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BETTER RADIO RECEPTION

Information on securing the

BEST RESULTS FROM YOUR RECEIVER

AN

Eddystone

PUBLICATION

PRICE ONE SHILLING

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HOW TO OBTAIN THE BEST RESULTS FROM YOUR RADIO RECEIVER

There are many different types of listener using Eddystone and other radio receivers and there are various types of receiver possessing different characteristics. Of necessity, therefore, the advice given in these notes is of a general character. Some users are very interested technically as well as aesthetically—others are solely interested in the actual performance obtained, and, providing the latter is good, they are not concerned how it is brought about. Those in the first category are usually in the position to know how to get the best out of the receiver, and we would ask those in the second category to appreciate the fact that, by paying attention to a few details when installing the receiver, their listening pleasure can be greatly enhanced. Some of the following suggestions, which amplify those given in the Instruction Book, can be carried out by the user with very little difficulty—other suggestions may need the assistance of a friend or of the distributor from whom the receiver was purchased.

PROPAGATION EFFECTS

For the benefit of those readers not already familiar with the subject, it is desirable to say something about the propagation characteristics which affect radio reception, particularly when long distances are involved.

On long waves (1000 metres upwards) conditions vary less between day and night than on lower wavelengths, and good reception (at a distance) of a high power station such as the B.B.C. Light Programme transmitter at Droitwich is generally a matter of using an efficient aerial, allied to a receiver with a good performance.

On medium and short waves, what is known as "skip effect" can increase the range of a transmitting station to a remarkable degree. Distant stations, weakly audible in daylight, may become quite loud during the dark hours whilst many stations not previously audible can be tuned in at some strength. During spells of good conditions, American medium wave stations are well received in Great Britain in the early morning hours, and reports are regularly received of British medium wave broadcasting stations being heard thousands of miles away. Generally however, the aim on both medium and long waves is to obtain adequate reception over a few hundred miles and the high signal strength obtained occasionally from a distant station can be a nuisance in that it causes interference.

Usually it is on the shorter waves—roughly below 50 metres (6 Mc/s)—that one relies for real long distance reception and effective use is then made of the reflecting layers which exist in the upper atmosphere. The reflecting action is due to radiation from the sun and it follows that the height and density of these layers will vary considerably between day and night. Further, there is a long term variation due to sunspot activity, peaking at intervals of approximately eleven years and resulting in spells of extremely good conditions alternating with periods of correspondingly poor conditions.

Those in charge of transmitting stations working on short waves, be they broadcast, commercial or amateur, take care to select wavelengths known to be the most effective at the time and for a given range. At the receiving end, some experience will need to be acquired—or guidance obtained from published charts—before it becomes possible to choose immediately the wavelength range which will be the appropriate one in the particular circumstances.

There are other factors which affect reception. Many broadcast programmes are intended for particular countries or areas (often in the appropriate language) and the signal is concentrated in a beam in the proper direction. In the path of the beam the signal strength is high but, in other directions, the signal is likely to be weak or completely inaudible.

It is usual, with short wave broadcasting services, to transmit programmes simultaneously on two or more wavelengths, in different bands, to ensure good reception on one or the other, according to conditions and the level of interference.

These various effects are mentioned to explain why results are liable to vary from one day to another and between one area and another. It may occasionally happen that the listener is puzzled, when looking for a station known to be on and using high power, at the poor signal or possibly complete absence of a signal. On the other hand, under favourable circumstances (*e.g.* optimum frequency, low noise and interference levels and good conditions), a low power station located in some remote spot can be tuned in clearly, if a good aerial is used with the receiver. It is this very factor which intrigues many enthusiastic short-wave listeners, some of whom spend much time, day and night, searching through the various bands for rare and elusive stations.

USE OF AN EARTH

Twenty years ago it was the rule to go to some trouble to provide a really good earth for any wireless set. To-day, probably the vast majority of users do not bother about a direct earth connection.

With a mains operated receiver, an earth of sorts generally exists. One side of the mains is usually earthed and the metal work in any receiver tends to take up earth potential, but this is not always the case, particularly on the higher frequencies. For reasons of safety, any metal apparatus connected to electrical supply mains should be well earthed and we strongly recommend this procedure should be followed with a radio receiver.

An earth connection provides several benefits. It helps to balance the aerial and assists towards securing maximum performance. Background noise will be reduced, particularly in cases where electrical interference is prevalent and, in many cases, a tendency towards hum in the output will be completely removed.

A good arrangement for the earth itself is a metal plate, of brass, copper or galvanised metal, buried in the soil some feet below the surface. The lead to the receiver should be a heavy gauge wire, preferably insulated and as short as possible. If an earth rod is used, it should be of substantial dimensions and penetrate well into the soil.

As an alternative to the foregoing, it is usually possible to fit a clip to a main water pipe.

On board ship, it should not be difficult to make a direct connection (but a clean and efficient one) to a metal bulkhead, which, being in electrical contact with the sea, will make a first-class earth. Sometimes, and particularly with small vessels, it is desirable to avoid a direct connection, which may set up electrolysis effects through circulating currents, and then a condenser (tubular paper type is suitable) of between 0.1 and .01 uF should be inserted in series with the earth lead. It will prevent the flow of direct current but will not affect the efficiency of the "earth".

FREQUENCY VERSUS WAVELENGTH

There are two methods of indicating the channel occupied by a broadcast (or other) radio station—one is frequency, the other wavelength. The latter is convenient for medium wave stations but too rough and inaccurate for short wave stations. Hence it has become practically universal to quote frequencies for stations of all kinds, other than medium and long wave stations. The scales on all Eddystone receivers are accordingly calibrated in frequency and it is a relatively easy matter to adjust the tuning and to find a station the frequency of which is known. Whether or not the station will be audible is governed by factors explained earlier.

It may be mentioned that frequency can be given in kilocycles (kc/s) or megacycles (Mc/s). One megacycle is equal to 1000 kilocycles, and, for the lower frequencies, it is usual to employ kilocycles. On higher frequencies, either expression may be used and conversion is simply a matter of moving the decimal point, *e.g.* 9.654 Mc/s is the same as 9654 kc/s.

BROADCAST TRANSMISSIONS

Various bands of frequencies are allocated by international agreement for the use of broadcasting stations. The reader will doubtless be familiar with reception of medium wave and long wave stations, but, for long distance work, much shorter waves are employed. The bands are often quoted in terms of wavelength, e.g., the "41 metre band" and the "16 metre band". As a general rule, the shorter the wavelength—which is the same as saying the higher the frequency—the greater the distance over which reception becomes possible. This applies up to about 10 metres (30 Mc/s) beyond which the spectrum is referred to as "VHF" (short for very high frequency) when the characteristics of propagation change.

As one goes higher in frequency, tuning can become more critical and it is then the benefit of a very precise slow motion drive, as fitted to Eddystone receivers, is much in evidence.

Very many countries operate short wave broadcasting stations and reliable information concerning frequencies and power employed can be found in the books mentioned in the appendix.

In between the recognised short wave broadcast and amateur bands will be found a medley of signals, transmitted in a number of modes, and representing commercial traffic, news bulletins, facsimile picture transmissions, navigational warnings and so on.

AMATEUR TRANSMISSIONS

Most countries permit amateur operators who have proved they possess the necessary skill, to transmit on certain narrow bands of frequencies. The power used varies considerably between one station and another, but since usually the aim (on the higher frequencies at least) is to communicate over long distances, much trouble is taken to achieve the maximum possible efficiency. Hence, it frequently happens that an amateur station thousands of miles away can be received but, as with broadcasting stations, much depends on conditions and on the type of aerial used, especially as regards its directive properties. By the nature of things, it will rarely be possible to hear both sides of an amateur contact. Because of the low power normally used in these transmissions, the more sensitive the receiver, the better the results.

Increasing use is being made of a special form of speech transmission known as "single sideband", where the carrier is eliminated. If the receiver has a BFO, careful tuning will allow what sounds like a confused jumble to be turned into intelligible speech, but without a BFO, it is not possible to resolve the signal.

THE TIME FACTOR

One factor to be taken into account is the difference in clock time in one country compared to another situated a long distance away. When a transmission is beamed at a given area, the broadcasting authority will ensure it is sent at a time appropriate to the receiving area and any difference in time is of no great importance. In other cases, this difference will need to be taken into account and, of course, it can be quite substantial. For example, South Australian time is ten hours ahead of Greenwich Mean Time, so that 10 a.m. in London is 8 p.m. in Sydney. Similarly, New York is five hours behind London and at noon in London, the time is 7 a.m. in New York.

FADING

One phenomenon frequently encountered is that of fading. Signals from a given station may travel by more than one path to a

receiver, and, due to the variations in length of path and also possibly to quick changes of conditions, the strength of a signal is liable to vary considerably. Not only will the strength of the carrier vary—a condition taken care of within limits by the automatic gain control (AGC) circuits in the receiver—but distortion, sometimes quite serious, is introduced. The changes, both in strength and quality, of a signal may at times be slow and at others very rapid. The somewhat poor reception during unsettled periods of this kind is due entirely to propagation conditions and does not indicate a fault in the receiver. Commercial interests go to considerable trouble, using several receivers and diverse aerial systems, to improve reception under these conditions but there is little that can be done by the average listener.

JAMMING

At times, what can only be described as "nasty noises", varying in character, will be heard on, or moving about around, the frequency used by a given short-wave broadcasting station. It is unfortunate that some countries see fit to interfere deliberately with broadcast transmissions from other countries, such interference usually occurring during news bulletins and discussions on world affairs. Unfortunately also, transmitters of a relatively crude type are employed and the interference is likely to be heard on frequencies other than those intended by the transmitter operators. The most effective remedy is to use an aerial of a d rective type aimed at the desired station and minimising interference from the jamming station. Changing to an alternative frequency may also improve matters.

AERIALS

Books have been written on aerials and all we can do here is to make suggestions regarding various types of aerials which, from practical experience, we know will give excellent results when used with an Eddystone receiver.

It cannot be too strongly emphasised that the aerial is all-important. From time to time, we hear reports of poor reception and, in every case, it is due to lack of appreciation of the finer points regarding aerial installation and efficiency.

An Eddystone receiver possesses high sensitivity and is responsive to weak signals but it stands to reason that a signal voltage from a given station must be present on the aerial if that station is to become audible. Almost any sort of aerial (and receiver) will bring in powerful broadcast stations in the medium wave band, but we are thinking here of those who want to receive stations over great distances and on short as well as medium waves. Hence, whilst on occasion fair results can be obtained with an indoor aerial, this is not recommended unless no alternative exists. An indoor aerial is usually badly screened by electric wiring, steel girders, metal pipes and so on, with the result that signal pick-up is poor but noise radiated from the mains wiring is emphasised.

In many cases, locally generated noise is one of the main factors influencing reception of weak signals, and this is particularly so on board ship. To ensure really good results, the aerial proper should be a length of wire, not necessarily long, but as high as possible and clear of other objects. It is most important that the lead-in be kept away from electrical wiring, especially when a single wire—in effect, a continuation of the aerial—is used. A clear run-in to the receiver will help to build up the signals but if the wire has to follow various contours, signal strength will be lost and noise made worse. If the lead-in cannot be clear and has to be of some length, it is better to use twin feeder cable, which helps to keep down noise levels. Designs for various types of aerial and lead-in are given later.

The wire used for the aerial may be of any thickness, mechanical strength being the main consideration. Otherwise, it can be thick or thin, plain or enamelled, single or multi-strand, with very little difference to results. Copper or phosphor-bronze is preferable to other metals.

Insulators should combine adequate mechanical strength with high insulating properties, and the latter should be maintained in all sorts of atmospheres. One at each supporting point is usually sufficient.

For general all round reception of the whole range of frequencies covered by the receiver, an aerial about 60 feet long is recommended. The greater portion of it should be well out in the clear and as high above ground as can conveniently be arranged. A tree is often available and can well be used, but the aerial proper must not be allowed to touch the leaves of branches—an insulator

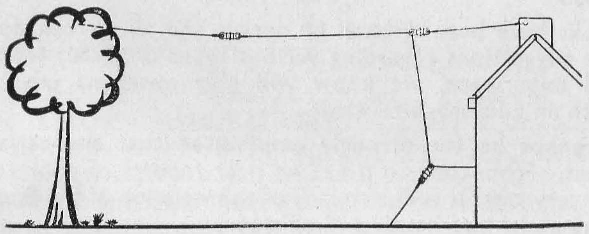

Fig. 1. A good general purpose aerial. It should be kept clear of obstructions.

well out from the tree will ensure this (see Fig. 1). Also keep the aerial well away from metal roofs, gutters, etc., even if this means shortening it to some extent. Signal pick-up is greater when the aerial is kept away from anything likely to act as a screen and this point is definitely more important than obtaining maximum length. Good insulation is necessary at the lead-in point.

Excellent results will be obtainable on aerials much shorter than 60 feet, particularly on the shorter wavelengths. This applies especially on board ship, where it may be difficult to erect a long aerial.

At the rear of an Eddystone receiver are two terminals or sockets, one marked "A" and the other marked "AE". The latter is normally strapped to the chassis and should remain so when a single wire is used. The aerial lead-in wire is attached to terminal "A" and the earth to terminal "AE". By the way, if you are temporarily stuck for an aerial, try connecting an earth lead to the aerial terminal "A" (leaving "AE" blank, of course). It is surprising how good results can be with this system—often they are better than with a poor indoor aerial.

SPECIAL AERIALS

Past experience shows that many listeners are particularly interested in certain shortwave broadcast stations, or possibly in one of the amateur bands, and wish to obtain optimum results just where their interests lie.

In such cases, the dipole (otherwise known as the doublet) type of aerial, is recommended. As can be seen from the sketch in Fig. 2, it consists of two equal lengths of wire "a" and "b" attached to a centre insulator, from which a twin feeder (or transmission line) runs to the receiver. This feeder, which takes the form of two wires embedded in solid insulating material, is convenient to

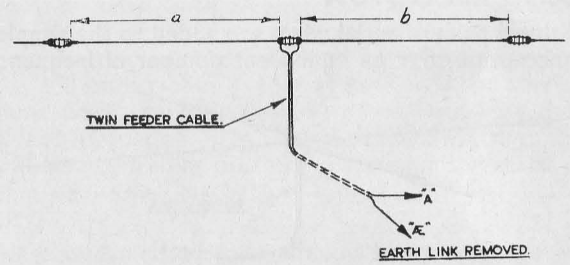

Fig. 2. The dipole or doublet type of aerial, the benefits of which are explained in the text.

use and easily obtainable. Alternatively, two 18 gauge wires (bare or enamel-covered) may be employed, small spacing insulators being fixed at intervals to keep the wires separate. The length of feeder, within reason (say up to 100 feet) has but little effect on the performance.

The two feeder wires are connected to the aerial wires, one each side of the centre insulator. At the receiver end, the two wires are attached to the "A" and "AE" terminals, the shorting strap or plug being removed.

Two further benefits derive from the use of a doublet aerial. Electrical interference, radiated off the electric mains, is picked up equally on each of the pair of wires and the induced voltages tend to cancel out, so that reception becomes free of local interfering noises. Also, the feeder does not require further insulation (unless the spaced type is used), and may be allowed to run near, or come into contact with metal objects. At times it may be wise to add some mechanical protection such as a wrapping of tape, to prevent the feeder insulation being rubbed away by wind movement.

Where interest lies in a particular frequency band, the lengths of the aerial wires can be adjusted to give optimum results. The following table gives details of the appropriate lengths to use for the short wave broadcast and amateur bands.

	Wavelength (Metres)	*Frequency (Megacycles)*	*Lengths of "a" and "b" (feet)*
Broadcast	49	6.1	40
	31	9.6	21
	25	11.8	20
	19	15.1	15.5
	16	17.8	13
	13	21.5	10.5
	11	26	9
Amateur	40	7	33
	20	14	16.5
	15	21	12
	10	28	8.25

WIDE BAND RECEPTION

If additional pairs of aerial wires are added to the simple dipole, improved reception over an equivalent number of frequency bands

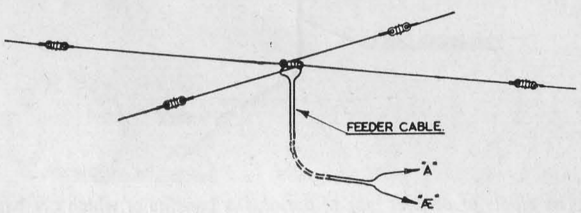

Fig. 3. Double dipole aerial, giving wider frequency coverage than a single dipole.

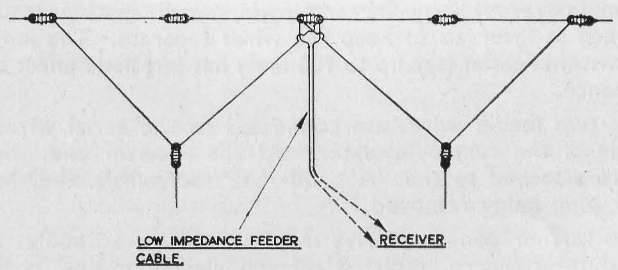

Fig. 4. Folded up version of double dipole aerial, and occupying less space.

becomes possible. Also, a cross-over effect occurs and good results are obtained over a wide frequency range.

The lengths of the additional wires should again be made according to the foregoing table. For example Fig. 3 shows an aerial with two pairs of wires. If space permits, more wires can be added.

A draw-back to the aerial shown in Fig. 3 is that four supporting points are required. A folded up version of the same aerial is sketched in Fig. 4. Only two main supports are called for, the lower portions of the aerial being anchored to any convenient points.

FOLDED DIPOLE AERIALS

An excellent aerial for amateur band reception, and also for specific short wave broadcast bands, is the folded dipole type shown in Fig. 5.

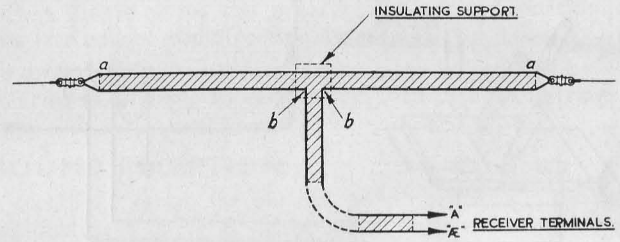

Fig. 5(a). Folded dipole aerial, constructed with 300 ohm feeder cable throughout.

There are two methods of constructing this type of aerial. One is to use 300 ohm ribbon feeder (Telcon K25, or similar, available from short wave specialist dealers) throughout—for the aerial and for the lead-in portion. Fig. 5(a) is self-explanatory. Strain insulators will be required as usual for supporting the aerial at the ends, and some additional mechanical support will be required at the centre.

The second method is to employ 16 or 18 gauge wire, spaced apart with small insulators of ceramic or other high grade insulating material. This system is illustrated in Fig. 5(b).

The lengths of the arms will be as shown in the table given earlier for the dipole aerial. The folded dipole will give maximum efficiency at the frequency for which it is cut, but it will also give good results on harmonic frequencies. The length should be made

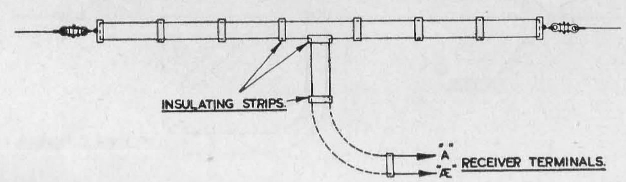

Fig. 5(b). Folded dipole aerial, using ordinary wire and spacing insulators.

to correspond with the band in which the user is mainly interested. For instance, an aerial constructed with arms each 33 feet long will ensure excellent reception on 40 and 20 metres. Results will be good on 10 metres but, as a separate aerial for the latter band will not take up much space, it is worth while erecting one. On 80 and 160 metres, the lower ends of the feeder should be connected together and to the aerial terminal.

Where the main interest lies in 20 metres, the arms should each be 16½ feet long. By using a switch connected as in Fig. 6, good reception will be obtained over a wide range of frequencies.

The earth connection from "E" to "AE" is only made when the switch is in the right hand position.

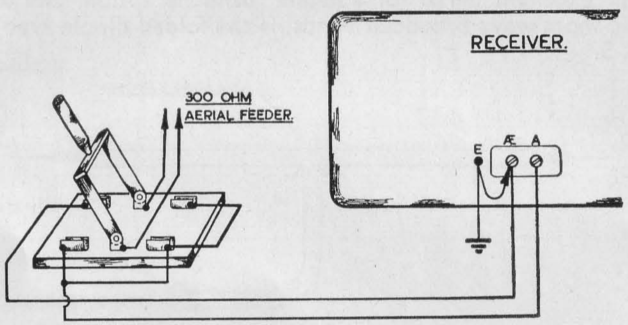

Fig. 6. Connections to switch for rapid change over of feeder wires from series to parallel.

For short wave broadcast reception, the lengths quoted can be altered to suit, according to the figures given earlier.

Another type of folded dipole aerial is shown in Fig. 7. It calls for more wire and is not quite so simple as the ordinary folded dipole, but it is of the "wide-band" type and gives excellent results over a wide range of frequencies. The wires should preferably be separated by six inches or so, when spacing insulators will not be required. Should it not be possible to arrange wide spacing, then small block insulators should be fitted at intervals.

The downlead portion of this aerial may be flat twin 300 ohm

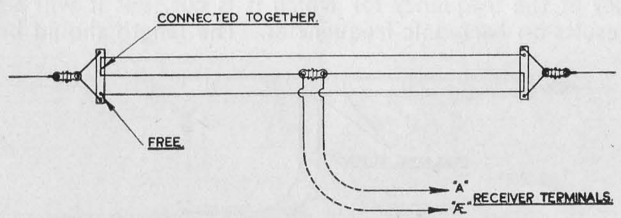

Fig. 7. Three-wire folded dipole, giving wide frequency coverage. 300 ohm feeder cable is recommended between centre insulator and receiver.

feeder or it may be constructed in the same way as that used in Fig. 5(b). The length is relatively unimportant. For high frequency use, it should be on the short side and made fairly long for lower frequencies—the table given earlier can be used as a guide, remembering to make the overall length equal to "a" plus "b".

DIRECTIONAL EFFECTS

On the shorter wavelengths, directional effects are likely to be experienced with almost any type of aerial. Advantage can be taken of the effects when reception from a particular country or station is the aim. A long wire aerial will receive best in four major directions at acute angles to the run of the aerial. A dipole exhibits two major directional lobes, at right angles to the length of wire and the wires should therefore be erected to take advantage of this property.

With a single wire, the greater the vertical portion of the aerial the less will be the directional effects.

The directional properties of a dipole can be reduced by running the two arms at an angle to each other, instead of in a straight line.

ALL ROUND RECEPTION

An excellent aerial, for general purpose use, is a vertical rod or whip, illustrated in Fig. 8. It should be made as long as possible—12 feet is a good average figure—and preferably erected well above surrounding objects. This type of aerial is useful in cases where space is restricted and it is not possible to put up a horizontal aerial of any length.

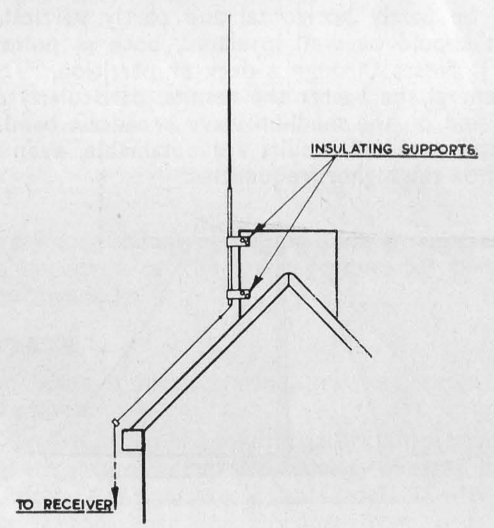

Fig. 8. Vertical whip aerial, for non-directional reception.

The vertical aerial should be mounted on insulating supports and a wire run from the base to the receiver. This wire should be kept away from walls and it will probably be necessary to provide mechanical (insulated) supports at intervals along the run.

If electrical interference is prevalent, of the type radiated off the mains wiring, it may be advisable to use screened co-axial cable for the last 10 to 20 feet of the lead-in, the inner wire being connected to the aerial proper, and the outer screen earthed at the receiver. The addition of this length of cable, whilst reducing noise, will also, to some extent, reduce the strength of signals, and it should therefore not be made any longer than necessary. Some special anti-noise aerial systems use a long length of screened feeder cable, but then matching transformers must be fitted at each end of the cable, or results will be poor. Further, in cases where the interest lies in short wave reception, these transformers must be suitable for short waves as well as for medium waves. which complicates the design.

A vertical aerial will receive signals equally well from any direction, and is usually slightly less susceptible to fading than the horizontal type of aerial.

AERIALS ON BOARD SHIP

Circumstances vary greatly on board ship, and the only advice generally applicable is to place the aerial as high as possible and well clear of other wires and metal objects. The insulated wire(s) forming the aerial proper must not be allowed to rub against anything—as might possibly happen in a high wind—or severe noises may mar reception.

Good results are obtainable from the usual single wire aerial, which may be partly horizontal and partly vertical, or entirely vertical. It should be well insulated, both at points of support and where it passes through a deck or partition. The longer the aerial, in general the better the results, particularly on the lower frequencies and on the medium wave broadcast band. But it will be found that excellent results are obtainable, even with quite a short aerial, on the higher frequencies.

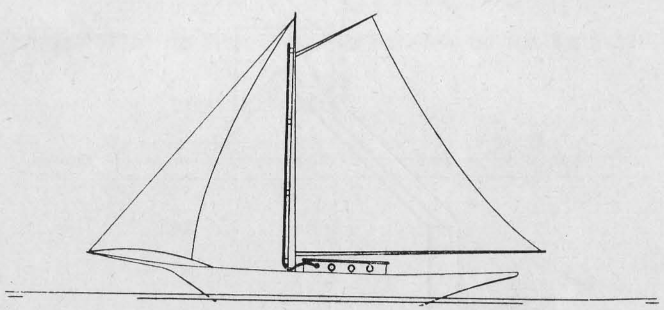

Fig. 9. A vertical wire, attached to the mast (and greatly exaggerated in the drawing) makes a good aerial on a yacht. No fouling with stay wires can occur.

That portion of the aerial near the deck is liable to pick up interference from nearby electrical wiring, and there is also the problem of arranging adequate insulation at the lead-in point. Both these disadvantages can be overcome by the use of a doublet type of aerial, details of which are given elsewhere. The Eddystone Cat. No 731/1 Aerial is of this type, and includes aerial wire, insulators and a hundred feet of special low impedance feeder, all ready for putting into use immediately, with the minimum of trouble.

It should be appreciated that, by employing a long length of feeder, it will often be possible to site the aerial proper in a better location. The longer length of feeder has practically no effect on reception. Where a surplus exists, there is no need to cut the feeder—it can be made up into a neat roll and stowed away out of sight.

The feeder wires are buried in insulating material, and no further insulation is necessary at the point of lead-in. In some cases, it may be advisable to protect the feeder against friction and a wrapping of insulating tape will serve.

The effect of local electrical interference tends to cancel out in the two wires forming the feeder, with the result that noise from this source is much less than it otherwise would be.

It may be of benefit to include the switching system shown in Fig. 6, particularly for good medium wave reception. A quick test,

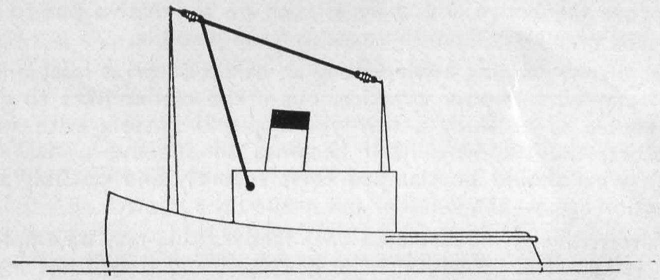

Fig. 10. A suitable aerial for use in a tug or similar vessel.

with temporary connections, should be made to ascertain how much reception is improved on the lower frequencies before installing the switch permanently.

SMALL BOATS

By small boats is meant yachts, trawlers, cabin cruisers and similar sized vessels.

Again, advice must be of a general nature, since so much depends on individual circumstances. In the majority of cases, it will only be possible to employ a comparatively short length of wire but, because of the open surroundings and freedom from serious screening, results will still be good.

Some suggestions are made in the sketches herewith. Where a single mast exists, alternative arrangements are possible. Running a wire directly up the mast, as in Fig. 9, will prevent any possibility of fouling guy wires. It is necessary to use insulated wire and the

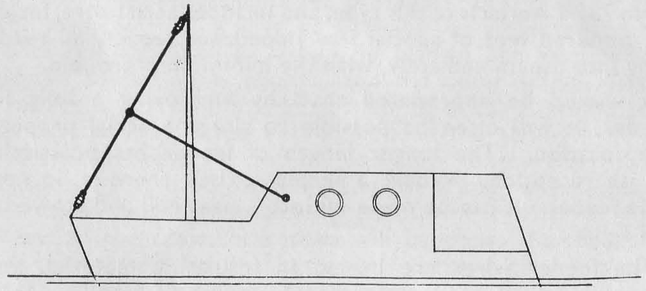

Fig. 11. Space is restricted on a motor cruiser but the aerial illustrated will give good results.

insulation known as P.V.C. is very suitable, since it is tough and will not deteriorate quickly when exposed. For maximum efficiency, the wire should be spaced away from the mast with the aid of small porcelain stand-off insulators, but this refinement is not essential.

On some boats, the mast is itself of metal and earthed in one way or another. In this case, a wire running up along the mast will prove ineffective and there is then no alternative but to sling the aerial wire away from the mast as far as possible.

Similarly, running a wire along an earthed—or at least uninsulated—stay-wire is poor practice, but if the owner likes to go to the trouble of breaking a stay-wire top and bottom with strong insulators, the stay-wire itself becomes an effective aerial. The lead-in wire should be clamped to it securely and possibly some protection against the weather put around the joint.

Alternatively, the insulated twin feeder cable may be employed as an aerial. The insulation is fairly robust and it will not matter much if the cable touches metal or other objects. The cable should be run right up to the receiver and the two bared ends twisted together and connected to the aerial terminal (or socket). Whatever sort of wire is used, it must be fixed in a way which does not result in damage to the insulating covering or to the internal conductors.

PROTECTION FROM LIGHTNING AND STATIC DISCHARGES

In temperate climates, only very rarely is trouble experienced with lightning, but it should be appreciated that an aerial can collect static electricity, particularly during hailstorms and thunderstorms. No ill effects are likely when a metallic path to earth exists, as will be the case with many receivers.

In the tropics, thunderstorms are frequent and there is a greater liability to both lightning discharges and to the collection of static electricity.

A number of devices are available which give simultaneous protection against lightning and static. One is the *Belling-Lee* type L.350, which consists of carbon blocks separated by a mica ring, the assembly being mounted in a sealed glass tube, provided with wire connections. On a larger scale is the *Ediswan* Gas Discharge Protector, two types of which exist. One will pass surges of more than 20 amperes, the second and smaller one, surges up to 5 amperes.

It is important, with any form of lightning arrester, to connect one electrode to a good low resistance earth.

MAINS CONNECTIONS

Advice regarding mains connections will be found in the handbook or folder which accompanies your receiver. It is desirable to emphasise that proper time and care should be taken over connecting your set to the mains in order that no loose connections will cause noise or any other difficulties.

The first operation is to see that the voltage adjustment is correctly set and, of course, this should be done before the receiver is in any way connected to the mains. The 110 volts point is for use with mains between 100 and 110 volts, and no harm will accrue should the mains be of a value below 100 volts, as may be found on board a ship. Where the mains are between 200 and 250 volts the voltage adjustment should be the value nearest to the actual mains voltage. It is very important, before connecting an AC mains operated receiver to the supply, to ensure that the latter is definitely AC and not DC. Should it be DC no dial light will show and the receiver may be seriously damaged.

If any doubt exists on this point, the receiver can be switched on momentarily to see if the dial light comes on—if it does not the set should not be left connected to the mains.

With an AC set, it is immaterial which way round the mains plug is inserted. With an AC/DC set, however, it may be found that a rough sort of hum accurs in one position, in which case, it is only necessary to reverse the mains plug when, in practically every case, the hum will disappear and reproduction will be entirely normal. Also, when connecting an AC/DC set to DC mains the dial light may glow but no sound will be heard. In this case, again, the mains plug must be reversed so that the correct polarity is applied to the receiver.

LOUDSPEAKERS AND TELEPHONES

Because compactness is desirable, a loudspeaker is fitted internally in some Eddystone receivers, but in others, the individual is free to choose a speaker to suit personal requirements.

An output transformer is fitted as standard in Eddystone receivers of all types—communications and broadcast. The secondary winding is brought out to terminals or sockets, and a loudspeaker, connected to the latter, should have an impedance of between 2 and 3 ohms. No matching transformer is required with an external loudspeaker.

Fig. 12. The Eddystone Cat. No. 935 Speaker which matches Eddystone receivers physically and electrically. Also, of course, it can be used with other receivers.

The Cat. No. 935 speaker is recommended for use with an Eddystone receiver (communications or broadcast) which it will match by correct choice of colour physically and electrically.

When it is desired to use an extension speaker, this should be connected to the terminals or socket on the receiver, either in place of the local speaker or, when simultaneous operation is required, in parallel with it. In the latter case, there may be a slight mismatch, but it will have negligible effect.

An important point is the length of wire necessary to connect the extension speaker to the receiver. Where the run is short, ordinary insulated bell wire is suitable, but it is desirable to use a heavier gauge of wire for a longish run, to prevent an unduly high proportion of the audio power being wasted in the wiring, with a consequent reduction of volume in the extension speaker.

Eddystone communications receivers are fitted with jacks for the insertion of a telephone plug. The telephones should be of the high impedance type, having a resistance of 2000 or 4000 ohms, of which a number of good makes are available. Crystal telephones are also suitable.

Sometimes, the listener may have on hand low impedance telephones, with a resistance of about 120 ohms, or moving coil telephones (about 50 ohms). In such cases, the better procedure is to connect them to the loudspeaker output terminals. This advice may seem to conflict with that previously given about using a speaker of 3 ohms impedance, but this is not actually the case. Power is required to work a loudspeaker, and matching conditions are important. Telephones take very little power, but require an adequate voltage and this is provided at the loudspeaker terminals, for telephones of the low impedance type.

CAUSES OF INTERFERENCE

Interference is a general term covering quite a number of unwanted noises to be heard at times on radio receivers—and the more sensitive a set is made, to cover long ranges, the more it is susceptible to noise, at least when not actually tuned to an incoming signal. As mentioned previously, an efficient aerial helps a lot since the stronger the signal, the greater the automatic volume control action in the receiver and the less the background noise.

One type of interference, on a broadcast or telephony signal, is a whistle accompanying the speech or music—a whistle which remains at a constant pitch irrespective of tuning. The cause is another transmitting station operating too close in frequency to the desired station, and, if the selectivity of the receiver is fixed. there is little the listener can do about it. Where a variable selectivity control is provided, the selectivity should be increased to a degree where the whistle is no longer objectionable, but the process should be carried no further than necessary or the audio quality will suffer unduly. Incidentally, this is the main use of a variable selectivity control when receiving speech or music. With CW signals it is normal to operate a receiver at a high degree of selectivity to avoid interference from other signals which are often present.

Atmospheric noise may occasionally be troublesome. It is generally at its worst on frequencies up to about 3 Mc/s, and is only rarely in evidence at the higher end of the range covered by a short wave receiver—12 Mc/s and on up to 30 Mc/s. This kind of noise is due to thunderstorms and other atmospheric disturbances quite possibly occurring many hundreds of miles away from the receiving site. The trouble is more in evidence in hot climates and during the summer season in temperate climates, and there is no remedy for it, other than perhaps using a directional aerial aligned to give a balance between minimum noise and maximum signal strength.

Noise of a different kind sometimes makes itself evident, when a rubbing action occurs between two metals, and particularly when the contact resistance is variable (due to dirt, corrosion, etc.). This gives rise to a random type of noise which is picked up by the aerial and becomes audible when a sensitive short wave receiver is in use. The effect can easily be demonstrated by touching the bared ends of a length of wire on to some metal object near but not necessarily touching the receiver.

Further, if a powerful broadcast station is working in the area, the loose wires (or other metal parts) will be collecting a signal from it and there will be rectification at the poor contact. This will lead to distortion and spurious responses in the receiver, stations becoming audible on frequencies which should be clear.

In mind here are such things as stay wires and rigging on board ship; wires or metallic ropes touching metal rails; and, in a domestic situation, wire netting fences and gutter pipes. In an aircraft inordinate care is taken to bond together all the various metal parts since otherwise noise in the radio receiver would seriously impair communications. Where the effect is experienced on board ship, or at home, it may be worth while seeking the offending metal structures and either separating them or placing a low resistance wire bond across them.

It is worth repeating that the actual severity of all types of noise, as made audible at the loudspeaker, will depend largely on the strength of the station being received. Noise practically inaudible on a strong station may well become quite annoying with a weak station. Hence the importance of erecting the best possible aerial system.

Finally, there is the so-called "man-made" interference, arising from electrical devices and appliances, and of many different types. One particular form comes from internal combustion engines, is caused by the sparking at the plugs and distributor and gives rise to a sharp, staccato noise. Generally it is heard only on the higher frequencies and can be troublesome from 12 Mc/s right up through into the very high frequency region occupied by television and other stations. Some receivers are fitted with a noise limiter which can be switched in and will reduce the annoyance.

Most electrical interference comes from appliances fitted with electric motors—fans, drills, refrigerators and vacuum cleaners, for example—and from such things as bells, razors and thermostats—the latter are often fitted to water-heaters, electric radiators and blankets—the noises then being of an intermittent nature. The interference is again due to the sparking which occurs, and the heavier the sparking (as in equipment which gets little or no maintenance) the greater the noise and the more difficult it becomes to prevent it spoiling radio reception.

It should be noted that the interference is carried to the radio receiver in two ways—one by direct conduction along the mains supply leads (which are common to both pieces of equipment) and, secondly by radiation from the mains wiring, or possibly from the offending equipment itself on to the aerial attached to the receiver. In the former case a mains filter unit will help considerably but will have little or no effect in the second case which really calls for suppression at the source.

There is one other source of interference which may occasionally be encountered. The extremely high voltage used with overhead transmission lines leads to an electrical discharge across the insulators in wet or foggy weather and the noise so generated can be radiated over quite a wide area. Research is going on to find means of minimising the trouble and the only advice that can be given is to erect an aerial at right angles to and as far as possible away from the transmission lines.

Experience is necessary to diagnose the type of electrical equipment producing noise in wireless receivers, and often considerable patience is necessary when tracking it down. Listeners

in the United Kingdom, whether they use communication or broadcast receivers, should obtain the appropriate form from the Post Office and send in details, when the matter will receive the attention of the Post Office engineers, who have been trained in the location and prevention of interference and who are properly equipped to carry out the work.

It is probable that the same procedure is available to overseas listeners—in any case, it is worth while making enquiries before tackling the work oneself.

METHODS OF REDUCING INTERFERENCE

The general advice which follows is provided mainly for the benefit of those using short wave broadcast receivers on board

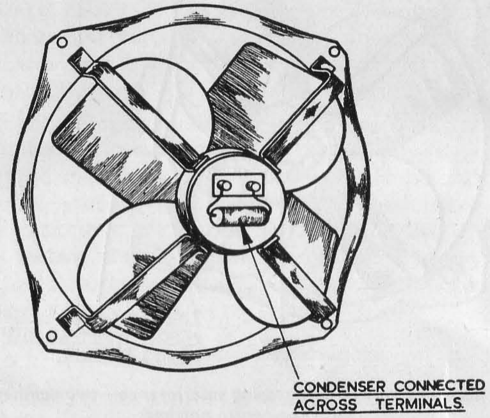

Fig. 13. Showing how a fixed condenser is connected across the terminals of a fan, for suppressing interference.

ship, but it is also applicable to others. It is necessary to emphasise two points—one is that great care should be taken when carrying out tests, since even 110 volt mains can cause a nasty shock under some conditions, and the second—only very reliable components should be used for reducing or preventing the interference. Where possible an expert familiar with the problems likely to be encountered should be called in.

It should be noted that any electrical noise heard may be emanating from a comparatively weak near-by source, or from a machine at a distance but producing severe interference. Further the sensitivity of the receiver comes into the picture. Maybe noise is weak or inaudible on a domestic type of receiver, but becomes serious on a set possessing high sensitivity, as is the case with Eddystone receivers, particularly communications models.

Another point to bear in mind is that the interference created by a machine is likely to vary over the frequency range used for radio communication and although, after fitting a suppressor, the interference disappears over one particular range on a receiver, it may appear again at other frequencies. It may happen that some equipment in use has already been fitted with suppressors by the manufacturers—for instance, a rotary converter, as frequently employed for transforming DC to AC or *vice versa*—but often such suppressors are designed for cutting out interference on medium frequencies (that is, the medium wave broadcast band) and they may not be fully effective at the high frequencies used for long distance short wave broadcast transmissions.

There are two ways of tackling the problem: (a) to endeavour to eliminate the interference at the source, and (b) to prevent it entering the radio receiver. It is more satisfactory, and, in the long run, more economical, to suppress the interference at the

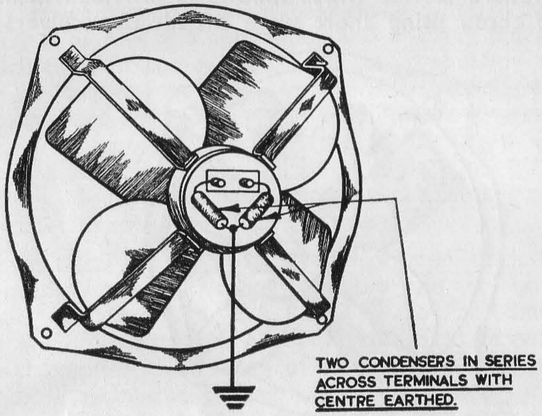

Fig. 14. An improved way of suppressing interference—two condensers in series with the centre earthed.

source, since, in a bad case, the noise may be affecting reception over a comparatively wide area. On board ship, efforts to cure the trouble at the source will probably meet with considerable support, since both the ship's communications installation and receivers used for broadcast reception will benefit equally.

When the offending machine or apparatus has been located, the first thing to do is to check its condition. All connections should be examined for tightness and, where a metal frame exists, a test should be made to ensure that it is properly earthed. If no earth exists, or if there is a high resistance connection to earth, the radiation of interference from the metalwork itself can be quite severe. Quite likely the equipment has been in use for a long time, and renovation may be required. If a motor, perhaps the brushes are badly worn or the commutator may be rough, causing severe sparking and calling for renewals. If other equipment, the contacts may be worn or dirty.

If the machine is found to be in good condition but still producing interference, it becomes necessary to fit a suppressor, either across the terminals of the offending unit, or in series with them, depending on the type of suppressor employed. The simplest

takes the form of a single condenser, connected as shown in Fig. 13. It is difficult to specify a definite value of capacity, since what may be correct in one instance may not be entirely suitable in another. An average value is 0.1 uF but other capacities between 0.01 and 0.5 uF should be tried, if possible. Where the interference occurs on short waves, the addition of mica condensers, having values between .0005 uF and .005 uF may improve matters.

The alternative arrangement, illustrated in Fig. 14 and using two condensers in series, with the centre earthed, usually proves very effective, provided the earth lead can be made short.

Whilst a common type of electric fan is indicated, the same principle (of connecting condensers) can be applied to other electrical equipment, of larger or smaller size.

The voltage rating of the condenser is important. It should be not less than 500 volts DC working, under any circumstances, and if the mains are 200/250 AC the condenser should be rated at not less than 600 volts AC working.

More elaborate suppressor units are available for cases where the interference is severe and not completely amenable to the relatively simple methods outlined above. These units are larger, and incorporate various combinations of condensers and chokes. Where large machines are concerned, the current rating becomes an important factor, and since some disturbance of the mains wiring is called for, it is recommended that the services of a skilled electrical or radio engineer be utilized in such cases.

Users of Eddystone and other short wave receivers will find much information of interest in the following publications:—

Short Wave Listeners' Annual (Data Publications Ltd.).
World Radio Handbook (Lund Johansen).
International World Radio Station List (Bernards Ltd.).
DX Operators' Handbook (Data Publications Ltd.).
Guide to Broadcasting Stations (Wireless World).
Short Wave Magazine.
R.S.G.B. Bulletin.