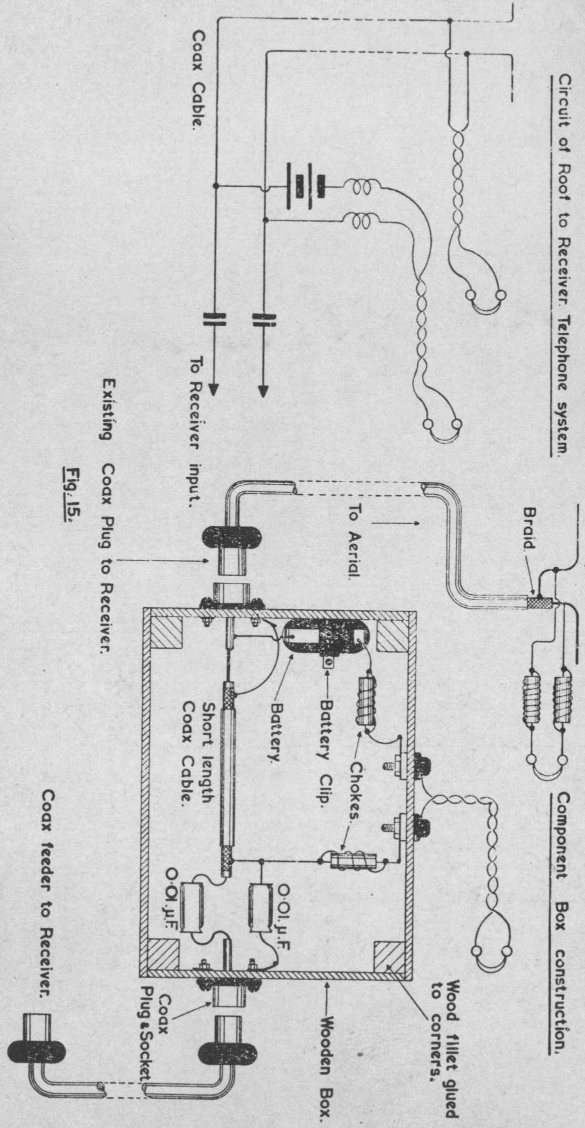


Fig. 15.

insulating material. At both of these fittings a half-inch space should be between the elements.

Suggested lengths of rod for each frequency are to be found in Table 5.

Should these aerials be on view in the room it would be a good plan either to polish the rods or to have them plated, and the block decorated to match the furnishings of the room.

ROOF TO RECEIVER TELEPHONE SYSTEM

When rigging and siting an outdoor aerial, it is extremely difficult for one person to do. Here is a simple telephone system using the co-axial feeder as the speech conductor, while having the receiver connected to the aerial.

Two pairs of head telephones are required, a 4.5 volt flashlamp battery, two 0.01 microfarad paper capacitors and four small chokes which are hand wound on to four 1 megohms half watt resistors. The wire being about 18 S.W.G. enamelled.

A small wooden box can be made to house the batteries the coils and capacitors at the receiver end.

To make the chokes seven turns of 18 S.W.G. wire are wound on each resistor the ends being soldered to the resistor's own wire ends. Two are fitted into the leads of one pair of 'phones, with crocodile clips attached, to make simple contact on the cable at the aerial end.

Making the box is a fairly simple matter. Two terminals are used to connect the 'phones at the receiver end. Two co-axial sockets, of the type used on the receiver, one to plug in the existing cable, the other to connect the box to the set by a short length of co-axial cable fitted with the necessary plugs.

Clips are made to hold the battery and the capacitors, the chokes being soldered directly on to the terminals. A piece of co-axial cable connects between the two sockets inside the box. By detaching one of the 'phones from the headband of each pair, and used as a microphone, a simple circuit is completed.

Care **must** be taken to make sure that the capacitors will stand at least the mains voltage and that the system is isolated away from the receiver.

Fig. 15 shows the circuit and also the method of making and wiring the box.

INTRODUCING THE WOLSEY "QUICK FIX" CROSS OVER UNIT

A cross over unit plays an essential part where Band I and Band III reception is concerned, because it allows for the use of only one downlead. This prevents having to drill extra holes in woodwork, and so makes the task of having two aerials much easier.

It is quite small in size and incorporates the latest printed circuit technique. The co-axial cable from either aerial are connected to the appropriate sockets and the one downlead from the unit to the receiver.

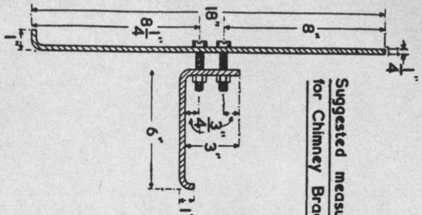
The unit is housed in a die-cast rubber sealed box which is available for mounting to masts, walls or any convenient place.

For wall or wainscot mounting Part No. 1957 is required, and for mast mounting Part No. 1957A.

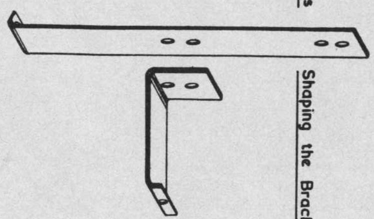
Extremely little insertion loss is claimed for the unit and the rejections between the two bands is very high.

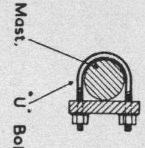
A series of sketches shown in Fig. 16 will illustrate how useful this device can be. The first sketch shows separate Band I and Band III aerials coupled to the cross over unit, while in sketch II is a combined aerial, the receiver having two separate input sockets.

The third sketch shows how two cross over units may be used to compensate for a very long downlead. In sketch IV a multiple arrangement is shown for use in flats or shops where a number of receivers



Suggested measurments for Chimney Bracket.
Fig.17a.


Shaping the Bracket.
Fig.17b.



Plan view of mast clamping.
Fig.17c.

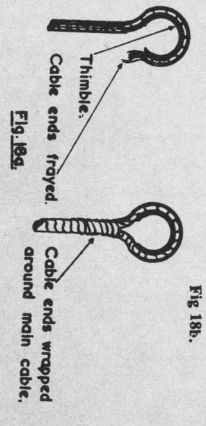


Fig.18a.

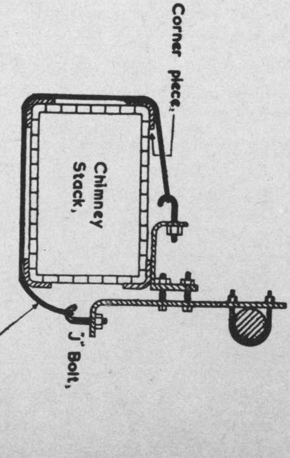


Fig 18b.

Suggested method for Chimney lashing.

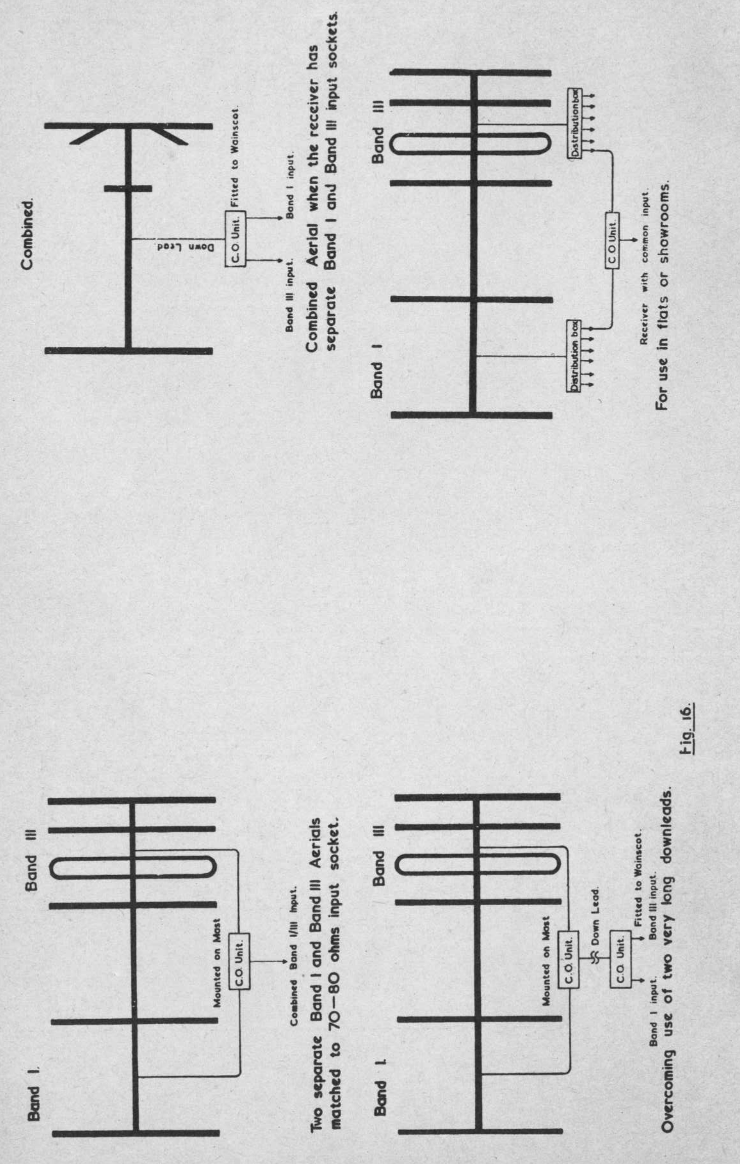


Fig. 16.

are operating at one time.

SUGGESTED METHOD FOR LASHING TO CHIMNEY

Here, perhaps, a word on Chimney Lashings will not be out of place. The chimney stack of a house is a very convenient place to site an aerial, as at least there is something upright to give a useful start.

Two sets of lashings will be needed to give the mast full support.

The metal brackets for carrying the mast are made of mild steel and should be 1 inch wide by ¼ inch thick. "U" bolts hold the mast in position when lashed to the chimney. The pieces of mild steel for making the main part of the bracket are made red hot and bent to shape as in the diagram. The overall measurements are left to the constructor to suit particular requirements although suggested lengths are shown in Fig. 17a.

To lash the masting "J" bolts are used with strong galvanised iron cable of seven strand 20 S.W.G. Corner pieces are made from sheet iron so that the cable does not cut into the brickwork.

Fig. 17b indicates the shape of the main brackets and the suggested positioning of holes, while Fig. 17c shows in plan view the mast in the "U" bolt clamping.

For ease of slipping the galvanised cable over the "J" belts a thimble can be used to terminate the ends. The cable is stranded back a short distance, say six or seven inches, and the thimble is then placed in position, so that the frayed ends of the cable are available to bind round the main cable. Each of the strands are then wrapped round the main cable to give a neat strong finish as shown in Fig. 18a.

Fig. 18b shows a plan view of the completed construction.

TABLE 1

FREQUENCIES ALLOTTED TO BAND I CHANNELS

Channel	Vision Mc/s	Sound Mc/s
1	45.0	41.5
2	51.75	48.25
3	56.75	53.25
4	61.75	58.25
5	66.75	63.25

Lengths of Tubing for Channel	Dipole	Reflector	Directors 1.	Directors 2.
1	10′ 10″	11′ 2″	10′ 5″	10′ 0″
2	9′ 4″	9′ 8½″	9′ 0″	8′ 8″
3	8′ 6	8′ 10″	8′ 2″	7′ 11″
4	7′ 9″	8′ 0″	7′ 5½″	7′ 2½″
5	7′ 2½″	7′ 5½″	6′ 11½″	6′ 9″

SPACING BETWEEN DIRECTORS AND DIPOLE

Channel		
1	2′ 2½″	Reflector ¼ wavelength behind Dipole
2	1′ 11″	
3	1′ 9″	
4	1′ 7″	
5	1′ 5″	

"H" AERIAL MEASUREMENTS

Channel	Reflector	Cross Bar
1	11′ 2″	4′ 6″
2	9′ 8″	4′ 6″
3	8′ 10″	4′ 6″
4	8′ 0″	4′ 1″
5	7′ 5½″	3′ 9″

TABLE 2

FREQUENCIES ALLOTTED TO BAND III CHANNELS

Channel	Vision Mc/s	Sound Mc/s
6	179.75	176.25
7	184.75	181.25
8	189.75	186.25
9	194.75	191.25
10	199.75	196.25
11	204.75	201.25
12	209.75	206.25
13	214.75	211.25

TUBING LENGTHS FOR ELEMENTS

Channel	Dipole	Directors			Reflector	Spacing between	
		1.	2.	3.		Directors and Dipole	Reflector and Dipole
6	5′ 4″	2′ 6″	2′ 5″	2′ 4″	2′ 9″	1′ 1″	1′ 1½″
7	5′ 2″	2′ 5″	2′ 4″	2′ 2½″	2′ 8″	1′ 0″	1′ 1¼″
8	5′ 0″	2′ 4½″	2′ 3″	2′ 1½″	2′ 7½″	0′ 11½″	1′ 1″
9	4′ 10″	2′ 3½″	2′ 2½″	2′ 1″	2′ 6½″	0′ 11¼″	1′ 0¾″
10	4′ 9″	2′ 3″	2′ 2″	2′ 0½″	2′ 5½″	0′ 11″	1′ 0½″
11	4′ 7″	2′ 2½″	2′ 1″	2′ 0″	2′ 5″	0′ 10¾″	1′ 0¼″
12	4′ 6″	2′ 1½″	2′ 0″	1′ 11″	2′ 4½″	0′ 10½″	1′ 0″
13	4′ 5″	2′ 0½″	1′ 11½″	1′ 10″	2′ 3½″	0′ 10¼″	0′ 11¾″

TABLE 3

DIMENSION FOR F.M. AERIALS

	Reflector	Dipole	Director	Spacing	
				Reflector to Dipole	Dipole to Director
Wrotham	5′ 6″	10′ 3″	4′ 10½″	2′ 1″	1′ 0¾″
North Hessary Tor	5′ 4½″	10′ 2″	4′ 10¾″	2′ 1¾″	1′ 1″
Sutton Coldfield	5′ 4½″	10′ 1″	4′ 10¾″	2′ 1¾″	1′ 1″
Pontop Pike	5′ 4½″	10′ 1″	4′ 10¾″	2′ 1¾″	1′ 1″
Meldrum	5′ 4½″	10′ 1″	4′ 10½″	2′ 1¾″	1′ 1″
Blaen Plwy	5′ 4½″	10′ 1″	4′ 10½″	2′ 1¾″	1′ 1″
Holme Moss	5′ 6″	10′ 1″	4′ 10″	2′ 1″	1′ 0¾″
Tacolneston	5′ 5″	10′ 1″	4′ 10″	2′ 1″	1′ 0¾″
Wenvoe	5′ 3″	9′ 10″	4′ 9¾″	2′ 1″	1′ 0¾″
Divis	5′ 3″	9′ 10″	4′ 9¾″	2′ 1″	1′ 0¾″

TABLE 4

"X" AERIAL DIMENSION

Two pieces each of the following lengths are required.

Channel	Director	Dipole
1	5′ 2½″	5′ 11″
2	4′ 5″	5′ 2″
3	4′ 1½″	4′ 6½″
4	3′ 7½″	4′ 0″
5	3′ 4″	3′ 6″

TABLE 5

Recommended dimensions for the "Rabbit's Ear" and Circular Aerials. Two lengths of each required.

Channel	Length
6	16″
7	15½″
8	15″
9	14½″
10	14¼″
11	13¾″
12	13½″
13	13¼″

BANDS

1	41. - 68 Mc/s.	V.H.F. 30 - 300 Mc/s.
2	87.5-100 Mc/s.	
3	174. -216 Mc/s.	
4	470. -585 Mc/s.	U.H.F. 300 - 3000 Mc/s.
5	610. -960 Mc/s.	

TELEVISION TRANSMITTERS

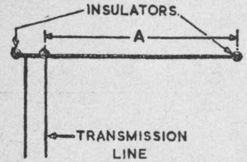
BRITISH BROADCASTING ASSOCIATION

Stations	ch	kW	Pol	Stations	ch	kW	Pol.
Crystal Palace	1	200	V	Sandale	4	30*	H
Ashkirk	1	18*	V	Melvaig	4	25*	V
Divis	1	35*	V	Meldrum	4	17*	H
Redruth	1	10*	H	Manningtree	4	5*	H
Thrumster	1	7*	V	Haverfordwest	4	10*	H
Llanddona	1	6*	V	Les Platons	4	1	H
Llandrindod Wells	1	1.5	H	Oban	4	3*	V
Redruth	1	10*	H	Wenvoe	5	100	V
Holme Moss	2	100	V	Orkney	5	15*	V
Rosemarkie	2	20*	H	Pontop Pike	5	17	H
No. Hessary Tor	2	15*	V	Forfar	5	5*	V
Swingate	2	1.5*	V	Br. Mountain	5	7*	V
Londonderry	2	1.5*	H	Douglas	5	3*	V
Kirk o'Shotts	3	100	V	Fort William	5	1.5	H
Rowridge	3	100*	V	Peterborough	5	1	H
Tacolneston	3	45*	H	Moel-y-parc	6	20*	V
Skriaig	3	12*	H	Sandale	6	70*	H
Bressay	3	6*	V	Bedford	10	3*	H
Morecambe Bay	3	5*	H	Winter Hill	12	125*	V
Blaen-plwyf	3	3*	H	Belmont	13	20	V
Sutton Coldfield	4	100	V	Wenvoe	13	200*	V

Stations	ch	kW	Pol	Stations	ch	kW	Pol.
Ridge Hill	6	10	V	Winter Hill	9	100	V
Sandy Heath	6	30	H	Arfon	10	10	H
Scarborough	6	1	H	Aviemore	10	1	H
Sheffield	6	0.1	H	Black Hill	10	475	V
Newhaven	6	1	V	Dover	10	100	V
Bala	7	0.1	V	Emley Moor	10	200	V
Belmont	7	20	V	St. Hilary	10	200	V
St. Hilary (W)	7	100	V	Abergavenny	11	0.1	H
Whitehaven	7	0.1	V	Angus	11	50	V
Bath	8	0.5	H	Caldbeck	11	100	H
Burnhope	8	100	H	Chillerton Down	11	100	V
Lichfield	8	400	V	Huntshaw X	11	0.5	H
Presely	8	100	H	Llandovery	11	0.1	H
Richmond Hill	8	10	H	Mendlesham	11	200	H
Rothesay	8	1	V	Moel-y-parc	11	25	V
Rumster Fst	8	30	V	Caradon Hill	12	200	V
Strabane	8	100	V	Lethanhill	12	3	V
Brecon	8	0.1	H	Membury	12	30	H
Black Mntn	9	100	H	Mounteagle	12	50	H
Croydon	9	350	V	Ballycastle	13	0.1	H
Durris	9	400	H	Rosneath	13	0.1	V
Fremont Pt.	9	10	H	Selkirk	13	25	V
Llandrindod Wells	9	3	H	Ffestiniog	13	0.1	V
Stockland Hill	9	100	V				

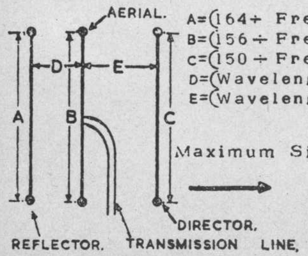
FORMULAS FOR AERIALS CUT TO RESONATE AT ANY DESIRED FREQUENCY.

LONG WIRE MULTIBAND ZEPPELIN AERIAL.



A= [164 (Number of Half Waves on the Aerial Required, Minus .05) ÷ (Frequency in Megacycles of most used brand)] yds.

DIRECTOR AND REFLECTOR HALF WAVE AERIAL.



A=(164÷ Frequency in Megacycles) yds.
B=(156÷ Frequency in Megacycles) yds.
C=(150÷ Frequency in Megacycles) yds.
D=(Wavelength in metres x .125 x 1.094) yds.
E=(Wavelength in metres x .1 x 1.094) yds.

Maximum Signal Direction for Transmission on Reception →

INSULATORS THUS ●

BRITISH LOCAL RADIO STATIONS

Town	Station		BAND MW m	kHz	VHF MHz	
Birmingham	Radio Birmingham	BBC	206	1456	95.6	
Birmingham	Sound Broadcasting	IBA	261	1151	94.8	
Blackburn	Radio Blackburn	BBC	351	854	96.4	
Brighton	Radio Brighton	BBC	202	1485	95.3	
Bristol	Radio Bristol	BBC	194	1546	95.5	
Carlisle	Radio Carlisle	BBC	397	755	95.6	
Carlisle	Radio Carlisle	BBC	206	1456	-	
Chatham	Radio Medway	BBC	202	1485	95.8	
Derby	Radio Derby	BBC	269	1151	96.5	Main
Derby	Radio Derby	BBC	-	-	94.2	Relay
Edinburgh*	Radio Forth	IBA	194	1546	96.8	
Glasgow	Clyde Radio	IBA	261	1151	95.1	
Hull	Radio Humberside	BBC	202	1485	96.9	
Leeds	Radio Leeds	BBC	271	1107	92.4	
Leicester	Radio Leicester	BBC	188	1596	95.1	
Liverpool	Radio Merseyside	BBC	202	1485	95.8	
Liverpool*	Sound of Mersey	IBA	194	1546	96.7	
London	Radio London	BBC	206	1456	94.9	
London	London Broadcasting	IBA	417	719	97.3	Now
London	London Broadcasting	IBA	261	1151	97.3	Later
London	Capitol Radio	IBA	539	557	95.8	Now
London	Capital Radio	IBA	194	1546	95.8	Later
Manchester	Radio Manchester	BBC	206	1456	95.1	
Manchester	Piccadilly Radio	IBA	261	1151	97.0	
Newcastle/T	Radio Newcastle	BBC	206	1456	95.4	
Newcastle/T*	Metropolitan Broad-casting	IBA	261	1151	97.0	
Nottingham	Radio Nottingham	BBC	197	1523	95.4	
Oxford	Radio Oxford	BBC	202	1485	95.2	
Plymouth*	- -	IBA	261	1151	96.0	
Sheffield	Radio Sheffield	BBC	290	1034	97.4	Main
Sheffield	Radio Sheffield	BBC	-	-	88.6	Relay
Sheffield*	- -	IBA	194	1546	95.2	Main
Sheffield*	- -	IBA	-	-	95.9	Relay
Southampton	Radio Solent	BBC	301	997	96.1	Main
Southampton	Radio Solent	BBC	188	1596	-	Relay
Stoke on Trent	Radio Stoke	BBC	200	1500	96.1	
Swansea*	Swansea Sound	IBA	287	1167	95.1	

* Not Yet Open

The following IBA stations will follow in due course : Belfast / Blackburn / Bournemouth / Bradford / Brighton / Bristol / Cardiff / Coventry / Huddersfield / Ipswich / Leeds /Nottingham / Portsmouth / Reading / Teesside / Wolverhampton.

BBC = British Broadcasting Corporation
IBA = Independent Broadcasting Authority

TELEVISION STATIONS OF EUROPE CAPABLE OF BEING RECEIVED IN GREAT BRITAIN UNDER SUITABLE CONDITIONS

T.V. STATION		CHANNEL	kW
Aalter	Belgium	E2	100
Anlier	Belgium	E11	10
Froidmont	Belgium	E7	20
Genk	Belgium	E44	200
Oostvleteren	Belgium	E49	20
Ougree	Belgium	E3	100
Riviere	Belgium	E52	200
Wavre	Belgium	E8	100
Wavre	Belgium	E10	100
Esbjerg	Denmark	E9	50
Kolding	Denmark	E9	100
Abbeville	France	E57	10
Amiens	France	E47	20
Brest	France	E21	50
Caen	France	E25	50
Le Havre	France	E43	10
Le Mans	France	E27	50
Lille	France	E21	50
Paris	France	E22	25
Reims	France	E46	50
Rennes	France	E45	50
Rouen	France	E33	20
Carlow	Ireland	1F	100
Clare	Ireland	1B	80
Cork	Ireland	1D	100
Dublin	Ireland	1H	100
Dublin*	Ireland	B7	100
Sligo	Ireland	1J	100
Sligo*	Ireland	B11	100
Arnhem	Netherlands	E50	30
Goes	Netherlands	E7	10
Goes	Netherlands	E29	125
Goes	Netherlands	E32	125
Lopik	Netherlands	E4	100
Lopik	Netherlands	E27	1000
Markelo	Netherlands	E7	30
Markelo	Netherlands	E54	300
Roermond	Netherlands	E5	50
Roermond	Netherlands	E31	500
Smilde	Netherlands	E6	50
Smilde	Netherlands	E47	1000
Wieringermeer	Netherlands	E39	300
Wieringermeer	Netherlands	E45	300

All above Transmitters operate on 625 lines system except those with * which operate on 405 lines system.

WORLD TV TRANSMISSION CHARACTERISTICS

STANDARD	A	B	C	D	E
Lines	405	625	625	625	819
Channel Width MHz	5	7	7	8	14
Modulation Sound	AM	FM	AM	FM	AM
Modulation Video	+	-	+	-	+
Band Width Video MHz	3	5	5	6	10
Separation Video-Sound MHz	-3.5	+5.5	+5.5	+6.5	±11.15
Picture Frequency Hz	25	25	25	25	25
Sideband Vestigal MHz	0.75	0.75	0.75	0.75	2.00
Field Frequency Hz	50	50	50	50	50
Line Frequency kHz	10.125	15.625	15.625	15.625	20.475

STANDARD	G	H	I	K	L	M
Lines	625	625	625	625	625	525
Channel Width MHz	8	8	8	8	8	6
Modulation Sound	FM	FM	FM	FM	AM	FM
Modulation Video	-	-	-	-	+	-
Band Width Video MHz	5	5	5.5	6	6	42
Separation Video-Sound MHz	+5.5	+5.5	+6	+6.5	+6.5	+4.5
Picture Frequency Hz	25	25	25	25	25	30
Sideband Vestigal MHz	0.75	1.25	1.25	0.75	1.25	0.75
Field Frequency Hz	50	50	50	50	50	60
Line Frequency kHz	15.625	15.625	15.625	15.625	15.625	15.750

AM = Amplitude Modulated　　+ = Positive
FM = Frequency Modulated　　- = Negative

TYPE A　Ireland, U.K.
TYPE B　Austria, Australia, West Germany, Denmark, Finland, AFN (American Forces Network - Germany), East Germany, Gibraltar, Greece, Netherlands, Iceland, Italy, Malta, Norway, Portugal, Spain, Sweden, Switzerland, Yugoslavia, Algeria, Canary Isles, Egypt, Ethiopia, Ghana, Kenya, Liberia, Libya, Madeira, Mauri-tius, Morocco, Nigeria, Rhodesia, Spanish Sahara, Senegal, Sierra Leone, Somalia, Sudan, Tunisia, Uganda, Zaire, Zambia, India, Indonesia, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Malaysia, Pakistan, Qatar, Sabah, Saudi Arabia, Singapore, Syria, Thailand, Turkey, United Arab Emirates, Yemen, New Zealand
tius,
TYPE C　Belgium, Luxemburg
TYPE D　Albania, Bulgaria, Czechoslovakia, Hungary, Poland, Romania, U.S.S.R., Congo, Upper Volta, China, Mongolia
TYPE E　France, Monaco
TYPE G　Austria, Denmark, Finland, West Germany, AFN (American Forces Network - Germany), East Germany, Netherlands, Italy, Norway, Portugal, Spain, Sweden, Switzerland.
TYPE H　Belgium
TYPE I　Ireland, U.K.
TYPE K　Afars & Issas, Gabon, Ivory Coast, Malagasy, Reunion, New Caledonia, Tahiti, St Pierre & Miquelon, Guadaloupe, Martinique, French Guiana
TYPE L　France, Luxenburg
TYPE M　Azores (American Forces Network), U.S.A., Taiwan, Japan, Khmer Republic, Korea (Republic), Philippines, Vietnam, Guam, Hawaii, Johnston Island, Midway Island, Samoa, Pacific Trust Territories, Bermuda, Canada, Greenland, Antiqua, Barbados, Costa Rica, Cuba, Dominican Republic, El Salvador, Guatemala, Haite, Honduras, Jam-aica, Mexico, Netherlands, Antilles, Micaragua, Panama, Puerto Rico, St. Kitts, Trinidad & Tobago, Virgin Isles, Argentina, Bolivia, Brazil, Chile, Colombia, Equador, Paraguay, Peru, Surinam, Uruguay, Vene-zuela

AERIAL DIMENSIONS

A = dipole
B = reflector
C = 1st. director
D = 2nd. director
E = separation between directors and dipole
F = separation between reflector and dipole.

BAND 1

CHANNEL	A	B	C	D	E	F
1	10'10"	11' 2"	10' 5"	10' 0"	2' 2½"	4' 5"
2	9' 4"	9' 8½"	9' 0"	8' 8"	1'11"	3'10"
3	8' 6"	8'10"	8' 2"	7'11"	1' 9"	3' 6"
4	7' 9"	8' 0"	7' 5½"	7' 2½"	1' 7"	3' 2"
5	7' 2½"	7' 5½"	6'11½"	6' 9"	1' 5"	2'10"

BAND 11

CHANNEL	A	B	C	D	E	F
6	2' 8"	2' 9"	2' 6"	2' 5"	1' 1"	1'1½"
7	2' 7"	2' 8"	2' 5"	2' 4"	1' 0"	1'1¼"
8	2' 6"	2' 7½"	2' 4½"	2' 3"	11½"	1'1"
9	2' 5"	2' 6½"	2' 3½"	2' 2½"	11¼"	1' ¾"
10	2' 4½"	2' 5¼"	2' 3"	2' 2"	11 "	1' ½"
11	2' 3½"	2' 5"	2' 2½"	2' 1"	10¾"	1' ¼"
12	2' 3"	2' 4½"	2' 1½"	2' 0"	10½"	1'0 "
13	2' 2½"	2' 3½"	2' ½"	1'11½"	10¼"	11¾"

FM AERIALS

STATION	A	B	C	E	F
Wrotham	5' 1½"	5' 6"	4'10½"	1' ¾"	2' 1"
North Hessery Tor	5' 1"	5' 4½"	4'10¾"	1' 1"	2' 1¾"
Sutton Coldfield	5' ½"	5' 4½"	4'10¾"	1' 1"	2' 1¾"
Pontop Pike	5' ½"	5' 4½"	4'10¾"	1' 1"	2' 1¾"
Meldrum	5' ½"	5' 4½"	4'10½"	1' 1"	2' 1¾"
Blaen Plwyf	5' ½"	5' 4½"	4'10½"	1' 1"	2' 1¾"
Holme Moss	5' ½"	5' 6 "	4'10 "	1' ¾"	2' 1 "
Wenvoe	4'11"	5' 3"	4' 9¾"	1' ¾"	2' 1 "
Divis	4'11"	5' 3"	4' 9¾"	1' ¾"	2' 1"
Norwich	4'11"	5' 3"	4' 9¾"	1' ¾"	2' 1"
Rowbridge	5' ½"	5' 4½"	4'10¾"	1' 1 "	2' 1¾"
Kirk O'Shotts	4'11"	5' 3"	4' 9¾"	1' ¾"	2' 1"
Sandale	4'11"	5' 3"	4' 9¾"	1' ¾"	2' 1"
Rosemarie	5' ½"	5' 6"	4'10 "	1' ¾"	2' 1"
Llanddona	5' ½"	5' 6"	4'10 "	1' ¾"	2' 1"
Llangollen	5' ½"	5' 6"	4'10 "	1' ¾"	2' 1"

V. Cooper & Partners W.C.2.