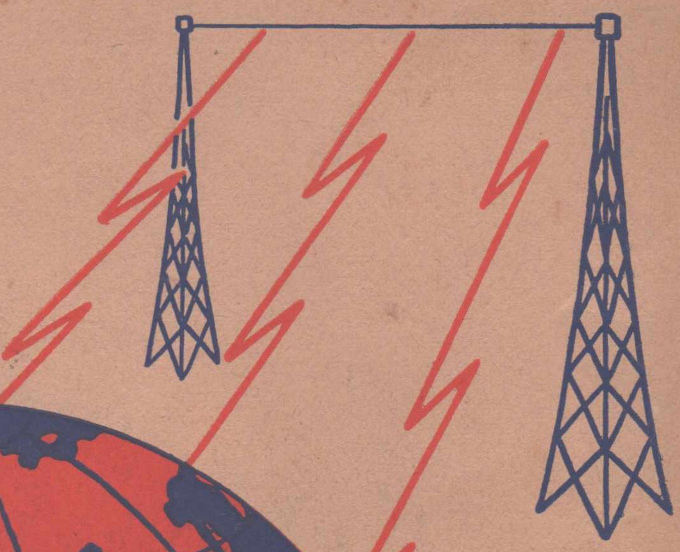
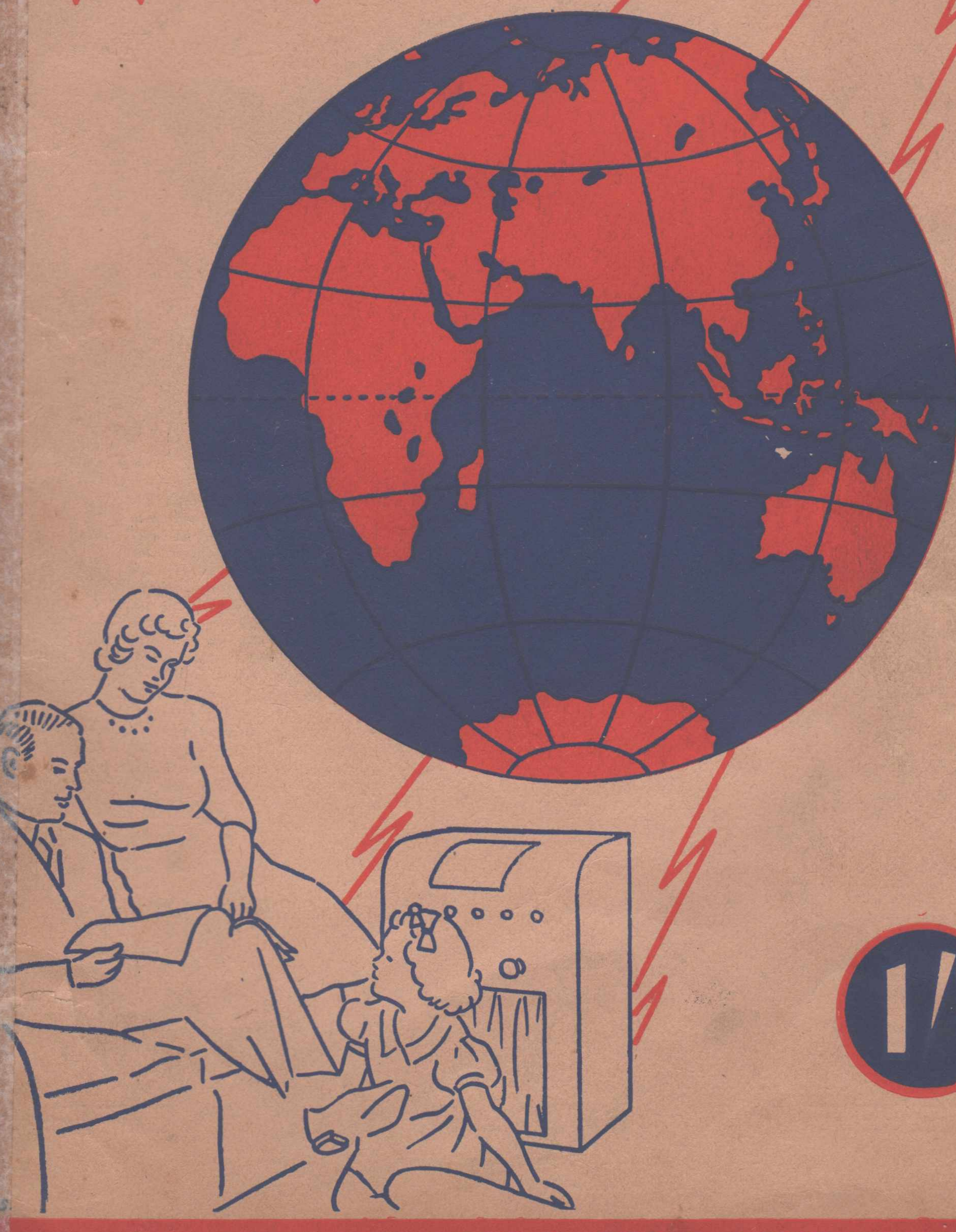
THE LISTENER IN HANDBOOK No. 15

SHORT WAVES





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Printed and published by EDGAR H. BAILLIE, of 185 Balaclava Road, Caulfield, for United Press, Herald and Weekly Times Limited, at its Registered Office, 44-74 Flinders Street, Melbourne.

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SHORT WAVES

Foreword

RECEPTION of overseas short-wave broadcasting stations has long been a hobby of the radio tinkerer and the experimenter. So far back as 1924 radio enthusiasts were tuning in the broadcasts of the American station KDKA.

Overseas reception has improved enormously since those days, however, and it is now possible, with the aid of suitable receivers, to hear the broadcasts from London, Paris, New York, Rome — in fact, practically every world capital — at a strength and clarity approaching that of local broadcasts.

The present international situation has given an added fillip to short-wave listening, for it is on these wave lengths that the latest news commentaries from both belligerent and neutral countries are to be heard.

Unfortunately, many newcomers to the ranks of overseas listeners fail to obtain satisfactory reception because they do not appreciate the differences between short and medium wave reception and are ignorant of the technicalities of the equipment necessary to tune in the high frequency stations.

The purpose of this manual is to clear up these misunderstandings on the part of the general public and to assist the home builder and the experimenter in the construction of suitable receivers.

The Editor

FIRST let us get an idea of what Short-Waves are. For all practical purposes the radio spectrum may be said to extend from 1 to 30,000 metres. The top portion of this spectrum, from 1000 to 30,000 metres, is usually termed the Long-Wave range. It is used chiefly for Morse Code trensmission, although a section between 700 and 2000 metres is used by European countries for Long-Wave broadcasting.

The Medium - Wave range from 200 to 550 metres is given over entirely to domestic broadcasting, being particularly widely used for this purpose in America, Australia and Canada.

Next comes the Short-Wave range, which usually is considered to lie between 10 and 100 metres. It is in this wave band that the chief International communications and International broadcasting systems are operated.

Below 10 metres is the Ultra-Short Wave range which is now being developed for television, facsimile transmission and special short-distance point-to-point services.

Transmission Principles

BEFORE we can appreciate the difference between and the relative values of these four wave bands we must have a working idea of the fundamental principles of radio transmission.

The primary object of a radio transmitter is to set up a train of impulses in the conducting medium, called the Ether for want of a better name, which surrounds the earth. At some 100 to 150 miles above the earth, however, is a non-conducting belt called the Heaviside Layer through which the transmitter signals either will not pass or, if they do, are lost in outer space.

The Heaviside Layer might be thought of as a huge mirror and the signals from a radio transmitter as a beam of light. If the transmitter (light beam) is directed towards the Heaviside Layer (mirror) at an angle of 45 degrees then the signals (light) will be reflected groundwards at an angle of 45 degrees from the point at which they hit the Layer.

Now, long wave transmissions take place at a low frequency and it has been found that the lower the frequency the flatter the angle at which the transmitted impulses strike the reflecting layer. This reflected signal is called the "Sky Wave."

However, the train of impulses set up by the radio transmitter also travels over the surface of the earth where it is weakened to a greater or lesser extent—depending upon the wave length used—by the absorptive capacities of trees, mountains, tall buildings and the earth itself.

We can summarise the four wave band groups by saying:

Long-Waves travel easily over the surface of the earth and are not nearly so subject to loss as Medium, Short or Ultra-short-waves. On the other hand, Long-Wave transmission requires high power, and in tropical and sub-tropical areas is subjected to considerable interference by static.

Medium-wave transmission requires less power than Long-Wave transmission, but the Ground Wave from such transmitters is subject to serious losses at distances over 100 miles. Transmitter operating on the higher medium waves—around 500 metres—cover greater areas by Ground Wave than do those operating on the lower wave lengths—around 200 metres.

Most of the national broadcasting stations operate in the region from 350 to 550 metres, but need high powers to provide adequate coverage in country areas. The lower powered Commercial broadcasting stations provide excellent coverage over purely local areas, become weakened badly between 50 and 100 miles, yet, by means of the reflected Sky Wave, are heard excellently 700 to 1000 miles distant.

Short Wave transmission. With the short waves it is found that the Ground Wave dies out rapidly—in some cases only a few miles distant from the transmitter. However, the

Sky Wave may provide reception up to 12,000 miles or more distant, depending on the wave length used and the transmission conditions existing at the time.

Ultra-Short-Waves are also known as Quasi-Optical waves because for all general purposes their transmission range is restricted to the optical distance between the transmitter and receiver.

Heaviside Layer's Part

TO return to the Heaviside Layer and its effect on short-wave transmission. We have referred to the layer as being analogous to a giant mirror. However, it is not a smooth mirror nor is it a stable one. First let us explain that this non-conducting layer is produced by the bombardment of the earth's atmosphere with ions (electric particles) from the sun. The intensity of this bombardment varies from hour to hour and from day to day. Further, it is subject to an 11-year cycle of activity.

With a given short-wave transmitter the receiving station may be too far away to receive the Ground Wave signal. However, the Sky Wave signal directed towards the Heaviside Layer will hit it at such an angle that the reflected signal will come down at the desired reception point.

Between the point at which the Ground Wave died out and the Sky Wave was reflected back to earth no signal from this particular station would be audible. This "Skip Distance" area will vary with the wavelength used and the time of the day or night at which the transmission takes place.

It should not be thought from the foregoing that the radiated signal is in the form of a pin point. Rather it is cone shaped and so the spattering of the Heaviside Layer with the transmitted signal causes a similar spattering effect with the reflected signal so that the area over which the reflected signal may be heard is quite wide.

Furthermore, multiple reflections — seven for a 15 metre wave to cover 10,000 miles—in which the reflected signal is again directed towards the Heaviside Layer after it has reached the earth—are common in short wave transmission.

Fading Explained

THE foregoing and our earlier explanation of the Heaviside Layer gives us the reason for two of our short wave problems—fading, and the complete disappearance of a station which earlier was being heard at excellent strength.

Fading—the waxing and waning of signal strength — is caused by movements in the height of the Heaviside Layer above the earth.

This in turn is caused by variations in the sun's ionic bombardment and by the effect which the ultra-violet rays emitted by the sun have on the non-conducting qualities of the Heaviside Layer.

With the transmitting station operating from a fixed position and radiating a signal towards the Heaviside Layer at a definite angle, it can be appreciated that if the layer rises, the reflected signal will come down further away and if it falls will come down nearer to the transmitter.

The practical effect of this movement is that the signal is momentarily weakened or in severe cases caused entirely to disappear. As the layer returns to the precise point at which the correct reflection is obtained, so the received signal is heard at normal strength.

This is the simplest form of fading encountered in short-wave reception. Another more complex form is that in which, although the signal is only slightly weakened, the fade-out is accompanied by tonal distortion in which both music and speech become unintelligible. This effect is caused by the multiple reflection of the transmitted signal so that one reflected signal arrives at the receiver out of step (phase) with the other.

A third effect, noticed sometimes in reception of the lower wave-length (highest frequency) stations, is the so-called "echo effect." Here, although the transmission of music is not seriously affected, speech is marred by a reverberation or echo.

The explanation offered for this phenomenon is that the signal has been reflected completely round the world. At one stage of its reflection portion of its energy was picked up by the receiver, but sufficient energy was still left for the signal to continue its reflections until it again reached the receiver, but some fraction of a second later than the first received signal.

SKIP DISTANCES FOR SHORT WAVES

SUMMER VALUE MIDDAY	WINTER VALUE MIDDAY
Up to 10 Metres only direct Rays (No Skip)	Up to 10 Metres only direct Rays (No Skip)
10 Met. .. .. .. 800 to 1000 Miles	10 Met. .. .. .. over 1000 Miles
16 Met. .. .. .. 800 to 1000 Miles	16 Met. .. .. .. 1400 to 1500 Miles
21 Met. .. .. .. 400 to 600 Miles	21 Met. .. .. 800 to 900 Miles
32 Met. .. .. .. 300 to 450 Miles	32 Met. .. .. 400 to 450 Miles
40 Met. .. .. .. 150 to 200 Miles	40 Met. .. .. .. 200 Miles
80 M. Nil.	80 Met. Nil.
SUMMER VALUE MIDNIGHT	**WINTER VALUE MIDNIGHT**
16 Met. 2500 Miles	3500 to 4000 Miles
21 Met. 1000 Miles	2000 Miles
32 Met. 700 Miles	1000 Miles
40 Met. 400 Miles	600 to 650 Miles

THE above approximate skip distances are the distances from the transmitter to the nearest point where the reflected ray returns to the earth at a maximum strength.

The shortest value of skip distance usually occurs around about midday and the midnight value is about 2½ times the noon value.

At sunrise the skip distance becomes very variable, but gradually falls back to the minimum at noon. The shorter the wavelength the greater the skip distance and weak and distorted signals must usually be expected in the skip area due to scattering, etc.

The amount of absorption of the ground and sky waves and of the angle of reflection of the sky waves depends on the wave-length used, the time of the day, and the seasonal condition of that section of the earth's surface over which the waves have to pass. Thus fading and skip distance effects are variable and cannot be predicted with certainty. On the other hand, transmission engineers have a reasonably accurate knowledge of the requirements for a broadcast service between any two points of the earth's surface at any given time or season. From this basic knowledge they plan the operating wave-lengths and the programme hours and adjust these to keep in touch with seasonal changes. From the short-wave listener's angle some knowledge of the general transmission characteristics of the various short-wave lengths is essential. First it should be understood that there are nine special wave-bands set out in the 13-100 metre spectrum especially for the needs of international broadcasting. These are the 13, 16, 19, 25, 31, 41, 49, 62, and 90 metre bands.

RANGE OF SHORT-WAVE SIGNALS

IT is difficult to estimate the exact range of short waves, as this factor again varies with the time of day and wave-length. But it is interesting to note that if conditions for reception are good between two points in one direction, reception in the opposite direction on about the same wave-length is usually about equal.

This is why two-way communication is usually carried out with wave-lengths of about the same value.

From a 5 to 10 K.W. non-directive transmitter, the following are the approximate maximum ranges. Range of transmission, however, is not greatly affected by the power used.

MAXIMUM RANGE

Wavelength.	Range Entire Daylight.	Range Entire Twilight.	Range Entire Darkness.
80 Met.	500 Miles	1000 Miles	10,000 Miles
50 Met.	1200 Miles	3000 Miles	10,000 Miles
40 Met.	2000 Miles	5500 Miles	9000 Miles
35 Met.	3000 Miles	9000 Miles	5000 Miles
30 Met.	4000 Miles	12,000 Miles	4000 Miles
25 Met.	7000 Miles	12,000 Miles	2000 Miles
20 to 15 Met.	10,000 Miles	12,000 Miles	——

Atmospheric Interference

ATMOSPHERICS are not negligible on the average short wave band, there being in reality three bands or divisions into which the short wave spectrum can be divided.

Bad: 40 metres to 80 metres.
Medium: 17 metres to 40 metres.
Negligible: 17 metres to 5 metres.

In Australia, during the summer, atmospheric interference is usually very bad after dark between about 40 and 80 metres. Conditions, however, improve during the winter months, but even at their best the level is usually fairly high.

The peak interference period seems to be between 8 p.m. and 3 a.m., after which the interfering level drops, providing better conditions in the early morning than at night. During the day on these waves the interference level is at a minimum, apart, of course, from any local disturbance, lighting, etc.

Atmospherics which come in below 40 metres are not so violent, but usually correspond in time with that of the signal maximum, which tends to show that the wavelength of the disturbance varies.

Waves below 16 or 17 metres, however, are very subject to local disturbances, such as man-made noises, spark plugs, machines, etc.

These observations show that there is a definite annual cycle in atmospheric interference, a maximum in summer and a minimum in winter. The figures above were obtained at the same time as signal strengths were being observed.

For fuller details as to the best listening hours and wave lengths, readers are referred to the tables appearing in this article.

They have been compiled by the Australian short wave authority, Mr Charles M. Scott, and are the result of several years' experience and experiment with short wave reception in Eastern Australia.

EUROPE

ENGLAND, FRANCE, GERMANY, ITALY, HOLLAND, SPAIN, WESTERN RUSSIA, ETC.

Average distance, 10,000 Miles—Routes: North-West, North-East, South-West, South-East.

SIGNAL PATH ACROSS DARKNESS AND LATE DARKNESS ZONES.

SEASON	FREQUENCY	WAVELENGTHS	Time in Hours, E.S.T. MAX. SIGNAL.
Summer	8.6 to 3.75 Mc.	35 to 80 M.	3.00 a.m. to 6.45 a.m.
Equinox	8.6 to 3.75 Mc.	35 to 80 M.	3.00 a.m to 7.00 a.m.
Winter	8.6 to 3.75 Mc.	35 to 80 M.	3.00 a.m. to 7.30 a.m.

THIS INCLUDES THE 49 METRE BROADCAST BAND.

SIGNAL PATH ACROSS TWILIGHT INTO DARKNESS ZONES.

SEASON	FREQUENCY	WAVELENGTHS	MAX. SIGNAL
Summer	20 to 15 Mc.	15 to 20 M.	8.00 p.m. to 1.30 a.m.
	15 to 10 Mc.	Includes 16 and 19	†7.00 a.m. to 10.00 a.m.
	10 to 7.5 Mc.	Metre Bands.	10.00 p.m. to 2.30 a.m.
		20 to 30 M.	†7.00 a.m. to 10.00 a.m.
		Includes 25 Metre	11.00 p.m. to 4.00 a.m.
		Band	†6.00 a.m. to 8.00 a.m.
		30 to 40 M.	
		Includes 31 Metre	
		Band	

†DURING SUMMER MORNING RECEPTION USUALLY POOR.

SEASON	FREQUENCY	WAVELENGTHS	MAX. SIGNAL
Equinox	20 to 15 Mc.	15 to 20 M.	3.00 p.m. to 6.00 p.m.
Spring	15 to 10 Mc.	20 to 30 M.	9.30 p.m. to 1.00 a.m.
and	10 to 7.5 Mc.	30 to 40 M.	6.30 a.m. to 10.00 a.m.
Autumn			10.00 p.m. to 2.30 a.m.
			6.00 a.m. to 9.00 a.m.
			4.30 p.m. to 6.30 p.m.
			4.30 p.m. to 7.00 p.m
			6.00 a.m. to 8.30 a.m.
			11.00 p.m. to 3.00 a.m.

DURING EQUINOCTIAL PERIODS SIGNALS ARE INCLINED TO BE PATCHY.

SEASON	FREQUENCY	WAVELENGTHS	MAX. SIGNAL
Winter	20 to 15 Mc.	15 to 20 M.	7.00 a.m. to 10.00 a.m.
	15 to 10 Mc.	20 to 30 M.	12 Noon to 5.30 p.m.
	10 to 7.5 Mc.	30 to 40 M.	2.30 p.m. to 5.00 p.m.
			7.00 a.m. to 10.00 a.m.
			2.30 p.m. to 5.30 p.m.
			6.00 a.m. to 8.30 a.m.

THIS INCLUDES THE 19, 25 AND 31 METRE BROADCAST BAND.

Summer means Nov., Dec., Jan. and early Feb.

Equinox means—

[Spring]—Late August, Sept., Oct.

[Autumn]—Late Feb., Mar., April, early May.

Winter means May, June, July and August.

In all the signal strength charts Mc. stands for Megacycles and M for Metres, and all times shown are Australian Eastern Standard Time, which is 10 hours ahead of Greenwich Mean Time (G.M.T.).

Notes on European Reception

FROM Europe, owing to the seasonal effect, observations show that during the winter months there are two twilight periods, but as summer approaches these periods merge gradually into one.

The period referred to here is that of peak signal strength. Weaker signals can often be heard many hours earlier or later, as the case may be.

During mid-winter the two periods are from approximately 2.30 p.m. to 5.30 p.m. and 7.0 a.m. to 9.30 a.m. These gradually advance and retard till midsummer, when the period is from 11 p.m. to 2 a.m.

Signals above 35 metres, including the 49 metre band, have really only one period, that is, the all-darkness zone between 3 a.m. and 6.30 a.m. throughout the year. These signals come in via the North-West route, rather than the South-East, which is more twilight.

There is another period of reception between 4 p.m. and 6 p.m. from the North-East across America. As there is a fair amount of daylight between America and Europe at this time, only signals as high as about 45 metres are capable of getting through.

On the shorter waves. 16, 19, 25 and 31 metres, during the two winter periods, signals travel along the twilight zones and can come to us from either direction. In the morning from the North-West or over the Antarctic from the South-East. In the afternoon from the North-East or over the Antarctic from the South-West.

The fact of there being two good twilight paths at one time results in excellent steady signals, as only one path may fade at a given instant.

The midnight summer reception is also along an extended twilight path, which provides excellent signals.

After about 8 p.m. in the winter there is no night reception from Europe on any wave, apart from the early morning darkness path. The normal morning reception on the shorter waves is also usually poor during summer.

AUSTRALASIA

TASMANIA, NEW SOUTH WALES AND SOUTH AUSTRALIA

DAYLIGHT reception is good between 20 and 50 metres throughout the year. Night reception is good during summer and poor during winter. From 50 to 80 metres is a good night wave, strong signals.

NORTHERN AUSTRALIA, WESTERN AUSTRALIA, NEW ZEALAND AND FIJI

DAYLIGHT reception is good between 16 and 30 metres throughout the year. Night reception is good during summer, but is fair to poor during winter. From 30 to 80 metres are good night waves all the year round. Special tests made with New Zealand on 40, 50, 60 and 80 metres have produced excellent signals in

Melbourne from 6.00 p.m. to after midnight all the year round.

Daylight reception during the winter months is quite good on 33 metres but as summer approaches about November, 24 metres gives a much stronger signal in Melbourne. During the summer 24 metres is also a good night wave. In February, however, when summer is passing, a return to 33 metres produces better results. For winter daylight reception 30 metres seems to be the limit for best signals.

SOUTH AFRICA AND SOUTH AMERICA

OWING to the geographical position of these two countries, communication between them and Australia is more difficult as the connecting circuit can lie over so many grades of different condition. Taking Africa, particularly the southern portion, during the winter, about 4.00 p.m. would be a good time for communication using waves between 18 and 28 metres. Over the darkness zone between 3.00 and 6.00 a.m. produces good signals between 35 and 80 metres. During the summer somewhat similar conditions prevail.

South America is somewhat similarly situated, but a semi-twilight path is possible round about dusk and at dawn for 16 to 35 metre transmission. A darkness path is also available after dusk for a brief period, for waves over 35 metres in winter.

Notes on North American Reception

RECEPTION from America over the north-east route can be very good providing the correct times and wavelengths are chosen.

For waves above 35 metres the period between 5.00 p.m. and midnight is by far the best, just after dusk being particularly suitable. Early morning reception on these waves is usually rather poor.

Wavelengths between 18 and 35 metres give the best results and these peak at several periods during the 24 hours. The 31 metre band produces good signals after 8.00 p.m. and in the late afternoon, also during the early morning.

From 8.30 a.m. to about 2.00 p.m. waves between 18 and 23 metres are particularly suitable for reception from the Hawaiian Islands and California. These shorter waves also peak round about midnight during the summer.

At the Equinox periods, reception from New York between 8 a.m. and 10 a.m. has been observed to be very good on 23 and 35 metres; 60 metres has also been heard at this time, but signals have been very weak.

FAR EAST

JAPAN, CHINA, SIAM, SIBERIA, PHILIPPINE ISLANDS, DUTCH EAST INDIES, ETC.
Average distance 6000 Miles—approximately North.

SIGNAL PATH ACROSS DARKNESS AND LATE DARKNESS ZONES.

SEASON	FREQUENCY	WAVELENGTH	Time in Hours, E.S.T. MAX. SIGNAL
Summer	8.6 Mc.-3.75 Mc.	35 to 80 M.	8.30 p.m. to 5.30 a.m.
Equinox	8.6 Mc.-3.75 Mc.	35 to 80 M.	8.30 p.m. to 6.00 a.m.
Winter	8.6 Mc.-3.75 Mc.	35 to 80 M.	8.30 p.m. to 5.30 a.m.

THIS RANGE INCLUDES THE 49 METRE BROADCAST BAND.

SIGNAL PATH ACROSS TWILIGHT INTO DARKNESS ZONES.

SEASON	FREQUENCY	WAVELENGTH	Time in Hours, E.S.T. MAX. SIGNAL
Summer	20 Mc. to 8.6 Mc.	15 - 35 M.	5.00 p.m. to 2.30 a.m.
Equinox	20 Mc. to 8.6 Mc.	15 - 35 M.	6.00 a.m. to 9.00 a.m.
Winter	20 Mc. to 8.6 Mc.	15 - 35 M	4.30 p.m. to 10.30 p.m.
			5.30 a.m. to 9.00 a.m.
			4.30 p.m. to 9.00 p.m.
			4.00 a.m. to 8.30 a.m.

THIS RANGE INCLUDES 16, 19, 25 AND 31 METRE BROADCAST BANDS.

SIGNAL PATH ACROSS INTENSE DAYLIGHT ZONE.

SEASON	FREQUENCY	WAVELENGTH	Time in Hours, E.S.T. MAX. SIGNAL
Summer	23 Mc. to 15 Mc.	13 to 20 M.	9 a.m. to 5 p.m.
Equinox	23 Mc. to 15 Mc.	13 to 20 M.	9 a.m. to 4.30 p.m.
Winter	23 Mc. to 15 Mc.	13 to 20 M.	8.30 a.m. to 4 p.m.

THIS RANGE INCLUDES 13, 16 AND 19 METRE BROADCAST BANDS.

Notes on Far Eastern Stations

IT is obvious from the foregoing that short-wave stations located in the East, North of Australia between East India and West of the Hawaiian Islands are not to any great extent affected by seasonal changes.

The only difference of note is that stations below 25 metres become inaudible a little after sunset during our winter months. This is due to the fact that the great circle joining these countries to Australia becomes further away from the twilight zone than in summer, when reception of these shorter wave stations lasts well on to midnight, or even later.

Good loud signals have been observed from Japan on the following wave lengths: 40 to 50 metres during winter nights, 28 and 22 metres during the summer and equinox nights and early evening twilight, and 17 metres during daylight.

During the equinox periods excellent signals have appeared from Japan between 6 and 8 p.m., due to the fact that at this time the great circle joining Japan and Australia lies straight along the twilight zone.

NORTH AMERICA

Including CALIFORNIA (U.S.A.), CENTRAL AMERICA (MEXICO) and HAWAIIAN ISLANDS.
Average distance, 8000 Miles.
Routes North-West, North-East.

SIGNAL PATH ACROSS DARKNESS AND LATE DARKNESS ZONES.

SEASON	FREQUENCY	WAVELENGTH	Time in Hours, E.S.T. MAX. SIGNAL
Summer	8.6 to 3.75 Mc.	35 to 80 M.	6.00 p.m. to midnight
Equinox	8.6 to 3.75 Mc.	35 to 80 M.	5.00 p.m. to 10.00 p.m.
Winter	8.6 to 3.75 Mc.	35 to 80 M.	4.00 p.m. to 8.30 p.m.

(INCLUDES 49 METRE BAND), MORNING RECEPTION USUALLY POOR.

SIGNAL PATH ACROSS TWILIGHT ZONE.

SEASON	FREQUENCY	WAVELENGTH	Time in Hours, E.S.T. MAX. SIGNAL
Summer	17 to 8.6 Mc.	18 to 35 M.	4.00 p.m. to 7.00 p.m.
Equinox	17 to 8.6 Mc.	18 to 35 M.	9.30 p.m. to 11.30 p.m. or later.
Winter	17 to 8.6 Mc.	18 to 35 M	6.30 a.m. to 8.30 a.m.
			4.00 p.m. to 7.30 p.m.
			9.30 p.m. to 11.15 p.m.
			7.00 a.m. to 9.00 a.m.
			3.30 p.m. to 7.00 p.m.
			8.00 p.m. to 10.00 p.m.
			7.00 a.m. to 10.00 a.m.

INCLUDES 19, 25 AND 31 METRE BANDS.

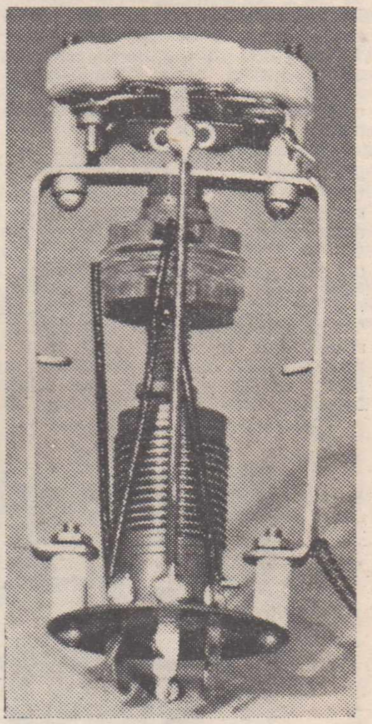
SIGNAL PATH ACROSS DAYLIGHT INTO TWILIGHT ZONES.

SEASON	FREQUENCY	WAVELENGTH	Time in Hours, E.S.T. MAX. SIGNAL
Summer	23 to 13 Mc.	13 to 23 M.	9.00 a.m. to 4.00 p.m.
Equinox	23 to 13 Mc.	13 to 23 M.	9.00 a.m. to 4.00 p.m.
Winter	23 to 13 Mc.	13 to 23 M.	9.00 a.m. to 4.00 p.m.

INCLUDES 13, 16 AND 19 METRE BROADCAST BANDS.

Converting The Broadcast Set For Short Wave Reception

Coil Units for Conversion—Placement of Components — Wiring Details — Addition of Band Spread — Alignment of Circuits.



A typical dual-wave coil with its shield can removed.

IN dealing with the conversion of existing broadcast sets for short-wave reception consideration must be given to the type of the receiver and the most effective way of obtaining high efficiency on the short wave bands. In the first place any superheterodyne type of receiver of reasonable sensitivity may be converted for dual wave operation by adding suitable short wave coils and switching arrangements. On the other hand many types of tuned radio frequency sets are not suitable for conversion in this way. T.R.F. sets of the commercial type which have no regeneration applied to the detector stage cannot be converted unless a means is provided of applying regeneration.

However, these receivers are usually sufficiently sensitive to allow of the use of a converter. (See p. 42.) Where this is not possible the use of an adaptor may solve the problem. (See P.39.)

Assuming that the set to be converted fulfils the above requirements a start may be made on its conversion. It must be understood that a second and separate set of coils is required for the reception of the short-wave signals. These coils and the existing broadcast coils in the receiver are connected to a multi section switch wired so that either set of coils may be thrown into circuit at will. The instructions given in this article apply mainly to the 5-valve type superheterodyne receivers employing a two gang condenser for tuning purposes.

Any receiver using a three gang tuning condenser should be examined by a competent radio engineer before an attempt is made by the home constructor to convert it.

Switches and Coils

THE actual design of the chassis of the receiver to be converted governs, to a large extent, the mechanics of the changeover. In most sets the tuning coils are mounted to one side of the ganged tuning condenser, with the mixer or first valve close to them. In this case the wave change switch may be mounted underneath the chassis, directly below the coil connections. This method allows of high efficiency, as the coil leads are kept short.

Two types of wave change switches are available. One consists of a single bank carrying 6 single pole double throw switches, while the other is made up of several banks, each carrying two single pole 5 position switches. The first-mentioned is the simplest, but the latter is necessary when one coil is mounted at some distance from the front of the chassis. The switch selected, it is then necessary to obtain the short wave coils. Here again the choice of several types is available.

The short wave coils may be obtained separately, or the broadcast coils in the set may be removed and a dual wave type substituted. If this latter method is possible, it will be more simple for the novice to follow, as the trimmers for each set of coils are housed in the shield can, and it is only necessary to connect up the numbered lugs to the switch contacts. Iron core types of short wave coils are now available, and are very compact. They can be conveniently mounted below the chassis, and the leads to the switch connections kept very short. This is most desirable, from the view of efficiency on the short waves. It is impossible to state any set rule for the mounting of the switch and coils, as each conversion would produce new mounting positions. However, so long as all the coil leads are kept as short as practicable, no difficulties should be experienced.

Wiring the Switch

THE coils and the switch having been mounted in place, the wiring is the next step. Before attempting the wiring, obtain a valve chart showing the socket connections of the valves used in the receiver. With this chart and the following instructions, no difficulty will be experienced in the wiring alterations. Attention should also be paid to the diagrams of the two types of wave-changing switches shown. First, remove the aerial connections from the broadcast coil and join the aerial terminal to the arm contact of one section of the switch. The old aerial connection of the aerial coil then joins to the No. 1 lug of this section of the switch, whilst the short-wave aerial coil lead joins to the No. 2 lug of the same section.

To the arm lug of another section of the switch solder a lead from the fixed plate lug of that section of the gang condenser which joins to the grid cap of the mixer valve. This lead and the one connecting the other fixed plate lug of the gang condenser to the switch should be kept very short. The wire from the broadcast coil to the gang should be disconnected and soldered to the No. 1 lug of the section of the switch to which the mixer gang lead is connected. The short-wave grid lead joins to the No. 2 lug of this section. Disconnect the broadcast oscillator grid coil connection and join this to the No. 1 lug of another section of the switch.

The arm lug of this section connects to the fixed plate lug of the remaining section of the gang condenser, which is also connected to one lug of the oscillator grid condenser. The No. 2 lug of this section of the switch joins to the grid lead of the short-wave oscillator grid coil.

The earth lead of this coil joins to a padder condenser or to earth, depending on the coil specifications. Disconnect the oscillator plate lead

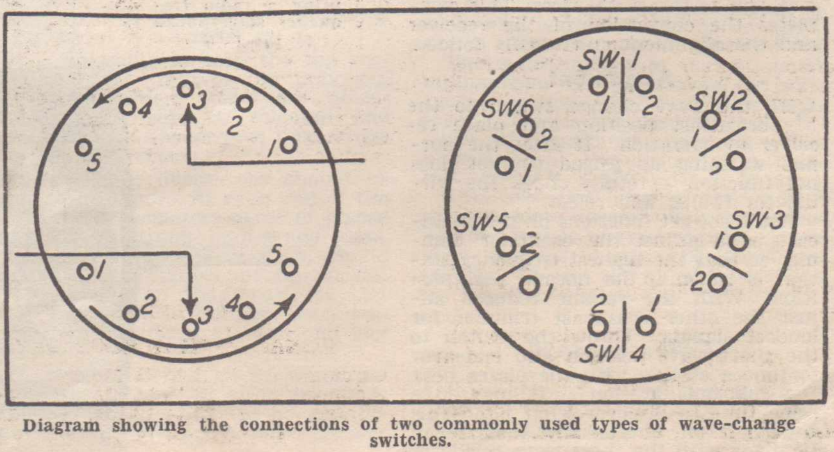


Diagram showing the connections of two commonly used types of wave-change switches.

from the broadcast coil, and join this to the arm of one of the remaining sections of the switch. The No. 1 lug of this section joins to the free broadcast oscillator coil lug.

The number 2 lug of this section joins to the oscillator plate connection of the oscillator coil. The "B" positive lead of this coil joins to the corresponding lead of the broadcast coil which joins to the oscillator feed resistor and a bypass condenser. The A.V.C. lead of the short wave aerial coil joins to earth, as does the earth lead of the same coil.

This completes the wiring of coils and switch. When separate coils are used in the changeover it will be necessary to solder four trimmer condensers in place on the wave change switch and to remove the trimmers on the gang condenser. Where dual wave type coils have been substituted for the broadcast coils the trimmers are usually located in the top of the shield can, in which case it is only necessary to remove the gang trimmers or to set them to minimum capacity. The fixed plate lugs of the four trimmers are soldered to the lugs of the switch to which the grid connections of the broadcast and short wave coils are connected, i.e., one to each of the four lugs.

The moving plate lugs of each trimmer join to the earth wire. This completes the conversion of the receiver and the alignment and testing follows.

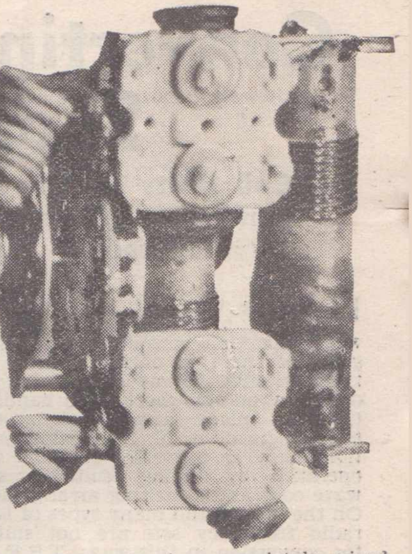
Alignment

SET the wave change switch to the broadcast position and place receiver in operation. If after the normal warming up period the set does not function, carefully check the wiring for faults, and retest.

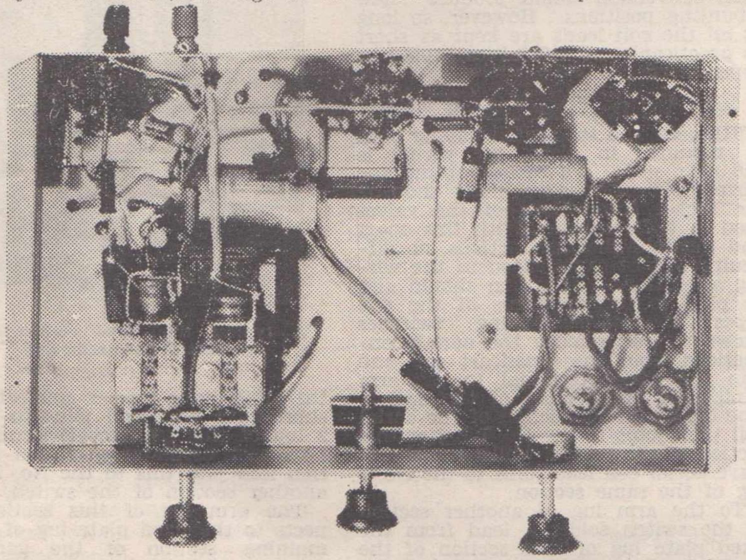
When the set functions on the broadcast band adjust the oscillator trimmer so that the highest frequency station is tuned in its normal dial position. With the volume reduced adjust the other broadcast trimmer for loudest signals. Throw the switch to the short wave position and endeavor to tune a station with the plates near the full out position. It may take some time to discover what band this station is on, but usually a start can be made with the short wave oscillator trimmer nearly full out. Adjust the remaining short wave trimmer for best results.

If a variable padder condenser is provided this should be adjusted with the set tuned to a station at the top of the dial scale, i.e., with the plates nearly full in.

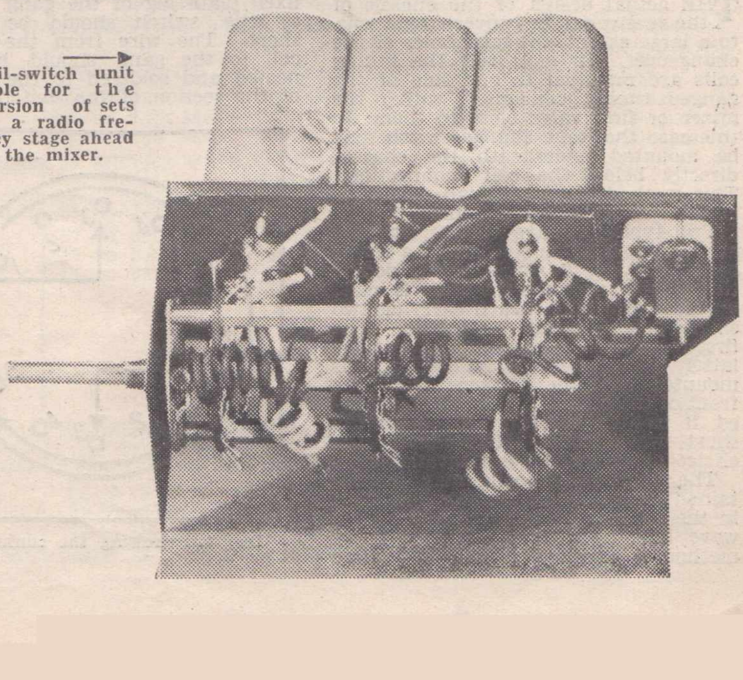
This done, the set should be aligned on both bands, and should be in a sensitive condition. In the conversion of T.R.F. type receivers the same general principles apply; however in most cases it will be necessary to have the coils specially wound, or to use home-wound coils. Windings suitable for various sizes of tuning condenser are given in the coil winding tables (See Page 71). The conversion of superheterodyne receivers using an R.F. stage is much more complicated. However, this has been simplified somewhat by the appearance of a completely wired switch and coil unit designed to be fitted to the existing chassis. With this unit three dual wave type shielded coils are mounted on a bracket, which carries the switch. In some cases it may be impossible to include this unit, in which case the shielded coils can be purchased separately and mounted in place of the ordinary broadcast coils. It is essential, however, to use the multi-bank type of switch (Fig. 1), and to place a small shield between the aerial and R.F. stage. The same applies to the conversion of two-stage T.R.F. sets. In addition to the three-stage conversion unit mentioned above there is also a two-stage unit ready wired for the conversion of the standard type of five-valve superheterodyne. In some cases this conversion is very simple. When the tone control is placed below the existing broadcast coils, this can be removed and the dual wave unit, which is provided with one hole mounting bolted in its place. The original broadcast coils can then be disconnected and the connection of six or seven leads from the coil-switch unit completes the job. The trimmers are included in both the above units and the alignment procedure is the same as described earlier in the article.



A two stage coil-switch unit for converting standard 5-valve super-heterodynes for dual-wave reception. →



This photograph shows a dual-wave coil-switch unit wired and mounted in a 5-valve super-heterodyne chassis.



A coil-switch unit suitable for the conversion of sets using a radio frequency stage ahead of the mixer. →

SHORT-WAVE AERIALS

Directional Effects — Doublet Design — Impedance Matching — Noise Reducing Aerials — Commercial Types.

THE extreme sensitivity of the superheterodyne circuit which makes possible reception of many stations without the employment of an aerial is responsible for the widespread belief that an aerial is a thing of the past. This is not so, for, as part of the equipment of a receiving station, the aerial has never assumed more importance than it possesses today.

A few feet of wire tacked around a cabinet or along a skirting board or picture railing, and frequently no aerial whatever, will enable a sensitive receiver to provide good volume from local and sometimes interstate stations. An aerial of this type, however, does not provide reception of the same high quality as those in the design of which commonsense principles have been observed.

A short inside aerial normally requires a receiver's sensitivity to be very high, with the result that reception is often marred by interference from electrical machinery.

Indoor aerials are generally in the field of electric wiring and pick up almost every form of disturbance that takes place in these circuits of which the power cables form part. The source of the interference may be located some several hundred yards from the receiver, but the electrical connection between the offending machine and the wiring about the receiver's aerial effectively transfers the unwanted noises to the set.

Where good reception of a nearby station may be obtained with a set's sensitivity controls well retarded, interference-free reception may be obtained with a small indoor aerial. But, tuning the receiver to another station will render the aerial less effective.

Noise Pick-up

FOR short-wave reception an efficient aerial is of paramount importance. On the higher frequencies even the slightest electrostatic discharge in an electrical circuit will announce its presence in the forms of clicks and buzzes in the receiver. High frequency reception demands that the receiver be in a very sensitive condition if any but the strongest of signals are to be heard.

When this is done the set's pick-up of unwanted noises is greatly increased.

Good reception of both medium wave and short wave stations requires that an incoming signal should be of the highest possible strength, that it should be picked up in an area in which interference is at a minimum, and that it should be led through the interference "cloud" surrounding electrical wiring in such a way that unwanted noises are not induced in the lead-in.

Very strong signals are not always necessary to make broadcasts enjoyable, a signal of medium strength and unmarred by fading, static or man-made interference, is much more valuable than a loud signal rendered less effective by unfavorable conditions.

Type Aerials

FOR reception of all stations it is a good plan to always use an outside aerial. The erection of the aerial well clear of trees, roofs and other objects, particularly those of metal, will result in an increase in signal pick-up, and keeping it as far distant as possible from tram and train lines, power lines, telephone lines, and roads on which motor traffic is heavy, will do much to ensure that incoming signals are received reasonably free from the effects of interference.

The most important problem is to transfer the "clean" signal from the aerial to the receiver without allowing the interference field through which it passes, and which normally extends to a height of about 25ft. above ground, to adversely affect it. The solution lies in the use of electrical screening of the down lead. This is discussed fully later in this article.

In some country districts and in parts where man-made interference assumes negligible proportions, the common inverted "L" type aerial will provide excellent results. A height of 25 to 40ft. is recommended and the length of the cross section should be approximately 40 to 60ft. It is inadvisable to increase the length of the horizontal section beyond 60ft.; such an increase will provide little gain in signal strength and may prove inefficient when the receiver is used on the broadcast band.

Constructional Hints

A FEW general hints on the construction of aerials should not go amiss. Heavy hard drawn copper wire, enamelled to prevent corrosion and oxidisation, is the best for short wave reception. High-frequency currents tend to travel along the outer surface of a conductor, and the elimination of corrosion and the stray capacities present in stranded wire, decreases the resistance of the path along which they move.

This reduces the wastage of energy in the aerial to a minimum.

It is advisable to keep the top section and the lead-in an unbroken length, but where joints are necessary, these should be soldered and wiped clean of any surplus flux, which may cause corrosion.

Furthermore, liberal use should be made of insulators. At each end of the aerial strain insulators made of glazed porcelain or strong high-grade glass, possessing a long leakage path, should be used. The number necessary will be dependent on the length of this path. Where it is no less than two inches, one insulator at each end will suffice.

To prevent friction, which would introduce noise and variation in signal strength, the lead-in must be well insulated from walls and window frames.

Noise Reducing Systems

THE simplest form of noise reducing aerial is illustrated in Fig. 1. It consists of a single horizontal wire, to which is attached one lead of a piece of twisted lighting flex. The remaining lead of the twin flex is not connected to the horizontal wire, but is taped up to prevent unravelling.

At the set end, this lead of the flex is connected to the earth terminal and the other lead to the aerial terminal. This aerial is very efficient on the broadcast band but, except in a few isolated cases, does not provide maximum reduction of interference on short wave transmissions.

The strength of short wave signals does not necessarily increase with an increase in aerial length. The most

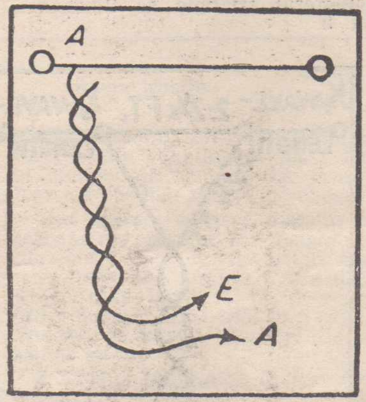


Fig. 1. — A simple noise-reducing aerial.

efficient aerial is one the electrical length of which is equal to one-half of the wave-length used by the station heard. In some cases the length is not critical, and an aerial cut to size will permit excellent reception over a band of frequencies, but, in no case, will it permit maximum efficiency on all bands. The all-wave aerial is merely a compromise and will be out-performed by one tuned for reception on a given wave-length.

The simplest way to transfer energy from an aerial, situated in an area fairly free from interference, to the receiver is to use a length of twisted flex. Noise disturbances are picked up by each wire, but as the energy in each wire is "out of phase," or opposite in effect, the noise is cancelled out.

The main problem is that of determining from what point along the horizontal section the lead-in is to be taken. This is governed by the principles of impedance matching. The impedance at the centre of a half-wave aerial is of the order of 70 ohms.

This increases until at the ends it reaches some several thousand ohms. The impedance of twisted cable ranges from 70 ohms to about 120 ohms, depending on the size of the wire and the spacing between each conductor.

Impedance Matching

IT is necessary to match the impedance of line and aerial proper and line and receiver in order to secure a maximum flow of energy from the aerial to the set. As mentioned before, the impedance of an aerial varies along its length, and the operation of making a correct match at any haphazard point is as hard as "putting the square peg in the round hole."

Half wave doublets, so called because the flat top section is divided into two equal sections each a quarter of the receiving wave length long, are simple and most efficient short wave aerials. By connecting two insulators between each quarter wave length and attaching one wire of the twin flex lead-in to each side, energy will flow from the flat top into the feeder or lead-in.

Good quality flex which will withstand exposure to the elements should be used for all lead-in applications. A lead-in of high grade electrical flex has an impedance of 100-130 ohms, and, to improve its match with the aerial, the ends of the quarter wave top sections should be spaced from 6in. to 3ft., and the top of the transmission line "fanned" out to form an equilateral triangle as illustrated in Fig. 2.

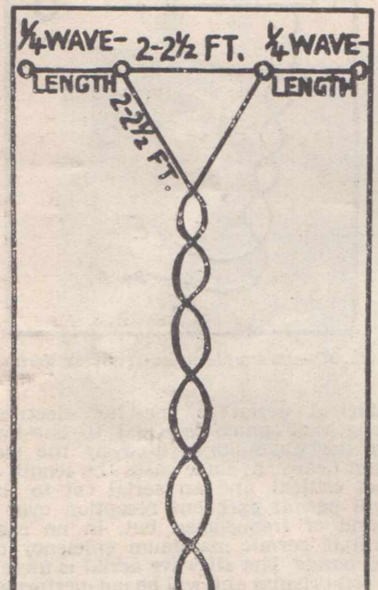


Fig. 2. — A half wave doublet using a twisted flex transmission line.

The purpose of the fanning is to connect the lead-in to the aerial at points where the aerial impedance is equal to that of the transmission line. A triangle having sides between 2ft. and 2½ft. in length will meet all requirements.

Transposed Lead-Ins

INSTEAD of twisted flex use may be made of transposition blocks and enamelled wire of the same type as that used in the flat top sections. The blocks, which are available commercially, are constructed of a high grade non-conductor, and are used for the purpose of spacing two-wire feeders. Slots are provided in them for the purpose of crossing the wires in order to reduce inter-action between them. Spaced at intervals of 2ft. to 3ft., one set of eight will meet most requirements.

When a half-wave doublet is used, care should be taken to ensure that one side of it is not earthed. Normally, one end of the primary winding of an aerial coil is connected to earth, and it is desirable that this lead should be disconnected from the chassis and taken to a separate insulated terminal. One side of the feeder is taken to this terminal, and the other to the aerial terminal on the set. Earthing one side will not cause a total elimination of signals, but will be responsible for a loss in efficiency.

In calculating the length of a doublet for any particular station convert the wavelength of the desired station to feet, one metre being equal to 39.37 inches, i.e., for a 20 metre station each quarter wave section would be 16.4ft. in length. The transmission line should be cut so that it will be an odd number of quarter wave lengths in length. For use with a 20 metre aerial the feeder should be 5, 15 or 25 metres long.

Multi-Band Aerials

THE most convenient length should be selected and any unwanted line coiled up. This is most important in the case of the commercial all-band aerial, which several manufacturers have now placed on the market. With these aerials impedances have not been exactly matched, but are, nevertheless, close enough to provide excellent reception on a number of bands. The aerial consists of a number of doublets having a common transmission line which is matched to them by a special transformer.

As the impedance varies along the length of an aerial, it is possible to connect a transmission line to points on several half-wave doublets in such a way that the line is matched to only one at a time.

The impedance offered to a 20-metre signal at the centre of a 40-metre doublet is equal to that at the ends of a 20-metre doublet, several thousand ohms. Consequently, where a feeder is common to both a 40 and 20-metre aerial only the 40-metre section will be effective on 40 metres, and the 20-metre section on 20 metres. By employing a special transformer, and in some cases connecting the line off centre, manufacturers have devised units which will provide a maximum noise-free signal on both broadcast and short wave bands. A multi-doublet or "spider-web" aerial of this type is illustrated in Fig. 3.

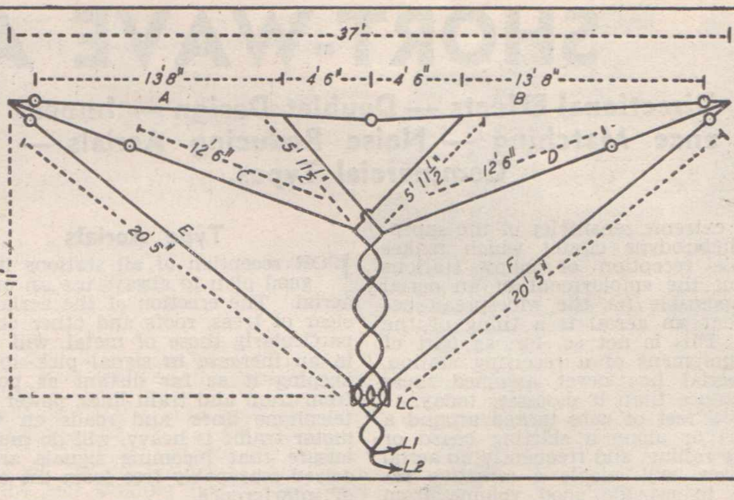


Fig. 3. — A full dimensional drawing of the "Spider Web" Aerial System.

Theory of the Spider-Web

GLANCE at the dimensional drawing while we explain the electrical characteristics of the system. The dipoles A and B, 18ft. 2in. in length, resonate in the 25-metre band and constitute the top section of the aerial. The middle dipoles C and D have an electrical length of 12ft. 6in. each and resonate at 16 metres. The lower dipoles, E and F measure 20ft. 5in. each and resonate at 49 metres.

Actually the dimensions of these dipoles should be greater for 49 metre resonance, but, in order to save space, they have been loaded by the coil LC to bring the resonant point to the desired wave-length.

It will be noted that the transmission line connecting C-D with A-B has been fanned to join A-B at points 4ft. 6in. on each side of the centre. The purpose of this is deliberately to mismatch the impedances of the line and the aerial to broaden the resonance point of the 25-metre doublet so that it will also possess good efficiency characteristics on 31 metres. Similar impedance matching is arranged by tapping the line into the loading coil, LC, connected in series with the 49-metre dipoles.

The impedance relationship existing between the three doublets and the transmission line is such that at resonance each doublet has an impedance of slightly more than 70 ohms. This impedance rises greatly off resonance so that any non-resonant doublet will have such a high parallel impedance as not to affect the working impedance of the doublet in use. In other words there will be no interaction between any doublet.

Another point which should be noted is that the standard method of cross connection is used. Thus the fan lead from the A side of the 25-metre doublet joins the D side of the 16-metre doublet. The D side of this doublet is, in turn, joined through the line to the E side of the 49-metre section.

Note that the transmission line is in two sections. The first extends from the junction of the 25 and 16-metre doublets to the 49-metre doublet.

The second is the 75ft. length of line which must be used with the main line which has an impedance of 90 ohms and provides a reasonably good impedance match with the three aerials.

The termination of the line is a problem for the experimenter. Hampered as he is for lack of accurate measuring equipment, he must be prepared to cut and try to obtain maximum performance on each wave band.

Coupling Problems

A SIMPLE system of coupling the line to the receiver is shown in Fig. 4. Here we find that a terminating impedance has been connected across the line and joined to the input circuit of the receiver by means of a pair of leads, one of which is tapped at a point above the low potential side of the system.

Note that the installation is for sets designed for operation from doublet aerials. Grounding the transmission line by connecting one of its sides to the set's earth terminal will unbalance the line and destroy the effectiveness of the aerial.

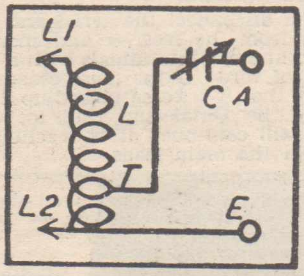


Fig. 4. — A method of terminating a transmission line.

The materials required are 150 feet of 16-gauge enamelled copper wire, a dozen insulators, 200 feet of 3/.029 V.I.R. cable, a small piece of bakelite tube and the coupling coil materials.

It is essential that the V.I.R. cable used should be of the stranded variety. Being very brittle, there is a tendency for a single wire to break when the slightest strain is imposed on it. Three strands of .029 will withstand the effects of exposure to high winds.

The best way to build this aerial is to set it out in the yard, anchoring the various points as the assembly is carried out. All measurements (and they must be reasonably accurate) are carried out from the end of the wire looped inside the insulator. Thus it will be necessary to allow about four inches more wire for each insulator than the lengths specified.

Start off by making the A-B doublet. Attach the fans and bring them down to the point at which the C-D dipoles are to be attached. Attach these dipoles to the extremes of the flat top section. Next, place the E-F dipoles into position, arranging their placement in strict accordance with the dimensional diagram.

Make sure that the crossovers are correct, as explained earlier. The loading coil consists of 24 turns of 22 gauge enamelled copper wire wound on a half-inch diameter wooden dowel which is placed inside a three-quarter inch diameter bakelite tube and cemented into place by means of a wax compound made by boiling together paraffin wax and resin.

The coil is tapped at the third turn from either end, and the twisted pair line from the junction of the 25 and 16 metre sections is connected to this point to which is also connected the main transmission line.

The next job is the construction of the coupling transformer.

This is an autotransformer, and may consist of 65 turns of 22 gauge enamelled copper wire wound on a 2in. diameter former. The winding is tapped at the fourth turn from the low potential end, this tap point being taken to the receiver aerial terminal through a .0007 mfd. variable condenser made up by connecting two sections of a .000385 mfd. gang in parallel.

Commercial Systems

OTHER commercial aerials do not use a complex doublet system, but, nevertheless, are dependent on the variation in impedance along the length of the aerial for matching. One of these is illustrated in Fig. 5. It consists of three lengths of wire of 60, 39 and 5 feet, supplied with the necessary insulators attached, an aerial matching unit which is suspended in the aerial, a 60 feet length of metal screened and gutta percha insulated down lead, and a receiver matching unit. The lengths of aerial wire must not be shortened.

The most efficient arrangement of the aerial is with the 60 and 39 feet lengths end to end. The 39 and 5 feet lengths are connected together at the aerial matching unit. If possible, therefore, a site enabling at least 100 feet of horizontal wire to be erected as high as possible should be chosen.

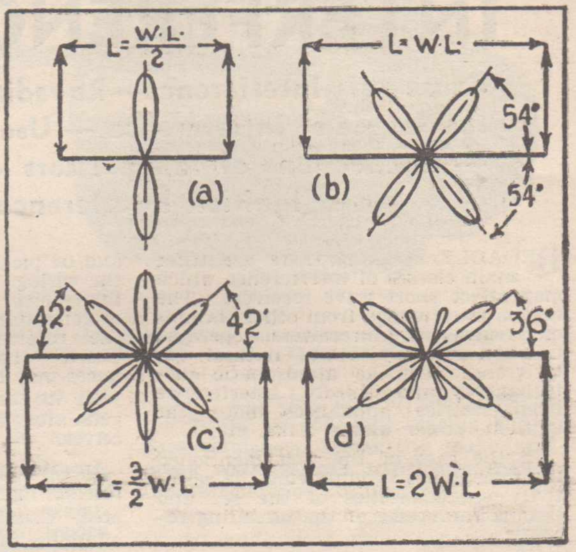


Fig. 6. — The directive characteristics of aerials of various lengths.

The makers suggest that to ensure satisfactory results the height of the horizontal wire should be at least 30 feet above the ground. Any difficulty which may have to be overcome in order to erect the aerial in a high position will be amply repaid by the gain in signal strength.

A further suggestion is that where a choice has to be made between a high position with restricted area and a lower height of greater area, the former should be chosen and the aerial formation changed. Illustrations A and B in Fig. 5 show typical layouts where the two lengths of aerial may be kept end to end, and illustrations C and D the layouts where sufficient space for the total length is not available.

Whatever layout is used the 5 feet length must be kept vertical by the use of a strainer. This length is most efficient on wavelengths of the order of 7-11 metres.

(Continued on Page 38)

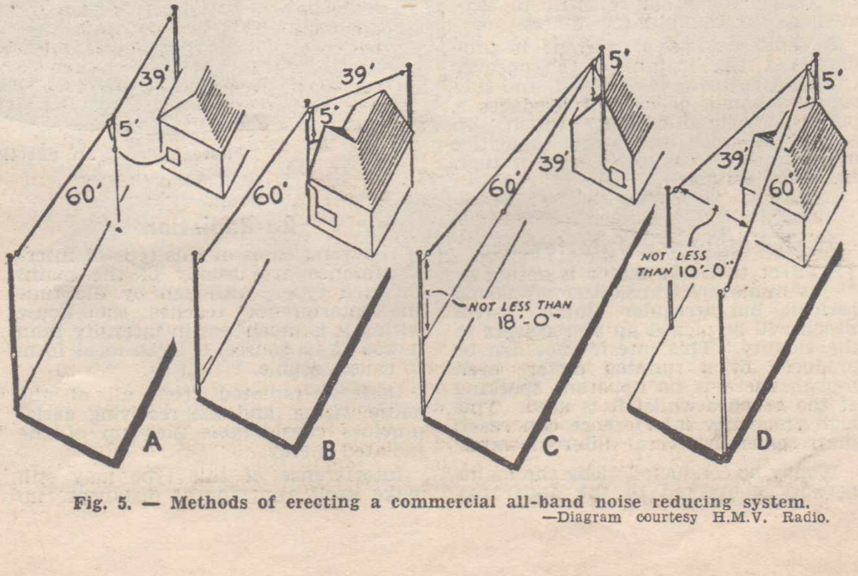


Fig. 5. — Methods of erecting a commercial all-band noise reducing system.
—Diagram courtesy H.M.V. Radio.

INTERFERENCE ELIMINATION

Cause of Interference—Re-radiation—Tracing the Source of Interference — Use of Line Filters — Connection of Suppressors — Curing Car Ignition Interference.

BROADLY speaking there are three main classes of interference which may affect short wave receivers. The first is interference from other stations or regenerative receivers operated nearby; secondly comes natural interference such as atmospheric disturbances; and thirdly, interference from electrical appliances, motor car ignition, power mains leaks, etc.

In the case of the first mentioned the remedy lies in improving the selectivity characteristics of the set and tracing the owner of the offending receiver.

When it comes to static and other similar atmospheric disturbances there is little that can be done by the listener to overcome this interference. Fortunately except at odd periods this type of interference does not constitute the main interference problem and is easily recognised from the more annoying "man made" noises which are usually the bane of short-wave reception.

Coming to the third type of interference that generated by electrical appliances, power mains leaks and motor car ignition noises here at least it is possible to reduce the offending noise to a low level providing time and care is taken.

This interference makes itself heard in the form of crackles, roaring noises, clicking, and the characteristic splutter of car ignition. Possibly the most prevalent of this form of interference is that from electric motors driving household appliances such as vacuum cleaners, sewing machines, small lathes, fans, etc.

Such motors consist of a commutator and field windings. The commutator, which is mounted on the rotating shaft, consists of a number of segments, contact with which is made by carbon brushes resting upon it. The purpose of the brushes is to change the connection from segment to segment as the commutator rotates.

A rapid change of current is produced at the instant of changeover from one segment to the next, and this sudden change of current produces a pulsating magnetic field, which, in association with the stray capacities in the motor sets up a series of high frequency waves.

High-Frequency Interference

IN effect then the motor is acting as a miniature transmitter producing periodic but irregular radio waves which will be picked up by receivers in the vicinity. This interference can be produced by a running motor even though there is no apparent sparking at the brushes whilst it is used. This high frequency interference can reach the receiver in several different ways.

It may be conducted along the mains network connected to the apparatus, and be picked up by the receiver from the wiring. On the other hand, where the receiver is operated from the motor or generator the disturbance may enter the receiver via the power leads. Thirdly, these high frequency disturbances may be re-radiated by metal objects in the vicinity of the motor or generator and picked up by the receiver.

In attempting to eliminate this interference many factors must be considered. Usually direct radiation from the offending apparatus is limited to a few yards, and can be cured quite effectively by the connection of suppressor condensers to the brushes and leads of the motor.

Where this form of high frequency interference is present in the mains lead to the receiver it will usually be found to be present also in a radiated form from the wiring, which will be much more severe, due to its high amplification by the circuits of the receiver. A low frequency form of interference may also be present under these circumstances, but a line filter will clear this up effectively.

Re-Radiation

THE worst cases of this type of interference are usually of the mains radiated type. Although by the time the interference reaches the house wiring it is much less in intensity than it was at its source, it is an ideal form to cause trouble.

It is re-radiated from all of the house wiring, and the receiving aerial provides considerable pick up of the radiated energy.

Interference of this type may still make itself annoying at distances up to two miles from its source. Obviously, the best way to overcome this trouble is to trace the interference to the offending apparatus, and to have suitable suppressors fitted to it.

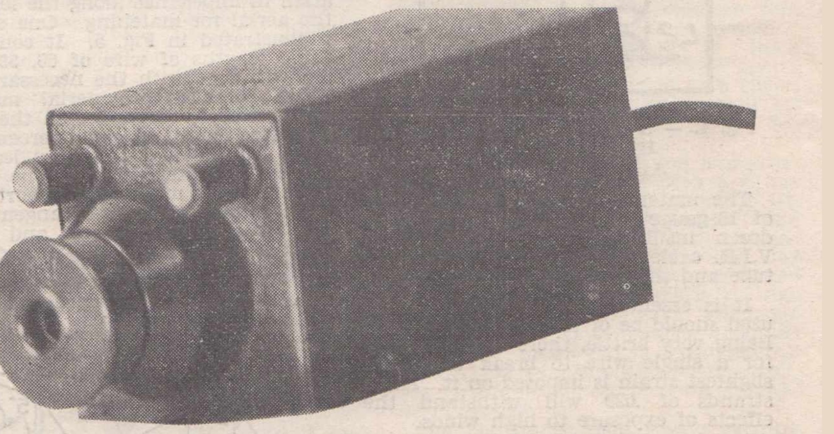
If this is not possible, the noise may be reduced considerably by connecting suitable suppressor type condensers across the main leads at the point of entry into the house. However, this must be correctly carried out by a licensed electrician, and fuses provided in the condenser leads. Even though this is done, in some cases the interference may still be bad, as the noise could be picked up from the wiring of the adjacent house.

Shielding Effective

THE only remedy then is to completely house the receiver in an earthed shield can and to use one of the many forms of noise reducing aerial systems to minimise the pick-up. The remaining type of interference, that radiated from metallic fixtures near the motor, also may be overcome in the above manner.

In some cases, it is difficult to decide how the interference is entering the receiver. The following suggestions will assist in checking the source of the interference, which is the first step towards its cure.

First disconnect the aerial and earth wires from the receiver and short the aerial and earth terminals with a small piece of wire. If the noise ceases, this shows that it is being picked up directly by the aerial and lead in, whilst if it still continues, it is reaching the set via the main leads.



Photograph of an effective commercial line filter.

Photo courtesy Hartleys Ltd.

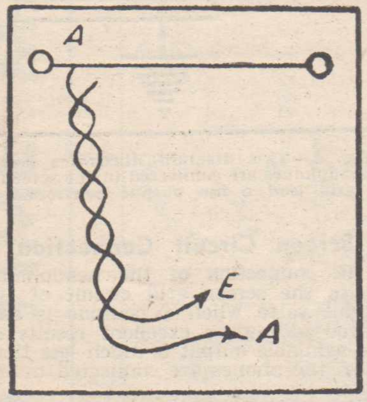
In the case of a battery set or in some cases with A.C. or D.C. mains receivers the noise may be picked up directly by the wiring of the set. In this case the only remedy is to house the chassis of the set in a shield can which must be joined to an efficient earth connection. Where the noise is definitely found to be entering the set via the mains power leads the connection of a line filter will prevent the interference.

Many reasonably priced commercial type line filters are available which are simple to connect and generally prove more satisfactory than the home-made article. Where the noise is found to be due to direct pick-up by the aerial system special precautions are necessary if the interference is to be reduced to a minimum.

Aerial Pick-up

IN the first place it is necessary to ascertain as far as possible the source of the noise. If this is found to be adjacent power cables it is essential to use a noise-reducing aerial system and to erect this in such a way that the aerial wire runs at right angles to the power lines.

In some cases a simple noise-reducing aerial system will fill the bill, but where a short or dual wave type receiver is employed, special matching devices are necessary in order to prevent any reduction in signal pick-up when the noise-reducing aerial is connected to the set. Several commercial type aerials for this purpose are available and are illustrated in the chapter devoted to Short-wave Aerials on Pages 13, 14 and 15.



A simple form of noise-reducing aerial which is extremely effective in operation.

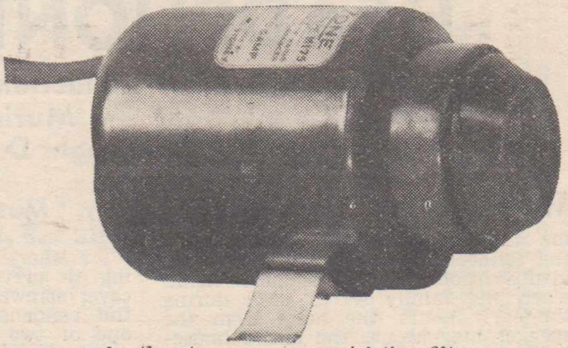
Full details as to the erection of these special aerials is supplied with them and it is outside the scope of this article to discuss this. Motor car ignition often causes bad interference in situations close to main roads which carry heavy motor traffic. This form of interference is particularly troublesome on the higher frequency bands, as the frequency of the interference is just above 30 mega-cycles.

This form of interference is usually picked up directly by the wiring of the receiver and in a minor degree by the aerial itself. However, if the aerial is erected at a fair average height from the nearest earthed object such as houses or trees the interference from this source should not be very great. The only remedy to direct pick-up is to use a shield can on the receiver chassis as described earlier in the chapter.

Interference from Neon signs, flasher lights, and electrical appliances used in garages, workshops or factories usually can be considerably reduced if the owners are approached and asked to fit suitable suppressor condensers.

Faulty House Wiring

ATTENTION to the electrical wiring and installation of the house in which the receiver is used will often clear up mysterious plops and crackles. Frequent sources of trouble are worn or loose switch contacts. The set screws in these units often work loose with continuous use and an overhaul by a competent electrician will be well repaid.


Another type of commercial line filter.
Photo courtesy Hartleys Ltd.

Loose wires or metallic surfaces in the vicinity of the receiver or its aerial, even though not being directly connected to it, are a likely source of extraneous noise.

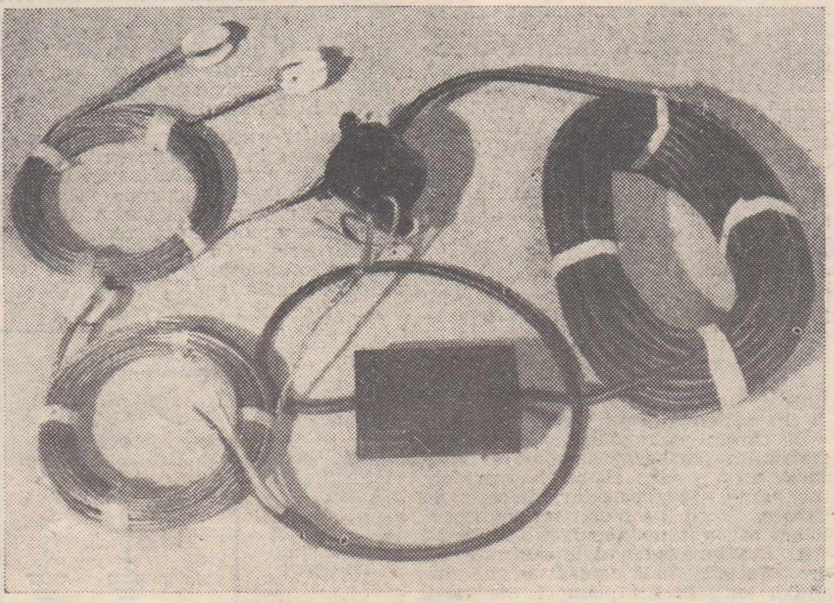
Any interference noticed mainly during high winds is usually due to this cause. Here again careful examination of surrounding metal fences, sheds, etc., is the only remedy.

Other causes of high frequency interference are house buzzers, door-bells, and house or inter-office phone systems. In each of these instances the trouble is due to the high frequency field set up by the inductance and rapid make and break contact, similar to that produced by the ordinary electric motor mentioned previously. Where the unit is operated from the same mains supply as the receiver a line filter connected in the supply lines as close to the interfering unit as possible will often effect a cure.

Useful Hints

IN other cases where the wiring of the telephone or buzzer is extensive the interference may be picked up directly from this wiring. This is much more difficult to eradicate, and it may be necessary to shield the set by placing it in a shield can and using a shielded lead-in type of all-wave aerial. Earthing one of the leads to the buzzer or bell, and placing a by-pass condenser across the make and break contacts will sometimes reduce the interference considerably.

Other forms of interference can be traced and cured providing the set-owner understands the general principles involved, which may be outlined as follows:—First, reduce the interference as much as possible at its source by the use of suppressor condensers or line filters. It is important that efficient earth connections be used with these units if best results are to be expected. Secondly, where the interference is being picked up directly by the aerial or lead-in, experiment with a different aerial or erect a matched all-wave noise-reducing system in its place. Thirdly, shield the set entirely where the wiring or grid leads of the R.F. valves are picking up the interference from its source. And, last of all, remember that an efficient line filter will remove the last trace of the interference where the noise is still present when the set is shielded and the aerial and earth terminals are shorted out

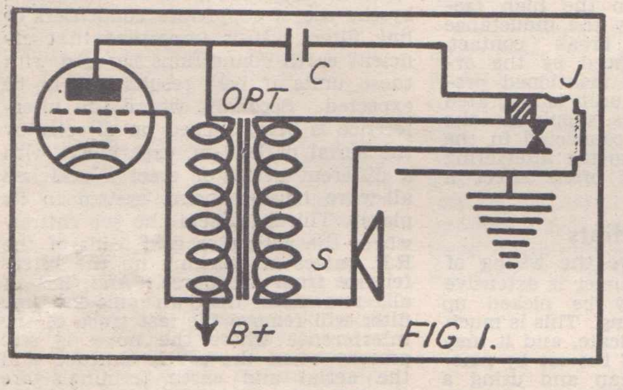

A special all-wave noise reducing aerial kit complete with matching transformers.
Photo courtesy H.M.V.

HEADPHONE CONNECTIONS

Uses for Headphones — Reduction of Output — Simplified Connections — Muting the Loud Speaker — Danger of High D.C. Currents.

WHERE standard dual-wave receivers are employed for short wave DX-ing the problem often arises as to the connection of headphones for the identification of weak signals. Again when the family set is used during the early hours, the noise from the speaker may arouse the entire household, whereas if headphones were fitted probably more listening would result, as this obstacle would be removed. It is really quite a simple matter for the home listener to fit phones to his receiver and to so arrange the speaker that it may be switched in or out at will.

The headphone connections are shown in diagrammatic form, but for the benefit of the novice a detailed account of the procedure necessary in their fitment will no doubt be of assistance.



A jack inserted in the output plate circuit will mute the speaker when headphones are used.

The simplest way to fit the phones to a set is shown in Fig. 1. In this case a condenser is connected to the plate of the valve and the phone leads connected from the free end of the condenser to the chassis of the set. The speaker is muted by arranging a switch in the lead from the secondary winding of the speaker transformer to the actual voice coil winding on the cone of the speaker.

If the following procedure is followed it will not be necessary to remove the chassis of the set from the cabinet to connect the phone feed condenser. Unscrew the cover of the speaker plug attached to the set and twist a piece of flexible hook-up wire to one of the pigtails of the condenser, which may be a .1 mfd. tubular unit.

Try the effect of touching the free end of the condenser in turn to each of the contacts of the speaker plug.

Be careful not to touch these contacts with the bare hands, or a nasty shock may result. However, providing the hands are kept clear, there is no danger. With the condenser connected to one of these contacts it will be found that the tone and volume of the set are affected. This contact is the one which joins to the plate of the valve and one lead of the condenser should be soldered to it.

Muting the Speaker

THE lead should first be covered with a short piece of spaghetti sleeving to prevent shorts and the plug cover screwed back. The free end of the condenser is then connected to one of two terminals mounted on a small piece of insulating material and the other terminal joined to the chassis. If the phones are then connected to the terminals it will be found that they are in working order.

The muting of the existing speaker then must be arranged. This is carried out as follows:—Carefully inspect the terminal strip attached to the speaker and unsolder one of the heavy wire leads connecting the transformer with the strip. Solder a long flex lead to the lug from which the lead was disconnected and another flex lead to the lead itself.

The ends of the two leads then connect to the contacts of a single circuit switch. When this switch is closed the speaker will operate and when the switch is opened the speaker will be muted and the phones alone can be used. The one drawback to this form of headphone connection is the large audio output being fed to the phones. Even with the volume control set to a low level bursts of static and other noises will reach large proportions due to the high output of the power valve.

A better arrangement is to connect the phones in the plate circuit of the first stage audio valve or in the grid circuit of the output tube. One such system is shown in which the grid side of the coupling condenser is fed to the arm of a two-position switch. The normal grid resistor and a lead from the grid lug of the output valve socket are connected to one position, while to the other is wired one of the headphone leads. The other headphone lead joins to the earth terminal or chassis.

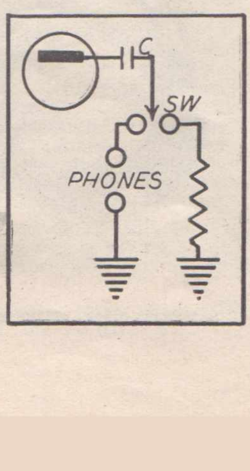


Fig. 2. — A switch in the plate circuit of an intermediate amplifier will permit the choice of either headphone or speaker reception.

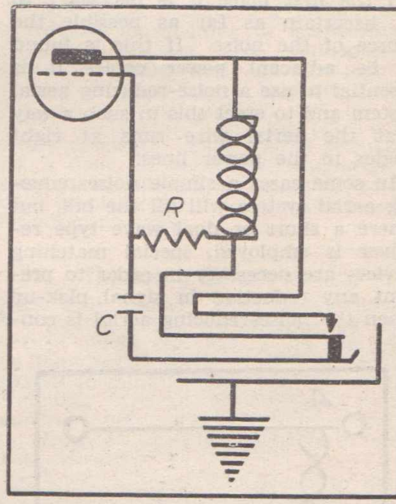


Fig. 3.—This diagram illustrates how headphones are connected in the screen grid lead o fan output pentrode.

Screen Circuit Connection

THE connection of the headphones to the screen grid circuit of the output valve when a pentode is employed also gives excellent results as the available output is much less than when the phones are connected to the plate.

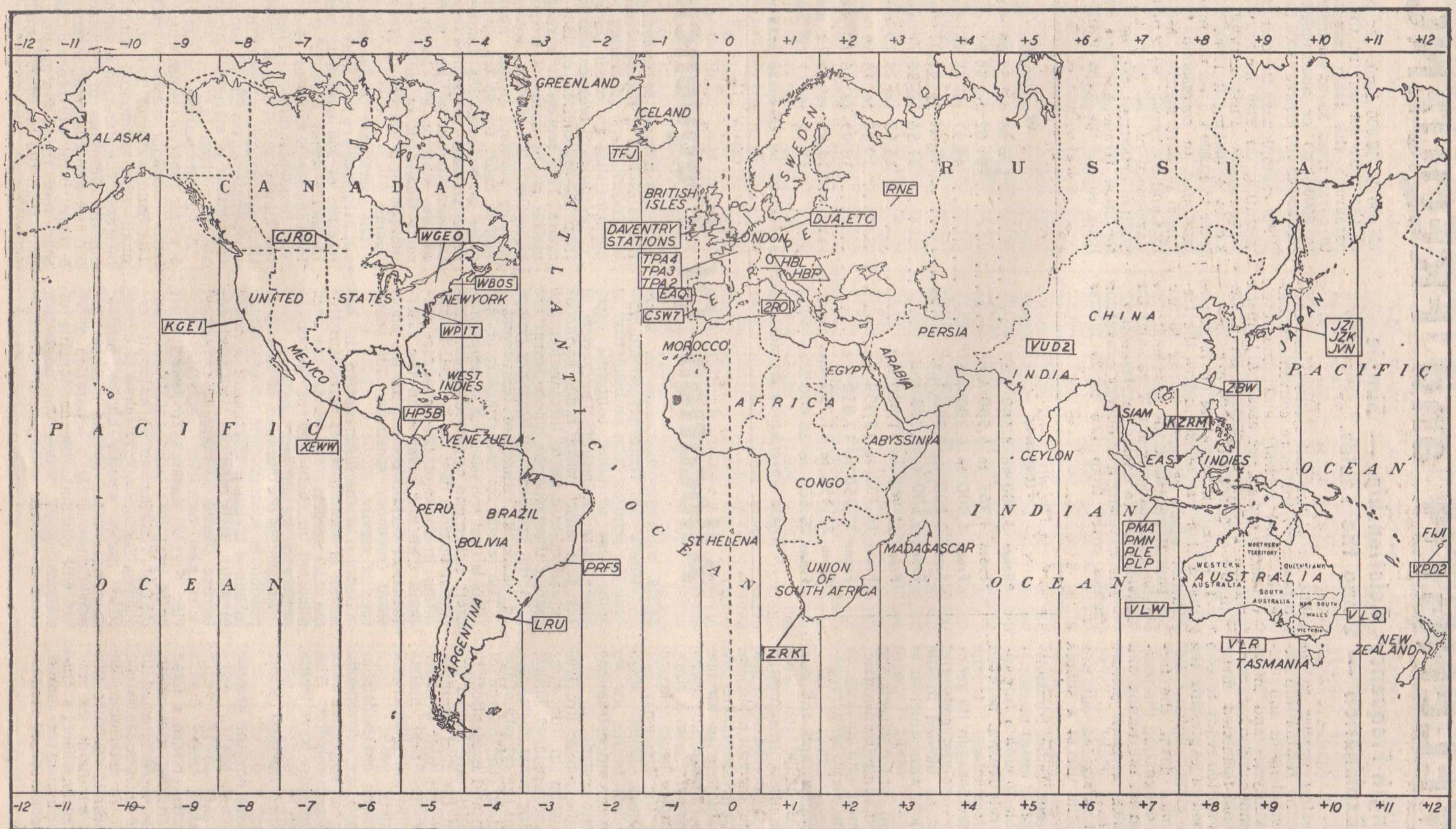
This system may be so arranged that the connection of the phones automatically mutes the speaker. Two contacts of a double circuit phone jack are used as a single circuit switch to short the primary of the speaker transformer when the phone plug is inserted, whilst the frame of the jack and the other long contact make the phone connections. The circuit diagram of this arrangement is shown in Fig. 3.

The condenser may be a 5 or 8 mfd. tubular electrolytic type. With this arrangement it will be noticed that it is necessary to connect a 2 watt 10,000 ohm resistor between "B" positive and the screen grid connection of the socket. In obscure cases where the headphones are connected in the plate circuit of the output valve of a regenerative type receiver, trouble may be experienced due to a body capacity effect.

This is noticed after a station has been tuned and when the operator moves away from the set the station disappears. This is due to R.F. being present in the phone leads, and can be cured by connecting standard R.F. chokes in series with the phone leads.

Whilst experimenting with differing types of headphone connections the novice should be careful to see that the plate circuit of any pentode output valve is not left open. If this occurs the screen grid will draw an abnormally high current, and this may result in permanent damage to the valve. On no account should headphones be connected directly into circuits carrying high D.C. currents, as the windings of the phones will burn out very quickly.

WORLD TIME MAP



With the assistance of this map and station operating schedules (Short Wave Station List, Page 24) listeners can ascertain when to listen for overseas stations.

In following published programmes it should be remembered that only in New Zealand and a few East Asian countries are local times ahead of those in Australia. The standard times of the various countries become further behind that of New Zealand, as they are situated nearer to the left-hand margin of the map. Sometimes the time difference between countries on either side of the map is so great that some alteration in date also is necessary.

For example, when it is 8 a.m. in Eastern Australia it is 10 p.m. (the previous day) in London and 2 a.m. in San Francisco (KGEI), Greenwich time being 10 hours behind Eastern Australian time, and Pacific Coast time of America a further eight hours behind Greenwich.

The time differences are based on mean times, hence some adjustment must be made when countries, in adopting daylight saving, advance their local times beyond mean times.

WAVELENGTH and FREQUENCY

Wavelength-Frequency Relationship — Simple Explanation — Using the Tables.

ONE of the greatest puzzles to the uninitiated is the relationship existing between wavelength and frequency. Cycles, kilocycles and megacycles seem so complicated when compared with the old-fashioned metre that the novice is all too ready to skip this modern method of expressing the dial setting of a given station. Yet when it is all boiled down, the frequency method of designating the position of any station on the tuning dial gives by far the most accurate picture of affairs.

Let us try and straighten out this mental tangle by the use of a simple analogy.

If we consider our radio transmitting station as a super speed machine-gun, we may be able to gain a full appreciation of the relationship between wavelength and frequency. If the transmitter is a machine-gun its generative apparatus — valves, coils and transformers—may be likened to the cordite in the bullets with which it is loaded.

The aerial system, which directs the radio waves emitted by the transmitter, would in our machine-gun analogy be the barrel and the sighting arrangements.

We press the trigger and the gun starts to fire. Each bullet represents a train of radio impulses. Imagine the gun fires at the rate of 500 shots per second Then one second after the trigger has been depressed there are 500 bullets flying through the air one behind the other. The radio transmitter emits its wave trains in a similar manner, the number being released each second being the frequency.

Now in our second's firing when there were 500 bullets in the air we assume that each is separated from the following one by one metre.

If we speed up the gun to fire 1000 shots per second then in the same second's firing there are 1000 bullets in line but over the same distance—bearing in mind that the velocity of the bullets is governed by the charge of cordite behind each and is identical in each case—1000 bullets are spaced instead of the 500 in the first example. Thus there can be only half a metre separating each of the 1000 bullets against the one metre which separated each of the 500 bullets.

The distance between our bullets in the machine-gun analogy corresponds to the distance between successive wave trains in the radio transmission. The distance between successive wave trains is called Wavelength.

We have established the first point, i.e.:

The lower the frequency the greater the wavelength.

Applying The Table

NOW radio waves travel with a fixed velocity irrespective of wavelength or frequency. Their speed is equal to that of light—186,000 miles or 300,000,000 metres per second. To determine the wavelength of a transmission when the frequency is known we divide the frequency into the velocity. Thus a frequency of 15,000,000 cycles per second is equal to a wavelength of 20 metres.

The use of the unit cycles is too cumbersome so the more convenient kilocycle (1000 cycles) and megacycle (1,000,000 cycles) are used. A 15 metre station is said to operate on a frequency of 20,000 k.c. or 20 m.c.

If instead of operating on 15 metres the station was on 30 metres the frequency would be 10,000 k.c. or 10 m.c.

Thus if we double the wavelength we halve the frequency and if we halve the wavelength we double the frequency.

The wavelength frequency conversion tables cover from 12.5 to 25 metres (24,000 to 12,000 k.c.). By application of the rules set out in the preceding paragraph this table can be doubled to cover from 25 to 50 metres (12,000 to 6000 k.c.) or quadrupled to cover from 50 to 100 metres (6000 to 3000 k.c.).

For example take the case of a station operating on 3200 k.c. What is its wavelength? First multiply the 3200 k.c. by 4, making it 12,800 k.c. Then refer to 12,800 k.c. on the table. It will be found to correspond to a wavelength of 23.43 metres. Multiply 23.43 by 4 and the answer, 93.72 metres, is the wavelength of the 3200 k.c. station. Similar extensions can be carried out for other frequencies and wavelengths lying outside the scope of the tables.

Frequency		Wavelength
*From 3,300 to 3,500 k.c.	....	*90.86 to 85.66 metres
*From 4,965 to 5,500 k.c.	....	*61.02 to 54.51 metres
From 6,000 to 6,200 k.c.	....	49.97 to 48.36 metres
From 7,200 to 7,300 k.c.	....	41.64 to 41.07 metres
From 9,500 to 9,700 k.c.	....	31.56 to 30.91 metres
From 11,700 to 11,900 k.c.	....	25.63 to 25.20 metres
From 15,100 to 15,350 k.c.	....	19.86 to 19.54 metres
From 17,750 to 17,850 k.c.	....	16.95 to 16.31 metres
From 21,450 to 21,750 k.c.	....	13.99 to 13.79 metres
From 25,600 to 26,600 k.c.	....	11.72 to 11.28 metres

*These wave bands are not approved for use by European stations.

Allocation Of Frequencies

THE foregoing discussion on wavelength and frequency should provide the solution to a problem that at some time or other confronts every short wave enthusiast. The review of his first short wave radio handbook reveals quite a lot of information, and among the principal points learnt are that the broadcast stations are grouped in small "bands" of frequencies.

The reason for the grouping of stations is that the demands of ships, aircraft, police and commercial communication services have to be met, in addition to those of the broadcast stations. This has resulted in the reservation of certain portions of the short wave frequency spectrum for each type of service.

Because of the difference in the behavior of wireless waves at various frequencies, several small bands have been allocated to each type of station in preference to one large band.

Regarding the question of how is it possible to accommodate many stations in bands of but a fraction of a metre in width, it is essential that some reference should be made to frequency.

In most countries regulations provide that a station's frequency must be at least 10 kilocycles different from that of a station on an adjacent frequency. Engineers have taken 10 k.c. or 10,000 cycles, as the highest audible note transmitted by the average station. Consequently, a separation of 10 k.c. will eliminate the overlapping of stations at all times. An inselective receiver circuit will permit overlapping, but it must be remembered that the fault lies in the receiver and not in transmitters operating on frequencies that are closer than 10 k.c.

The standard broadcast band extends from 200-545 metres, or 1500-550 kilocycles. This represents a range of 350 metres or, in terms of frequency, 950 kilocycles. It will be seen that by spacing stations 10 k.c. apart provision is made for 95 transmissions. In order to increase this number two or more stations sometimes operate on the same frequency, but, when this is so, the stations are located perhaps some thousands of miles apart and their power is reduced to prevent interference.

The short wave bands vary in width, but in no case are they more than a small fraction of 350 metres in width. The 16 metre band extends from 16.81-16.95 metres, a range of .14 of a metre. The frequency range is 17850-17750, or 100 kilocycles. Thus, it will be seen that band width expressed in terms of wavelength gives little indication of the number of stations that may operate in a given band.

A further example is shown in the 5 metre amateur band which extends from 5-5.357 metres (60,000-56,000 k.c.). The band width of .357 of a metre is small when compared with the 350 metres of the standard broadcast band, but the difference in frequency range, 950 and 4000 kilocycles, means that the 5 metre band will accommodate more than four times the number of stations than the broadcast band.

WAVE-LENGTH — FREQUENCY TABLE

K.C.	Metres	K.C.	Metres	K.C.	Metres	K.C.	Metres	K.C.	Metres	K.C.	Metres	K.C.	Metres
24,000	12.500	23,140	12.964	22,280	13.464	21,420	14.005	20,560	14.591	19,710	15.220	18,860	15.907
23,990	12.505	23,130	12.970	22,270	13.471	21,410	14.012	20,550	14.598	19,700	15.228	18,850	15.915
23,980	12.510	23,120	12.975	22,260	13.477	21,400	14.018	20,540	14.605	19,690	15.236	18,840	15.924
23,970	12.516	23,110	12.981	22,250	13.483	21,390	14.025	20,530	14.612	19,680	15.247	18,830	15.932
23,960	12.520	23,100	12.987	22,240	13.489	21,380	14.031	20,520	15.619	19,670	15.251	18,820	15.940
23,950	12.526	23,090	12.992	22,230	13.495	21,370	14.038	20,510	14.627	19,660	15.259	18,810	15.949
23,940	12.531	23,080	12.998	22,220	13.501	21,360	14.044	20,500	14.634	19,650	15.267	18,800	15.957
23,930	12.537	23,070	13.003	22,210	13.507	21,350	14.051	20,490	14.641	19,640	15.274	18,790	15.966
23,920	12.542	23,060	13.009	22,200	13.513	21,340	14.058	20,480	14.648	19,630	15.282	18,780	15.974
23,910	12.547	23,050	13.015	22,190	13.519	21,330	14.064	20,470	14.655	19,620	15.290	18,770	15.982
23,900	12.552	23,040	13.020	22,180	13.525	21,320	14.071	20,460	14.662	19,610	15.298	18,760	15.991
23,890	12.558	23,030	13.026	22,170	13.531	21,310	14.077	20,450	14.669	19,600	15.306	18,750	16.000
23,880	12.563	23,020	13.032	22,160	13.537	21,300	14.084	20,440	14.677	19,590	15.313	18,740	16.009
23,870	12.569	23,010	13.937	22,150	13.544	21,290	14.091	20,430	14.684	19,580	15.321	18,730	16.017
23,860	12.573	23,000	13.043	22,140	13.550	21,280	14.097	20,420	14.691	19,570	15.329	18,720	16.026
23,850	12.579	22,990	13.049	22,130	13.556	21,270	14.104	20,410	14.698	19,560	15.337	18,710	16.034
23,840	12.584	22,980	13.054	22,120	13.562	21,260	14.111	20,400	14.705	19,550	15.345	18,700	16.043
23,830	12.589	22,970	13.060	22,110	13.568	21,250	14.117	20,390	14.713	19,540	15.353	18,690	16.051
23,820	12.594	22,960	13.066	22,100	13.574	21,240	14.124	20,380	14.720	19,530	15.360	18,680	16.060
23,810	12.600	22,950	13.071	22,090	13.580	21,230	14.130	20,370	14.727	19,520	15.368	18,670	16.069
23,800	12.605	22,940	13.077	22,080	13.586	21,220	14.137	20,360	14.734	19,510	15.376	18,660	16.077
23,790	12.610	22,930	13.083	22,070	13.593	21,210	14.144	20,350	14.742	19,500	15.384	18,650	16.086
23,780	12.616	22,920	13.089	22,060	13.599	21,200	14.150	20,340	14.749	19,490	15.392	18,640	16.094
23,770	12.620	22,910	13.094	22,050	13.605	21,190	14.157	20,330	14.756	19,480	15.400	18,630	16.103
23,760	12.626	22,900	13.100	22,040	13.611	21,180	14.164	20,320	14.763	19,470	15.408	18,620	16.112
23,750	12.632	22,890	13.106	22,030	13.617	21,170	14.170	20,310	14.771	19,460	15.416	18,610	16.120
23,740	12.637	22,880	13.111	22,020	13.623	21,160	14.177	20,300	14.778	19,450	15.424	18,600	16.129
23,730	12.642	22,870	13.117	22,010	13.630	21,150	14.184	20,290	14.785	19,440	15.432	18,590	16.138
23,720	12.648	22,860	13.123	22,000	13.636	21,140	14.191	20,280	14.792	19,430	15.440	18,580	16.146
23,710	12.653	22,850	13.129	21,990	13.642	21,130	14.197	20,270	14.800	19,420	15.447	18,570	16.155
23,700	12.658	22,840	13.134	21,980	13.648	21,120	14.204	20,260	14.807	19,410	15.455	18,560	16.164
23,690	12.663	22,830	13.140	21,970	13.654	21,110	14.211	20,250	14.814	19,400	15.463	18,550	16.173
23,680	12.668	22,820	13.146	21,960	13.661	21,100	14.218	20,240	14.822	19,390	15.471	18,540	16.181
23,670	12.674	22,810	13.152	21,950	13.667	21,090	14.224	20,230	14.829	19,380	15.479	18,530	16.190
23,660	12.679	22,800	13.157	21,940	13.673	21,080	14.231	20,220	14.836	19,370	15.487	18,520	16.199
23,650	12.684	22,790	13.163	21,930	13.679	21,070	14.238	20,210	14.844	19,360	14.495	18,510	16.207
23,640	12.690	22,780	13.169	21,920	13.686	21,060	14.245	29,200	14.851	19,350	15.503	18,500	16.216
23,630	12.695	22,770	13.175	21,910	13.692	21,050	14.251	20,190	14.858	19,340	15.511	18,490	16.224
23,620	12.701	22,760	13.181	21,900	13.698	21,040	14.258	20,180	14.866	19,330	15.519	18,480	16.234
23,610	12.706	22,750	13.186	21,890	13.704	21,030	14.265	20,170	14.873	19,320	15.527	18,470	16.243
23,600	12.711	22,740	13.192	21,880	13.711	21,020	14.272	20,160	14.880	19,310	15.535	18,460	16.251
23,590	12.717	22,730	13.198	21,870	13.717	21,010	14.278	20,150	14.888	19,300	15.544	18,450	16.260
23,580	12.722	22,720	13.204	21,860	13.723	21,000	14.285	20,140	14.895	19,290	15.552	18,440	16.269
23,570	12.728	22,710	13.210	21,850	13.729	20,990	14.292	20,130	14.903	19,280	15.560	18,430	16.278
23,560	12.733	22,700	13.215	21,840	13.736	20,980	14.299	20,120	14.910	19,270	15.568	18,420	16.287
23,550	12.738	22,690	13.221	21,830	13.742	20,970	14.306	20,110	14.917	19,260	15.576	18,410	16.295
23,540	12.744	22,680	13.227	21,820	13.748	20,960	14.312	20,100	14.925	19,250	15.584	18,400	16.304
23,530	12.749	22,670	13.233	21,810	13.755	20,950	14.319	20,090	14.932	19,240	15.593	18,390	16.313
23,520	12.755	22,660	13.239	21,800	13.761	20,940	14.326	20,080	14.940	19,230	15.600	18,380	16.322
23,510	12.760	23,650	13.245	21,790	13.767	20,930	14.333	20,070	14.947	19,220	15.609	18,370	16.331
23,500	12.765	22,640	13.250	21,780	13.774	20,920	14.340	20,060	14.955	19,210	15.617	18,360	16.340
23,490	12.771	22,630	13.256	21,770	13.780	20,910	14.347	20,050	14.962	19,200	15.625	18,350	16.349
23,480	12.776	22,620	13.262	21,760	13.786	20,900	14.354	20,040	14.970	19,190	15.633	18,340	16.358
23,470	12.782	22,610	13.268	21,750	13.793	20,890	14.360	20,030	14.977	19,180	15.641	18,330	16.367
23,460	12.787	22,600	13.274	21,740	13.799	20,880	14.369	20,020	14.985	19,170	15.649	18,320	16.376
23,450	12.793	22,590	13.280	21,730	13.805	20,870	14.374	20,010	14.992	19,160	15.658	18,310	16.384
23,440	12.798	22,580	13.286	21,720	13.812	20,860	14.381	20,000	15.000	19,150	15.666	18,300	16.393
23,430	12.804	22,570	13.291	21,710	13.818	20,850	14.388	19,990	15.007	19,140	15.674	18,290	16.402
23,420	12.809	22,560	13.297	21,700	13.824	20,840	14.395	19,980	15.015	19,130	15.682	18,280	16.411
23,410	12.815	22,550	13.303	21,690	13.831	20,830	14.402	19,970	15.022	19,120	15.690	18,270	16.420
23,400	12.820	22,540	13.309	21,680	13.837	20,820	14.409	19,960	15.030	19,110	15.699	18,260	16.429
23,390	12.825	22,530	13.315	21,670	13.844	20,810	14.416	19,950	15.037	19,100	15.707	18,250	16.438
23,380	12.831	22,520	13.321	21,660	13.850	20,800	14.423	19,940	15.045	19,090	15.715	18,240	16.447
23,370	12.836	22,510	13.327	21,650	13.856	20,790	14.430	19,930	14.052	19,080	15.723	18,230	16.456
23,360	12.842	22,500	13.333	21,640	13.863	20,780	14.436	19,920	15.060	19,070	15.732	18,220	16.465
23,350	12.847	22,490	13.339	21,630	13.869	20,770	14.443	19,910	15.067	19,060	15.740	18,210	16.474
23,340	12.853	22,480	13.345	21,620	13.876	20,760	14.450	19,900	15.075	19,050	15.748	18,200	16.484
23,330	12.858	22,470	13.351	21,610	13.882	20,750	14.457	19,890	15.082	19,040	15.756	18,190	16.493
23,320	12.864	22,460	13.357	21,600	13.888	20,740	14.464	19,880	15.090	19,030	15.765	18,180	16.502
23,310	12.870	22,450	13.363	21,590	13.895	20,730	14.471	19,870	15.098	19,020	15.773	18,170	16.511
23,300	12.875	22,440	13.368	21,580	13.901	20,720	14.478	19,860	15.105	19,010	15.781	18,160	16.520
23,290	12.881	22,430	13.374	21,570	13.908	20,710	14.485	19,850	15.113	19,000	15.789	18,150	16.529
23,280	12.886	22,420	13.380	21,560	13.914	20,700	14.492	19,840	15.120	18,990	15.798	18,140	16.538
23,270	12.892	22,410	13.386	21,550	13.921	20,690	14.499	19,830	15.128	18,980	15.806	18,130	16.547
23,260	12.897	22,400	13.392	21,540	13.927	20,680	14.506	19,820	15.136	18,970	15.814	18,120	16.556
23,250	12.903	22,390	13.398	21,530	13.934	20,670	14.513	19,810	15.143	18,960	15.823	18,110	16.565
23,240	12.908	22,380	13.404	21,520	13.940	20,660	14.520	19,800	15.151	18,950	15.831	18,100	16.575
23,230	12.914	22,370	13.410	21,510	13.947	20,650	14.527	19,790	15.159	18,940	15.839	18,090	16.583
23,220	12.919	22,360	13.416	21,500	13.953	20,640	14.534	19,780	15.166	18,930	15.848	18,080	16.593
23,210	12.925	22,350	13.422	21,490	13.959	20,630	14.541	19,770	15.174	18,920	15.856	18,070	16.602
23,200	12.931	22,340	13.428	21,480	13.966	20,620	14.548	19,760	15.182	18,910	15.865	18,060	16.611
23,190	12.936	22,330	13.434	21,470	13.972	20,610	14.556	19,750	15.189	18,900	15.873	18,050	16.620
23,180	12.942	22,320	13.440	21,460	13.979	20,600	14.563	19,740	15.197	18,890	15.881	18,040	16.630
23,170	12.947	22,310	13.446	21,450	13.986	20,590	14.570	19,730	15.205	18,880	15.890	18,030	16.639
23,160	12.953	22,300	13.452	21,440	13.992	20,580	14.577	19,720	15.212	18,870	15.898	18,020	16.648
23,150	12.958	22,290	13.458	21,430	13.999	20,570	14.584					18,010	16.657

WAVE-LENGTH — FREQUENCY TABLE (Continued)

K.C.	Metres	K.C.	Metres	K.C.	Metres	K.C.	Metres	K.C.	Metres	K.C.	Metres	K.C.	Metres
18,000	16.667	17,140	17.503	16,280	18.428	15,420	19.455	14,560	20.604	13,700	21.898	12,840	23.364
17,990	16.676	17,130	17.513	16,270	18.439	15,410	19.468	14,550	20.619	13,690	21.914	12,830	23.383
17,980	16.685	17,120	17.523	16,260	18.450	15,400	19.481	14,540	20.633	13,680	21.930	12,820	23.401
17,970	16.694	17,110	17.534	16,250	18.462	15,390	19.493	14,530	20.647	13,670	21.946	12,810	23.419
17,960	16.704	17,100	17.544	16,240	18.473	15,380	19.506	14,520	20.661	13,660	21.962	12,800	23.438
17,950	16.713	17,090	17.554	16,230	18.484	15,370	19.519	14,510	20.675	13,650	21.978	12,790	23.456
17,940	16.722	17,080	17.564	16,220	18.496	15,360	19.531	14,500	20.690	13,640	21.994	12,780	23.474
17,930	16.732	17,070	17.575	16,210	18.507	15,350	19.544	14,490	20.704	13,630	22.010	12,770	23.493
17,920	16.741	17,060	17.585	16,200	18.519	15,340	19.557	14,480	20.718	13,620	22.026	12,760	23.511
17,910	16.750	17,050	17.595	16,190	18.530	15,330	19.569	14,470	20.733	13,610	22.043	12,750	23.529
17,900	16.760	17,040	17.606	16,180	18.541	15,320	19.582	14,460	20.747	13,600	22.059	12,740	23.548
17,890	16.770	17,030	17.616	16,170	18.553	15,310	19.595	14,450	20.761	13,590	22.075	12,730	23.566
17,880	16.779	17,020	17.626	16,160	18.564	15,300	19.608	14,440	20.776	13,580	22.091	12,720	23.585
17,870	16.788	17,010	17.637	16,150	18.576	15,290	19.621	14,430	20.790	13,570	22.108	12,710	23.603
17,860	16.797	17,000	17.647	16,140	18.588	15,280	19.634	14,420	20.804	13,560	22.124	12,700	23.622
17,850	16.807	16,990	17.657	16,130	18.599	15,270	19.646	14,410	20.819	13,550	22.140	12,690	23.641
17,840	16.816	16,980	17.668	16,120	18.610	15,260	19.659	14,400	20.833	13,540	22.157	12,680	23.659
17,830	16.826	16,970	17.678	16,110	18.622	15,250	19.672	14,390	20.848	13,530	22.173	12,670	23.678
17,820	16.835	16,960	17.689	16,100	18.634	15,240	19.686	14,380	20.862	13,520	22.189	12,660	23.697
17,810	16.844	16,950	17.699	16,090	18.645	15,230	19.698	14,370	20.877	13,510	22.206	12,650	23.715
17,800	16.854	16,940	17.710	16,080	18.657	15,220	19.711	14,360	20.891	13,500	22.222	12,640	23.734
17,790	16.863	16,930	17.720	16,070	18.668	15,210	19.724	14,350	20.906	13,490	22.239	12,630	23.753
17,780	16.873	16,920	17.730	16,060	18.680	15,200	19.737	14,340	20.921	13,480	22.255	12,620	23.772
17,770	16.882	16,910	17.741	16,050	18.692	15,190	19.750	14,330	20.935	13,470	22.272	12,610	23.791
17,760	16.892	16,900	17.751	16,040	18.703	15,180	19.763	14,320	20.949	13,460	22.288	12,600	23.801
17,750	16.901	16,890	17.761	16,030	18.715	15,170	19.776	14,310	20.964	13,450	22.305	12,590	23.828
17,740	16.911	16,880	17.773	16,020	18.727	15,160	19.789	14,300	20.979	13,440	22.321	12,580	23.847
17,730	16.920	16,870	17.783	16,010	18.738	15,150	19.802	14,290	20.994	13,430	22.338	12,570	23.866
17,720	16.930	16,860	17.794	16,000	18.750	15,140	19.815	14,280	21.008	13,420	22.355	12,560	23.885
17,710	16.940	16,850	17.804	15,990	18.762	15,130	19.828	14,270	21.023	13,410	22.371	12,550	23.904
17,700	16.949	16,840	17.815	15,980	18.773	15,120	19.841	14,260	21.038	13,400	22.388	12,540	23.923
17,690	16.959	16,830	17.825	15,970	18.785	15,110	19.851	14,250	21.053	13,390	22.405	12,530	23.943
17,680	16.968	16,820	17.836	15,960	18.797	15,100	19.868	14,240	21.067	13,380	22.422	12,520	23.962
17,670	16.978	16,810	17.847	15,950	18.809	15,090	19.881	14,230	21.082	13,370	22.438	12,510	23.981
17,660	16.988	16,800	17.857	15,940	18.821	15,080	19.894	14,220	21.097	13,360	22.455	12,500	24.000
17,650	16.997	16,790	17.868	15,930	18.832	15,070	19.907	14,210	21.112	13,350	22.472	12,490	24.019
17,640	17.007	16,780	17.878	15,920	18.844	15,060	19.920	14,200	21.127	13,340	22.489	12,480	24.038
17,630	17.016	16,770	17.889	15,910	18.856	15,050	19.934	14,190	21.142	13,330	22.506	12,470	24.058
17,620	17.026	16,760	17.900	15,900	18.868	15,040	19.947	14,180	21.157	13,320	22.523	12,460	24.077
17,610	17.036	16,750	17.910	15,890	18.880	15,030	19.960	14,170	21.171	13,310	22.539	12,450	24.096
17,600	17.046	16,740	17.921	15,880	18.892	15,020	19.973	14,160	21.186	13,300	22.556	12,440	24.116
17,590	17.055	16,730	17.932	15,870	18.904	15,010	19.987	14,150	21.201	13,290	22.573	12,430	24.135
17,580	17.065	16,720	17.943	15,860	18.916	15,000	20.000	14,140	21.216	13,280	22.590	12,420	24.155
17,570	17.075	16,710	17.953	15,850	18.927	14,990	20.013	14,130	21.231	13,270	22.607	12,410	24.174
17,560	17.084	16,700	17.964	15,840	18.839	14,980	20.027	14,120	21.246	13,260	22.624	12,400	24.194
17,550	17.094	16,690	17.975	15,830	18.951	14,970	20.040	14,110	21.262	13,250	22.642	12,390	24.213
17,540	17.104	16,680	17.986	15,820	18.963	14,960	20.053	14,100	21.277	13,240	22.659	12,380	24.233
17,530	17.114	16,670	17.996	15,810	18.975	14,950	20.067	14,090	21.292	13,230	22.676	12,370	24.252
17,520	17.123	16,660	18.007	15,800	18.987	14,940	20.080	14,080	21.307	13,220	22.692	12,360	24.272
17,510	17.133	16,650	18.018	15,790	18.999	14,930	20.094	14,070	21.322	13,210	22.710	12,350	24.291
17,500	17.143	16,640	18.029	15,780	19.011	14,920	20.107	14,060	21.337	13,200	22.727	12,340	24.311
17,490	17.153	16,630	18.040	15,770	19.023	14,910	20.121	14,050	21.352	13,190	22.745	12,330	24.331
17,480	17.162	16,620	18.051	15,760	19.036	14,900	20.134	14,040	21.368	13,180	22.762	12,320	24.351
17,470	17.172	16,610	18.061	15,750	19.048	14,890	20.148	14,030	21.382	13,170	22.779	12,310	24.370
17,460	17.182	16,600	18.072	15,740	19.060	14,880	20.161	14,020	21.398	13,160	22.796	12,300	24.390
17,450	17.192	16,590	18.083	15,730	19.072	14,870	20.175	14,010	21.413	13,150	22.814	12,290	24.410
17,440	17.202	16,580	18.094	15,720	19.084	14,860	20.188	14,000	21.429	13,140	22.831	12,280	24.430
17,430	17.212	16,570	18.105	15,710	19.096	14,850	20.202	13,990	21.444	13,130	22.848	12,270	24.450
17,420	17.222	16,560	18.116	15,700	19.108	14,840	20.216	13,980	21.459	13,120	22.866	12,260	24.470
17,410	17.231	16,550	18.127	15,690	19.120	14,830	20.229	13,970	21.475	13,110	22.883	12,250	24.490
17,400	17.241	16,540	18.138	15,680	19.133	14,820	20.243	13,960	21.490	13,100	22.901	12,240	24.510
17,390	17.251	16,530	18.149	15,670	19.145	14,810	20.257	13,950	21.505	13,090	22.918	12,230	24.530
17,380	17.261	16,520	18.160	15,660	19.157	14,800	20.270	13,940	21.521	13,080	22.936	12,220	24.550
17,370	17.271	16,510	18.171	15,650	19.169	14,790	20.284	13,930	21.536	13,070	22.953	12,210	24.570
17,360	17.281	16,500	18.182	15,640	19.182	14,780	20.298	13,920	21.552	13,060	22.971	12,200	24.590
17,350	17.291	16,490	18.193	15,630	19.194	14,770	20.311	13,910	21.567	13,050	22.989	12,190	24.610
17,340	17.301	16,480	18.204	15,620	19.206	14,760	20.325	13,900	21.583	13,040	23.006	12,180	24.631
17,330	17.311	16,470	18.215	15,610	19.218	14,750	20.339	13,890	21.598	13,030	23.024	12,170	24,651
17,320	17.321	16,460	18.226	15,600	19.231	14,740	20.353	13,880	21.614	13,020	23.041	12,160	24.671
17,310	17.331	16,450	18.237	15,590	19.243	14,730	20.367	13,870	21.629	13,010	23.059	12,150	24.691
17,300	17.341	16,440	18.248	15,580	19.255	14,720	20.380	13,860	21.645	13,000	23.077	12,140	24.712
17,290	17.351	16,430	18.259	15,570	19.268	14,710	20.394	13,850	21.661	12,990	23.095	12,130	24.732
17,280	17.361	16,420	18.270	15,560	19.280	14,700	20.408	13,840	21.676	12,980	23.112	12,120	24.752
17,270	17.371	16,410	18.282	15,550	19.293	14,690	20.422	13,830	21.692	12,970	23.130	12,110	24.773
17,260	17.381	16,400	18.293	15,540	19.305	14,680	20.436	13,820	21.708	12,960	23.148	12,100	24.793
17,250	17.391	16,390	18.304	15,530	19.317	14,670	20.450	13,810	21.723	12,950	23.166	12,090	24.814
17,240	17.401	16,380	18.315	15,520	19.330	14,660	20.463	13,800	21.739	12,940	23.184	12,080	24.834
17,230	17.412	16,370	18.326	15,510	19.342	14,650	20.478	13,790	21.755	12,930	23.202	12,070	24.855
17,220	17.422	16,360	18.337	15,500	19.355	14,640	20.492	13,780	21.771	12,920	23.220	12,060	24.876
17,210	17.432	16,350	18.349	15,490	19.367	14,630	20.506	13,770	21.786	12,910	23.238	12,050	24.896
17,200	17.442	16,340	18.360	15,480	19.380	14,620	20.520	13,760	21.802	12,900	23.256	12,040	24.917
17,190	17.452	16,330	18.371	15,470	19.392	14,610	20.534	13,750	21.818	12,890	23.274	12,030	24.938
17,180	17.462	16,320	18.382	15,460	19.405	14,600	20.548	13,740	21.834	12,880	23.292	12,020	24.958
17,170	17.472	16,310	18.394	15,450	19.417	14,590	20.562	13,730	21.850	12,870	23.310	12,010	24.980
17,160	17.483	16,300	18.405	15,440	19.430	14,580	20.576	13,720	21.866	12,860	23.328	12,000	25.000
17,150	17.493	16.290	18.416	15,430	19.443	14,570	20.590	13,710	21.882	12,850	23.346		

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★ Whether you are planning to build one of the latest types of Short Wave sets, or whether you are only "tinkering" around with an old job, remember that you cannot get the best results if your batteries aren't fresh and full of power. That's why leading D.X.-ers insist on genuine Eveready Radio Batteries for their circuits. Made in Australia in the largest and most up-to-date dry cell manufacturing plant in the world, they reach you in the "pink of condition," ready to give you the longest possible period of serviceable life.

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R47A—1502

SHORT-WAVE BROADCASTING STATIONS of the WORLD

Metres	M.C.	Call	Station	Time
13.85	21.660	DXD	Berlin, Germany	Heard testing late evenings
13.87	21.630	WRCA	New York City, N.Y.	3.0 a.m.-6.30 a.m.
13.91	21.570	WCBX	New York City, N.Y.	11.0 p.m.-3.30 a.m.
13.92	21.550	GST	London, England	8.45-11.50 p.m. 12 midnight to 2.30 a.m.
13.93	21.540	WPIT	Pittsburgh, Pa.	9.30 p.m. to 11.0 p.m.
13.93	21.530	GSJ	London, England	8.45 p.m.-11.50 p.m.
13.94	21.520	WCAB	Philadelphia, Pa.	3.0 a.m.-6.45 a.m. ex. Sun.-Mon. 3.0 a.m.-5.30 a.m.
13.96	21.500	WGEA	Schenectady, N.Y.	Not in use
13.97	21.470	GSH	London, England	8.45 p.m.-11.50 p.m.
13.98	21.460	WRUL	Boston, Mass.	1-2 a.m. ex. Sun. Mon. 3.05 p.m.-10.55 p.m.
13.99	21.450	DJS	Berlin, Germany	Not in use
15.77	19.020	HS6PJ	Bankok, Thai	11.45 p.m.-1.45 a.m., irreg.
12.26	18.450	HBF	Geneva, Switzerland	3.05 p.m.-10.50 p.m., 11.12 p.m., 12 p.m.-2 a.m.
16.82	17.845	DJH	Berlin, Germany	
16.82	17.840	EIRE	Athlone, Ireland	11.30 p.m.-1 a.m., even dates 3.30 a.m. to 7.30 a.m., 8.30 a.m.-9 a.m; odd days 3.30 a.m.-5.30 a.m.
16.83	17.830	LRA5	Buenos Aires, Arg.	Saturday, 7-7.30 a.m.
16.84	17.820	2RO8	Rome, Italy	8 p.m.-10.25 p.m., 9 a.m.-10.25 a.m.
16.85	17.810	GSV	London, England	10 p.m.-11.50 p.m.; 12 midnight-2.15 a.m.
16.85	17.800	OIH	Lahti, Finland	Not in use
16.85	17.800	XGX	Yunnan, China	Not in use
16.86	17.790	GSG	London, England	8.45 p.m.-11.50 p.m.; 3.25 a.m.-7 a.m.
16.87	17.785	JZL	Tokio, Japan	Not in use
16.87	17.780	WNBI	New York City, N.Y.	7 a.m.-2 p.m. Latin America
16.87	17.780	WRCA	New York City, N.Y.	12 midnight-7 a.m. to Europe
16.89	17.770	PH12	Huizen, Holland	Sun. 9.40 p.m.-1.05 a.m.; Mon./Thurs. 10.40 p.m.-12 midnight; Tues./Wed./Fri./Sat. 10.40 p.m.-11.40 p.m.
16.89	17.765	TPB3	Paris, France	8.30 p.m.-1 a.m.
16.89	17.760	DJE	Berlin, Germany	3.05 p.m.-10.45 p.m.; 11 p.m.-2 a.m.; 7.55 a.m.-12 noon
19.47	15.410	RV96	Moscow, U.S.S.R.	8 p.m.-10.30 p.m.; 11.55 a.m.-1.30 p.m.
19.52	15.370	HAS3	Budapest, Hungary	Sun. 12 midnight-1 a.m.
19.54	15.350		Luxembourg, Luxembourg	Not in use
19.56	15.340	DJR	Berlin, Germany	7.55 a.m.-1.50 p.m., 8 p.m.-Mid.
19.57	15.330	WGEA	Schenectady, N.Y.	11 p.m.-9 a.m.
19.57	15.330	KGEI	San Francisco, Calif.	9.30 a.m.-2.15 p.m.
19.58	15.325	JLT3	Tokio, Japan	Noon-1.30 p.m.
19.58	15.320	OZH	Skamlebak, Denmark	4 a.m.-4.30 a.m.; Sundays 11 p.m.-4.30 a.m.
19.60	15.310	GSP	London, England	4.35-6.30 a.m., 5.0-8.0 p.m., 7.20 a.m.-9 a.m.
19.60	15.31	YDB	Soerabaja, Java	1.30 p.m.-5 p.m.; Sun 10.30 a.m.-5 p.m.
19.61	15.300	2RO6	Rome, Italy	7.10 p.m.-7.55 p.m., 1 a.m.-3.06 a.m., 4.30 a.m.-5.30 a.m., 6 a.m.-8.30 a.m., 10.30 a.m.-12 noon
19.62	15.290	LRU	Buenos Aires, Argentina	10 p.m.-12 midnight
19.62	15.290	VUD3	Delhi, India	4.30 p.m.-6.45 p.m., 10.30 p.m.-3.30 a.m., 12.30 p.m.-2.30 p.m.
19.63	15.28	DJQ	Berlin, Germany	3.05 p.m.-2 a.m., 7.50 a.m.-1.50 p.m.
19.64	15.270	WCAB	Philadelphia, Pa.	7-9 a.m., Sun. 3-9 a.m., Mon. 6-9 a.m.
19.64	15.270	WCBX	New York City, N.Y.	4 a.m.-6.30 a.m., Mon. 4 a.m.-5.30 a.m.
19.64	15.270	H13X	Trujillo City, D.R.	Sun 10.40 p.m.-12.40 a.m., Wed./Sat 11.10 a.m.-1 p.m.
19.66	15.26	GSI	London, England	4 p.m.-8 p.m., 3-4.30 a.m.
19.67	15.250	WRUL	Boston, Mass.	1-2 a.m. ex. Sun. & Mon.
19.68	15.243	TPA2	Paris, France	8.30 a.m.-1 a.m.; 4.30 a.m.-5.30 a.m.
19.68	15.240	YUG/ YUF	Belgrade, Yugoslavia	10.30 a.m.-12 noon.
19.68	15.240	CR7BD	Lourenco Marques, Moz.	7.30 p.m.-9.30 p.m., 12.30 a.m.-2 a.m.
19.70	15.230	2RO14	Rome, Italy	Irregular
19.71	15.220	PCJ2	Huizen, Holland	Su./M./Th. 10.40 p.m.-12 midnight; M./Tu./Wed./F./Sat. 10.40 p.m.-11.45 p.m.; Tu. 4 p.m.-5.30 p.m.; Thu. 12.30 a.m.-2 a.m.
19.71	15.215	CSW4	Lisbon, Portugal	2 a.m.-5 a.m.
19.72	15.210	WPIT	Pittsburgh, Pa.	11.0 p.m.-6.0 a.m.
19.74	15.30	DJB	Berlin, Germany	3.05 p.m.-11 p.m., 11 p.m.-mid., 12.05 a.m.-2 a.m.
19.74	15.200	XGOX	Szechwan, China.	Heard around noon
19.74	15.195	TAQ	Ankara, Turkey	8.30 p.m.-10 p.m. Not always used
19.75	15.190	OIE	Lahti, Finland	Off the air
19.76	15.180	RV96	Moscow, U.S.S.R.	6-6.45 p.m. English.
19.76	15.180	GSO	London, England	Not in use

SHORT-WAVE BROADCASTING STATIONS OF THE WORLD—(Continued)

Metres	*M.C.*	*Call*	*Station*	*Time*
19.78	15.170	TGWA	Guatemala, Guatemala	3.45 a.m.-4.45 a.m.; Sun. 3.45 a.m.-8.15 a.m.
19.78	15.165	LKV	Oslo, Norway	9.40 p.m.-8 a.m.
19.79	15.160	JZK	Tokio, Japan	3 a.m.-4.30 a.m., 10 p.m.-12.30 a.m., 5-7 p.m., 11-12 p.m.
19.80	15.155	SBT	Motala, Sweden	4 a.m.-7.15 a.m.; Thu./Sun. 11 a.m.-noon; Sun. 6 p.m.-7.30 p.m.
19.80	15.150	YDC	Bandoeng, Java	7.30 p.m.-1.30 a.m., 9 a.m.-noon ex. Sat., 1.30 p.m.-5 p.m., Sat. 10 a.m.-5 p.m.
19.82	15.140	GSF	London, England	6.30-8 p.m., 12 midnight-2.30 a.m., 6.50 a.m.-9 a.m.
19.83	15.130	TPB6	Paris, France	Irregular
19.83	15.130	WRUW	Boston, Mass.	6 a.m.-8 a.m., Sun. 4.45 a.m.-8.30 a.m., Mon. 1 a.m.-3 a.m., Thu. 5.30 a.m.-6 a.m.
19.84	15.120	SP19	Warsaw, Poland	Not heard recently
19.84	15.120	HVJ	Vatican City	Mon. 4 a.m.-4.30 a.m., Wed. 1.30 a.m.-2 a.m.
19.85	15.110	DJL	Berlin, Germany	3.05 p.m.-5 a.m., 11 p.m.-noon, 1.30 a.m.-7.25 a.m.
19.87	15.100	2RO12	Rome, Italy	7 a.m.-8.30 a.m., 9 a.m.-10 a.m., 10.30 a.m.-12 p.m. irreg.
19.95	15.040	RK1	Moscow, U.S.S.R.	10 a.m.-11.50 a.m.
20.08	14.940	PSE	Rio de Janeiro, Brazil	9 a.m.-10 a.m., Thu. 7-7.10 a.m.
20.11	14.920	KQH	Kahuku, Hawaii	Sun. 4.30 a.m.-noon. Mon. 12-12.30 p.m.
20.64	14.535	HBJ	Geneva, Switzerland	Irregular
20.75	14.460	DZH	Berlin, Germany	10 a.m.-1.50 p.m. Almost daily
20.80	14.420	HC1JB	Quito, Ecuador	10-11.15 p.m., 2.30 a.m.-5.30 a.m., 7.45 a.m.-1.15 p.m. ex Tue
21.58	13.900	YNDG	Leon, Nicaragua	Sun. 3.30 p.m.-4 p.m. or later
22.00	13.635	SPW	Warsaw, Poland	Not heard recently
24.03	12.486	HI1N	Trujillo City, D.R.	9.40 p.m.-1.40 a.m., 8.10 a.m.-1.40 p.m.
24.08	12.460	HCJB	Quito, Ecuador	10 p.m.-11.15 pm., 2.30 a.m.-5.30 a.m., 8 a.m.-1.30 p.m. ex. Mon.
25.00	12.000	RNE	Moscow, U.S.S.R.	10 a.m.-noon, noon-8.0 p.m., mid.-2 a.m.
25.06	11.970	CB1180	Santiago, Chile	10 a.m.-2 p.m.
25.06	11.970	H12X	Trujillo City, D.R.	Wed./Sat. 11.10 a.m.-1.10 p.m., Sun. 10.40 p.m.-12.40 p.m.
25.13	11.940	TI2XD	San Jose, C.R.	Believed off the air
25.19	11.91		Hanoi, F. indo-China	6.45 p.m.-7.15 p.m., 10 p.m.-12.30 a.m.
25.19	11.910	CD1190	Valdivia, Chile	1 a.m.-4 a.m., 6 a.m.-1 p.m.
25.21	11.900	XEW1	Mexico D.F., Mexico	Believed off the air
25.21	11.900	XGOY	Szechwan, China	8.30 p.m.-10.50 p.m., 11 p.m.-2 a.m., 2.10 a.m.-2.20 a.m., 5 a.m.-9.20 a.m.
25.22	11.895		Moscow, U.S.S.R.	6-9 a.m.
25.23	11.885	TPA4	Paris, France	8.30 p.m.-3.30 p.m.
25.27	11.870	WPIT	Pittsburgh, Pa.	6 a.m.-2 p.m.
25.27	11.870	VLQ2	Sydney, N.S.W.	Late afternoons, 5.30-6.30 p.m.
25.27	11.870	VUM2	Madras, India	Mon./Wed./Fri. 6.30-7 p.m.
25.30	11.860	GSE	London, England	6.30-8 p.m., 9.22 a.m.-12.15 p.m., occasionally from mid.
25.30	11.855	DJP	Berlin, Germany	3.05 p.m.-5 p.m., 7.50 a.m.-1.50 p.m., 11 p.m.-mid.
25.30	11.855	XMHA	Shanghai, China	8 p.m.-2 a.m., 2 p.m.-4 p.m.
25.32	11.850	VLR3	Lyndhurst, Vic.	6.30 a.m.-5.15 p.m.
25.32	11.850	CB1185	Santiago, Chile	Sun. 9 a.m.-3 p.m.
25.32	11.850	HAD	Budapest, Hungary	6 a.m.-9 a.m. irregular
25.33	11.845	TPC8	Paris, France	3.30 a.m.-8.30 a.m.
25.34	11.840	OLR4A	Prague, Bohemia	Irregular
25.36	11.830	VLW3	Perth, W.A.	Afternoons
25.36	11.830	WCBX	New York City, N.Y.	7-9 a.m., 9.30 a.m.-1 p.m., Mon. 6-9 a.m., 9.30 a.m.-1 p.m.
25.37	11.826	XEBR	Hermosillo, Mexico	Believed off the air
25.40	11.810	2RO4	Rome, Italy	7.30 p.m.-6 a.m., 9 a.m.-10.30 a.m., 10.30 a.m.-noon
25.42	11.801	DJZ	Vienna, Germany	7.50 a.m.-1.50 p.m.
25.42	11.800	ZTE	Durban, South Africa	Midnight-2.15 a.m.
25.42	11.800	COGF	Matanzas, Cuba	9 p.m.-noon
25.42	11.800	JZJ	Tokio, Japan	10 p.m.-12.30 a.m., 7.30-8.30 a.m.
25.45	11.790	WRUL	Boston, Mass.	6 a.m.-8 a.m., Sun. 4.45 a.m.-8.30 a.m., Mon. 1 a.m.-3 a.m
25.47	11.782		Luxembourg, Luxembourg	Irregular
25.47	11.780		Saigon, F. Indo-China	3.15 p.m.-3.45 p.m., 8.45 p.m.-11.30 p.m., 11.30 p.m.-12.45 a.m.
25.47	11.780	HP5G	Panama City, Panama	3-4 a.m., 9 a.m.-1 p.m.
25.47	11.780	OFE	Lahti, Finland	Not in use
25.48	11.775	MTCY	Hsinking, Manchoukuo	4.30 p.m.-5.30 p.m., 12.50 a.m.-1.50 a.m., 7-7.50 a.m.

SHORT-WAVE BROADCASTING STATIONS OF THE WORLD—(Continued)

Metres	M.C.	Call	Station	Time
25.49	11.770	DJD	Berlin, Germany	2.30 a.m.-7.25 a.m., 7.50 a.m.-1.50 p.m.
25.51	11.760	2RO15	Rome, Italy	6-8 p.m., 1 a.m.. 3 a.m., irreg.
25.53	11.750	GSD	London, England	4-8 p.m., 8.40-11.45 p.m., 2.52-6.30 a.m., 6.50-9 a.m., 12.37-3.30 p.m.
25.55	11.740	CB1174	Santiago, Chile	Daily to 1.30 p.m.
25.55	11.740	HVJ	Vatican City	Tuesdays 11.30 p.m.-midnight
25.55	11.740	SP25	Warsaw, Poland	Not heard recently
25.55	11.740	CR6RC	Luanda, Angola	9.30-10.45 p.m., W./Th./Su. 6.30-8 a.m.
25.57	11.735	COCX	Havana, Cuba	11 p.m.-3 p.m., irregular
25.57	11.735	YUE	Belgrade, Yugo-Slavia	10 a.m.-12.05 p.m.
25.57	11.735	LKQ	Oslo, Norway	7.30 p.m.-9.40 p.m., Sun. 5.30 p.m.-9.40 p.m.
25.58	11.730	WRUW	Boston, Mass.	8.30 a.m-10.30 a.m., 11 a.m.-2.30 p.m., Sun. 9-10.30 a.m., Mon. 5-10 a.m.
25.59	11.725	JVW3	Tokio, Japan	5-7 p.m., 7-11 p.m. irreg.
25.60	11.720	CJRX	Winnipeg, Canada	Believed off air
25.60	11.720	ZP14	Villarica, Paraguay	M./Th./Fri. 8-11 a.m. Sun./Mon. 2 a.m.-9 a.m.
25.60	11.718	CR7BH	Lourenco, Marques, Moz.	7.30-9.30 p.m. midnight-2 a.m.
25.61	11.718	TPB7	Paris, France	11 a.m.-3.30 p.m.
25.62	11.710	YSM	San Salvador, El Salvador	4-5.30 a.m.
25.62	11.710		Saigon, F. Indo-China	10.30 p.m.-12.45 a.m.
25.63	11.705	SBP	Motala, Sweden	4 a.m.-7.15 a.m., Sun. 6 p.m.-7.15 a.m., Thu./Sun. 11 a.m.-noon
25.64	11.70	HP5A	Panama City, Panama	10-11.30 p.m. 1-4 a.m., 8 a.m.-1 p.m., Mon. 9 a.m.-1 p.m.
25.64	11.700	CB1170	Santiago, Chile	1-5 a.m., 6.30 a.m.-2 p.m.
25.74	11.670	IQY	Rome, Italy	8.20-8.40 a.m., 3.07 a.m.-3.56 a.m., 4.50-5.30 a.m.
26.01	11.535	SPD	Warsaw, Poland	Not heard recently
26.32	11.402	HBO	Geneva, Switzerland	Sun. 3.45 p.m.-5.30 p.m.. irreg.
27.17	11.040	CSW5	Lisbon, Portugal	3-8.30 a.m., Mon. 1 a.m.-6.30 a.m.
27.27	11.000	PLP	Bandoeng, Java	7.30 p.m.-1.30 a.m., 9 a.m.-noon, 1.30-5 p.m.
28.3	10.600	ZIK2	Belize, Brit. Honduras	W./Fr./Su. 4.30-5 a.m., 11.30-noon
28.48	10.535	JIB	Taihoku, Taiwan	12-12.55 a.m.
28.55	10.400	YSP	San Salvador, El Salvador	4-6 a.m., 9.30 a.m.-2 p.m.
28.96	10.360	EAJ43	Tenerife, Canaries	6-7 a.m., 8-10 a.m., 10.45-11.45 a.m., noon-1 p.m.
28.98	10.350	LSX	Buenos Aires, Arg.	Irregular
29.04	10.330	ORK	Ruysseledge, Belgium	4.30-6 a.m.
29.15	10.290	DZC	Berlin, Germany	9.30 a.m.-noon to Brazil
29.24	10.260	PMN	Bandoeng, Java	7.30 p.m.-2.30 a.m., 9 a.m.-noon, 1.30-5 p.m.
29.35	10.220	PSH	Rio de Janeiro, Brazil	9-10 a.m., Tues. 11-11.30 a.m., Sat. 10-10.30 a.m.
29.7	10.100		"Deutsche Freiherts Sender," Germany	6.30 a.m.-7.30 a.m., irreg.
29.81	10.065	TIEM	San Jose, C.R.	7.30-11 a.m.
30.23	9.925	JDY	Darien, Manchoukuo	Not heard recently
30.33	9.982	CPI	Sucre, Bolivia	2-3 am., 10 a.m.-noon
30.45	9.855	EAQ	Madrid, Spain	9-11.30 a.m., Sun. 5-7 a.m., Mon. 9-11.30 a.m., 12.30 p.m.-1.30 p.m.
30.5	9.840	XGSE	China	Opens at 11 p.m.
30.52	9.830	IRF	Rome, Italy	8.20-8.40 p.m., 3 a.m.-3.25 a.m., 4.50 a.m.-5.30 a.m., 9 a.m.-10.30 a.m., 10.30 a.m.-noon
30.54	9.825	SVJ	Sparta, Greece	Heard from 11 p.m.
30.57	9.81	COCM	Havana, Cuba	11 p.m.-3.30 a.m.
30.71	9.770	HH3W	Port-au-Prince, Haiti	4-5 a.m., 10 a.m.-12.15 p.m.
30.77	9.752	ZRO	Durban, So. Africa	2.45 p.m.-3.50 p.m., 6.30-10.30 p.m. midnight-2.15 a.m., Sun. 8.30-10 p.m., Mon. midnight-2.15 a.m.
30.77	9.750	HJ6FAH	Armenia, Colombia	11 p.m.-1.30 a.m., 8 a.m.-1.30 p.m.
30.80	9.740	CSW7	Lisbon, Portugal	6-7 a.m., 7.15 a.m.-8 a.m.
30.80	9.740	CB974	Santiago, Chile	10 p.m.-2.30 p.m. inter.
30.83	9.730		Pereira, Colombia	Opens 10 p.m. nightly
30.86	9.720	HJFK	Fort-de-France, Martinique	9 a.m.-11.10 a.m. or 12.30 p.m.
30.95	9.695	JIE2	Tyureki, Taian	12.5 a.m.-1.20 a.m.
30.95	9.693		Tananarive, Madagascar	3.30-3.45 p.m., 6.30-7.30 p.m., 1-2 a.m.; Sun., 5.30-7 p.m.
30.96	9.690	GRX	Daventry, England	Early morning and afternoon
30.96	9.690	T14NRH	Heredia, Costa Rica	Tu/Th/Sat., noon-1 p.m.; Sun., 10-11 p.m.
30.96	6.690	LRA1	Buenos Aires, Argen.	1.30 a.m.-4 a.m., 7 a.m.-noon; Sun./Mon., 10 a.m.-noon.
30.96	9.690	ZHP	Singapore, S.S.	7.40 p.m.-12.40 a.m.; Wed/Sat., 3.40 p.m.-4.40 p.m.; Sun., 8.40 p.m.; Mon., 12.40 a.m.

SHORT-WAVE BROADCASTING STATIONS OF THE WORLD—(Continued)

Metres	M.C.	Call	Station	Time
30.98	9.685	TGWA	Guatemala, Guatemala	1 p.m.-2.30 p.m.; Mon., 10 a.m.-3 p.m.
30.98	9.683	HNF	Baghdad, Iraq	11 p.m.-12.30 a.m.
30.99	9.680	XEQQ	Mexico City, Mexico	Opens 1 a.m., closes 4 p.m.
30.99	9.680	TPC28	Paris, France	Noon-3.45 p.m., 4 p.m.-7 p.m. News 6.15 p.m.
31.01	9.675	DJX	Vienna, Germany	1.40 a.m.-7.25 a.m.
31.01	9.675		Saigon, F. Indo-China	10.30 p.m.-12.45 a.m.
31.02	9.67	WRCA	New York City, N.Y.	7 a.m.-4 p.m.
31.02	9.67	JVW2	Tokio, Japan.	Irregular
31.03	9.670	2RO9	Rome, Italy	3.40-8.30 a.m., 9-9.30 a.m., and 10.30 a.m.; noon, irregular.
31.06	9.660	LRX	Buenos Aires, Argen.	9-9.45 p.m., 12.15-1 p.m.
31.09	9.650	VLW2	Perth, W.A.	
31.09	9.650	12AA	Addis Ababa, I.E.A.	7.30-8.30 p.m., 2-5.30 a.m.
31.09	9.650	WCBX	New York City, N.Y.	1.30 p.m.-2.30 p.m.
31.1	9.645	JLT2	Tokio, Japan	Irregular
31.12	9.640	CXA8	Colonia, Uruguay	8 p.m.-1.45 p.m.; Sun., to 4 p.m.
31.12	9.640	CR7BE	Lourenco Marques, Mozambique	5-7 a.m. Opens midnight with news.
31.12	9.640	XGOY	Chungking, China	4-5 p.m., 3.7 a.m.-5.55 a.m.,
31.15	9.630	2RO3	Rome, Italy	8.30-10 a.m., 10.30 a.m.-noon.
31.15	9.630	KZRH	Manila, P.I.	7 p.m.-2 a.m.
31.15	9.630	JFO	Taihoku, Taiwan	7 p.m.-1.30 a.m.
31.19	9.625	HAD	Budapest, Hungary	Irregular
31.19	9.625	CXA6	Montevideo, Uruguay	1.30-3.30 a.m., 6.30 a.m.-12.30 p.m.
31.21	9.615	VLQ	Sydney, N.S.W.	5-7 p.m., 9.15-9.45 p.m., 10-11 p.m., 11.15-11.45 p.m., 1.30-2.30 a.m.
31.21	9.615	TIPG	San Jose, C.R.	10 p.m.-12.30 a.m., 3-5 a.m., 11 a.m.-2.30 p.m.
31.22	9.610	ZRL	Capetown, South Africa	2.45 p.m.-5.50 p.m. ex Sat. 6.30-10.20 p.m.; Sun., midnight-2.45 a.m., 6.30 p.m.-midnight; Mon., midnight-2.45 a.m.
31.22	9.610	LLG	Oslo, Norway	Not in use
31.22	9.610	DXB	Berlin, Germany	10 a.m.-1.50 p.m.
31.22	9.610	HP5J	Panama City, Panama	3-4.30 a.m., 9.30 a.m.-1.30 p.m.
31.24	9.614	XEYU	Mexico D.F., Mexico	Noon-2 p.m.
31.25	9.600	GRY	Daventry, England	Not in use
31.25	9.600	RAN	Moscow, U.S.S.R.	6-10 a.m., 10-11.50 a.m., noon-1 p.m.
31.25	9.600	CB960	Santiago, Chile	11 a.m.-2.30 p.m., 10 p.m.-1 a.m.
31.27	9.595	EIRE	Athlone, Ireland	Odd dates 5.30-7.30 a.m., 8.30-9 a.m.
31.28	9.590	VLQ5	Sydney, N.S.W.	11 p.m.-11.30 p.m. occasionally
31.28	9.590	PCJ	Huizen, Holland	Mon., 4.40-6 a.m., 10.15 a.m.-12.50 p.m.; Wed., 4.45-6.30 a.m., 10 a.m.-1.15 p.m.; Thurs., 10.15-11.40 a.m.; Sat., 11 a.m.-12 noon.
31.28	9.590	VK6ME	Perth, W. Australia	Not in use
31.28	9.590	VK2ME	Sydney, Australia	Not in use
31.28	9.590	WCAB	Philadelphia, Pa.	Sun/Tu/Fri., 9.30 a.m.-5 p.m.; Thurs., noon-5 p.m.
31.28	9.590	VUD2	Delhi, India	4.30-6.30 p.m., 9.30 p.m.-3.30 a.m.; 12.30-2.30 p.m.
31.30	9.585	KZHS	Manila, Philippines	Not in use
31.32	9.580	GSC	Daventry, England	4-4.45 p.m., 4.30-6.30 a.m., 6.50-9 a.m., 9.22 a.m.-12.15 p.m. 12.37-3.30 p.m.
31.32	9.580	VLR	Melbourne, Australia	5.30 p.m.-12.30 a.m.
31.35	9.570	WBOS	Boston, Mass.	11 p.m.-4 p.m.
31.35	9.570	KZRM	Manila, Philippines	Tu. to Sat., 7.30-9 a.m.; Mon. to Fri., 8 p.m.-midnight; Sat., 8 p.m.-1 a.m.; Sun., 7 a.m.-1 p.m.
31.35	9.570	CXA2	Montevideo, Uruguay	2 a.m.-7 a.m., 7.30 a.m.-12.30 p.m.
31.38	9.560	OAX4T	Lima, Peru	2.30 a.m.-4.30 a.m.
31.38	9.560	DJA	Berlin, Germany	9.30 a.m.-1.50 p.m., 4-8 p.m., mid.-2 a.m.
31.38	9.560	VLW2	Perth, W.A.	2-4 a.m. to South Africa
31.40	9.550	YDB	Soerabaja, Java	7.30 p.m.-1.30 a.m., 9 a.m.-noon, 1.30 p.m.-5 p.m. ex. Sat., Sun. 10 a.m.-5 p.m.
31.40	9.550	VUD2	Bombay, India	4.30-6.30 p.m., 8-9 p.m., 12.30-1.30 p.m.
31.41	9.550	WGEA	Schenectady, N.Y.	9.15 a.m.-12.15 p.m.
31.41	9.550	XEFT	Veracruz, Mexico	10.30 a.m.-3 p.m.
31.45	9.540	DJN	Zeesen, Germany	3.05-5.30 p.m., 7.50 a.m.-1.50 p.m.
31.46	9.538	VPD2	Suva, Fiji	7 p.m.-8 p.m.
31.47	9.535	SBU	Motala, Sweden	7.15-8 05 a.m.
31.47	9.535	JZI	Tokio, Japan	7.30-8.30 a.m., 10 p.m.-12.30 a.m.
31.48	9.530	KGEI	San Francisco, Calif.	10 p.m.-3 a.m., 3 p.m.-6 p.m.
31.48	9.530	WGEO	Schenectady, N.Y.	6-9 a.m., 9 a.m.-2.45 p.m.
31.48	9.528	VUC2	Calcutta, India	5-7 p.m., 1-5 p.m.
31.48	9.527		Luxembourg, Luxembourg	Not in use

SHORT-WAVE BROADCASTING STATIONS OF THE WORLD—(Continued)

Metres	M.C.	Call	Station	Time
31.50	9.525	ZBW3	Hong Kong, Hong Kong	8 p.m.-1 a.m., 2.30-4.15 p.m., Sun. 8 p.m.-midnight, Sat. noon on.
31.50	9.525	OQ2AA	Leopoldville, Bel. Congo	8.25-10 p.m.
31.50	9.525	SP31	Warsaw Poland	Not heard recently
31.50	9.523	ZRG	Pretoria, So. Africa	8-10 p.m.. Sun. 8.30-10 p.m.
31.51	9.520		Paris, France	Opens 7.30 a.m., news at 3.30 p.m.
31.51	9.520	OZF	Skamlebakm, Denmark	11 a.m.-12.30 p.m., 12.30-2 p.m.
31.51	9.520	RV96	Moscow, U.S.S.R.	4-6 a.m., 7-10 a.m., irreg
31.52	9.517	XEDQ	Guadalajara, Mexico	3-7.30 a.m., 10 a.m.-3 p.m
31.55	9.510	GSB	London, England	4-6.15 p.m., mid.-2.30 a.m., 6.50-9 a.m., 9.22-12.15 p.m.. 12.37-3.30 p.m.
31.55	9.510	HS8PJ	Bangkok, Thai	Not in use
31.57	9.505	YUC/ YUD	Belgrade, Yugoslavia	Daily to 8.30 a.m.
31.57	9.503	XEWW	Mexico, D.F., Mexico	10.45 p.m.-3.30 a.m.
31.58	9.501	PRF5	Rio de Janeiro, Brazil	7.45-8.55 a.m. ex. Mon Not heard
31.58	9.500	OFD	Lahti, Finland	Not in use
31.58	9.500	VK3ME	Melbourne, Australia	Not in use
31.60	9.492	KZIB	Manila, P.I.	11.30 a.m.-5.40 p.m., 9 p.m.-1 a.m.
31.67	9.475	VONG	St. John's, Newfoundland	10.30 p.m.-3.30 a.m., 7.30 a.m.-1 p.m.
31.70	9.465	TAP	Ankara, Turkey	8.30 p.m.-10 p.m., 2 am.-7.30 a.m.
31.77	9.445	HCODA	Guayaquil, Ecuador	11.15 a.m.-1.15 p.m. ex. Mon
31.78	9.440	COCH	Havana, Cuba	11 p.m.-2 a.m., Sun. 11 p.m.-Mon. 1 p.m.
31.95	9.39	OAX5C	Ica, Peru	10 a.m.-2.30 p.m.
32.04	9.363	COBC	Havana, Cuba	10 p.m.- 3 p.m.
32.12	9.340	OAX4J	Lima, Peru	3-6 a.m., 8 a.m.-3 p.m.
32.28	9.295	XTC	Shanghai, China	11 p.m.-midnight in Chinese
32.28	9.295	HI2G	Trujillo City, D.R.	9.40-11.40 p.m., 2.40 a.m.-5.10 a.m., 6.40-7.40 a.m.
32.29	9.29	LYR	Kaunas, Lithuania	Irregular
32.54	9.230		Bucharest, Rumania	5 a.m.-10 a.m., Mon. 4.15 a.m.-9.15 a.m.
32.56	9.205	COBX	Havana, Cuba	11 p.m.-2.30 p.m.
32.61	9.200		Sofia, Bulgaria	4.45 p.m., Sun. 11.15 p.m.
32.64	9.190	HC2ET	Guayquil, Ecuador	11 a.m.-1 p.m.; Mon., 11.30 a.m.-1.30 p.m.
32.72	9.170	HC1GQ	Quito, Ecuador	Tu/Th/Sun.. 12-12.55 p.m.
32.88	9.125	HAT4	Budapest, Hungary	10-11 a.m.; Sun., 9.10 a.m.
32.89	9.120	HC2CW	Guayaquil, Ecuador	2.4 a.m., 10 a.m.-2 p.m.

Metres	M.C.	Call	Station	Time
32.97	9.100	COCA	Havana, Cuba	3 a.m.-4.15 p.m. till 6 p.m. irregular
33.26	9.020	COBZ	Havana, Cuba	10.45 p.m.-4.15 p.m.
33.48	8.960	COKG	Santiago, Cuba	8-9 a.m., 12.30-1.30 p.m.
33.48	8.96	TPZ2	Algiers, Algeria	Wednesdays, 3.30-4.30 a.m.
33.94	8.840	COCQ	Havana, Cuba	8.55 p.m.-3 p.m.
34.48	8.700	COCO	Havana, Cuba	10.55 p.m.-3 p.m.
34.62	8.665	COJK	Camaguey, Cuba	2.30-3.30 a.m., 6.30-9 a.m., 11-11.30 a.m.
34.97	8.580	YNPR	Managua, Nicaragua	3.45-5.15 a.m., 9.45 a.m.-1.15 p.m.
37.50	8.000	HC1ETC	Quito, Ecuador	Sundays, 11 a.m.-2 p.m.
38.00	7.894	YSD	San Salvador, El Salvador	10 a.m.-1.30 p.m.
38.12	7.870	HC1RB	Quito, Ecuador	11.30 a.m.-2.30 p.m.
38.22	7.850	ZAA	Tirana, Albania	9.30-11.30 p.m., 3.20 a.m.-8 a.m.
38.20	7.854	HC2JSB	Guayaquil, Ecuador	2.5 a.m., 7 a.m.-2 p.m.
39.16	7.660	YNDG	Leon, Nicaragua	11.30 a.m.-12.30 p.m. ex Mon.
39.890	7.614	CR6AA	Lobito, Angola	Tu/Th/Sun., 5.30-7.30 a.m.
39.89	7.520	KKH	Kahuku, Hawaii	Mon., 12-12.30 p.m.; Sun., 10.30-11 a.m.
40.05	7.490	EAJ43	Tenerife, Canaries	10-11 a.m.
40.27	7.450	TI2RS	San Jose, C.R.	10 a.m.-2 p.m.
40.32	7.440	FG8AH	Pointe-a-Pitre, Guadeloupe	9.10-10 a.m.
40.65	7.380	XECR	Mexico D.F., Mexico	Mon., 9-10 a.m.
41.01	7.310	VIG	Port Moresby, Papua	6-8 p.m. irregular.
41.13	7.295	JIE	Tyureki, Taiwan	12.05-1.20 a.m.
41.19	7.284	YN1IP	Managua, Nicaragua	Mon., 1-2 a.m.
41.21	7.280	TPB11	Paris, France	1.15 a.m.-3.45 a.m., 4.30 a.m.-8 a.m.
41.32	7.260	CSW8	Lisbon, Portugal	Wed/Fri/Sun., 8.0-9 a.m.
41.32	7.260	OZU	Skamlebak, Denmark	5-8 a.m.
41.34	7.257	JVW	Tokio, Japan	5-7 a.m.
41.38	7.250	YDA	Bandoeng, Java	1.30-5 p.m.; Sun., 10.30-5 p.m.
41.49	7.230	GSW	London, England	Not heard recently
41.55	7.220	HAD	Budapest, Hungary	Not in use
41.55	7.220	YDX	Medan, Sumatra	9 p.m.-1.30 p.m., 1.30 p.m.-5 p.m.
41.78	7.180	EA9A1	Mellila, Span. Morocco	Sun., 12-1 p.m.
42.25	7.100	F08AA	Papeete, Tahiti	Sat., 3.01-6.30 p.m.
42.80	7.010	XPSA	Kweiyang, China	8.30 p.m.-2 a.m., 8-9 a.m.
43.80	6.850	XOJD	Hankow, China	9-11.35 p.m.
43.82	6.847	YNOP	Managua, Nicaragua	11 a.m.-12.30 p.m.; Mon., 5-6 a.m.
44.12	6.80	PZH	Paramaribo, D. Guiana	Wed/Sat., 8.41-11.41 a.m.
44.25	6.780	HIH	San Pedro, D.R.	10 a.m.-12.40 p.m.; Mon., 8.20-9.40 a.m.
44.38	6.76	H17P	Trujillo City, D.R.	10.10-11.40 a.m.; Mon., 12.40-1.40 p.m.

SHORT-WAVE BROADCASTING STATIONS OF THE WORLD—(Continued)

Metres	M.C.	Call	Station	Time
44.38	6.760	YNRF	Managua, Nicaragua	9.45 a.m.-1.15 or 2 p.m.
44.58	6.73	HI3C	La Romana, D.R.	To 11.20 a.m.
44.64	6.720	PMH	Bandoeng, Java	7.30 p.m.-2 a.m.; Mon., 11.30 a.m.-4.30 p.m.
44.81	6.695	TIEP	San Jose, C.R.	10 a.m.-3 p.m.
45.06	6.660	HI5G	Trujillo City, D.R.	To 11.40 a.m.
45.22	6.635	HC2RL	Guayaquil, Ecuador	Mon., 8.45-10.45 a.m., and Wed., 12.15-2.15 p.m.
45.25	6.630	HIT	Trujillo City, D.R.	3.10-4.40 a.m., 7.40-11.40 a.m.
45.29	6.625	PRADO	Riobama, Ecuador	Fridays noon-2 p.m.
45.39	6.610	YNLG	Managua, Nicaragua	4.30-5.30 a.m., 9 a.m.-1.15 p.m.
45.70	6.565	HI5P	Puerto Plata, D.R.	8.40-10.40 a.m., 11.40 a.m.-2.40 p.m.
45.87	6.540	YNIGG	Managua, Nicaragua	4-5.30 a.m., 11 a.m.-1 p.m. ex Mon.
46.15	6.500	HIL	Trujillo City, D.R.	3.30-5 a.m., 9 a.m.-11 or 12 noon ex Mon.
46.25	6.486	TGWB	Guatemala, Guatemala	10.45 a.m.-noon, 3.45-6.45 a.m., 10.30 a.m.-3.15 p.m., Mon. 1.30 a.m.-8.15 a.m., 10 a.m.-3 p.m.
46.26	6.485	HI1L	Santiago, D.1.c., D.R.	8.30 a.m.-12.30 p.m.
46.44	6.455	HI4V	S. F. de Macoris, D.R.	8.10-10.40 a.m., to 1 p.m., irreg.
46.51	6.450	COHI	Santa Clara, Cuba	10 p.m.-3 p.m.
46.88	6.400	TGQA	Quezaltenango, Guatemala	11 a.m.-2 p.m., Sun. 10.30 p.m.-Mon. 6 a.m., Sun. 11 a.m.-4 p.m.
46.92	6.395	COCQ	Havana, Cuba	10 p.m.-3 p.m.
46.97	6.388	HI9B	Santiago, D.R.	8 a.m.-11.45 a.m.
46.99	6.384	ZIZ	Basseterre, St. Kitts	7-7.45 a.m., Thurs. 10 a.m.-10.30 a.m.
47.02	6.380	TIWS	Puntarenas, C.E.	8-10 a.m., 10.30 a.m.-1 p.m.; Mon. 8-9 a.m.
47.17	6.360	COCQ	Havana, Cuba	10 p.m.-3 p.m.
47.20	6.357	HRP1	San Pedro, Sula, Honduras	9-10.30 p.m., 5-7 a.m., irreg. to 1 p.m.
47.32	6.340	HI1X	Trujillo City, D.R.	11.10 a.m.-1.10 p.m., Sun. 10.40 p.m.-12.40 a.m. Mon.
47.39	6.330	COCW	Havana, Cuba	10.55-4 p.m., Mon. 12.55 a.m.-1 p.m.
47.51	6.315	HI1Z	Trujillo City, D.R.	2.40 a.m.-3.40 a.m., 8.10-10.40 a.m. ex. Mon.
47.66	6.295	OAX4G	Lima, Peru	9 or 10 a.m.-3 p.m.
47.69	6.290	HI1G	Trujillo City, D.R.	9.40-11.40 p.m., 2.40-5.10 a.m., 6.40 a.m.-12.40 p.m.
47.96	6.255	CP12	La Paz, Bolivia	10 a.m.-noon
48.05	6.243	HI1N	Trujillo City, D.R.	8.10 a.m.-1.40 p.m. or later
48.11	6.235	HRD	La Ceiba, Honduras	11 a.m.-2 p.m., Mon. 7 a.m.-9 a.m.
48.27	6.215		Saigon, F. Indo-China	10.30 p.m.-12.45 a.m., 2.45-4 p.m.
48.39	6.200	CP5	La Paz, Bolivia	9.30 a.m.-2.30 p.m.
48.43	6.195	TG2	Guatemala, Guatemala	10.30 p.m.-1 a.m., 9 a.m.-2.30 p.m., Sun. 9 a.m.-6 p.m., Mon. 6 a.m.-11 a.m.
48.43	6.195	H12D	Trujillo City, D.R.	8.10-10.10 a.m.
48.47	6.190	KGEI	San Francisco, Cal.	Not in use
48.47	6.190	HVJ	Vatican City	5-6 a.m., irregular.
48.47	6.190	HI1A	Santiago, D.R.	1.40 a.m.-4.40 a.m.; 9.40 a.m.-12.40 p.m.
48.51	6.185	LRA2	Buenos Aires, Argen.	7.0 a.m.-noon ex Mon., Tue., 10 a.m.-noon
48.51	6.185	TIRCC	San Jose, Costa Rica	W/F/Su., 9-10 a.m.; Mon., 11 a.m.-1 p.m.
48.54	6.180	OAX1A	Chiclayo, Peru	11 a.m.-2 p.m.
48.58	6.175	XEXA	Mexico, D.F., Mexico	11 p.m.-2 a.m.; 5.30-7 a.m.; 10.30 a.m.-3.45 p.m.
48.66	6.165	HJCD	Nueva Granada, Columbia	Forenoons irregular
48.66	6.165	TILS	San Jose, C.R.	3 a.m.-5.30 a.m.; 9 a.m.-2 p.m.
48.78	6.150	HJDE	Medellin, Colombia	12.30-4 a.m.; 8 a.m.-2.30 p.m.
48.81	6.147	ZTD	Durban, South Africa	2.20 a.m.-6.45 a.m.; Mon., 2.30 a.m.-6.20 a.m.
48.81	6.147	CJRO	Winnipeg, Canada	Not in use
48.86	6.140	WPIT	Pittsburgh, Pa.	2 p.m.-4 p.m.
48.86	6.140	KZEG	Manila, Philippines	8 p.m.-1 a.m.
48.86	6.140	OQ2AA	Leopoldville, Bel. Congo	Sundays, 8.35-10 p.m.
48.86	6.140	SP48	Warsaw, Poland	Not heard recently
48.88	6.138	COCD	Havana, Cuba	1 a.m.-2 p.m.; Mon., 1 a.m.-noon
48.93	6.132	CHNX	Halifax, N.S., Canada	10 p.m.-2.15 p.m.; Sat., 11 p.m.-midnight; Sun. midnight-2 p.m.; Mon., 3 a.m.-2 p.m.
48.94	6.130	VP3BG	Georgetown, Guiana	1.15-2.15 a.m.; 6.45-10.45 a.m. ex Mon.
48.94	6.130	LKJ	Jeloy, Norway	3 a.m.-9 a.m., irregular

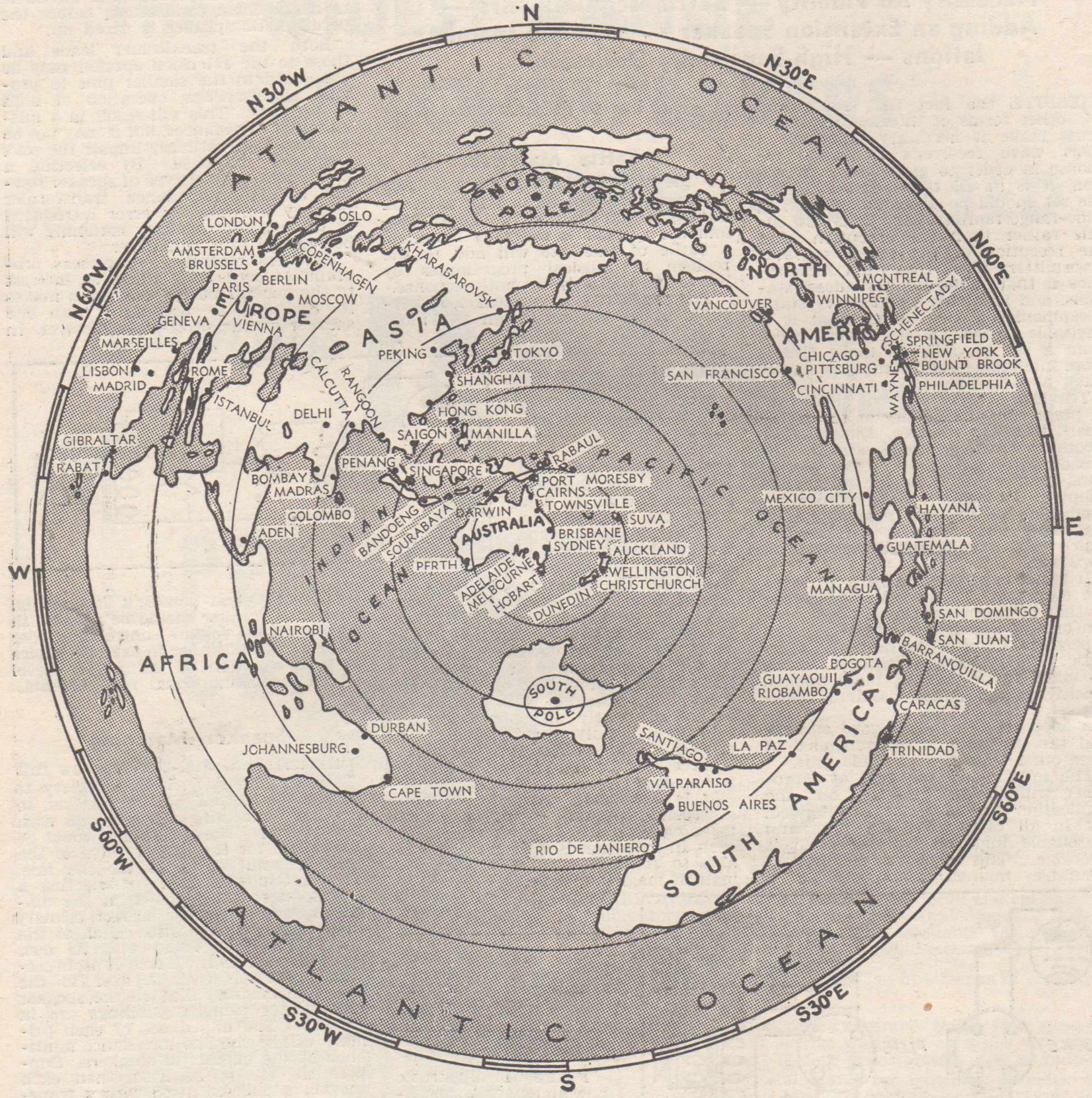
SHORT-WAVE BROADCASTING STATIONS OF THE WORLD—(Continued)

Metres	M.C.	Call	Station	Time
48.98	6.125	MTCY	Hsinking, Manchoukuo	7 p.m.-midnight
49.00	6.122	FK8AA	Noumea, New Caledonia	5.30-6.30 p.m., ex Sun.
49.00	6.122	HPSH	Panama City, Panama	9 a.m.-1.30 p.m. to 3.0 p.m irregular
49.00	6.120	WCBX	New York City, N.Y.	3.0 p.m.-5.0 p.m.
49.04	6.117	XEUZ	Mexico, D.F., Mexico	Mid. to 4 a.m; 10 a.m.-5 p.m.
49.05	6.116	—	Saigon, F. Indo-China	9-9.30 p.m.; 9.45-10.15 p.m.; 2.45-3.15 p.m.
49.08	6.112	HI6H	Trujillo City, D.R.	8.0 a.m.-11.50 a.m.
49.12	6.108	HJ6ABB	Manizales, Colombia	8.30 a.m.-1.0 p.m.
49.18	6.100	YUA/ YUB	Belgrade, Yugoslavia	3.43-6 p.m.; 9.30-11.30 p.m.; 3 a.m.-8.30 a.m.: 10.30 a.m.-noon.
49.18	6.100	WNBI	New York City, N.Y.	3-4 p.m.
49.18	6.100	KZRH	Manila, Philippines	Irregular
49.18	6.100	ZHJ	Penang, S.S.	9.40-11.40 p.m., ex Sun. and irregular
49.20	6.097	ZRK	Capetown, South Africa	3-7 a.m.; Mon. 3-6.20 a.m.
49.20	6.097	ZRJ	Johannesburg, S. Africa	2.45 p.m.-3 a.m.; inter ex Sat.
49.25	6.090	ZNS2	Nassau, Bahamas	11.30 p.m.-mid., 6-7 a.m., 11.0 a.m.-12.30 p.m.
45.25	6.090	—	Luxembourg, Luxembourg	Not in use
49.25	6.090	XEBF	Jalapa, Mexico	Irregular in forenoons
49.30	6.085	ZAA	Tirana, Albania	3.20-9 a.m.
49.32	6.083	VQ7LO	Nairobi, Kenya	8.30-9 p.m.; 2.15 a.m.-5.15 a.m.; Tu/Th. 11.15 p.m.-12.15 a.m.
49.34	6.08	CRY9	Macao, Macao	Mon. 11.30 p.m.-1 a.m Tues.
49.34	6.080	CKFX	Vancouver, Canada	4-6 p.m., ex Sun.
49.37	6.077	OAX4Z	Lima, Peru	10.0 p.m.-4.30 p.m.
49.42	6.070	CFRX	Toronto, Canada	10-3.30 p.m.; Mon. 1 a.m.-2 p.m.
49.46	6.065	SBO	Motala, Sweden	7.35-8.05 a.m.
49.48	6.063	—	Tananarive, Madagascar	3.30-3.45 p.m.; 1-2 a.m.; Sun. 5.30-7 p.m.
49.50	6.060	WCAB	Philadelphia, Pa	M/W/SA. 9.30 a.m.-2.0 p.m., Th. 9.30 a.m.-11.30 a.m.
49.50	6.060	WLWO	Cincinnati, Ohio	Sun. 11 p.m.-9.30 a.m.; Mon/Th. 8.40 p.m.-5 p.m.; Tu/Wed/Fri. 8.45 p.m.-8.30 a.m.; Sun. 8.45 a.m.-2.0 p.m.; M/W/Sat. 2.0 p.m.-5.0 p.m.
49.54	6.056	9MI	M/V Kanimbla	Not in use
49.56	6.050	GSA	London, England	Mid.-2.30 a.m.; 2.52-6.30 a.m.
49.56	6.050	HP5F	Colon, Panama	10a.m.-noon
49.56	6.050	HJ6ABA	Pereira, Colombia	Mid.-3 a.m., 9.30 a.m.-1 p.m.
49.63	6.045	XETW	Tampico, Mexico	10 a.m.-2 p.m.
49.67	6.04	WRUL	Boston, Mass	8.30 a.m.-11.0 a.m., ex Sun. and Mon.; Sun. 9.0 a.m.-10.30 a.m., 1-2.30 p.m.; Mon. 5.0 a.m.-11 a.m.
49.67	6.04	KZIB	Manila, Philippines	9 p.m.-1 a.m.
49.67	6.040	WDJM	Miami, Florida	4-6 a.m., noon-5 p.m.; Sun. 7-9 a.m.
49.73	6.033	HP5B	Panama City, Panama	1.30-5 a.m., 9 a.m.-1 p.m.
49.75	6.030	CFVP	Calgary, Alta., Canada	1 a.m.-5 a.m.
49.75	6.030	RV96	Moscow, U.S.S.R.	11.0 p.m.-12.30 a.m.
49.81	6.023	XEUW	Veracruz, Mexico	1 a.m.-4 p.m.
49.83	6.02	DJC	Berlin, Germany	2.30 a.m.-7.25 a.m.
49.83	6.02	CR7AA	Lourenco Marques, Moz.	3-4 p.m., ex Sun.
49.86	6.017	HJCX	Bogota, Colombia	Noon-2.30 p.m.
49.88	6.015	PRA8	Pernambuco, Brazil	7 a.m.-noon.
49.92	6.01	CJCX	Sydney, Nova Scotia	10 p.m.-4.30 a.m., 7 a.m.-11.30 a.m.
49.94	6.007	XYZ	Rangoon, Burma	9.30 p.m.-1 a.m., noon-2 p.m.; Sat. 12.30 p.m.-2.30 p.m.
49.94	6.007	ZRH	Pretoria, Sth. Africa	2.45-3.45 a.m., ex Sun., 12.30 a.m.-7 a.m.; Mon. 12.40-3 a.m., 3.15-6.15 a.m.
49.94	6.005	CFCX	Montreal, Canada	10.45-4 p.m.; Mon. midnight-2.15 a.m.
50.00	6.000	HP5K	Colon, Panama	10 p.m.-midnight, 3-4 a.m., 9 a.m.-2 p.m.
50.00	6.000	XEBT	Mexico D.F., Mexico	1 a.m.-4.45 p.m.
50.11	5.987	HH2S	Port-au-Prince, Haiti	9.30 a.m.-noon or 1 p.m.
50.17	5.98	VONG	St. John's, Newfoundland	7.30 a.m.-11.30 a.m.
50.21	5.975	OAX4P	Huancayo, Peru	Noon-2 p.m.
50.34	5.960	HI1J	San Pedro, D.R.	2.40 a.m.-4.40 a.m., 9.10 a.m.-11.30 a.m.
50.50	5.941	PJC1	Curacao, D.W.I.	9.36 a.m.-11.36 a.m.; Mon. 1.36-3.36 a.m.
50.51	5.940	TG2X	Guatemala, Guatemala	Tu/Fri. noon-2.30 p.m.; Sun. 1-3 a.m.
50.51	5.940	OAX2A	Trujillo, Peru	Wed/Thur/Sun/Mon. 10 a.m.-1 p.m.

SHORT-WAVE BROADCASTING STATIONS OF THE WORLD—(Continued)

Metres	M.C.	Call	Station	Time
50.63	5.926	HI1S	Santiago, D.R.	8.40-10.35 a.m., ex Mon.
50.85	5.900	ZNB	Mafeking, Bechuanaland	4-5.30 a.m., 9-10 p.m., ex Sun.
51.07	5.875	HRN	Tegucigalpa, Honduras	9 a.m.-2 p.m.
51.24	5.855	TGX1	Guatemala, Guatemala	Daily to 2.30 p.m.
51.46	5.830	TIGPH	San Jose, C.R.	10 a.m.-1 p.m.
51.46	5.830	TIXGP3	San Jose, C.R.	1-3 p.m.
51.50	5.820	TIGPH2	San Jose, C.R.	3-5 a.m., 10 a.m.-2 p.m., ex Mon.
51.77	5.795	HRK	Tegucigalpa, Honduras	Daily to 2 p.m.
52.40	5.725	HC1PM	Quito, Ecuador	Mon. noon-2 p.m.
55.97	5.360	HCK	Quito, Ecuador	Irregular
58.31	5.140	PMY	Bandoeng, Java	8.30 p.m.-3 a.m.
59.58	5.035	YV5RN	Caracas, Venezuela	7 a.m.-2.30 p.m.; Sun. 11.30 p.m.-Mon. 2.20 a.m., 6.30 a.m.-2 p.m.
59.76	5.020	YV4RQ	Puerto, Cabello, Venez.	Broadcasting nightly
59.88	5.010	YV5RM	Caracas, Venezuela	6.30 a.m.-1 p.m.; Sun. 11 p.m.-Mon. 1.30 p.m.
60.12	4.990	YV3RX	Barquisimeto, Venez.	1.0 a.m.-2.0 p.m.
60.31	4.975	YV1RJ	Coro, Venezuela	Signs off at 12.35 p.m.
60.48	4.960	VUD2	Delhi, India	10.30 p.m.-3.30 a.m.
60.480	4.960	YV5RS	Caracas, Venezuela	7.30 a.m.-12.30 p.m. or later
60.57	4.953	YV4RO	Valencia, Venzeuela	3.0 a.m.-4.0 a.m., 9 a.m.-1 p.m.
60.73	4.940	YV5RO	Caracas, Venezuela	Signs off at 1 p.m.
60.85	4.930	YV4RP	Valencia, Venezuela	8 a.m.-12.30 p.m.
60.92	4.924	HJAP	Cartegena, Colombia	Midnight-4.30 a.m., 10 a.m.-1.15 p.m. Mon.
60.98	4.920	YV5RU	Caracas, Venezuela	8 a.m.-12.30 p.m.; Mon. to 1.30 p.m.
60.98	4.920	VUM2	Madras, India	9.30 p.m.-3 a.m.
61.04	4.915	HJFC	Pereira, Colombia	
61.10	4.910	YV1RY	Coro, Venezuela	9.30 a.m.-12.30 p.m., ex Mon.
61.16	4.905	HJAG	Barranquilla, Colombia	2 a.m.-2 p.m.; Mon. 2-11 a.m.
61.22	4.900	YV6RT	Bolivar, Venezuela	Signs off at 12.30 p.m.
61.29	4.895	HJCH	Bogota, Colombia	2.30 a.m.-5 a.m., 9 a.m.-2 p.m.
61.35	4.890	YV1RX	Maracaibo, Venez.	1.30 a.m.-4.30 a.m., 7.30 a.m.-1.30 p.m.
61.42	4.885	HJDP	Medellin, Colombia	11 p.m.-5 a.m., 9 a.m.-2 p.m.
61.48	4.880	YV6RU	Ciudad, Bolivar, Venez.	
61.48	4.880	VUB2	Bombay, India	10.30 p.m.-3.30 a.m.
61.54	4.875	HJFH	Armenia, Colombia	11 p.m.-2 a.m., 9 a.m.-1 p.m.
61.60	4.870	YV2RN	San Cristobal, Venez.	2.30-3.30 a.m., 9 a.m.-noon ex Mon.
61.67	4.865	HJBJ	Santa Maria, Colombia	8.30 a.m.-1.30 p.m.
61.73	4.860	YV1RL	Maracaibo, Venez.	2-4 a.m., 7.30 a.m.-1.30 p.m.
61.80	4.855	HJCF	Bogota, Colombia	10 a.m.-3 p.m., ex Mon.
61.88	4.850	YV1RZ	Valera, Venezuela	2.30 a.m.-4, 8.45 a.m.-11.45 a.m.
61.98	4.840	VUC2	Calcutta, India	9.30 p.m.-3 a.m.
61.98	4.840	YV4RX	Maracay, Venezuela	Daily to 1 p.m.
62.05	4.835	HJAE	Cartegena, Colombia	10 p.m.-9 a.m., 10 a.m.-2 p.m.
62.11	4.83	YV5RH	Caracas, Venezuela	9.30-10.30 a.m., 1.30-4 a.m., 6.30 a.m.-1 p.m.
62.17	4.825	HJED	Cali, Colombia	10 a.m.-2 p.m., ex Mon.
62.24	4.820	YV3RN	Barquisimeto, Venez.	2.30-4.30 a.m., 8.30 a.m.-12.30 p.m.
62.31	4.815	HJBB	Cucuta, Colombia	
62.38	4.810	YV1RU	Maracaibo, Venezuela	1.45-3.45 a.m., 7.30 a.m.-1.30 p.m.
62.44	4.805	HJDU	Medellin, Colombia	10-11.50 a.m.
62.53	4.798	YV1RV	Maracaibo, Venezuela	1.45-3.45 a.m., 7.30 a.m.-1.30 p.m.
62.57	4.795	HJFI	Ibague, Colombia	
62.63	4.790	YV5RY	Caracas, Venezuela	
62.70	4.785	HJAB	Barranquilla, Colombia	
62.76	4.780	YV1RO	Trujillo, Venezuela	Under construction
62.87	4.772	HJGB	Bucaramanga, Colombia	
62.89	4.770	YV1RT	Maracaibo, Venezuela	
62.96	4.765	HJFB	Manizales, Colombia	
63.11	4.755	HJEH	Buenaventura, Colombia	
63.23	4.745	HJCX	Bogota, Colombia	
67.01	4.273	RV15	Khabarovsk, U.S.S.R.	7 p.m.-1 a.m.
73.05	4.107	HCJB2	Quito, Ecuador	10-11.15 p.m., 2.30 a.m.-5.30 a.m., 5.45 a.m.-1.15 p.m., ex Tuesday.
75.00	4.002	CT2AJ	Ponta Delgada, Azores	Thu/Sun. 8-10 a.m.
85.70	3.500	YV5RV	La Guaira, Venezuela	
86.20	3.480	YV3RF	Acaragua, Venezuela	
87.00	3.450	YV6RC	Barcelona, Venezuela	
88.20	3.400	YV5RW	Caracas, Venezuela	
128.20	2.340	HOA	Panama City, Panama	9.0 a.m.-1.0 p.m.
129.30	2.320	TGWC	Guatemala City, Guat.	10.0 a.m.-3.0 p.m.

WORLD DISTANCE MAP



THIS Azimuthal map differs from the ordinary Mecatorial Projection map in that it is drawn to show the true direction of the countries of the world from a given point. In this case it is arranged to show true direction from Sydney as well as the distances travelled by radio signals following the Great Circle path. This is the path over which radio signals normally travel after having been propagated from the transmitting aerial.

The Circles on the map with Sydney as their centre represent multiples of distances of 2000 miles from this point. As an example, suppose we wish to ascertain the distance a radio signal would travel between Vancouver and Sydney. As each circumference of the circles represents 2000 miles and their are four such circles between the two points the Great Circle distance would be 4 multiplied by 2000 or 8000 miles.

The use of this map in conjunction with the aerial directivity patterns shown on page 15 will assist in erecting an aerial for best reception from any particular country or direction. To find the true direction of any city or country draw an imaginary line between the points representing Sydney and that city and extend this line to the margin. Each marked section around the margin is equal to 30 degrees.

For example, if we project a line from Sydney to London we find that it intersects a point 30 degrees West of North-West. Although the map is drawn around Sydney practically no change in directions and distances will take place if Melbourne is regarded as the central point.

Loudspeakers for Short-Wave Sets

Necessity for Fidelity — Baffle Requirements — Adding an Extension Speaker — Multiple Installations — High Sensitivity Desirable.

DESPITE the fact that static and other forms of interference sometimes make it necessary to reduce a short wave receiver's frequency response in order to gain clearer reception, it is at all times desirable that the set should be capable of providing wide-range reproduction. It is now the rule rather than the exception, that the reception of the major overseas transmitters is as free from interference as that of the local broadcast stations, and it is only when heavy static accompanies a local storm that it is advisable to cut off the higher tones from a set in order to make speech more intelligible and listening generally more pleasurable.

The loud speaker plays no small part in preserving the fidelity of the signal heard from the receiver. Distortion or frequency attentuation within the broadcasting station is no concern of ours, however, it is in our interest to adopt as an objective, the lifelike reproduction of the fine programmes of the many short wave broadcasters, of which most have installed high-fidelity apparatus.

It is not our intention here to review the theory of the modern loudspeaker or that of its predecessors. The modern unit of the dynamic type has long superseded those of the horn and magnetic cone types and features among its many improvements, tonal fidelity, sensitivity and power handling capacity.

A good set demands a good speaker and the purchase is recommended of none other than a first grade unit.

The selection of the type of reproducer will depend largely on the application for which it is intended, but in all cases good low note and reasonable high note reproduction is desirable. The standard products of reputable manufacturers provide a high note response that will meet with average requirements and it is possible to secure an adequate low note response by using a baffle board or a speaker mounting of the labyrinth or infinite baffle type.

Low frequency response is a function of the size of the baffle. It will normally be found that a square of three or four feet will be the largest size that can be accommodated in the home.

Baffle Materials

IF the material used is wood, celotex or other sound insulating material having a thickness of at least ¾in., and the speaker is centrally mounted, a baffle of this size will add to the realism of musical programmes by increasing the set's low note response.

The sensitivity of a speaker is governed by its general design and more particularly by the power of the magnets incorporated in it. The larger the magnet in a permanent magnet type speaker the greater is the output. The sensitivity of the electro-magnet type is controlled by the amount of energy consumed in exciting its field. Usual values are approximately six watts for speakers having a diameter of 6in. or less and 8 or 9 watts for those having a diameter of 10 or 12in.

Standard speakers will handle the output of nearly all short wave receivers: it is only when a set's output exceeds a value of 9 or 10 watts that it is necessary to use one of the auditorium type.

It is sometimes necessary to instal a second speaker to make remote listening possible. In every case where such an extension is desired it is advisable to select a speaker of the permanent magnet variety.

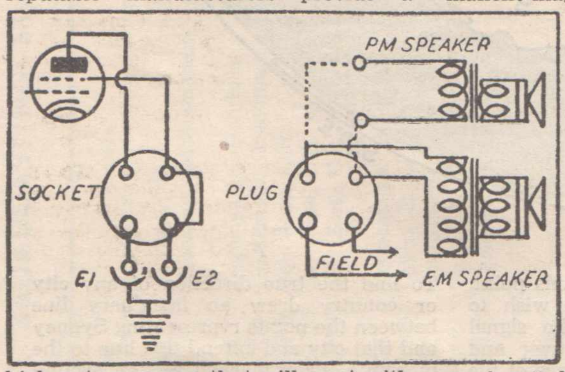


FIG. 1.—How to connect an extension permagnetic speaker to a receiver.

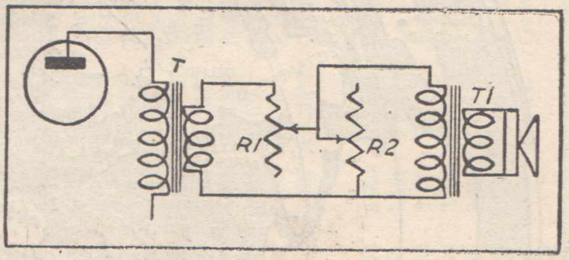
Figure I illustrates how an extension speaker of this type is added to a receiver in which the existing speaker is of the electro-magnet type. The field winding of the original speaker is left in circuit, and the two leads on the extension speaker substituted for the leads of the original speaker's input transformer.

Standard practice rules that the field winding of a speaker should be connected to the two large pins whenever a four-pin plug is used, and the transformer connected to the other two. Sometimes some departure is made from this; consequently it is advisable to check these connections before the permagnetic speaker is wired up.

Both the transformer leads and those to the extension speaker may be connected to the smaller pins to provide simultaneous operation of both reproducers. This will result in a mismatch of impedances, but it may not be so great as to seriously impair the set's frequency response. By selecting a permanent magnet type of speaker having a high impedance transformer primary winding, the error introduced in the original speaker's matching will be reduced to a minimum.

Excellent reception of overseas programmes containing items of interest to the general public sometimes makes it desirable to use more than one speaker on the short-wave receiver. In hotels and guest-houses it is essential that each speaker should be fitted with its individual volume control, in order to permit the listener to exercise choice in the selection of an output level which meets individual requirements.

FIG. 2.—The system of volume control employed in multi-speaker installations.



Speaker Matching

THE circuit of Fig. 2 shows how this is done. Firstly, it is necessary to match the output of the receiver to the line connecting the speakers with the receiver. Normal values would be 7000 ohms for the output valve of the receiver, and 500 ohms for the line. The matching is done by selecting a transformer (shown as T in the diagram), which has the correct primary to secondary turns ratio. Each of the speakers will be fitted with its own input transformer. Hence it is necessary to match each speaker to the line, remembering that all the speaker transformer primary windings are in parallel. The impedance of each primary will be the line impedance multiplied by the number of speakers. Suppose six are to be used, then each speaker should be fitted with a transformer, the primary of which has an impedance of 3000 ohms (6 x 500). It should be noted that in Fig. 2, transformer T is the output transformer of the set, matching its output valve to the low impedance line. Transformer T2 is the input transformer to be connected to each of the individual speakers. The ganged potentiometers, R1 and R2, are connected to the input transformers, and serve as volume controls for each speaker. Potentiometer R1 should have a resistance some five times that of the impedance of the speaker into which it is to work. R2 should be approximately a quarter of the resistance of R1.

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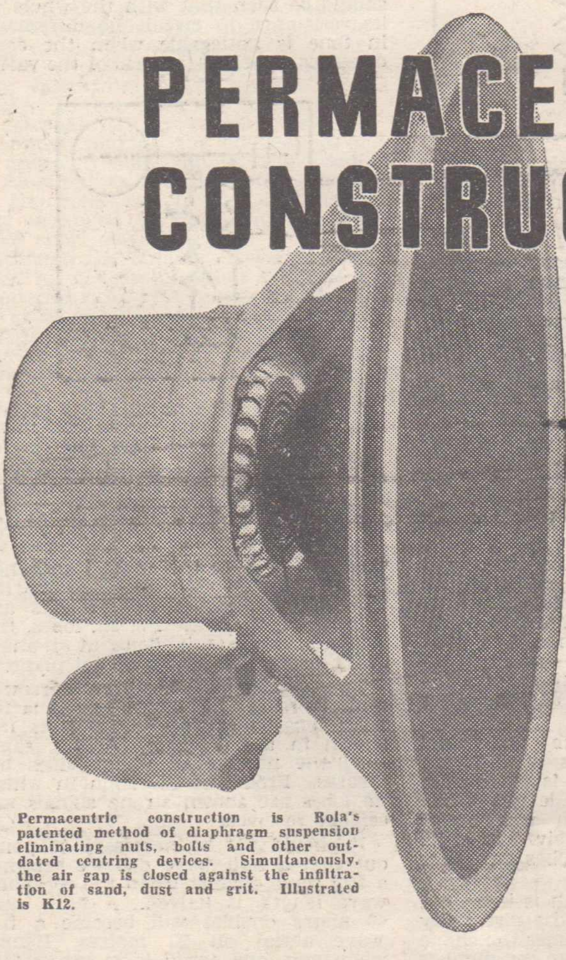

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TONE CONTROLS

Effective Control reduces the Effect of Static — Choice of Several Systems — Preventing Audio Feedback.

THE addition of variable tone control to short wave receivers may, to the uninitiated, seem a rather useless waste of material and space. The regular short wave DX fan will, however, appreciate the advantages of incorporating an efficient tone control arrangement in both short and dual wave type receivers.

The tone control provides a reliable means of reducing static and other local interference which usually is of a fairly high audio frequency, allowing of the reception of weak stations which otherwise would be marred by the high noise level.

Several forms of tone control may be used. The most popular system is shown in diagrammatic form in Fig. 1. Basically this consists of a variable resistance and a suitable value of condenser to by-pass the high frequency tones, thus preventing them from being reproduced by the speaker or headphones.

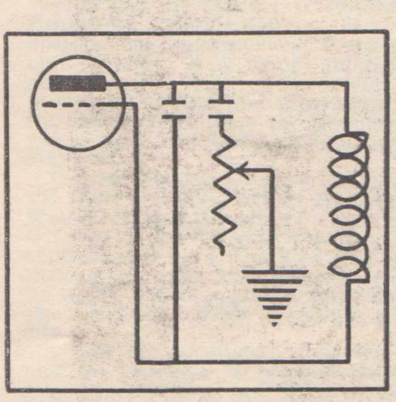


Fig. 1.—A simple and widely used system of tone control. The valves are given in the text.

The actual values are not critical although those most generally used will be found to lie within the following limits:—From 5000 to 50,000 ohms for the variable resistor, and between .02 and .1 mfd. for the condenser. A value of 50,000 ohms for the variable resistor and a capacity of .05 mfd. for the condenser gives excellent results. With values of resistance and capacity above 10,000 ohms and .03 mfd., respectively, it is desirable to connect a small fixed condenser with a capacity of about .005 mfd. between the plate and screen or plate and cathode of the output valve. This prevents the possibility of audio feedback taking place.

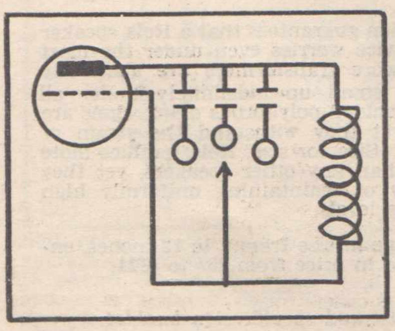


Fig. 2.—Another method in which a multi-point switch connects condensers of several different capacities in the output circuit of the power valve.

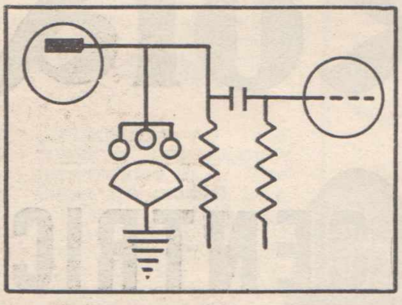


Fig. 3.—How a variable capacity type tone control is connected in the plate circuit of the first stage audio valve.

This feedback makes itself known in the form of howls and other annoying noises when the tone control is advanced towards the treble setting. Another popular system is shown in Fig. 2. In this case a multi-point switch is employed to switch in several different values of capacity. One disadvantage of this form of control is that if a wide range of tone compensation is required, five or six switch positions are necessary, and the values of the condenser must be carefully selected to give the desired effect.

For a three-position control, which is quite common, values of .005, .02, and .05 mfd. would be suitable. This type of control is usually fitted in addition to the usual values of fixed tone compensation provided in the output pentode circuit. Some little time ago there appeared on the market a special form of tone control consisting of a built-up mica insulated condenser, arranged so that its capacity could be varied by rotation of its control knob.

This was designed to be fitted to the plate circuit of the first stage amplifier valve and provided excellent means of varying the tone of the receiver. Although only a variation of the system detailed above smaller capacities are used as they have greater effect by being connected to the high impedance plate circuit of the first stage valve. Fig. 3 shows the connections for the latter type of control, and Fig. 4, an alternative method of connecting a variable resistor and condenser in the grid circuit of the output valve.

In this case, the value of the resistor should be such that with the whole of its resistance in circuit no difference in tone is noticeable when the condenser is joined to the grid of the valve.

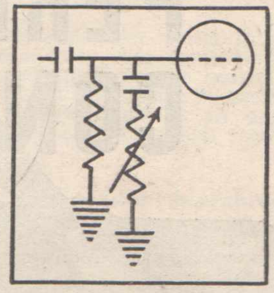


Fig. 4.—A variation of Fig. 1 in which the control is connected in the grid circuit of the output valve.

SHORT-WAVE AERIALS—Continued

NEARLY all aerials have directional properties; that is, they receive better from some directions than from others. Because of this it is possible to design an aerial in such a way that most efficient response may be obtained from some directions and interference noises excluded from other directions.

Fig. 6 illustrates the directional characteristics of aerials of different lengths. In Fig. 6a use is made of a doublet having an overall length of one half wavelength. With this aerial maximum signals are received from its sides, as shown by the lobes on either side of it.

When the overall length is increased to one wavelength long, the directivity pattern of the aerial assumes the shape illustrated in Fig. 6b. Here the number of lobes has increased to four, each having its centre at an angle of 54 degrees to the plane of the horizontal wire. In Fig. 6c the aerial length has been increased by another quarter wavelength, and its pattern has assumed a shape featuring six lobes, the four nearer the aerial being at an angle of 42 degrees to its horizontal plane.

The four major lobes grow narrower and increase in length as quarter wave lengths are added. This is not shown in the diagram. At the same time the number of minor lobes increases. From the direction in which no lobes are shown strong signals are seldom received.

It should not be necessary to point out that a half wave doublet becomes a full wave doublet when the receiving wave length is halved. A half wave 40 metre doublet will become a full wave aerial on 20 metres. Hence, when only one aerial is in use, reference must be made to the receiving wave length to determine the aerial's directive properties.

Adaptors and Regenerative Sets

How Adaptors Work—Battery and A.C. Circuits Connections to Existing Receivers—Simple Regenerative One and Two-Valvers—Coil Winding Suggestions—Importance of Reaction Control.

THE simplest method of tuning in short wave stations on existing broadcast T.R.F. and regenerative receivers is by the use of a short wave adaptor. In some cases an adaptor could be used on a superheterodyne type of set, but this method makes use of only the audio stages of the broadcast set, whereas, when a converter is used all of the valves in the superheterodyne are in use with consequently higher sensitivity and efficiency.

This article deals with the design of adaptors suitable for connection to the two first mentioned types of receivers. Two basic circuits are shown, one for A.C. receivers and the other for battery type sets. A plug-in socket is connected to the adaptor and this socket is plugged in to the detector socket of the receiver after having removed the detector valve from it. The valve is then replaced in the adaptor. In this way all external battery connections are eliminated, making the connection of the unit extremely simple. The adaptor functions as a regenerative detector, the coils and tuning condensers being arranged to tune over the required short wave bands.

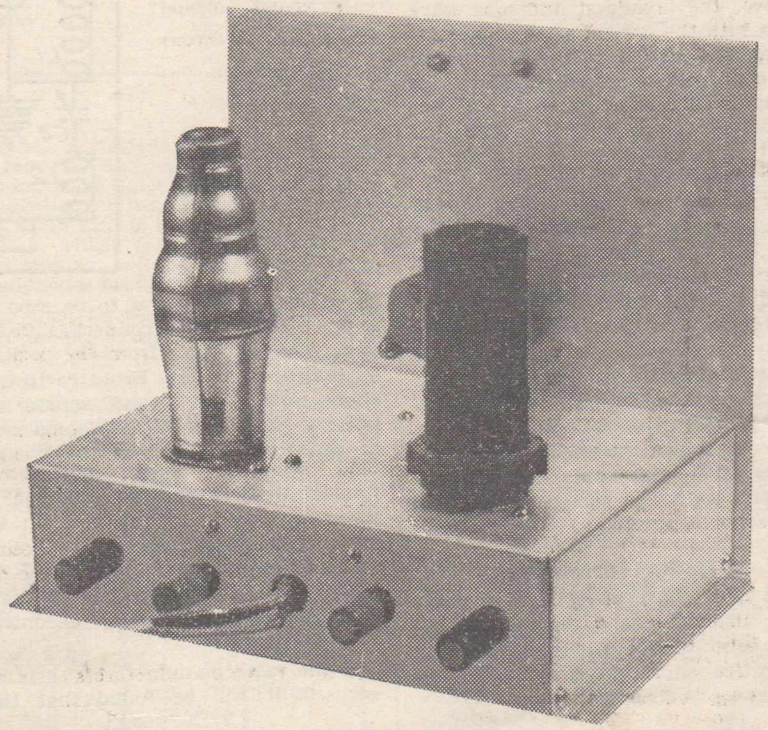
Although the circuits shown are designed for the use of triode valves if a screen grid valve is in use in the broadcast receiver this may be used in the adaptor. The screen grid connection being connected to the additional pin of the adaptor socket.

Regeneration Control

AN adaptor of this type relies to a large extent on smoothness of regeneration control for its success. If the detector valve goes in and out of oscillation with a loud plop it will be impossible to obtain effective results. Any time and trouble spent in making the regeneration control operate smoothly and efficiently will be well repaid. Where a screen grid valve is used it is sometimes advantageous to arrange a potentiometer control to vary the screen grid voltage.

Judicious use of this control together with the normal reaction control will allow of extremely fine regeneration adjustments necessary for the efficient operation of the adaptor. The tuning ranges of the adaptor must of course be decided by the individual constructor. However, it is advisable where possible to use low capacity tuning condensers which provide a certain amount of band spread. The disadvantage of this lies in the fact that a greater number of coils are necessary to cover the various recognised bands, but this is more than compensated for by greater ease of tuning and the ability to receive weak signals between their more powerful neighbors.

Midget condensers may be used for tuning, but where ordinary tuning condensers are available these may be employed quite effectively by connecting fixed condensers of suitable capacity in series with them to reduce the maximum capacity to the required value. Coil winding details are covered fully in the chapter devoted to coils and coil tables on Page 71 and coils suitable for various sizes of tuning condensers are quoted. Where the values of the condensers on hand are considerably higher in capacity than those stated, the following formula will be of assistance in determining the value of the fixed condenser to be connected in series with the unit to reduce it to the required value.



This photograph illustrates the layout of an adaptor or one valve battery regenerative set.

This formula reads, C1 multiplied by C2 divided by C1 plus C2. For example where the value of the existing tuning condenser is .0005 mfd. and the required value is .00015 mfd. or 150 mmfd. the caculation would be as follows:—Bearing in mind that with condensers in series the total capacity is always smaller than the smallest capacity in circuit, and using the above formula we would try 250 mmfd.

This gives an answer of 166 mmfd. Slightly too high. However, on working with a capacity of 200 mmfd. we find that:

500 multiplied by 200 equals 100,000, and this figure divided by the sum of 500 and 200 gives an answer of 143 mmfd.

With this capacity a set of five coils would be necessary to cover the short wave spectrum from 12 to 115 metres.

Aerial Resonance

ANY of the band spread tuning arrangements discussed in the chapter under that heading can be used quite effectively in an adaptor. The layout of the chassis for the adaptor is not very critical, providing the leads in the grid and tuning circuits are kept as short as possible. One serious disadvantage which sometimes occurs with regenerative type sets is failure of the detector valve to oscillate over sections of the tuning range.

This is usually due to aerial resonance and can be overcome by providing a variable aerial coupling. In the circuits shown this is simply arranged by connecting the aerial through a three-plate midget condenser direct to the grid end of the tuned winding. When a dead spot is encountered the setting of the condenser is altered slightly to shift the dead spot to another frequency.

Another cause of trouble with adapter units is their failure to oscillate because the broadcast reaction coil is left in the plate circuit of the detector valve even after this tube has been removed from its socket to permit the adaptor tube to be plugged in. The broadcast reaction coil and condenser

ADAPTORS, Etc.—Continued

form an absorption trap which damps out oscillation of the adaptor detector valve when the latter is tuned over the short wave range. The remedy, of course, is to ensure that the broadcast reaction circuit is broken when the adaptor is plugged in.

In Fig. 1 an adaptor circuit is shown using a six pin socket into which the coil formers are plugged. By connecting a condenser of suitable size between the points 1 and 2 and wiring the secondary coil winding between points 1 and 5 a band spread arrangement can be used. If on the other hand, it is desired to use standard condensers and coils to cover the range from 12 to 35 or from 16 to 50 metres, points 1 and 2 are bridged on the coil former.

With this arrangement it is possible to cover the broadcast and long wave bands with the normal size tuning condenser, and to reduce the capacity of this condenser as described above for tuning on the short wave bands. For the broadcast and long wave coils the aerial coil should connect between the points 5 and 6.

For short wave work, point 6 and point 1 are bridged on the coil former and a fixed condenser of suitable capacity, connected between the points 1 and 2. With battery adaptors three connections are necessary to the plug which connects to the broadcast set. The two filaments and the plate pins are connected as shown in the diagram. With the A.C. adaptor, four connections are necessary, the two heater or filament pins, the cathode and the plate. In each case the grid pin is not connected.

Audio Instability

THE data above on coils, tuning arrangements and reaction control apply also to one and two valve regenerative short wave sets be they battery or A.C. operated

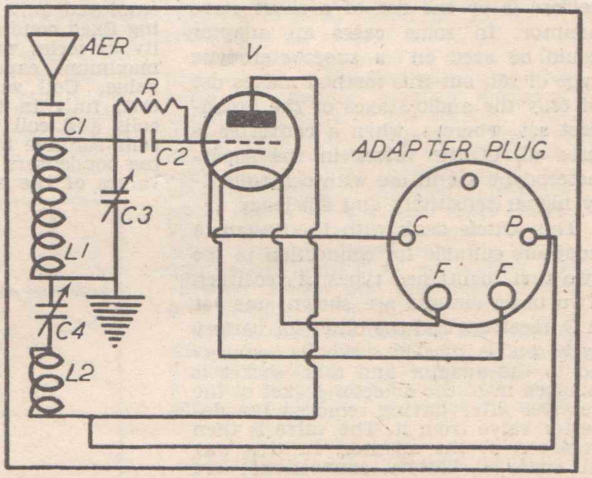
Two typical circuits are shown, together with a list of the components and their values. The circuits have been drawn to show headphone connections as they would appear on a one valve receiver, minus the power output stage. In both of these circuits variation of the screen voltage is provided for, and standard tuning condensers are employed together with a fixed condenser, to reduce the effective capacity to suitable limits.

In the case of the A.C. set it would be advisable, when it is to be used as a one valve set, to connect a 25,000 ohm voltage divider from the positive or centre contact of E2 to earth. A choke and wire wound resistor to make a total valve of 2500 ohms must be connected in place of the speaker field winding. Some constructors, finding that the speaker volume of these receivers is low on any but the major oversea stations add a second audio frequency stage between the detector and the output valve. In many cases, the only result is an uncontrolable audio howl.

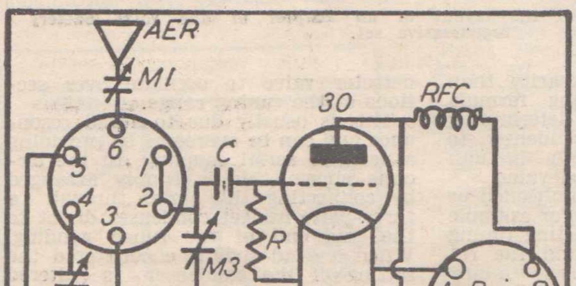
If the valve manufacturers' lists are perused, it will be found that they state, that, on no account, should more than one audio stage be used when a pentode is employed in the final stage.

The trouble arises because of the exceptionally high voltage gain in the two stages. In some cases decoupling the plate circuits of the detector and first audio valves will cure the trouble, but, in other cases, it is almost impossible to control. On no account should two transformer coupled stages be used in a battery or A.C. set. If it is necessary to use an additional stage, this should be resistance coupled, and the plate circuit decoupled to prevent feedback taking place

Even when this is done, it is sometimes necessary to reduce the grid resistor to a comparatively low value in order to reduce the gain in the stage. The addition of an un-tuned R.F. stage to regenerative sets is an advantage, it removes the aerial loading from the grid circuit of the detector valve, and allows of smoother and more efficient control of reaction. On the higher frequencies, no actual signal gain results, but the improvement in regeneration control is well worth the addition of the extra valve and components.



A simple adaptor designed for battery operation.



An A.C. version of a simple short wave adaptor.

Un-tuned R.F. Stage

THE circuit is quite simple, an R.F. choke or a resistor of about 500,000 ohms is connected from the grid of the screen grid, R.F. valve to earth, and the aerial lead is connected to the junction of the resistor and the grid lead. The plate circuit may be series fed through a primary winding on the detector coil, or shunt fed by means of a coupling condenser of .00025 mfd., connected from the plate lug of the R.F. valve to the grid end of the detector coil.

The plate voltage is fed to the plate of the R.F. valve through an R.F. choke, and the screen from a tap on the "B" battery, or in the case of an A.C. set, from a voltage divider or series resistor, suitably by-passed.

Tuning Hints

A WORD on the tuning of the regenerative type receiver will prove of assistance to the beginner. A station should be located with the detector valve just oscillating, the adjustment of this point of oscillation will vary as the frequency setting of the receiver is altered, and the reaction control must be adjusted each time the main tuning condenser is shifted. Once the station has been located, the reaction condenser or control is adjusted for best results. This will be found to be just before the point of oscillation is reached. Usually any alteration to the reaction control necessitates slight re-tuning of the station.

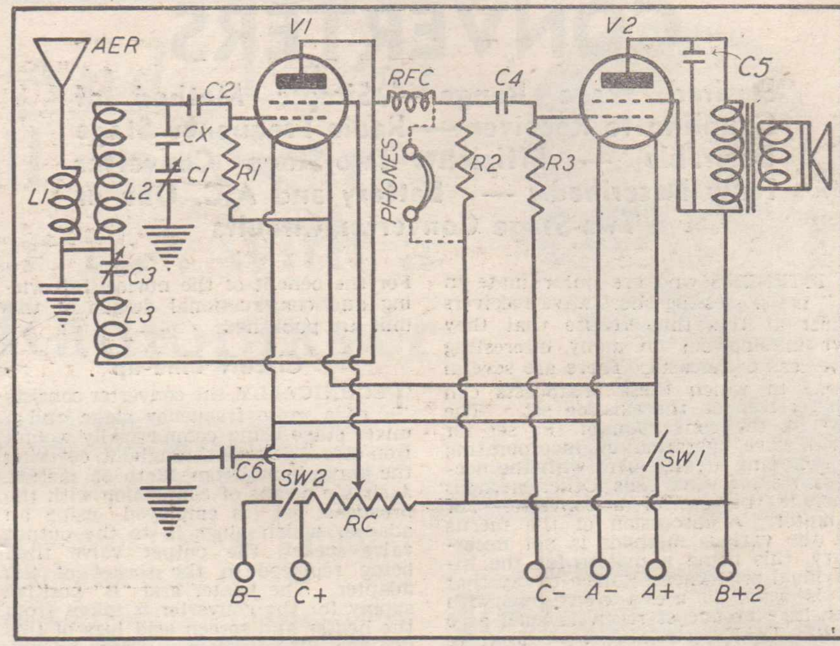
The use of the reaction control on receivers of this type is most important, and the sensitivity of the set is governed by the operator's ability to make judicious use of it. As mentioned previously, where dead spots are encountered on the tuning range, and the detector valve refuses to oscillate, the aerial coupling condenser should be altered slightly until oscillation is made possible.

In many cases where an R.F. choke is not used in the plate circuit of the detector valve, the connection of this component in the circuit will make for smoother control of regeneration.

Another annoying trouble encountered in regenerative type sets using transformer coupling is fringe howl. It gets its name from the fact that just on the fringe of oscillation a loud howl results. This may be cured by connecting a fixed resistor ranging in value from 100,000 ohms to 500,000 ohms across the secondary winding of the transformer. The highest value possible which will stop the howl should be employed so that the gain of the stage is not greatly reduced.

If the foregoing hints are observed, the user of these small regenerative sets will be agreeably surprised at the number of stations which it is possible to receive. With sets of this type possessing good signal to noise ratios, the connection of headphones to the output valve also is an advantage. Weak signals which cannot be followed on the speaker will be intelligible when headphones are used.

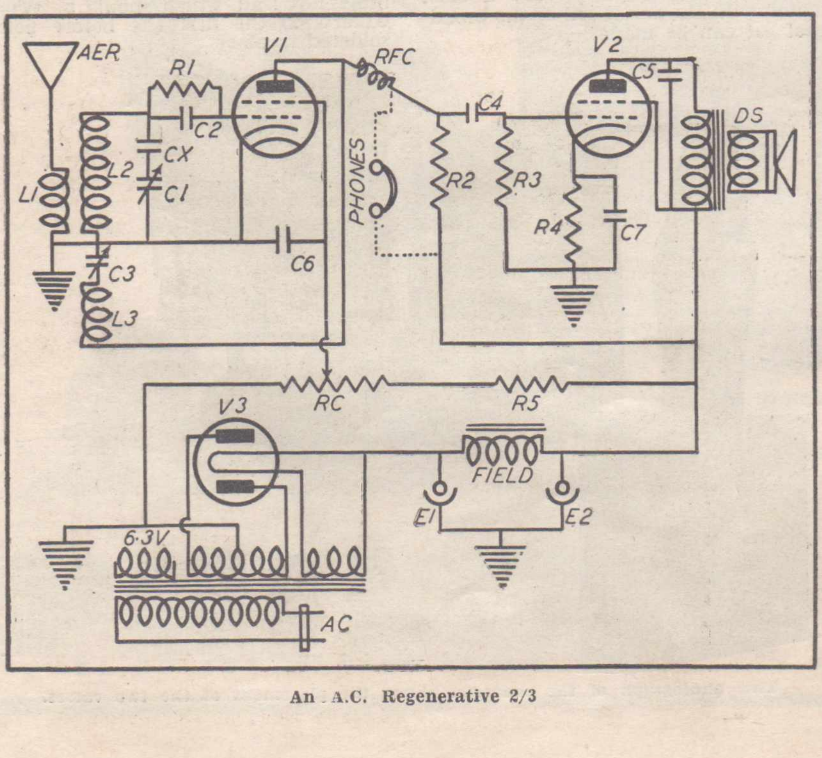
It must be realised, of course, that due to the comparatively low sensitivity of these receivers, it is essential that an effective aerial and earth system be employed. With an efficient directive antenna system, it is amazing what can be done in the way of DX.



A Battery Operated Regenerative 2 Valver.

PARTS LIST :

- CHASSIS: 10 inches by 8 inches by 2½ inches.
- COIL: L1, L2, L3.—Standard short wave aerial coil with reaction winding.
- C1: Single gang condenser. (See text.)
- C2: .00025 mica condenser.
- C3: 100 mfd. variable condenser.
- C4: .02 mfd. tubular condenser.
- C5: .01 mfd. tubular condenser.
- C6: .1 mfd. tubular condenser.
- C7: 25 mfd. 25 volt electrolytic condenser.
- CX: Fixed condenser. (See text.)
- DS: Dynamic speaker 2500 ohms; field to suit output valve.
- E1, E2: 8 mfd. 500 volt electrolytic condensers.
- FIELD: Loudspeaker field winding. (See DS.)
- R1: 2 megohm 1 watt carbon resistor.
- R2: 250,000 ohm 1 watt carbon resistor.
- R3: 500,000 ohm 1 watt carbon resistor.
- R4: Wire wound resistor. (Bias resistor, value determined by output valve.)
- R5: 100,000 ohm 1 watt carbon resistor.
- RC: 50,000 ohm potentiometer.
- RFC: Radio frequency choke.
- V1, V2, V3: R.F. pentode valve, power pentode valve and rectifier valve.
- SUNDRIES: Hookup wire, coil wire, solder lugs, grid clip, six pin coil formers, 3 knobs, dial, 2 insulated terminals, 2 4-pin, 3 6-pin sockets (one isolantite for coils).



An A.C. Regenerative 2/3

CONVERTERS

Desired Wave Range — Simple Method of Coupling to Receiver — Radio Frequency Stage Desirable — Efficient Two-Stage Converter Fully Described — Battery and A.C. One or Two-Stage Converter Circuits

LISTENERS who are unfortunate in not possessing short wave receivers must at this time realise that they are missing out on many interesting overseas broadcasts. There are several ways in which these broadcasts can be received on the existing set. The first is the conversion of the set for dual wave operation by incorporating a switching arrangement with the necessary short wave coils. Other methods include the use of a converter or adaptor. A discussion of the merits of the various methods is not necessary, this being a matter for the individual set owner. Suffice to say that it is usual to use a converter with sensitive broadcast receivers such as 5 valve T.R.F. sets and 4 or 5 valve superheterodynes. Either one or two stage converters may be employed and the accompanying diagrams are drawn so that the R.F. stage may be deleted if required. Where possible it is desirable to use the two stage unit as the additional amplification provided by the radio frequency stage greatly improves reception particularly on the weaker signals. In designing a converter several problems come under consideration, i.e. the bands to be covered, the type of coils to be employed, the provision of heater and plate supply for the converter valves. Regarding the problem of band coverage, here again the ability and ideas of the individual constructor enter into the question. For the less technically minded a simple single coil converter will prove easy to construct and operate whilst for the older head one using several sets of coils and having band spread characteristics (see page 70) may be required. Most of the short wave broadcasts of interest take place between 12 and 100 metres. In this spectrum many internationally accepted commercial broadcasting bands are used. These are commonly known as the 13, 16, 19, 25, 31, 41, 49 and 60 metre bands. The five first-mentioned bands usually provide the best reception, and a converter which covers these would be quite suitable for the newcomer to short wave listening.

Wave Coverage

PHOTOGRAPHS accompany this article showing the construction of a two stage converter using commercially wound iron cored coils of high efficiency. This has been made so simple that even those with little or no experience in radio construction should have no difficulty in building it from the instructions given. This unit is designed to cover the 13, 16, 19, 25 and 31 metre broadcasting bands, or, alternatively, the 16, 19, 25, 31 and 49 metre bands, whichever the constructor desires. Broadly speaking, the first mentioned coverage is the better, as most often static is troublesome above 45 metres. For the benefit of the novice, full wiring and constructional details of this unit are published.

Circuit Line-up

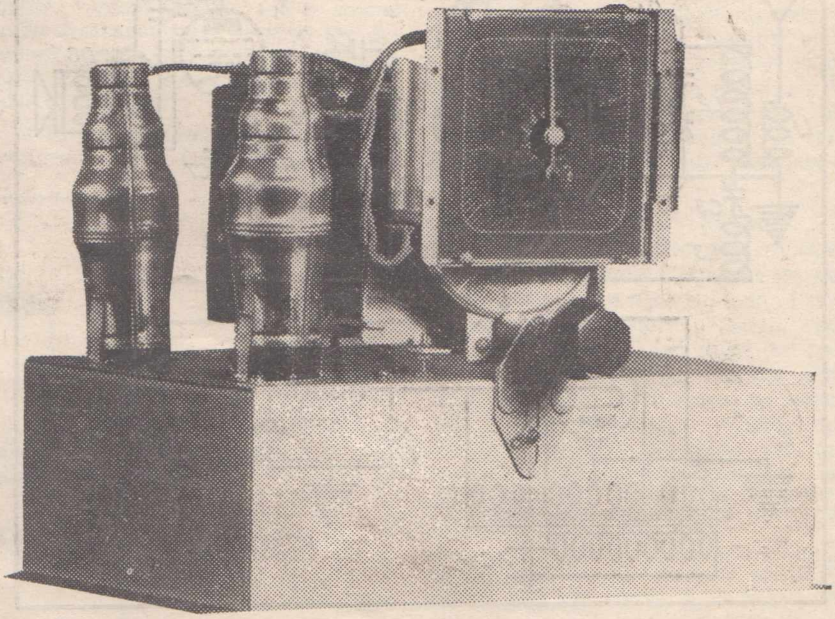
TECHNICALLY, the converter consists of a radio frequency stage and a mixer stage using commercially wound iron core type coils throughout, covering the wave band from 12 to 35 metres. A simple means of connection with the broadcast set is employed using an adaptor which plugs in to the output valve socket, the output valve then being replaced in the socket of the adapter. The heater and "B" positive supply for the converter is taken from the heater and screen grid lugs of this adapter. This system can only be employed when the output valve is one of the screen grid type, such as types 47, 2A5, 42, or their metal equivalents. The adapter consists of a 5, 6 or Octal type base, on the top of which is affixed a socket of the corresponding type. The base pins of the adapter are connected directly with the corresponding type. The base pins of the adapter are connected directly with the corresponding connections of the adapter, and three leads are soldered to the socket, one lead to each of the heater pins, and the other to the "B" positive or screen grid lug of the socket. The special coupling IF on the converter is provided with both high and low impedance windings, so that a close match with the aerial coil of the broadcast set can be made.

Assembly

THE three gang condenser is mounted centrally on the chassis with the socket for the valves V1 and V2 bolted in place to the left of the gang condenser the socket for V1 being nearest to the front of the chassis. When bolting the gang condenser, sockets and other parts in position place solder lugs under the holding bolts to provide fixing for the earth network. The IF transformer mounts in the rear right-hand corner of the chassis while on the rear wall are mounted four terminals. Two for the high and low impedance connections of IF and the others being the aerial and earth connections. If it is desired to use a doublet (see Aerials, P. 13), with the converter another terminal must be provided to which will connect the earth return lead of the Aerial winding.

Coil Mounting

BELOW the chassis the three coils are bolted in place by means of bolts screwed into the tapped collar of the coils. The aerial coil is mounted nearest to the front wall of the chassis, the R.F. coil in the centre and the oscillator coil near the rear wall of the chassis. A small shield measuring 3½ inches by 2¾ inches must be placed between the Aerial and R.F. coils to prevent interaction. A lug insulated from contact with the metal chassis should be mounted between the sockets for V1 and V2. This lug will be termed the "B" positive lug, and it will form an anchor point for all of the "B" positive leads. The parts having been mounted in place, a start may be made on the wiring of the converter. The wiring description will be made as detailed as possible for the benefit of less experienced constructors. Commence the wiring by soldering a flex lead to one of the heater lugs of the socket for V1 and joining the other end of this lead to the corresponding heater lug of the socket for V2. Join the remaining heater lugs of each socket together with another flex lead, which should be twisted around the first one before being soldered in place.



This photograph of the converter shows the placement of the two valves.

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R.C.S. I

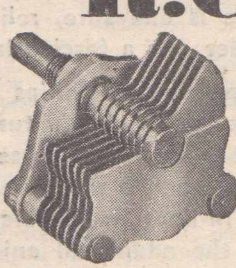

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plate capacity.

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3	15	3
4	25	3.5
5	35	4
7	50	4
9	70	5
14	100	6

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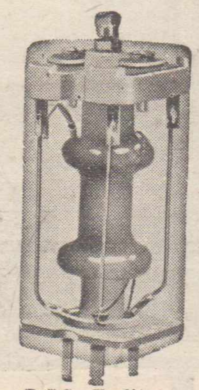
3	CV34	3/6	CV41	6/9
3	CV35	3/9	CV42	7/3
3.5	CV36	4/	CV43	7/10
4	CV37	4/3	CV44	8/6
4	CV38	4/9	CV45	9/
5	CV39	5/4	CV46	9/6
6	CV40	5/11	CV47	10/3



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MODEL 954A—5 Valve A.C. CONSOLE	30 GNS.
MODEL 959—5 Valve A.C. CONSOLE	22 GNS.
MODEL 40-59—5 Valve A.C. CONSOLE	24 GNS.
MODEL 866—6 Valve A.C. CONSOLE	42 GNS.
MODEL 887—8 Valve A.C. CONSOLE	49 GNS.
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CONVERTERS—Continued

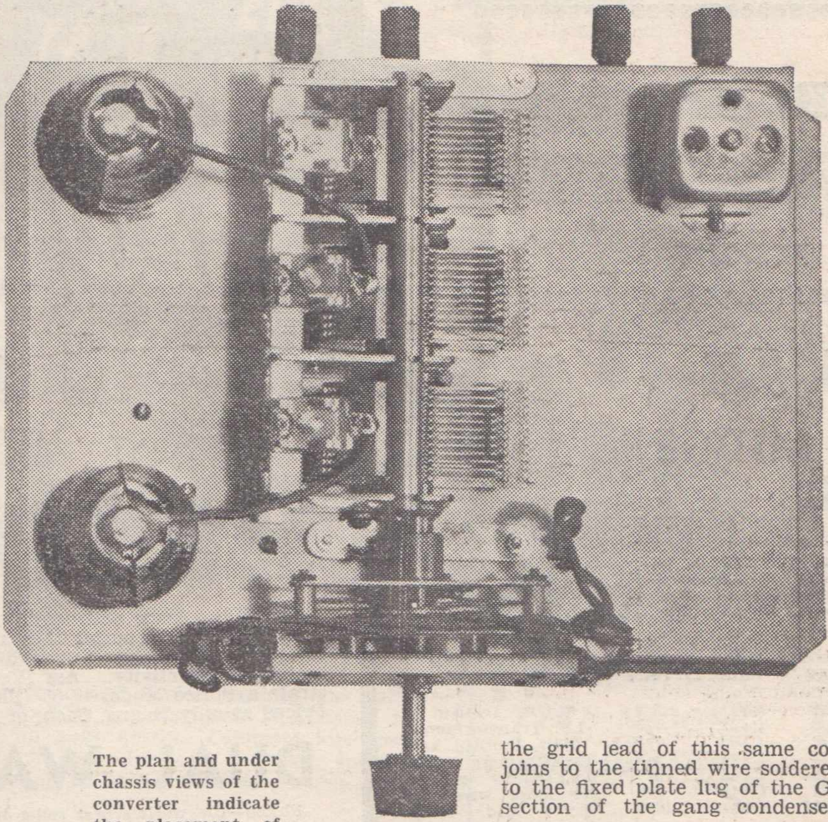
Wiring Details

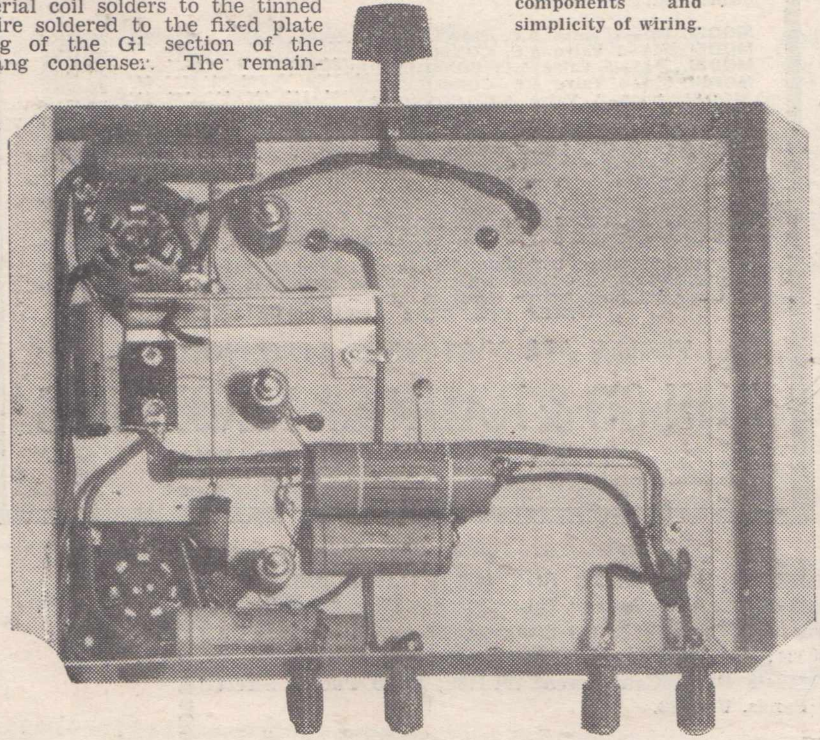
THE wiring description will be made as detailed as possible for the benefit of less experienced constructors. The coil connections should be made with the aid of the connecting code contained in each coil box. Commence the wiring by soldering a flex lead to one of the heater lugs of the socket for VI and joining the other end of this lead to the corresponding heater lug of the socket for V2. Join the remaining heater lugs of each socket together with another flex lead, which should be twisted around the first one before being soldered in place.

The earth network should now be soldered in place as it provides for easy soldering of the earth returns of bias resistors and by-pass condensers. The earth network is formed of tinned copper wire stretched straight. The wire is soldered to the solder lugs placed under the holding bolts of the sockets and other parts, and should be joined to the earth terminal with a similar piece of tinned wire. Join to the earth network the wiping contacts of the moving plates of the gang condenser. Solder short lengths of tinned copper wire of heavy gauge to the fixed plate lugs of each section of the gang condenser and cut them off so that about ¾ inch shows below the floor of the chassis.

Doublet Connections

THESE leads should then be covered with spaghetti sleeving to prevent them coming into contact with the metal chassis and the sleeving cut back so that the coil leads may be soldered to the projecting wires. Solder the aerial lead of the aerial coil to the aerial terminal and the earth lead of the same coil to the earth network or, if a doublet is to be used, to an additional terminal provided on the rear wall of the chassis. The grid lead of the aerial coil solders to the tinned wire soldered to the fixed plate lug of the G1 section of the gang condenser. The remaining lead of the aerial coil solders to the earth wire. The plate lead of the R.F. coil solders to the plate lug of the socket for the Valve V1, whilst the "B" positive lead of this coil solders to the "B" positive insulated lug. The grid lead of the R.F. coil connects to the tinned wire lead soldered to the fixed plate lug of the G2 section of the gang condenser. The remaining unconnected lead of the R.F. coil joins to the earth wire The plate lead of the oscillator coil joins to the oscillator plate lug of the socket for V2, whilst the grid lead of this same coil joins to the tinned wire soldered to the fixed plate lug of the G3 section of the gang condenser.





The plan and under chassis views of the converter indicate the placement of components and simplicity of wiring.

Screen Connections

THE earth lead of the oscillator coil joins to the earth wire. Solder one lead of the 15,000 ohm resistor R5 to the "B" positive lug and to the other lead of this resistor solder the positive or Red lead of the 8 mfd. tubular condenser, C6, one lead of the .1 mfd. tubular condenser, C5, and the remaining "B" positive lead of the oscillator coil. Solder the unconnected leads of C5 and C6 to the earth wire. To the cathode and suppressor grid lugs of the socket for V1 solder one lead each of the .1 mfd. tubular condenser C1 and the 350 ohm resistor R1. Earth the remaining leads of these two components. Connect together the screen grid lugs of the sockets for V1 and V2 and to the lug of V2 solder one lead of the .1 mfd. tubular condenser C2. The remaining lead of the condenser C2 solders to the earth terminal.

To the screen grid lug of V1 solder one lead of the 35,000 ohm resistor R2 and join the other lead of this resistor to the "B" positive lug.

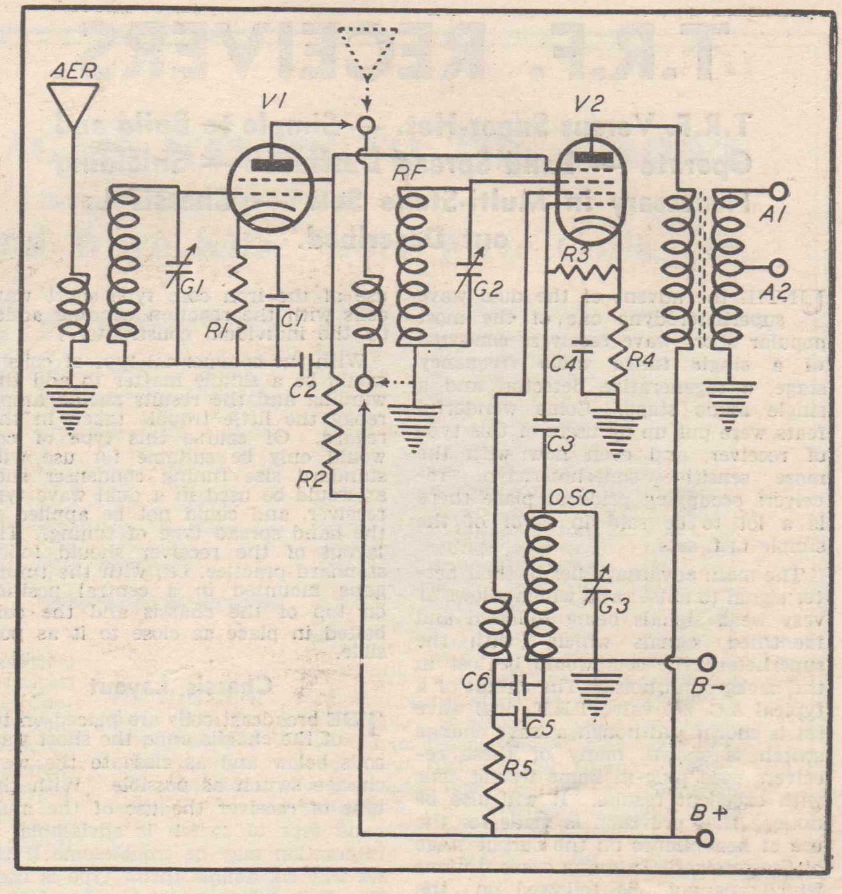
To the cathode lug of the socket for V2, solder one lead each of the 300 ohm resistor R4, and the .1 mfd. tubular condenser C4. Earth the remaining leads of these components. To the oscillator grid lug of the V2 socket solder one lead each of the .0001 mfd. mica condenser C3, and the 50,000 ohm resistor R3. The remaining lead of the resistor R3 joins to the cathode lug of the V2 socket, whilst that of C3 solders to the junction of the grid lead of the oscillator coil and the tinned wire lead from the fixed plates of the G3 section of the gang condenser. The plate lead of the IF joins to the plate lug of the V2 socket whilst the "B" positive lead of the same component joins to the "B" positive lug. The high and low impedance leads of the IF join to the high and low impedance output terminals respectively whilst the earth lead of IF joins to the earth wire.

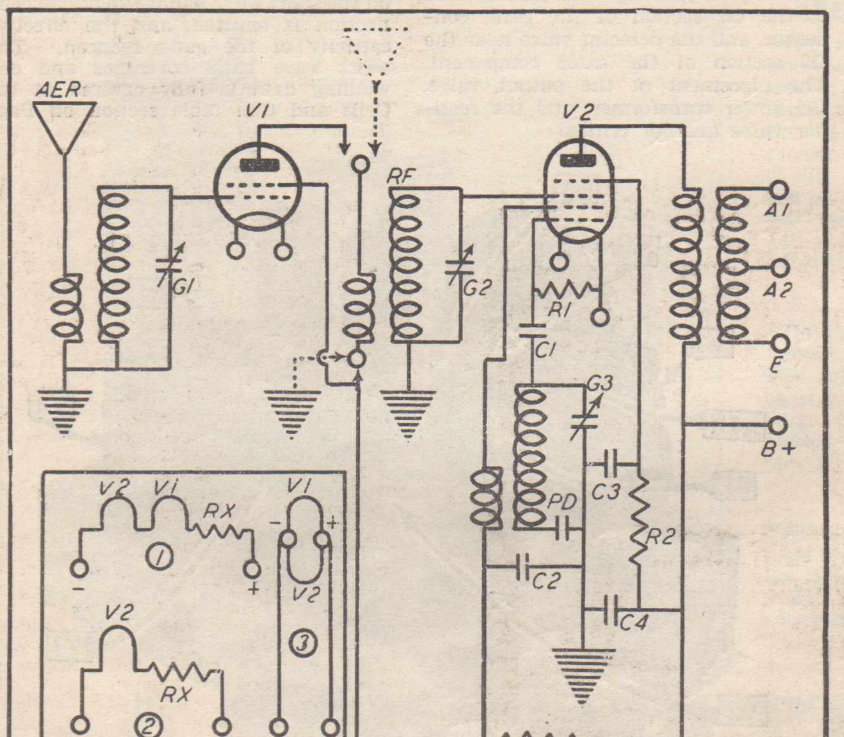
The ends of the leads from the adapter pass through a rubber grommett and then connect as follows:—The lead from the screen grid lug of the adapter joins to the "B" positive lug, whilst the two heater leads join one to each of the heater lugs of the socket for V2. The wiring is completed by soldering flex leads to the fixed plate lugs of the G1 and G2 sections of the gang condenser. These flex leads terminate in the grid clips for the caps of the valves V1 and V2 respectively. This completes the construction of the converter; the next step is its connection to the receiver and the alignment of the unit.

Connecting the Converter

FIRST remove the output valve from the broadcast set, plug-in the converter adapter and replace the valve in the socket of the adapter. Switch on the receiver and tune the broadcast set to a frequency near 550 k.c., i.e., just above 3AR, where no station is heard. Remove the aerial lead from the broadcast set and connect it to the aerial terminal of the converter. Join together the earth terminals of the set and the converter and join the aerial terminal of the set to the correct impedance matching terminal of the converter.

(Continued on page [illegible])





A.C. and Battery Two Stage Converter Circuits.

PARTS LIST :

CHASSIS.—To suit parts.

COIL KIT.—Aerial, Oscillator and R.F. iron-cored short wave coils. (See text).

C1, C2, C4, C5. .1 mfd. tubular condensers.

C3: .0001 mfd. mica condenser.

C6: 8 mfd. 500 volt tubular electrolytic condenser.

G1, G2, G3: 3 gang variable condenser with trimmers.

I.F.: Converter type intermediate frequency transformer 550 k.c.

P.D.: Padder Condenser.

R1: 350 ohm wire wound resistor.

R2: 35,000 ohm 1 watt carbon resistor.

R3: 50,000 ohm 1 watt carbon resistor.

R4: 300 ohm wire wound resistor.

R5: 15,000 ohm 1 watt carbon resistor.

V1, V2: R.F. pentode and mixer valves (see text).

Sundries: Terminals, solder lugs, hook-up wire, nuts and bolts, dial, two valve sockets, two valve shields and adaptor plug.

(Battery Adaptor Parts List in Page 85.)

T.R.F. RECEIVERS

T.R.F. Versus Super-Het. — Simple to Build and Operate — Band Spread Desirable — Shielding Necessary in Multi-Stage Sets — Chassis Lay-out Described.

UNTIL the advent of the dual wave superheterodyne one of the most popular short wave receivers consisted **of a single tuned radio frequency** stage, a regenerative detector, and a single audio stage. Some wonderful feats were put up by users of this type of receiver, and even now with the more sensitive superheterodyne receivers occupying pride of place there is a lot to be said in favor of the simple t.r.f. sets.

The main advantage lies in their better signal to noise ratio which allows of very weak signals being followed and identified, signals which, with the superheterodyne sets would be lost in the background noise. The circuit of a typical A.C. 3/4 valve T.R.F. dual wave set is shown. Although a wave change switch is shown, many of these receivers used plug-in home wound coils with excellent results. It will also be noticed that provision is made for the use of headphones on the output stage of the receiver. In many cases stations which cannot be followed on the speaker will be quite intelligible when headphones are used.

Some enthusiasts prefer to build a set such as this solely for short wave reception. The main advantage in doing this is the use of lower capacity tuning condensers so that the different bands occupy larger sections on the dial scale and consequently provide wider separation of stations on the more crowded bands. In some cases a type of band spread tuning (see P. 70) is employed, which allows of each band being tuned over 80 to 90 degrees on the main tuning scale, which is very desirable for D.X. work.

The use of two stages of T.R.F. in receivers of this type is not usual, but many enthusiasts claim extraordinary results from this type of receiver. However, many difficulties arise in the construction of such a set.

Shielding Necessary

SHIELDING must be extensively used to prevent feedback and a queer interlocking effect peculiar to this type of set.

The building of the 3/4 valve receiver should present no difficulties to the average constructor. In most cases the coils have to be home wound as the R.F. coil with reaction is not generally available for the shortwave bands. An innovation would be the use of the iron core type short wave coils with the reaction winding added by the individual constructor.

With the commercial type of coils it would be a simple matter to add this winding and the results should amply repay the little trouble taken in this regard. Of course this type of coil would only be suitable for use with standard size tuning condenser such as would be used in a dual wave type receiver, and could not be applied to the band spread type of tuning. The layout of the receiver should follow standard practice, i.e., with the tuning gang mounted in a central position on top of the chassis and the coils bolted in place as close to it as possible.

Chassis Layout

THE broadcast coils are placed on top of the chassis andq the short wave coils below and as close to the wave change switch as possible. With this type of receiver the use of the multi bank type of switch is adviseable, as interaction may be troublesome if the six-way six double throw type is used. The R.F. valve should be placed close to the G1 section of the gang condenser, and the detector valve near the G2 section of the same component. The placement of the output valve, the power transformer, and the rectifier valve are not critical

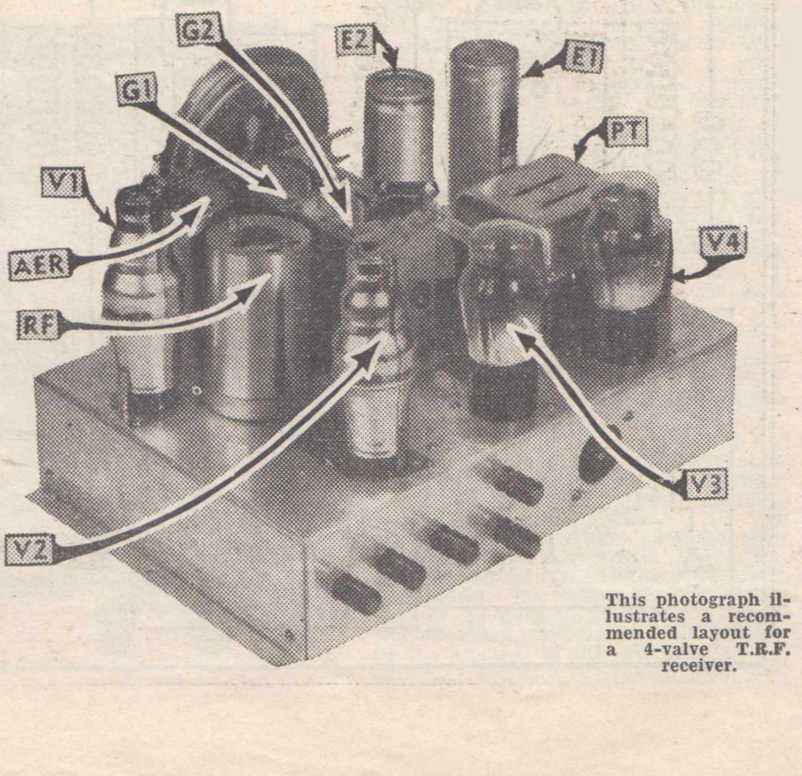
In wiring the receiver the coil leads and the plate and grid connections of the R.F. and Detector valves should be kept short. In some cases the use of shielded wire for the heater wiring helps to reduce the hum level of the set.

Reducing Hum

ALTHOUGH not shown in the diagram, it is sometimes necessary to decouple the plate circuit to the detector valve to still further reduce the hum level. Suitable valves for this purpose would be a 50,000 ohm decoupling resistor connected in series with the existing resistor R3 and a by-pass condenser of at least .5 mfd. connected from the junction of the two resistors to earth.

Several other methods of increasing the efficiency on the short wave bands would be to use a separate and lower capacity gang condenser for the short wave tuning ranges or to employ matched fixed condensers in series with the large gang so that the effective capacity of this unit is about 180 mfd. on the short wave bands. With plug-in coils this is quite simply done by using a four-pin former for the aerial coil and a seven-pin former for the R.F. coil.

The general idea can be seen on perusal of the diagram on Page 40. The fixed series condenser and the ganged tuning condenser are so arranged that on the broadcast band a bridge connection on the coil former shorts out the fixed condenser, whilst on the short wave bands the bridge connection is omitted, and the effective capacity of the gang reduced. The short wave band coverages and coil winding data is fully covered in the Coils and Coil table section on Page 71.



This photograph illustrates a recommended layout for a 4-valve T.R.F. receiver.

T.R.F. Continued from Page 48

BATTERY-OPERATED receivers of this type also give excellent results. In some cases where mains interference is bad, battery receivers are used in preference to the A.C. type, as they are less prone to electrical noise.

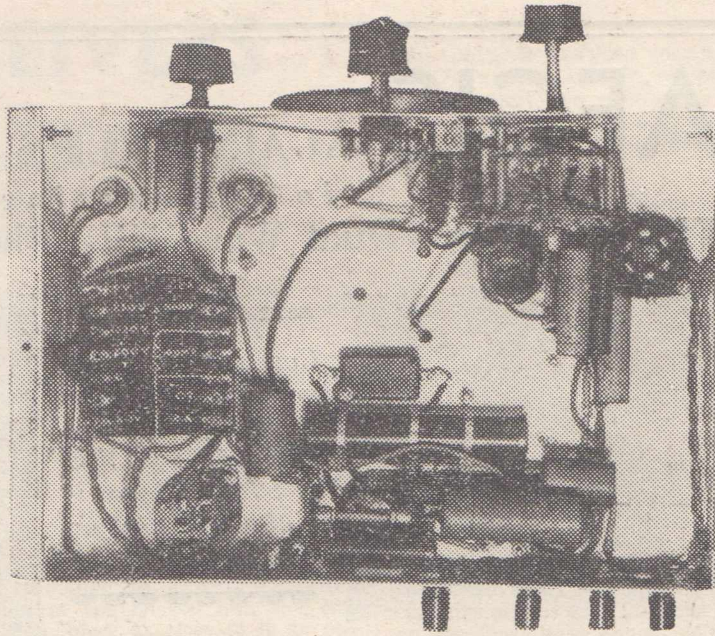
The layout of a battery T.R.F. receiver is similar to that of the A.C. model illustrated. Dispensing with the power transformer, rectifier, filter condensers and other items of an A.C. power pack makes possible the construction of a highly compact unit. By using the 1.4 filament series of valves, which require only a midget dry cell for filament supply, and two small 45 volt battery blocks for high tension, such a unit may be designed as a portable.

Three valves, or even two, one R.F. valve and a twin valve such as the 1D8GT, used as a combined triode detector and pentode output valve will provide results which will satisfy any but the most exacting enthusiast.

An efficient aerial such as the doublet described in the section on Short Wave Aerials (note connections for short wave doublet A2 and A3 in the diagram) will give results from a T.R.F. unit rivalling those of complicated multi-valve sets.

The only disadvantage is that its lower selectivity will occasionally make it harder to reduce interference from a strong local station. This is offset, however, by its low noise level, easy handling and low initial cost.

A point to be observed in the construction of a battery model is that a switch is necessary in one of the filament leads to prevent discharge from the batteries when set is not in use.

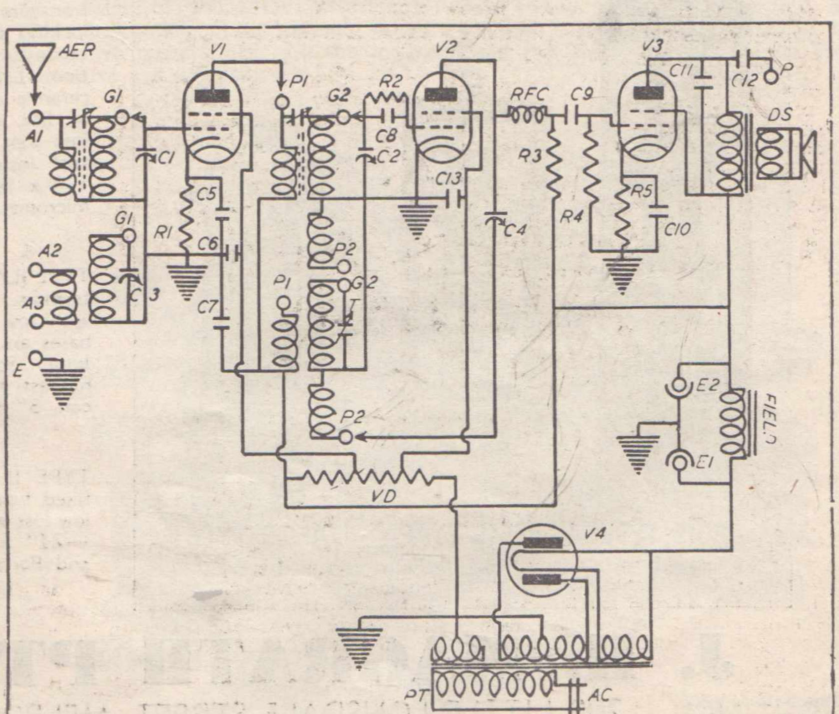


This photograph of the underside of the 4-valve T.R.F. receiver shows the placement of the smaller components and a general view of the wiring.

In some receivers a potentiometer is connected across the high tension battery for the purpose of controlling volume or regeneration by varying the voltage applied to the screen or plate of the detector valve. Where such a system is employed, it will be necessary to disconnect this potentiometer from the battery when operation is not required. A simple solution is to use a common switch for connecting the negative side of the filament supply and the low potential end of the potentiometer to earth.

Dual-Wave TRF Four

Chassis:— Measuring 12 inches by 8½ inches by 2½ inches.
Coils:— Aerial and R.F. coils for broadcast and short wave bands.
C1, C2.—Two gang condenser to suit coils.
C3.—Three plate midget condenser.
C4.—23 plate midget condenser.
C5, C6, C13.—1 mfd. fixed condensers.
C7.—.5 mfd. tubular condenser.
C8.—.00025 mfd. mica condenser.
C9.—.02 mfd. tubular condenser.
C10.—25 mfd. 25 volt electrolytic condenser.
C11.—.01 mfd. tubular condenser.
C12.—.002 mfd. tubular condenser.
DS:— Dynamic Speaker to suit type 42 valve, with field resistance of 2500 ohm.
E1, E2.—8 mfd. 600 volt electrolytic condensers.
PT:— Power transformer 385-0-385 volts at 60 m.a., one 5 volt filament winding and one 6.3 volt filament winding.
RFC:— Radio frequency choke.
R1.—300 ohm wire-wound resistor.
R2.—2 megohm resistor.
R3.—.25 megohm resistor.
R4.—.5 megohm resistor.
R5.—400 ohm wire-wound resistor.
Valves:— 6D6, 6C6 and 42 with sockets to suit.
VD:—25,000 ohm voltage divider.
Sundries:— 5 terminals, hook-up wire, nuts and bolts, dial, 4 knobs, 4 pin socket, rubber grommet, two grid clips, two valve shields and a 6 Pole double throw switch.



Schematic circuit of a simple and highly efficient 4-valve A.C. dual-wave T.R.F receiver.

SUPER-HETS.

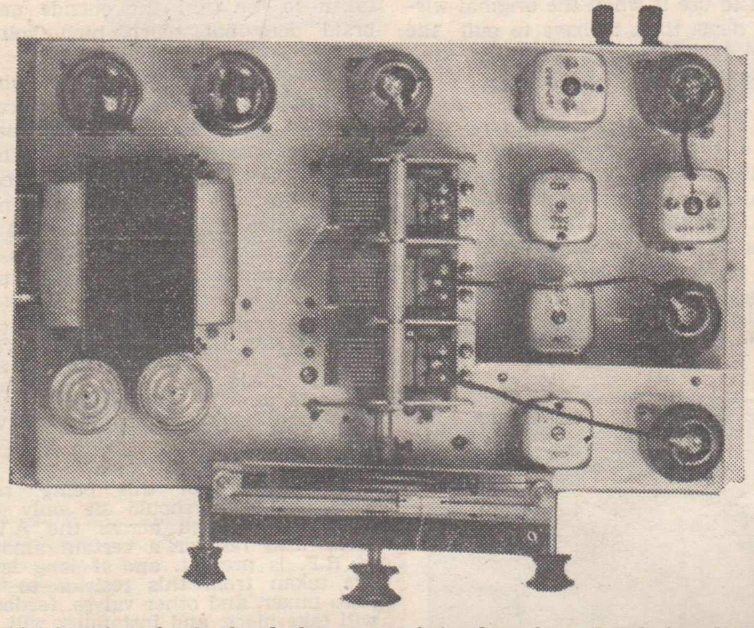
Chassis Layout — Circuit Diagrams of Battery, A.C. and Vibrator Sets — Interesting Ready Wired Coil-Switch Units, Wiring Hints — Use of Shield Wire — Importance of Earth Network.

THE superheterodyne type of receiver is universally used for the reception of short wave signals. In the majority of cases the sets are of the dual-wave type, although some are specially designed solely for short wave reception. In devoting this chapter to the various types of superheterodynes A.C. battery and vibrator types are illustrated, most of them being of the dual wave type.

The same circuit and component values can be used regardless of the type of coils and tuning condenser employed, so that the circuits shown can be used with band spread type of tuners or as ordinary dual wave receivers. A new and most interesting development in coil design, which should appeal to the home constructor, is the release of a dual wave switch and coil unit for use in receivers using a tuned radio frequency stage ahead of the mixer valve.

In the past it has been necessary to use separate coils and extensive shielding in sets of this type, and this has deterred the home constructor from attempting their construction. The new unit which is illustrated on Page 12 comes already wired and covers the broadcast band as well as one short wave band. Two types are available, one covering the short wave spectrum from 13 to 30 metres, and the other 16 to 52 metres with standard tuning condensers.

In designing the chassis of a high gain superheterodyne certain points must be watched if feedback and instability are to be avoided. In most cases the chassis layout should follow the circuit diagram, i.e., intermediate frequency transformers and their associate valves should be mounted close together, and the grid and plate leads kept as short as possible.



This plan view of a 6-valve dual wave superheterodyne shows the placing of the valves and other parts.

Constructional Features

In fixing the positions of the valves sockets these should be mounted in such a way that the heater wiring can be made to lay in the angle formed by the wall and the floor of the chassis. On no account should it be necessary to take the plate lead to the individual valve across its socket. Generally speaking the best rule to follow is to mount the sockets with the heater or filament lugs towards the outside walls of the chassis, and to lay the set out so that the valve order proceeds from right to left. In the case of a typical six valve set, the gang condenser would be placed in the centre of the chassis, and the coils and switch gear to the right and as close to it as possible.

The R.F. or V1 valve stocket would then be mounted in the front right hand corner of the chassis. The remaining sockets and I.F. transformers would then mount in the same order as they appear in the circuit diagram, proceeding from the R.F. valve socket, along the side edge of the chassis, and then along the back. Providing the heater or filament lugs of the sockets are kept towards the walls of the chassis, the plate and grid leads of the mixer, and I.F. amplifier valves will be very short, and high gain coils and I.F. transformers can be used throughout with little likelihood of instability.

Regardless of the type of receiver under construction the R.F., mixer, I.F. and second detector valves should all be fitted with valve shields unless they are of the metal or metal coated types. It is often advisable where the constructor has not had a great deal of experience in set construction, to place a shield between the R.F. and mixer valve sockets. The shield should consist of a piece of aluminium extending from the gang condenser to the outside edge of the chassis and its height should be slightly greater than the distance to the top of the valve shield.

In many cases very bad R.F. oscillation is cleared up by the addition of this shield. In very obstinate cases another shield should be placed between the sockets below the chassis.

Audio Instability

THE placement of the audio valve and its associate equipment is not very critical, providing the grid and plate leads are not exceptionally long. An obscure form of audio instability in high gain receivers using variable tone compensation is often troublesome, and very hard to locate. It occurs in the form of a steady howl, when the tone control is turned towards the treble position.

The connection of a fixed condenser of about .005mfd. capacity between plate and earth of the output valve will usually cure the trouble. It is advisable to include this condenser in any high gain receiver in which variable tone compensation is used. The positions of the power transformer, rectifier valve and filter condensers require little mention. However, there is one important fact which the average home constructor is apt to overlook, that of the proximity of the electrolytic condensers to the rectifier or other valves which radiate a considerable amount of heat.

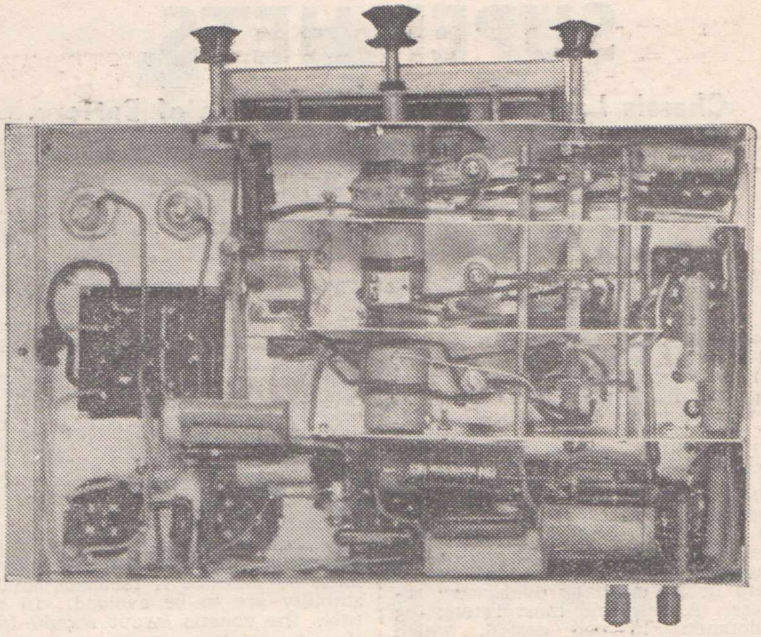
This will eventually dry up the electrolyte in the condensers, causing a breakdown, in which the rectifier and the power transformer may be severely damaged

The electrolytic condensers should always be situated well away from any valve or component which is apt to radiate heat. So much for the general layout. A little care in the wiring of a superheterodyne may mean the difference between mediocre and perfect results. It is advisable to decide on a system of wiring and always to stick to it. In this way the constructor is less likely to forget certain points, and the wiring can be made much neater than when the job is done haphazardly.

The writer usually follows this procedure:—First the heater and the rectifier socket wiring is done. All of the leads from the power transformer carrying A.C. are twisted in pairs, and, where possible, tucked into the corner formed by the floor and the wall of the chassis. An earth network is then laid down, by soldering stretched tinned copper wire to solder lugs placed under the holding bolts of the coils, I.F.'s, sockets, etc. This network is then joined to the earth terminal.

This network makes a convenient connection for the earthed ends of by-pass condensers and resistors, and also ensures a low R.F. resistance path for tuned circuit returns. With any high gain receiver it is essential that the wiper contacts on the moving plates of the gang condenser be soldered to this earth network. It is preferable to connect all grid returns of the tuned circuits to this same point. Incurable instability may result if this is not done.

The wiring of the coils to the wave-change switch, and the completion of each successive stage, working from the R.F. to the audio end, is then carried out. When each stage is wired and completed in this way there is less likelihood of the constructor leaving out parts, and then having to make long leads to wire them in place.



An under chassis view of the 6 valve dual wave receiver showing the short-wave coils and the wave change switch.

Shielded Wiring

THE appropriate use of shielded wire is another detail requiring discussion. In "the good old days" if a receiver showed any signs of instability liberal use was made of shielded wire for grid and plate leads. Certainly the instability was overcome, but only at the expense of considerable gain. In most cases, once the shielded wire was connected, it was impossible to align the receiver correctly, and low sensitivity and distortion were the result.

With the modern high efficiency coils and I.F. transformers, the use of shielded wire for plate and grid leads is definitely taboo. However, certain leads in most superheterodyne sets require the use of shielded wire. Although many commercially built receivers do away with it altogether, it is advisable for the home constructor to make judicious use of shielded wire when building a high gain set. It is much easier and neater to use it when the original wiring is done, than to have to pull the wiring about, to add shielding after the completion of the job.

A.V.C. Wiring

ALL of the A.V.C. wiring may be done with shielded wire; it should be used also for the second detector diode return, and the leads from the volume control to the grid of the first stage audio valve.

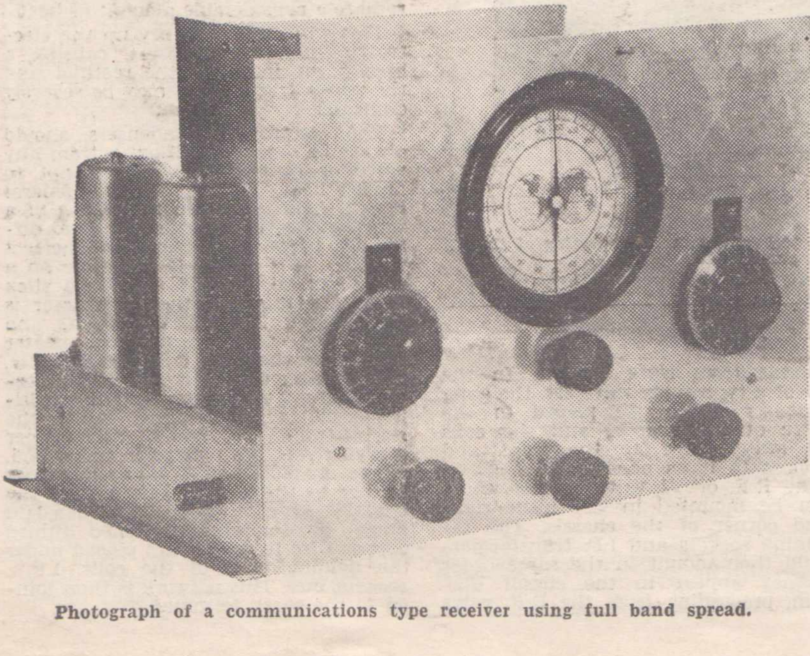
In using the wire the inside flex lead is used solely for the actual wiring connection, the outside shield soldering to the earth network. Care must be taken to see that the outside metal braid does not touch high voltage points, or that stray strands do not make contact with the lugs to which the inside lead is soldered. There is one point which arises when the shielded wire is used for A.V.C. leads. Where the A.V.C. feed condenser is connected to the plate of the preceding valve, all of the A.V.C. feed resistors should be placed as close to the diode lug of the A.V.C. rectifier as possible.

On no account should shielded wire be used for the connection between the A.V.C. feed condenser lug and the rectifier diode or for any lead which connects directly to this point. Even when no shielding is used on the A.V.C. leads, it is still good practice to group the resistors in this way.

The theory of this being that although there should be only d.c. voltages developed across the A.V.C. diode load resistor a certain amount of R.F. is present, and if long leads are taken from this resistor to the R.F., mixer, and other valves, feedback will take place, and instability will result.

This type of instability is very hard to trace, and it is much easier to take the precautions mentioned in the first place. Conversely, the A.V.C. by-pass condenser should be placed as close as possible to the connection of the respective coil or I.F. winding to which they are connected. Where possible, the condenser can be placed in the coil or I.F. can with excellent results.

If shielding braid is used on the connections to the diode plate, or the A.V.C. feed condensers, without the insertion of the resistors, the capacity of the shielded wire will be placed, virtually in parallel with the I.F. winding, and the trimmer on this winding will not peak.



Photograph of a communications type receiver using full band spread.

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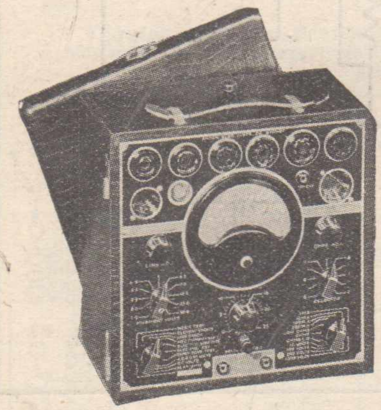
The efficiency and reliability of these Palec instruments is attested by dozens of unsolicited testimonials from satisfied users, as well as by reports from independent authorities such as State and Commonwealth Government Departments. In addition to the basic instruments covered, Palec also offers a full range of precision workshop and laboratory meters and instruments of all types. Included in this range are cathode-ray oscillographs, beat-frequency oscillators, a diode-rectifier type V.T.V.M. resistance and capacitance decade boxes, counter and portable-type valve testers, high-sensitivity voltmeters and a variety of multi-testers.



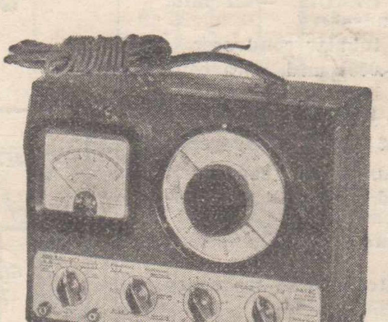
Every year brings an increase in the complexity of radio receiver design and, with it, a greater need for precision servicing. Correspondingly, service instruments must be built to more exacting specifications, to meet requirements that did not even exist a few years ago. The Palec "G" series of all-wave oscillators have been designed to anticipate these requirements and such desirable features as equalised output from band to band, constant depth sine-wave modulation, a ratio-calibrated attenuator system capable of giving reliable repeat readings, a frequency-stabilised oscillator, and a .5% accurate direct-reading dial have been incorporated. Many of these features previously were only found in instruments listing at ten times (and more) the price of this unit, so that the serviceman now can achieve laboratory precision at a price he can afford to pay.

Palec "G" series All-Wave Oscillators are available in three basic types, each with or without a built-in output meter, as required thus making six types in all, as under:—

Model GA	**AC operated**	**£11**	**15**	**0**
Model GAO	**AC operated with built-in Output Meter**	**£15**	**15**	**0**
Model GAV	**AC-Vibrator dual operation from A.C. mains or 6 v. accumulator**	**£13**	**15**	**0**
Model GAVO	**AC-Vibrator with built-in output Meter**	**£17**	**15**	**0**
Model GB	**Battery operated**	**£11**	**15**	**0**
Model GBO	**Battery operated with built-in Output Meter**	**£15**	**15**	**0**

A worthy companion to the "G" series of oscillators is found in the Palec model "VCT" valve and the circuit tester. This compact instrument combines the functions of a standard valve emission and leakage tester with those of an elaborate multimeter and condenser tester, and, with a "G" series oscillator, provides the technician with the basic instruments essential to rapid and accurate receiver servicing. An outstanding feature of the "VCT" it its four-range provision for resistance measurements, enabling continuous readings to be effected over the range from 0.1 ohm to 10 megohms, while a high-sensitivity neon indicator provides reliable leakage tests on resistances ranging up to several hundred megohms. Other features are electrolytic condenser tests for leakage at operating voltage, complete D.C., A.C. and Output voltage tests and a wide range of direct current measurements. Sockets and complete instructions are provided for the testing of all standard valve types used in Australasia.

In addition to the standard model for A.C. mains operation, the "VCT" is also available with a built-in vibrator unit which permits optional operation from either A.C. mains or a 6 v. accumulator.



Standard A.C. model "VCT"	**£15**	**10**	**0**
Dual-power A.C./Vibrator model "VCT"	**£17**	**17**	**0**

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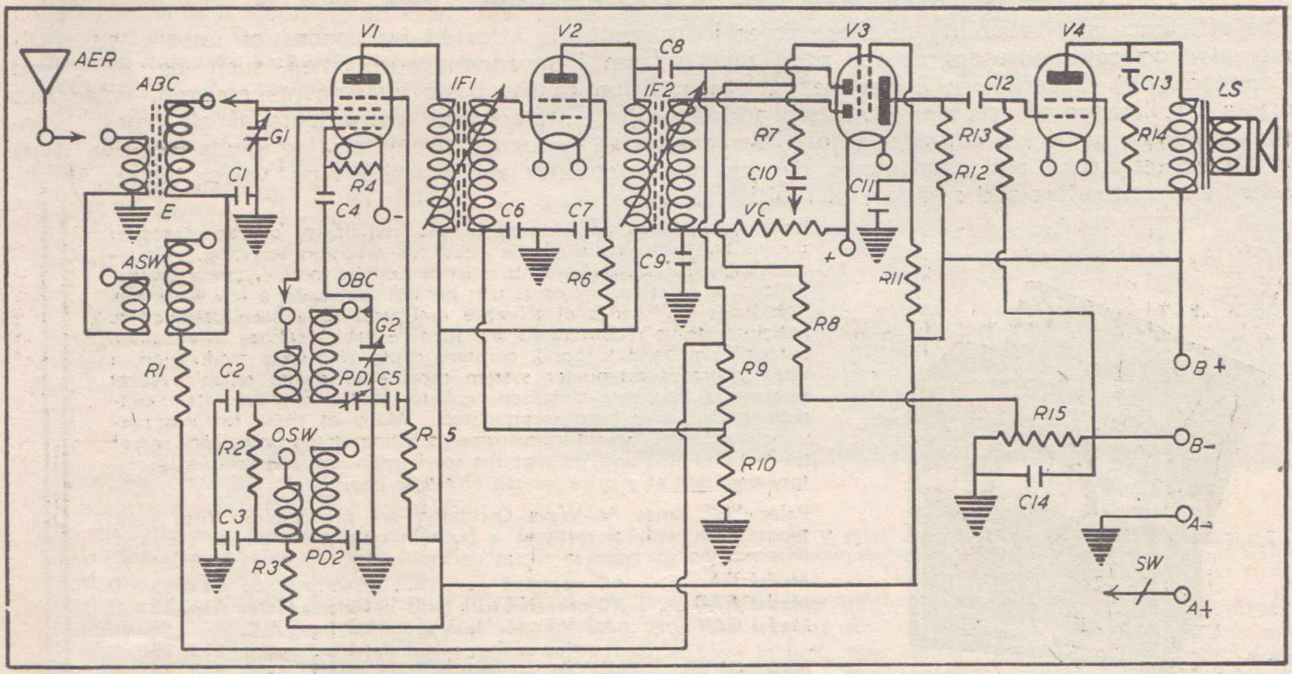
BATTERY DUAL-WAVE FOUR



Coil Kit.—Aerial and Oscillator dual wave coils with padder condensers to suit.

C1, C2, C5, C7, C11. — .1 mfd. tubular condensers.

C3.—.5 mfd. tubular condenser.

C4, C8, C9.—.0001 mfd. mica condensers.

C6.—.05 mfd. tubular condenser.

C10, C12.—.02 tubular condensers.

C13.—.01 mfd. tubular condenser.

C14.—25 mfd. 500 volt electrolytic condenser.

G1, G2.—Two gang condenser with dial.

IF1, IF2—Intermediate frequency transformers 465 k.c.

LS. — Permagnetic speaker to match output tube.

R1, R12.—250,000 ohm resistors.

R2.—30,000 ohm resistor.

R3.—20,000 ohm resistor.

R4.—50,000 ohm resistor.

R5.—60,000 ohm resistor.

R6.—75,000 ohm carbon resistor.

R7.—100,000 ohm resistor.

R8.—2 megohm resistor.

R9, R10, R13.—500,000 resistors.

R11.—1 megohm resistor.

R14.—10,000 ohm resistor.

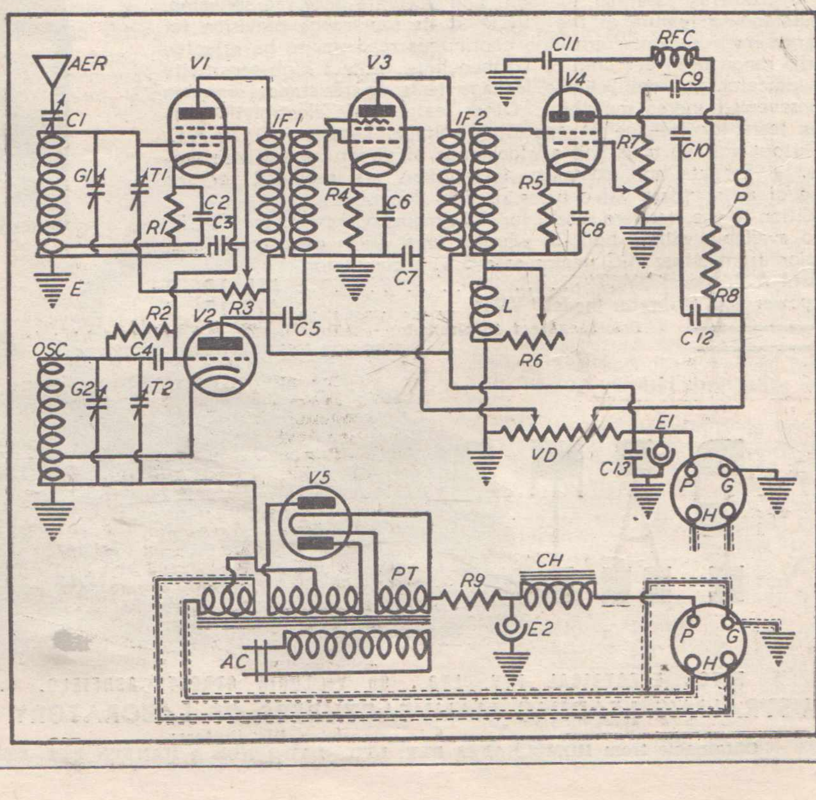
R15.—300 ohm wire wound resistor.

SW, VC.—500,000 ohm potentiometer with battery switch.

VALVES.—1C6, 1C4, 1K6 and 1F4, with sockets to suit.

SUNDRIES.—Two valve shields, hook-up wire, grid clips, nuts and bolts, two knobs, two bank Yaxley multi-switch and four terminals.

SHORT-WAVE HEADPHONE SUPER FOUR



Battery, Aircell, or Vibrator D/W 5

CHASSIS: Measuring 15 inches by 9 inches by 2¼ inches.

COIL KIT: Dual-wave iron-cored aerial, R.F., and 465 k.c. oscillator coils.

C1, C2, C5, C7.—.05 mfd. tubular condensers.

C3, C9, C10, C11.—.0001 mfd. mica condensers.

C4, C8, C14.—.1 mfd. tubular condensers.

C6.— .5 mfd. tubular condensers.

C12, C13.—.02 mfd. mica condensers.

DS.—Permanent magnet type dynamic speaker to suit 15,000 ohm load.

G1, G2, G3.—Three-gang tuning condenser to suit coil kit.

IF1, IF2.—465 k.c. iron-cored I.F. transformers.

PD.—465 k.c. padder condenser.

PD1.—Short wave padder to suit coils (.004 mfd. with home-wound type).

R1, R8.—.1 megohm carbon resistor.

R2, R3, R5, R15.—50,000 ohm carbon resistors.

R4.—20,000 ohm carbon resistor.

R6, R9, R10, R11, R13.—1 megohm carbon resistors.

R7.—75,000 ohm carbon resistor.

R12.—250,000 ohm carbon resistor.

R14.—200,000 ohm carbon resistor.

S.—Single pole double throw pick-up switch.

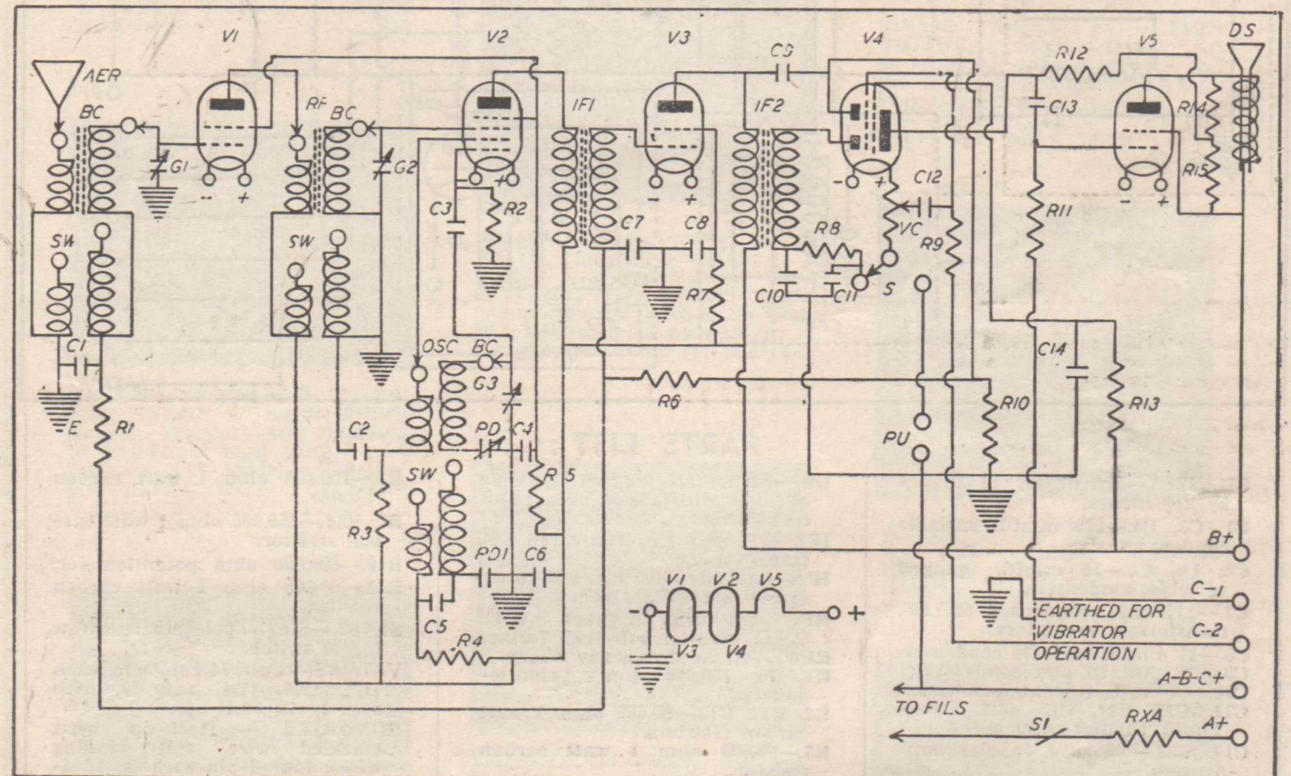
S1.—Battery switch built into VC.

VALVES.—Two 1C4's, one each 1C6, 1K6, and 1D4 (or 1F4 for air-cell use).

VC.—500,000 ohm potentiometer with switch.

NOTE.—Resistor RXA is needed only for air-cell operation.

Vibrator operation demands that a special vibrator filament choke, by-passed on the filament side by a 500 mfd. 12 volt electrolytic condenser, should be inserted between the filament supply switch and the positive side of the filaments.



PARTS LIST FOR S/W HEADPHONE SUPER 4

CHASSIS: Measuring 12½ inches by 8½ inches by 2½ inches complete with shields.

C1.—25 mfd. M.E.C. Trimmer Condenser.

C2, C5.—.01 mfd. mica condensers.

C3, C6, C7.—.1 mfd. mica condensers.

C4.—.0001 mfd. mica condenser.

C8.—25 mfd. 35 volt electrolytic condenser.

C9.—.01 mfd. tubular condenser.

C10, C11.—.002 mfd. tubular condensers.

C12, C13.—.5 mfd. tubular condensers.

DIAL.—To suit tuning condensers.

E1, E2.—8 mfd. 500 volt electrolytic condensers.

G1, G2.—20 mmfd isolantite insulated midget condensers.

IF1, IF2.—465 k.c. intermediate frequency transformers.

L.—See text.

P.T.—Power Transformer, 385-0-385 aside at 60 milliamperes, one 5 volt 2 ampere, one 6.3 volt two amperes.

R.F.C.—Radio Frequency Choke.

R1, R5.—500 ohm 1 watt resistor.

R2.—50,000 ½ watt resistor.

R3.—50,000 ohm wire-wound potentiometer to carry 10 milliamperes.

R4.—450 ohm wire-wound resistor to carry 10 milliamperes.

R6.—2500 ohm wire-wound potentiometer.

R7.—25,000 ohm carbon type potentiometer.

R8.—10,000 ohm 1 watt resistor.

R9.—2500 ohm wire-wound resistor to carry 100 milliamperes.

SOCKETS: Two 4-pin isolantite sockets, one isolantite octal socket, three octal sockets, one 4-pin socket.

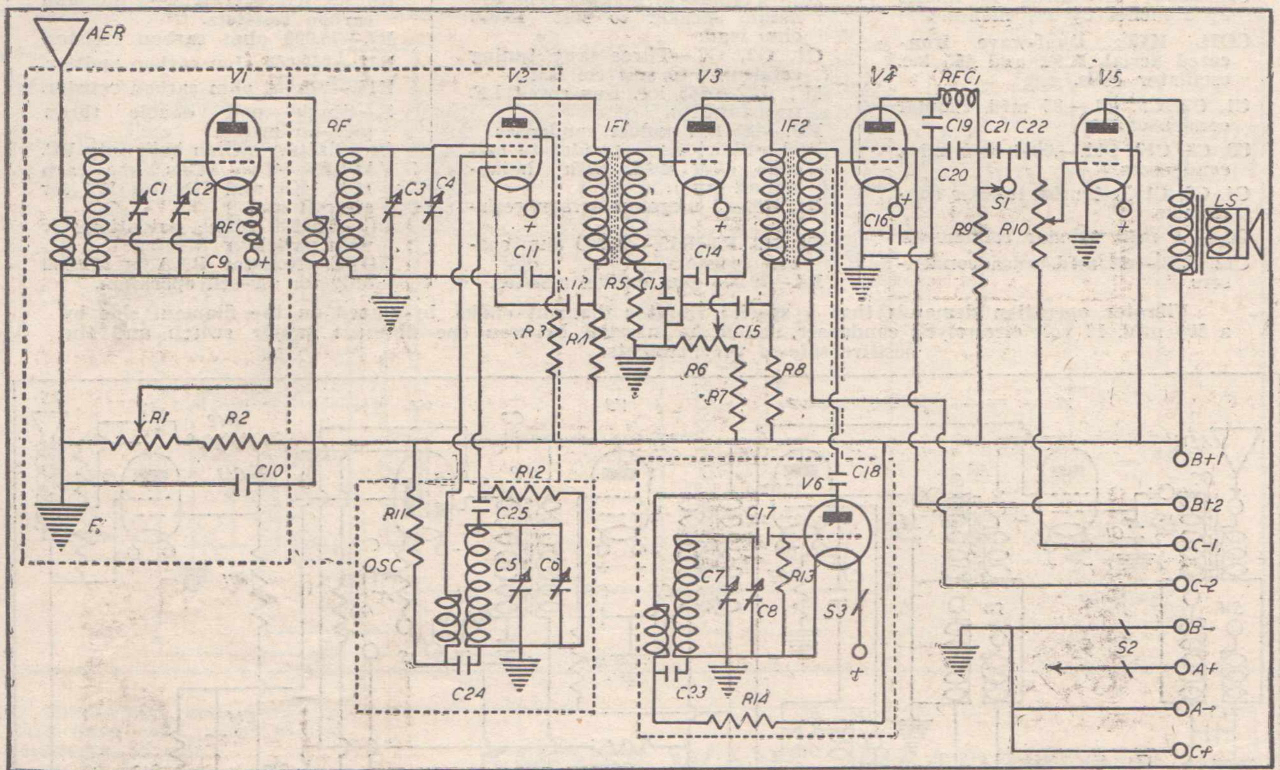
T1, T2.—100 mmfd. isolantite midget condensers.

VALVES: One each 6L7, 6C5, 6K7, 6N7 and 80.

SUNDRIES: Wiring flex, nuts and bolts, solder lugs, some tinned wire, 8 4-pin 1¼ inch diameter coil formers, a 4oz. reel of 22 gauge D.S.C. wire, a small quantity of 30 gauge enamel-covered wire, 4 terminals, 4 knobs, 2 small bakelite dials, 3 yards of shielded wire and one flexible coupling.

(For Coil Details See Page 59)

De Luxe Short-Wave Battery 6



PARTS LIST :

CHASSIS.—Measuring 14 inches by 2½ inches.

C1, C3, C5.—180 mmfd. variable condensers.

C2, C4, C6.—35 mmfd. ganged variable condensers.

C7.—Trimmer condenser on I.F. transformer secondary.

C8.—15 mmfd. variable condenser.

C9.—.25 mfd. tubular condenser.

C10.—.5 mfd. tubular condenser.

C11, C12, C14, C15, C23, C24.—.1 mfd. tubular condensers.

C13, C22.—.05 mfd tubular condensers.

C17, C19, C20, C25.—100 mmfd. mica condensers.

C18.—5 mmfd. condenser.

C21.—250 mfd. mica condensers.

DS.—Permanent magnet Dynamic Speaker with 15,000 ohm input transformer.

IF1, IF2.—465 k.c. iron-cored I.F. transformers.

IF3.—Air-cored 465 k.c. I.F. transformer for B.F.O. unit.

RFC.—120 turns 30 gauge S.W.G. S.S.C. wire on half-inch former.

RFC1.—Radio frequency choke.

R1, R6.—100,000 ohm potentiometers.

R2, R12, R13.—50,000 ohm. 1 watt carbon resistors.

R3.—60,000 ohm 1 watt carbon resistor.

R4, R8.—2000 ohm 1 watt carbon resistors.

R5.—1 megohm 1 watt carbon resistor.

R7.—100,000 ohm 1 watt carbon resistor.

R9, R14.—250,000 ohm 1 watt carbon resistor.

R10.—500,000 ohm potentiometer.

R11.—20,000 ohm 1 watt carbon resistor.

S1, S3.—Single pole single throw toggle switch.

VALVES.—Two 1C4's, one each 1C6, 1K4, 1D4, and 30, with sockets to suit.

SUNDRIES. — Hook-up wire, shielded wire, coil winding wires, four 4-pin sockets, 12 4-pin formers, 4 grid clips, dial, 8 knobs, 5 valve shields, machine screws and nuts and aluminium for shields.

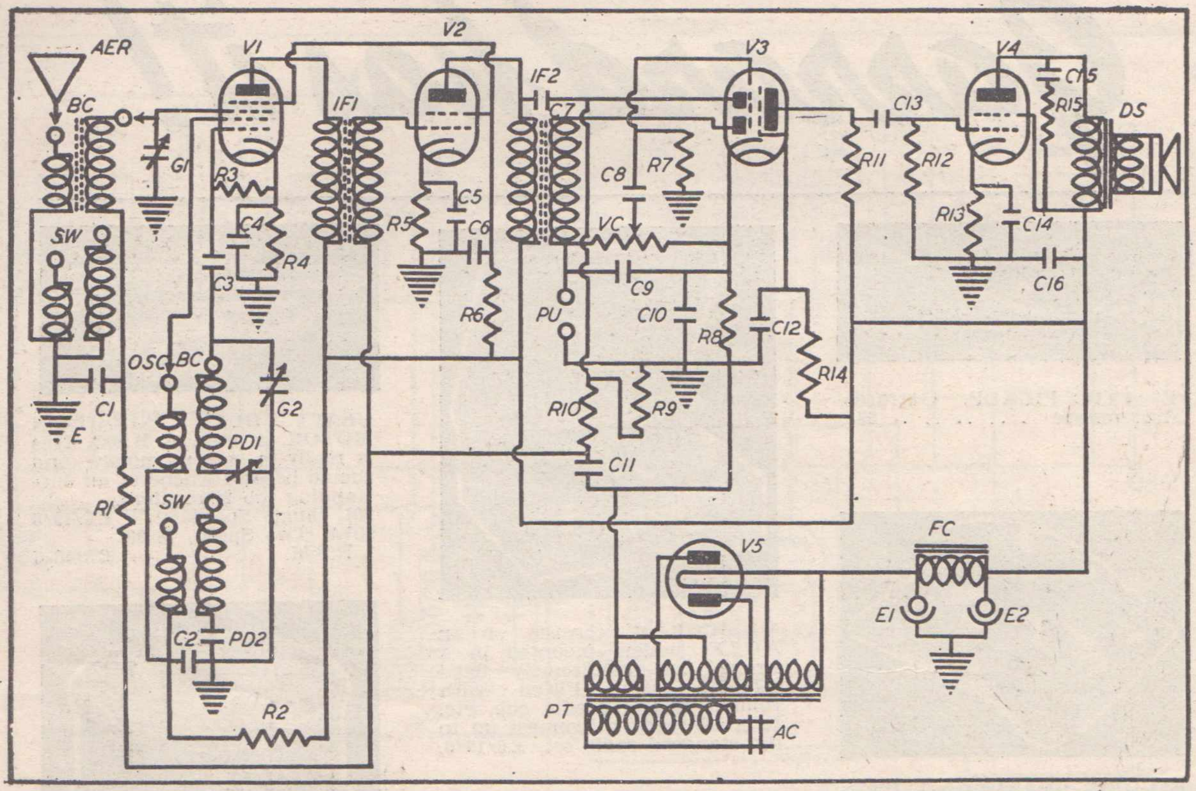
COIL DETAILS

Wavelength in Metres	AERIAL Primary Turns	Wire	Secondary Turns	Wire	Tap	R.F. Primary Turns	Wire	Secondary Turns	Wire	OSCILLATOR Primary Turns	Wire	Secondary Turns	Wire
128-57	9	a	33	b	1	25	a	33	b	10	a	36	b
58-25	5½	a	15¼	c	¾	11	a	15	c	5	a	15½	c
27.5-11.5	2½	a	5¾	d	¾	4¾	a	5½	d	4	a	5	d
21-9.8	1¾	a	2⅞	d	⅝	1¾	a	2⅞	d	2½	a	2¾	d

All coils are wound on 1¼ inch former, and where tapping is required measurement is taken rfom the bottom end of the secondary windings.

(a) 30 gauge S.W.G. d.s.c. wire interwound in secondary from the bottom end.
(b) 28 gauge S.W.G. enamel wire wound 32 turns per inch.
(c) 29 gauge S.W.G. tinned copper wire wound 10 turns per inch.
(d) 18 gauge S.W.G. tinned copper wire wound 6 turns per inch.

A Simple Dual-Wave Five

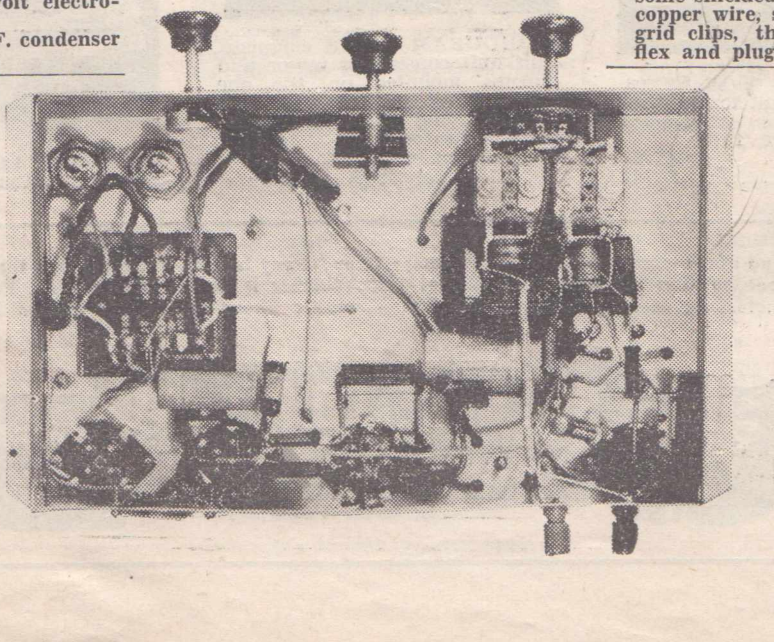


PARTS LIST :

Chassis.—Measuring 13 inches by 8½ inches by 3 inches.
Coil Kit.—Special dual wave type unit covering broadcast band, and one short wave band.
C1, C2, C4, C5, C6, C12.—.1 mfd. tubular condensers.
C3, C7.—.0001 mfd. mica condensers.
C8, C13, C15.—.02 mfd. tubular condensers.
C9.—.0002 mfd. mica condenser.
C10, C14.—25 mfd. 35 volt electrolytic condensers.
C11.—.05 mfd. tubular condenser.
C16.—.5 mfd. tubular condenser.
E1, E2.—8 mfd. 500 volt electrolytic condensers.
G1, G2.—2 gang type F. condenser with suitable dial.

IF1, IF2.—Iron core type 465 k.c. Intermediate frequency transformers.
PT.—Power transformer 385-0-385, 1 5 volt 2 ampere, 1 6.3 volt 3 ampere.
R1, R11: 250,000 ohm resistors.
R2.—20,000 ohm resistor.
R3.—50,000 ohm resistor.
R4.—300 ohm wire wound resistor.
R5.—250 ohm wire wound resistor.
R6.—30,000 ohm resistor.

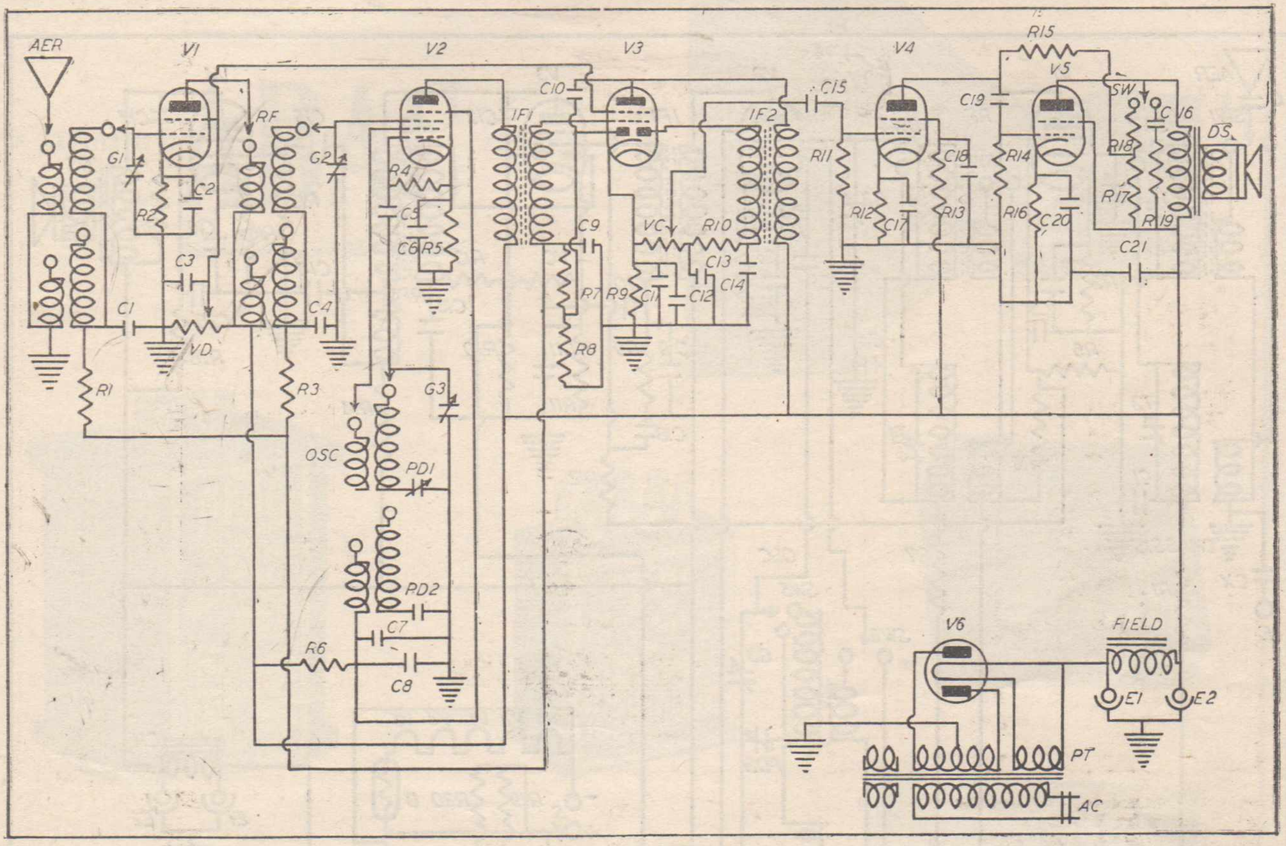
R7, R9, R10, R14.—1 megohm resistors.
R8.—2000 ohm wire wound resistor.
R12.—500,000 ohm resistor.
R13.—400 ohm wire wound resistor.
R15.—10,000 ohm resistor.
Speaker.—Dynamic speaker, 2500 field, to suit 42 valve.
Valves.—One each type 6A7, 6D6, 6B7S, 42 and 80, with sockets.
VC.—500,000 ohm volume control.
Sundries.—Wiring flex, bolts and nuts, three valve shields, one 4 pin speaker socket, 4 terminals, some shielded wire, some tinned copper wire, solder, lugs, three grid clips, three knobs, power flex and plug.



This under chassis view of the Simple Dual Wave Five will give the constructor an idea of the best layout for a set of this kind. The power section should be kept well away from the tuning circuit, and all leads kept short.

The use of a dual wave switch-coil unit (illustrated in the top right-hand corner of the photograph) and the reduction of the number of components to a minimum, has resulted in a simple and economical set from which the novice will obtain excellent results.

A.C. DUAL-WAVE SUPER 6



PARTS LIST:

CHASSIS: 16 gauge aluminium measuring 14 inches by 10 inches by 3 inches.

COIL KIT: Standard broadcast and short wave aerial, R.F. and oscillator coils.

C1, C4, C15, C19: .05 mfd. tubular condensers.

C2, C3, C6, C7, C9, C12, C18: .1 mfd. tubular condensers.

C5, C10, C13: .0001 mfd. mica condensers.

C8: 8 mfd. 300 volt electrolytic condenser.

C11, C17, C20: 25 mfd. 25 volt electrolytic condensers.

C14: .00025 mfd. mica condenser.

C16: .02 mfd. tubular condenser.

C21: .5 mfd. tubular condenser.

DIAL: To suit gang condenser.

DS: To match 42 valve field winding 2000 ohms.

E1, E2: 8 mfd. 500 volt electrolytic condensers.

G1, G2, G3: Three gang condenser to suit coil kit.

IF1, IF2: 465 k.c. iron cored I.F. transformers.

PD1, PD2: Supplied with coil kit.

PT: Power transformer, 385-0-385 v. at 80 m.a., 6.3 v. at 2.5 a. and 5 v. at 2 a.

R1, R3, R10, R18: 100,000 ohm carbon resistors.

R2, R5: 300 ohm 50 m.a. W.W. resistors.

R4: 50,000 ohm carbon resistor.

R6: 20,000 ohm carbon resistor.

R7: 750,000 ohm carbon resistor.

R8, R13, R14: 1 megohm carbon resistors.

R9: 350 ohm 50 m.a. W.W. resistor.

R11: 500,000 ohm carbon resistor.

R12: 2000 ohm 50 m.a. W.W. resistor.

R15: 250,000 ohm carbon resistor.

R16: 400 ohm 100 m.a. W.W. resistor.

R17, R19: 10,000 ohm carbon resistors.

VC: 500,000 ohm potentiometer.

VD: 25,000 ohm voltage divider.

VALVES: One each 6D6, 6A7, 6B7s, 6C6, 42 and 80 with sockets to suit.

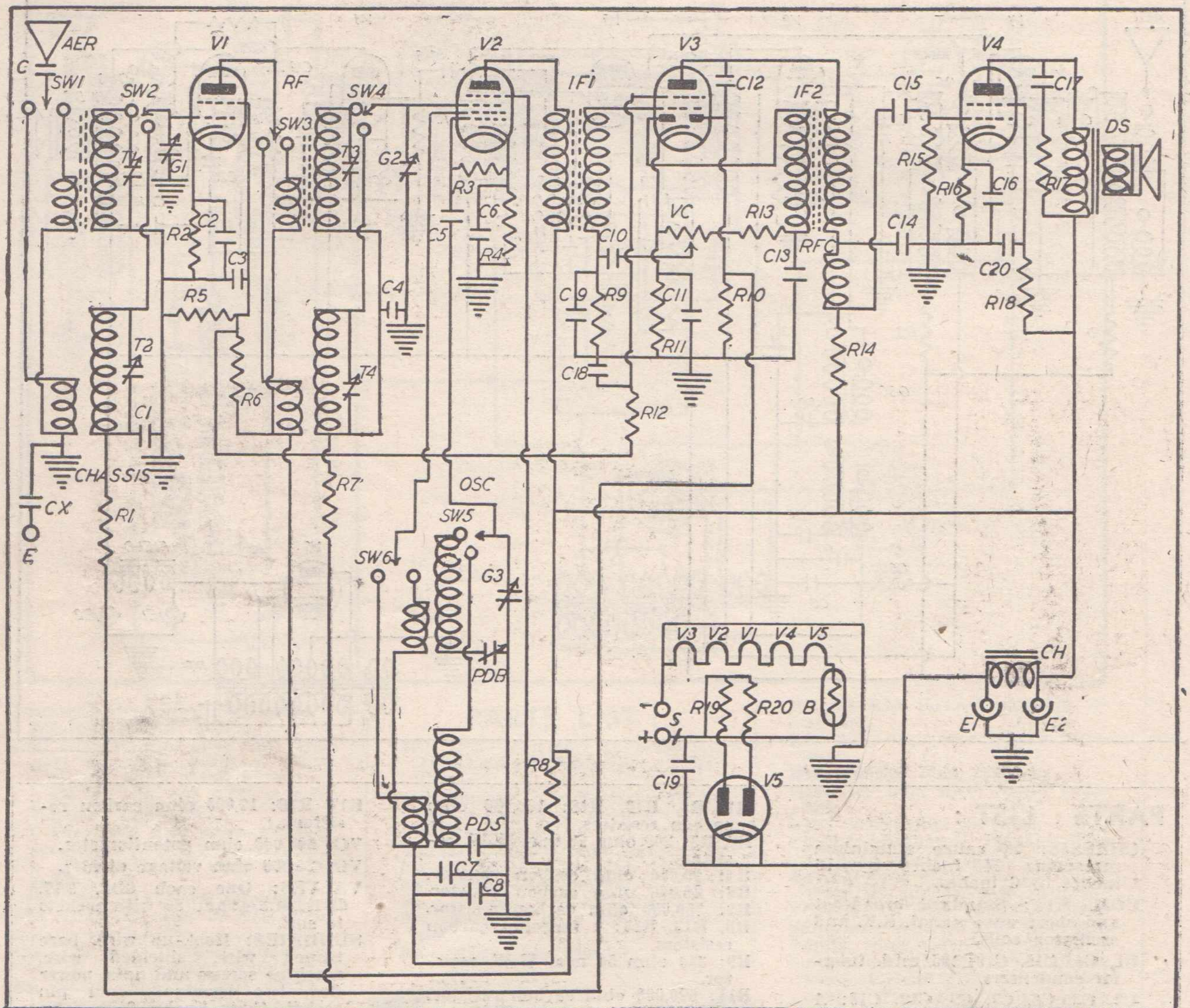
SUNDRIES: Hook-up wire, bare tinned wire, shielded wire, machine screws and nuts, power flex, two terminals, four pin socket, three knobs, four valve shields, four grid clips, three gang wave change switch, aluminium shield pieces and S.P.D.T. switch.

Coil Details for Short Wave Headphone Super 4

WAVELENGTH	AERIAL COIL Turns	Spaced to cover	Tapping point	OSCILLATOR COIL Turns	Spaced to cover	Tapping point
9-15 metres . . .	3¾	1 in.	¼ turn	3¾	1 in.	1½ turns
13.5-25 metres . .	6	1 in.	¼ turn	6	1 in.	1½ turns
24-42 metres . . .	14	1½ in.	½ turn	13	1¼ in.	4 turns
65-85 metres . . .	38	1¾ in.	¾ turn	32	1¾ in.	10 turns

NOTE.—All coils are wound with 22-gauge double silk covered wire on 4-pin plug-in formers having an outside diameter of 1¼ inches. In determining the position of tapping points measurement is taken from the earth end of each coil.

Universal Re-flexed D/W Super 5



CHASSIS.—To suit layout and components.

COILS.—Iron-cored Aerial, R.F. and Oscillator coils for broadcast band. Aerial, R.F. and Oscillator coils for the S.W. band, with padders. (See text.)

B.—Barretter. (See valves.)

C, CX, C19.—.01 mfd. mica condensers.

C1, C4, C7, C15.—.05 mfd. tubular condensers.

C2, C3, C6, C18.—.1 mfd. tubular condensers.

C5, C9, C12.—.0001 mfd. mica condensers.

C8, C20.—8 mfd. tubular electrolytic condensers.

C10, C17.—.02 mfd. tubular condenser.

C11, C16.—25 mfd. 35-volt electrolytic condensers.

C13, C14.—.0002 mfd. mica condensers.

CH.—Special low-resistance filter choke.

DIAL.—To suit gang condenser.

D.S.—Permagnetic type speaker to suit 25A6G.

G1, G2, G3.—Three gang condenser to suit coils.

IF1, IF2.—Iron-cored type 465 k.c. intermediate frequency transformers.

R1, R7, R13, R14.—100,000 ohm carbon resistors.

R2.—300 ohm wire wound resistor.

R3.—50,000 ohm resistor.

R4.—250 ohm wire wound resistor.

R5, R17.—10,000 ohm resistors.

R6.—13,000 ohm resistor.

R8.—15,000 ohm resistor.

R9, R15.—500,000 ohm resistors.

R10.—1 megohm resistor.

R11.—2000 ohm wire wound resistor.

R12.—250,000 ohm resistor.

R16.—440 ohm wire wound resistor.

R18.—6000 ohm w.w. resistor.

R19, R20.—100 ohm 100 m.a. w.w. resistors.

S. — Single-pole single-throw mains switch.

SW1, SW2, SW3, SW4, SW5, SW6. — Multi-bank wave-change switch.

T1, T2, T3, T4, T5, T6.—M.E.C. trimmer condensers.

VALVES—One each 6U7G, 6K8G, 6G8G, 25A6G, 25Z6G, and a 302 Barretter, complete with sockets.

VC.—500,000 ohm potentiometer with switch.

SUNDRIES.—Wiring flex, three valve shields, nuts and bolts, two insulated terminals, shielded wire, tinned copper wire, power flex, solder lugs and three knobs.

TROUBLE SECTION

Lack of Regeneration — Coil Connections — Importance of Inductance-capacity Ratios — Oscillator Vagaries — Frequency Drift — Image Effects.

BESIDES the usual run of troubles to which all types of radio receivers are heir, there are a number of additional ones encountered in short wave receivers. These in the main are due to the more exacting conditions under which the short wave receiver must operate. In considering the causes and remedies for these it would be as well if we dealt with the two general types of short wave receivers—the simple regenerative detector and t.r.f. type, and the super-heterodyne type—separately.

In the regenerative detector type of receiver the most common trouble is faulty oscillation. This is generally due either to incorrectly proportioned feedback windings, valves which have partially lost their emission, unbalanced LC ratios or, most common of all, to incorrectly wired coils.

First let us take the case of the receiver which cannot be brought into a state of oscillation. Incidentally this can be quickly checked by touching the moistened finger on the grid of the detector valve. If the valve is oscillating a distinct click will be heard in the headphones or loud speaker both when the finger is placed on the grid terminal of the valve socket and when it is removed. Lack of oscillation may be due to incorrect connections of the reaction winding.

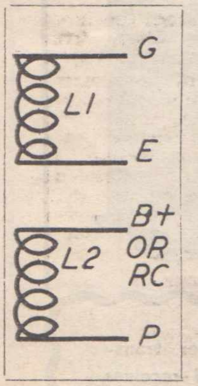


Fig. 1. — Diagram showing the correct method of coil connections.

In Fig. 1 we have shown two windings, L1 the grid and L2 the plate. Consider them as being wound on the coil former exactly as diagrammed, i.e., both are wound in the same direction as L1 is at the top of the former. The top of L1 will go to the grid of the valve and the bottom of this winding will go to earth. The lower lead of the plate winding L2 joins to the plate of the valve and the top of this winding, nearest to L1, is taken to the B supply or to the reaction condenser, depending upon the particular type of feedback being used.

Coil Connections

THE main point is that when the two windings are laid on the coil former as specified, the connections given are the only ones which will permit the valve to oscillate — providing, of course, that the feedback winding is correctly proportioned and that a suitable plate voltage is being applied. Now if the plate winding is placed above the grid winding, its connections must be reversed so that the lead of L2 which is nearest to the grid end of L1 is taken to the plate of the valve.

If, as is sometimes done in order to minimise frequency shift as regeneration is applied, the reaction winding is wound in the reverse direction to the grid winding, then its connections are the reverse to those already given for the similarly wound coils. Next let us look at the two standard methods of applying regeneration to detector tube.

The first is that in which no direct current flows through the plate winding, as shown in Fig. 2. In this case the plate is said to be shunt or parallel fed. Under the other method the plate coil is wired in series with the high tension lead. This is effected by taking a lead from the stator plate of the condenser RC to the plate of the valve and breaking the connection between the latter point and the R.F. choke.

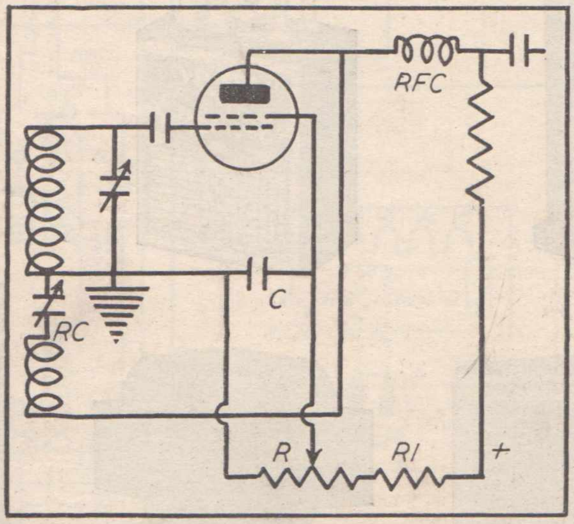


Fig. 2.—Diagram showing shunt fed and screen control regeneration systems.

In both cases control of regeneration is obtained by means of the throttle condenser RC. Both systems operate equally well, although it is generally found that a smoother control is obtained with the shunt fed method. One point which must be given special attention with the shunt fed system is the radio frequency choke RFC.

If this choke does not provide a complete block to the passage of radio frequency currents the valve will refuse to oscillate. The choke also is desirable with the series fed circuit but does not play such an important part as in the shunt fed version. And here is another frequent source of trouble in regenerative receivers. It may be found that the detector will function perfectly at some frequencies, yet will refuse to oscillate at others.

Resonance Effects

THIS is due to the radio frequency choke coil having resonances which fall in the frequency range being covered by the tuning coils. Practically all standard types of r.f. chokes suffer from this drawback, but if the choke coil is replaced by a carbon type resistor, which of course has no inductance, no trouble will be experienced from flat spots. A resistor of 50,000 ohms will usually be found adequate for use as an r.f. choke.

So far we have considered only the use of triodes as detectors. When a screen grid tube is used an additional aid to regeneration control can be employed. This consists of a screen grid voltage control arranged as shown in Fig. 2. Here R is a 50,000 ohm potentiometer connected in series with a limiting resistor R between "B" plus and earth.

The value of R1 must be adjusted so that a maximum potential of around 30 volts is developed across R. Then, adjustment of R and RC can be made to obtain an extremely smooth control of regeneration. The screen by-pass condenser C should be of fairly high capacity—about .5 mfd.—in order to damp out any noise which may be present as the arm of R is swept across the resistance element.

We come next to the case where the detector cannot be brought out of oscillation. This invariably is due either to too large a number of turns on the plate winding, too close coupling between it and the grid winding, or to too high a plate potential on the valve. So far as the latter is concerned it will usually be found that potentials ranging from 20 to 50 volts will give best results from triode tubes, but that the maximum rated potential should be applied to the plate of the pentodes.

However, the screen potential for the pentode detector tube should be kept low and will usually be from 15 to 20 volts.

Inductance Capacity Ratio

THE spacing beween the grid and plate windings should range from ¼ to 3-16th of an inch and the number of turns on the plate winding should never, even at the highest frequencies, be greater than ¾ of the number of grid turns. This is where the question of the inductance capacity ratio of the tuned circuit comes into the picture. If the capacity of the tuning condenser is high it follows that the inductance of the coil will be low and so only very few turns will be needed at the higher frequencies.

This being so, the ratio between plate and grid windings will approach unity and in some cases more turns will be needed for the plate winding in order that the valve will oscillate at all. Such a state of affairs is to be avoided because, apart from the tuning effect of a large number of plate turns and the resultant limitation of the frequency range of the grid

TROUBLE SECTION—Contd.

coil, the large number of reaction turns will produce a very inflexible regeneration system.

The maximum capacity of the tuning condenser for short wave reception should not exceed .00015 mfd. (150 mmfd.) and for reception on wavelengths below 50 metres even this is too high.

So far we have considered the straight regenerative detector. If this is followed by a transformer audio amplifier stage it may be found that a "fringe howl" effect is encountered. This, as its name implies, takes the form of a low-pitched howl as the valve is brought out of oscillation. The remedy for such a condition is the connection of a resistor of from .1 to .5 megohms across the secondary of the audio transformer.

The highest practicable value resistance should be used in order that the gain of the receiver is maintained, although with any resistance there will be some loss.

R.F. Instability

WHEN an r.f. amplifier stage is connected ahead of a regenerative detector we are likely to run into another set of troubles. It may be found that although the detector will regenerate nicely without the r.f. stage as soon as the latter is connected all signs of regeneration disappear. This is due to the fact that the r.f. amplifier itself is unstable and in a semi oscillating condition.

Suitable screening of the tube and its tuned circuit and filtering of the supply lines will cure this, but it is unwise completely to damp out the r.f. tube for the most sensitive operation of the receiver is obtained when this tube is regenerating slightly. This summary covers most of the general faults encountered with regenerative receivers. Others such as restricted tuning range are common to the regenerative and the super-heterodyne types of receiver.

In the super-het. our most serious problem at the high frequencies is the maintenance of oscillation. This is particularly true of battery operated receivers, because of the comparatively low mutual conductance of the tubes used in such sets. In Fig. 3 is shown a standard mixer circuit of a super-het. The check for satisfactory oscillator

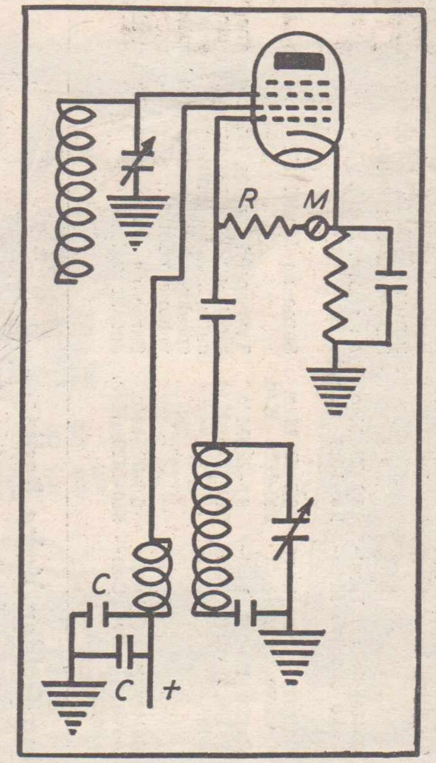


Fig. 3.—Illustrates how a milliammeter is connected for checking oscillator grid current.

performance is made by connecting a milliammeter M in series with the oscillator grid leak R and the point — cathode or earth — to which this resistance is returned.

The meter should be an 0-1 milliammeter and readings should be taken with the normal plate and filament voltages applied to the valve. The check for oscillator grid current should be made at various points throughout the tuning range. It will probably be found that the readings vary considerably as the tuning condenser is rotated, but provided that these fall within reasonable limits everything will be in order.

Oscillator Grid Current

AS a general rule an a.c. type of mixer tube should give a minimum grid current reading of 100 microamperes—.1 m.a.—at the high frequencies—around 24 m.c., 12.5 metres and a maximum of 400 at frequencies around the 6 m.c., 50 metre range. Higher grid currents than these are undesirable, and lower ones will result in impaired performance. With battery operated tubes of the 2 volt type the maximum oscillator grid current will probably be around 160 microamperes and the minimum about 80 microamperes.

The 1.4 volt type of battery operated tube has a much lowered grid current, the maximum on the broadcast band being only 35 microamperes. This explains the reason for this type of tube's poor short wave performance. In order to overcome this drawback an auxiliary oscillator tube is connected in parallel with the oscillator section of the mixer tube as shown in Fig. 4.

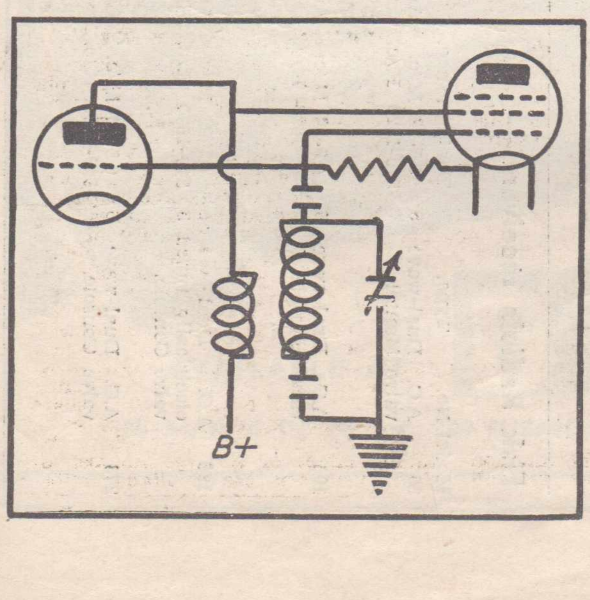
The auxiliary tube may be a triode or a pentode which has its screen grid tied to the plate. Its plate is connected to the oscillator plate, and its grid to the oscillator grid. Another trouble encountered with short-wave superheterodynes is that known as "frequency flutter." This is evidenced by distortion, howling and serious fading when a strong station is tuned in.

In the main this is caused by a fluctuating power supply or by the action of the automatic volume control. First it should be taken as a general rule that a.v.c. should not be applied to the mixer tube, although with some tubes, notably the 6J8G and the 6K8G, the effect of a.v.c. on frequency stability is small.

So far as the stability of the power supply system is concerned it has been found that trouble from this source can be cured by feeding the oscillator plate through a resistor from the input side of the power supply filter. This arrangement is diagrammed in Fig. 5.

The second method of overcoming such drifts is, in the case of tubes such as the 6K8G, to feed the screen grid and the oscillator grid through the same series resistor. This is done in order that the fluctuating voltage on both elements will cancel out the drift because the effect of a drop in screen voltage is to cause a drift in the opposite direction to that accompanying a

(Continued on page 84)



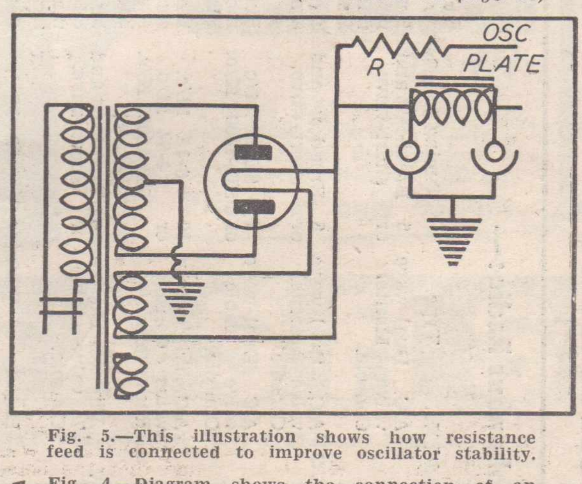


Fig. 5.—This illustration shows how resistance feed is connected to improve oscillator stability.

◄—Fig. 4.—Diagram shows the connection of an additional triode valve in parallel with an existing oscillator valve for increased efficiency.

Summary of Commercial Dual-Wave Receivers

Columbus Radio:—

Model No.	Type.	Tuning range.	Special features.
95	A.C. Dual-wave 5 valve Mantel or Console.	Broadcast and short-wave.	Ferro-coils, Edge-lit dial, Automatic volume control, High-fidelity speaker, and Oscillator frequency stabiliser.
35VC	A.C. Dual-wave 6 valve Mantel or Console.	Broadcast and short-wave.	As above with Radio frequency amplifier on both bands.
65	A.C. Dual-wave 7 valve Table or Console.	5.6-17 M/c. 550-1600 K/c.	Push-button tuning, Magic eye indicator, Bass compensation, Flat-topped I.F. amplifier.
88	A.C. Triple-wave 10 valve Console or Radio-gram.	6-16 M/c. 14-34 M/c. 550-1600 K/c.	Motor tuning, Optional remote control, Push-pull output, Magic eye indicator, and Inverse Feed-back.
68V	Vibrator Dual-wave 7 valve table or Console.	Broadcast and short-wave.	Magic eye indicator, Economiser circuit, Two speed selector, Automatic volume control, and Permagnetic speaker.
78	Battery or Vibrator 8 valve Triple-wave Console.	6-18 M/c. 2-6 M/c. 550-1500 K/c.	Convertible for battery or vibrator, Special Spiral Dial, Low level bass compensation, Push pull output, 10 inch high fidelity permagnetic dust-proof speaker.

Fisk Radiola receivers.—

Model. No.	Type.	Tuning range.	Special features.
85	A.C. Dual-wave 5 valve Mantel.	6.5-22 M/c. 540-1620 K/c.	Automatic two speed tuning, Air trimmers, Stabilised oscillator, Excellent reproduction, Automatic volume control.
195	A.C. Dual-wave 5 valve Console.	6.5-22 M/c. 540-1620 K/c.	Automatic two speed tuning Air trimmers, Frequency locked circuits, Tone control A.V.C., Special speaker, Stabilised oscillator.
196	A.C. Dual-wave electrically tuned 5 valve Console.	6.5-22 M/c. 540-1620 K/c.	Automatic two speed tuning, Electric tuning with keyboard control, Shock absorbed chassis. Other features as for Model 195.
273	A.C. Dual-wave 6 valve Console.	6.5-22 M/c. 540-1620 K/c.	Long distance reception, Magic eye indicator, Air trimmers, Frequency locked circuits, Stabilised oscillator. Tone control.
312	A.C. Dual-wave 5 valve Radio-gram Console.	6.5-22 M/c. 540-1620 K/c.	Brilliant reproduction and tone quality, Automatic two speed tuning, A.V.C., Frequency locked circuits, Exclusive record turntable assembly.
89	A.C./D.C. Dual-wave 5 valve Table Model.	6.5-22 M/c. 540-1620 K/c.	Two speed tuning, Long distance reception, Special speaker, Frequency locked circuits, Air trimmers, A.V.C., Stabilised Oscillator. Tone control.
189	A.C./D.C. Dual-wave 5 valve Console.	6.5-22 M/c. 540-1620 K/c.	As above.
87	Battery Dual-wave 5 valve Mantel.	6.5-22 M/c. 540-1620 K/c.	Long distance reception, Brilliant reproduction, Two speed tuning, A.V.C., Tone control, Stabilised Oscillator.
88	Batteryless Dual-wave 5 valve Mantel.	6.5-22 M/c. 540-1620 K/c.	As above.
199	Battery Dual-wave 5 valve Console.	6.5-22 M/c. 540-1620 K/c.	Same as Model 87.
190	Batteryless Dual-wave 5 valve Console.	6.5-22 M/c. 540-1620 K/c.	Two speed tuning, Long distance reception, Frequency locked circuits, Air trimmers, Special speaker, Tone control, Automatic volume control.
275	Batteryless Dual-wave 6 valve Console.	6.5-22 M/c. 540-1620 K/c.	Same as above with Push Pull output valves.

Healing Golden Voice Radio:—

Model No.	Type.	Tuning range.	Special Features.
550E	A.C. Dual-wave 5 valve Mantel.	7.89-24 M/c. 550-1620 K/c.	Permeability tuned coils and I.F. transformers, Air di-electic oscillator trimmers.
575E	A.C. Dual-wave 5 valve Console.	7.89-24 M/c. 550-1620 K/c.	As above, with special 10 inch speaker.
A449E	A.C. Dual-wave 5 valve Press Button Mantel.	7.89-24 M/c. 550-1620 K/c.	As above with Press Button tuning, Full vision Slide-rule dial and 2 I.F. stages.
499E	A.C. Dual-wave 5 valve Press Button Console.	7.89-24 M/c. 550-1620 M/c.	As above with special 10 inch speaker.
A499E	A.C. Dual-wave 5 valve Press Button De Luxe Console.	7.89-24 M/c. 550-1620 K/c.	As above.

(Continued on page 66)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Summary of Commercial Dual-Wave Receivers

Model No.	Type.	Tuning range	Special features.
A599E	A.C. Dual-wave 6 valve Press Button Console.	7.89-20 M/c. 550-1620 K/c.	As above with R.F. stage and special 12 inch speaker.
559A	Vibrator Dual-wave 5 valve Mantel.	7.89-24 M/c. 550-1620 K/c.	Permeability tuned I.F.'s, Iron cored aerial coil, 2 I.F. stages, and Slide-rule full vision dial.
599A	Vibrator Dual-wave 5 valve Console.	7.89-24 M/c. 550-1620 K/c.	As above with special 10 inch speaker.
A699A	Vibrator Dual-wave 6 valve Console.	7.89-24 M/c. 550-1620 K/c.	Permeability tuned I.F.'s, Iron cored aerial coil, 2 I.F. stages, Press button tuning and Slide-rule tuning dial.
A449C	A.C./D.C. Dual-wave 6 valve Mantel.	7.89-24 M/c. 550-1620 K/c.	As above with voltage regulator, and 8 inch speaker.
A599C	AC/D.C. Dual-wave 7 valve Console.	7.89-24 M/c. 550-1620 K/c.	Permeability tuned I.F.'s, Iron cored aerial and R.F. coils, R.F. stage, 2 I.F. stages ,Voltage regulator, Press Button tuning and Straight line tuning dial.

An important feature of all of the 1940 Healing Golden Voice receivers is the use of specially developed Air di-electric trimmers on both broadcast and short-wave bands in order to obtain maximum oscillator circuit stability.

H.M.V. Radio.—

Model No.	Type.	Tuning range	Special features.
880	A.C. Dual-wave 5 valve Mantel.	6.38-21.57 M/c. 500-1600 K/c.	Special Italian figured walnut cabinet, Floating deck chassis, Beam power valve output.
660	A.C. Dual-wave 5 valve Console.	6.38-21.57 M/c. 550-1600 K/c.	Tone diffuser, 12 inch speaker. Walnut grained cabinet.
410	A.C. Dual-wave 6 valve Console.	6.38-21.57 M/c. 550-1600 K/c.	6L6 beam power output, Variable I.F. adjustment for wide range reproduction
470	A.C. Dual-wave 8 valve Console.	6.38-21.57 M/c. 550-1600 K/c	Variable I.Fs.. High sensitivity on short wave, Static limiter, Beam power output
110	A.C. Dual-wave 5 valve Table Radiogram.	6.38-21.57 M/c. 550-1600 K.C.	Table model cabinet, Beam power output.
540	A.C. Dual-wave 5 valve Radiogram.	6.38-21.57 M/c. 550-1600 K.C.	Beam power output, Automatic stop on turntable.
420	A.C. Dual-wave 6 valve Radiogram.	6.38-21.57 M/c. 550-1600 K.C.	Walnut cabinet, Automatic stop on motor turntable, Beam power output
509	A.C. Dual-wave 8 valve Radiogram.	6.38-21.57 M/c. 550-1600 K.C.	Walnut cabinet, Floating deck chassis.

Model No.	Type.	Tuning range	Special features.
519	A.C. Dual-wave 8 valve Auto Radiogram.	6.38-21.57 M/c. 550-1600 K/c.	Automatic record changer, High fidelity speaker.
229	A.C./D.C. Dual-wave 5 valve Table Cabinet.	6.38-21.57 M/c. 550-1600 K/c.	Full size 8 inch speaker, A.C./D.C. voltage range 150 to 270 volts (Any frequency).
250	A.C./D.C. Dual-wave 5 valve Console.	6.38-21.57 M/c. 550-1600 K/c.	Wide voltage range, Floating deck chassis.
619	A.C./D.C. Dual-wave 6 valve Console.	6.38-21.57 M/c. 550-1600 K/c.	Wide voltage range, Beam power output.
145	Battery Dual-wave 4 valve Console.	6.38-21.57 M/c. 550-1600 K/c.	Using new type 1D8GT two in one valve, 5 valve sensitivity.
52	Battery Dual-wave 4 valve Bakelite Mantel.	6.12-18.17 M/c. 550-1500 K/c.	Floating deck chassis, 90 volts high tension supply, Convertible to vibrator operation.
62	Vibrator Dual-wave 4 valve Bakelite Mantel.	6.12-18.17 M/c. 550-1500 K/c.	2 volt Vibrator operation, 6 inch speaker, New air trimmers.
161	Vibrator Dual-wave 4 valve Console.	6.38-21.57 M/c. 550-1600 K/c.	Economical drain, 1.7 amp. 2 volt vibrator, Convertible to battery operation.
300	Vibrator Dual-wave 7 valve Console.	6.38-21.57 M/c 550-1600 K/c	6 volt Vibrator operation, Short wave exceptional, 12 inch speaker, Floating deck chassis.
320	Vibrator Dual-wave 5 valve Console.	6.38-21.57 M/c 550-1600 K/c.	6 volt vibrator operation, .75 watt, undistorted output.

Philips Radioplayer:—

Model No.	Type.	Tuning range.	Special features.
1952	A.C. Dual-wave 5 valve Mantel	8-22 M/c. 550-1600 K/c.	Moulded Philite cabinet Q-umulative wound pre-matched coils, Philips special air trimmers; Automatic volume control, Vertiscale edge lit dial.
2262	A.C. Dual-wave 6 valve Mantel.	8-22 M/c. 550-1600 K/c.	New audioscopic reproduction, Anti-static tone control, Frequency stabilisation circuit, Legiline dial with "Escalator" short-wave tuning, Automatic volume control. Cathode ray tuning indicator
2752	A.C. Dual-wave 5 valve Console	8-22 M/c. 550-1600 K/c.	New Audioscopic Reproduction, Anti-static tone control, Frequency stabilisation circuit, Legiline dial with "Escalator" short-wave tuning, Automatic volume control. 12in. speaker.

(Continued on page 68)

Summary of Commercial Dual-Wave Receivers

Model No.	Type.	Tuning range	Special features.
1362	A/C Dual-wave 6 valve chairside model.	7-22 M/c. 540-1520 K/c.	Chairside cabinet with plate glass top, Twilight edge lit dial, Air trimmers, Pre-matched coils, Separate RF sub chassis.
2462	A.C. Dual-wave 6 valve Radiogram.	7-22 M/c. 540-1520 K/c.	Audioscopic reproduction, Elect. motor 12in. turntable, Automatic stop, Twilight edge lit dial, Air trimmers.
2240	Battery, vibrator, or air cell Dual-wave 4 valve Mantel.	8-22 M/c. 550-1600 K/c.	Bakelite cabinet, Legi-line dial, "Escalator" short-wave tuning, A.V.C., Pre-matched coils, Air trimmers, Low battery consumption.
2740	Battery, vibrator, or air cell Dual-wave 4 valve Console.	8-22 M/c. 550-1600 K/c.	Legi-line dial, "Escalator" short-wave tuning, A.V.C., Pre-matched coils, Air trimmers, Low battery consumption.
1754	Battery, or vibrator Dual-wave 5 valve Console.	7-22 M/c. 540-1520 K/c.	Twilight edge lit dial, Unit sealed IF transformers, Pre-mtached coils, Air trimmers, A.V.C., Low battery consumption.
2268	AC/DC Dual-wave 5 valve Mantel.	8-22 M/c. 550-1600 K/c.	Legi-line dial with "Escalator" short-wave tuning, Q-umulative pre-matched coils, Unit sealed IF transformers, Air trimmers, A.V.C., Shockproof cabinet back.

All Philips 1940 Radioplayers feature Audioscopic Reproduction, a new anti-static tone control, distortion free automatic volume control, Q-umulative wound pre-matched coils, cadmium plated rust proof chassis full floating in live rubber, unit sealed IF transformers, rivet-constructed Philips speakers and precision air di-electric trimmers.

Philco Radio:—

Model No.	Type.	Tuning range.	Special features.
40-53	A.C. Dual - wave Mantel.	7.2-22 M/c. 540-1600 K/c.	Loop Aerial for Broadcast reception; Low-frequency beat Short-wave reception; Permeability tuned I.F. transformers.
40-59	A.C. Dual - wave Console.	7-22 M/c. 540-1600 K/c.	Rubber-mounted Gang; Air Dielectric trimmers; Quadrant Dial.
40-54	A.C. Dual - wave Console.	7-22 M/c. 540-1600 K/c.	Permeability tuned I.F. transformers with triple tuned band-pass 1st I.F. transformer, Quadrant dial.
40-65	A.C. Dual - wave Console.	7-22 M/c. 540-1600 K/c.	Same as Model 40-54 plus:— Stage of R.F. on both bands; High Short-wave sensitivity with low-noise level; Audio A.V.C.
40-5D	Battery Dual-wave Console.	7-22 M/c. 540-1600 K/c.	Permeability tuned I.F. transformers; Air Dielectric trimmers; Stage of R.F. on both bands; High Short-wave sensitivity with low noise-level Quadrant dial.
40-53U	A.C.-D.C. Dual-wave Mantel.	7.2-22 M/c. 540-1600 K/c.	Same as Model 40-53, plus:— "Barretter" Tube.
40-54U	A.C.-D.C. Dual-wave Mantel.	7-22 M/c. 540-1600 K/c.	Same as Model 40-54, plus:— "Barretter" Tube.

S.T.C. Radio.—

Model No.	Type.	Tuning range.	Special features.
634 R. & S.	A.C. triple-wave 6 valve Mantel.	2.2-7.1 M/c. 6.9-22.2 M/c. 550-1600 K/c.	Automatic volume control, Step-by-step tone control, Die-cast dial movement.
635 J. & U.	A.C. triple wave 6 valve Console.	2.2-7.1 M/c. 6.9-22.2 M/c. 550-1600 K/c.	Automatic volume control, Continuously variable tone control, Clearly marked multi-toned dial.
543 T., J. & U.	A.C. dual-wave 5 valve Console.	5.7-18.75 M/c. 550-1600 K/c.	Straight-line frequency tuning, Automatic volume control, Clearly marked multi-toned dial, Sensitivity control.
542 R. & S.	A.C. dual-wave 5 valve Mantel.	5.7-18.75 M/c. 550-1600 K/c.	Straight-line frequency tuning, Automatic volume control, Tone control, Clearly marked multi-toned dial, Sensitivity control.
831 W.	A.C. triple-wave 8 valve Mantel.	2.2-7.1 M/c. 7.1-22.2 M/c. 550-1600 K/c.	Straight-line frequency tuning, Automatic volume control, Continuously variable tone control, Clearly marked multi-toned dial, Magic Eye tuning indicator.
532 R. & S.	Vibrator triple wave 5 valve Mantel.	2.3-7.3 M/c. 7.3-22.2 M/c. 550-1600 K/c.	Automatic volume control, Tone control, dial light switch, Clearly marked multi-toned dial, Die-cast dial movement.
533 U.	Vibrator triple wave 5 valve Console.	2.34-7.5 M/c. 7.5-22.2 M/c. 550-1600 K/c.	Straight-line frequency tuning, Automatic volume control, Dial light switch, Die-cast dial movement.
636 U.	Vibrator triple wave 6 valve Console.	2.34-7.5 M/c. 7.5-22.2 M/c. 550-1600 K/c.	Straight-line frequency tuning automatic volume control, Tone control. Clearly marked multi-toned dial.

Entirely New Radio

A TABLE MODEL WITH CONSOLE FEATURES AND PERFORMANCE

Entirely new standard of medium and short-wave performance. ★ ★ ★ Full size console dial—not previously fitted to table receivers. ★ ★ ★ Two-speed (Automatic Vernier) Tuning. *High speed*—Complete dial coverage 1¼ turns of tuning control. *Low speed* (for short wave) —One-thousandth inch adjustment. ★ ★ ★ New electro-welded loudspeaker. ★ ★ ★ Cabinet— A masterpiece of modern design with choice veneers and piano finish. Price, 23 guineas.

AWA

The Fisk

RADIOLA

MANUFACTURED & GUARANTEED BY AMALGAMATED WIRELESS (A/SIA) LTD.

BAND SPREAD TUNING

Why Band Spread is Necessary — Band Spread Methods — Choice of Condensers — Band Spread Circuits.

THE wavelength to which a receiver is tuned may be varied by altering the size of the coils or condensers, or both. In short-wave receivers both methods are adopted, coils changed to provide reception of the various frequency bands and condenser values being changed to tune over those bands. In many receivers switches are used to bring coils of different sizes into circuit, but in others the change is effected by manual operation. Where the latter is the case the coils are wound on formers fitted with pins similar to those on a valve base, and to these pins are connected the windings on each former. A change in inductance values is then brought about by plugging different coils into a valve socket suited to the type of coil former used.

In receivers in which large condensers are used to cover the short-wave bands with a minimum of coils tuning frequently becomes difficult, particularly on the lower wavelengths. The reason for this is that because of the large capacity used a slight movement of the condenser's rotor plates results in the coverage of a wide range of frequencies.

Band Spread Features

BECAUSE of the confinement of the various types of stations to small bands of frequencies, radio engineers have endeavored to spread the stations in each band over the whole of a receiver's tuning dial. This has been done to facilitate tuning by enabling the listener to tune right on to a station's carrier wave and so minimise interference from adjacent broadcasters and, by systematically spacing the stronger stations on the dial, make it possible for him to receive several weaker stations which otherwise would be inaudible.

Another feature of band spread, as this system of spreading stations around a dial is known, is that it allows greater precision in calibrating a receiver, thereby making it easy to find an unknown station once its frequency is known. Most of us know what difficulties are experienced in endeavoring to tune in an unknown station on a commercial dual-wave set. It is mainly the absence of bandspread in sets of this type that distinguish them from what are known as communications receivers.

Band spread methods are divided into two classes, the mechanical and the electrical. The mechanical method consists merely of a high-ratio geared dial assembly. While it does not spread stations around the dial in the manner that the electrical system does, its high-ratio gears makes the separation of closely spaced stations possible. The main disadvantage of the system is that the gear ratio is limited by back-lash or slipping which becomes troublesome when very high ratios are employed. The presence of back-lash in any dial assembly prohibits the calibration of the receiver, and the tuning of an uncalibrated short wave receiver is an unenviable task.

Inductance-Capacity Ratio

THE electrical method is based on the principle that the wiring of a variable condenser across a coil will vary the coil's natural frequency to an extent determined by the condenser's minimum and maximum capacities.

In all tuned circuits a definite ratio of capacitance to inductance must be maintained to produce maximum efficiency. The reason for this is not within the scope of this article. Let it suffice for us to say that even if it should be possible to effectively alter the tuning of a receiver by making adjustments to the coil alone some capacitance in the form of a fixed condenser would still be necessary. The electrical methods of bandspread employ one variable condenser to introduce enough capacity to make the circuit efficient and at the same time make it capable of covering a wide range of frequencies, and an additional condenser for bandspread purposes.

Fig. 1. A simple and popular method of bandspread using a small capacity variable condenser in parallel with the main tuning condenser.

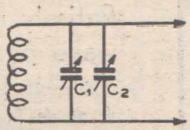


Fig. 2. A variation of Fig. 1, using a special two-section condenser.

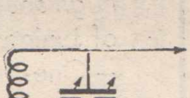


Fig. 3. A system in which two band spreading condensers are wired to a selector switch.

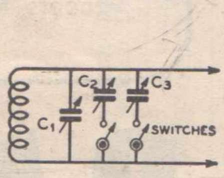


Fig. 4. An efficient and widely used system in which the band spreading condenser is tapped across portion of the tuning coil.

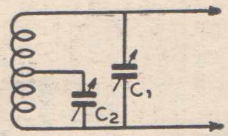
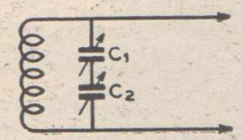


Fig. 5. A series method of band spread. This system is not popular, as it is difficult to calibrate.



The most effective and most popular system of bandspread is that which combines both the mechanical and electrical methods. A geared dial of moderate ratio is employed in conjunction with an additional variable condenser which is wired in circuit as shown in the diagrams.

It was pointed out earlier that the wiring of a small variable condenser across a coil would slightly extend its frequency range. In Fig. 1, C2 represents a standard short wave tuning condenser of the order of 100-150 mfd. By introducing C1, a variable condenser of about 5 mmfd., it is possible to swing C1 from minimum to maximum capacity and yet effect very little change in frequency. Thus by using C2 to set a receiver in a definite band of frequencies C1 may be employed to spread the stations in that band around the dial fitted to it.

Sometimes a special condenser is employed which is fitted with two sets of rotor plates which are controlled independently. A large capacity is used for the band setting condenser and a smaller capacity as a band spreader. This is illustrated in Fig. 2. Dual purpose condensers of this type are not readily available for short wave work.

Parallel Method

THE system whereby a small capacity is used in parallel with the main tuning condenser has one disadvantage. By using the same combination of condensers, it is not always possible to preserve an optimum ratio of inductance to capacitance when coils are changed to provide reception on other bands. Another disadvantage is that whilst a 5 mmfd. condenser will spread a high frequency band over the dial, the same capacitance will be too low when used on a low frequency.

Here also the converse holds good. Where C1 is of sufficient capacity to provide adequate bandspread on the lower frequencies, it will produce too high a capacity, and almost eliminate bandspread when used on the lower wavelengths.

(*Continued on Page 81*)

COILS AND COIL TABLES

The "Q" Factor — Choosing a Former — Selection of Wire Gauges — Form Factor — Mounting and Shielding — Coil-Condenser Tables.

THE design and efficiency of the coils used in a short or dual-wave receiver play a large part in the final operation of the set. Although recently many types of commercially wound short wave coils have been made available to the home constructor these are designed mainly for the dual wave type of set in which no provision is made for band-spread operation. The efficiency of short wave coils is measured by what is known as their "Q" factor. The higher this "Q" factor the more efficient the coil.

It will be found, however, that providing the coils are wound with fairly heavy gauge wire, on the best quality former available of a diameter between ½ and 1½ inches, they will give as good results as any. The quality of the former used plays an important part in the efficiency of the finished coil and the less solid material in the field of the coil the more efficient will it be.

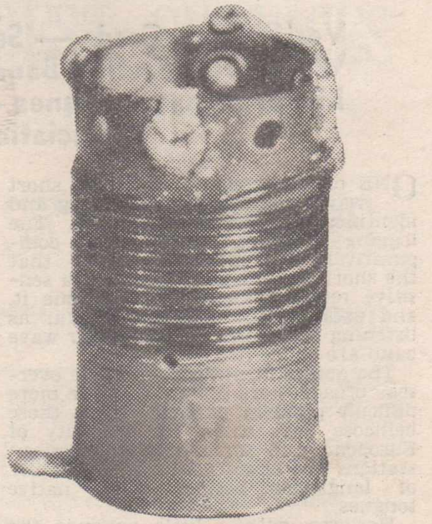
This accounts for the popularity of the ribbed type of former moulded from some good ceramic compound. The best of these compounds are manufactured under many different trade names, the most familiar being Isolantite, Steatite, Mycalex, Trolitul, etc. Next to these comes good quality bakelite.

Wire Gauges

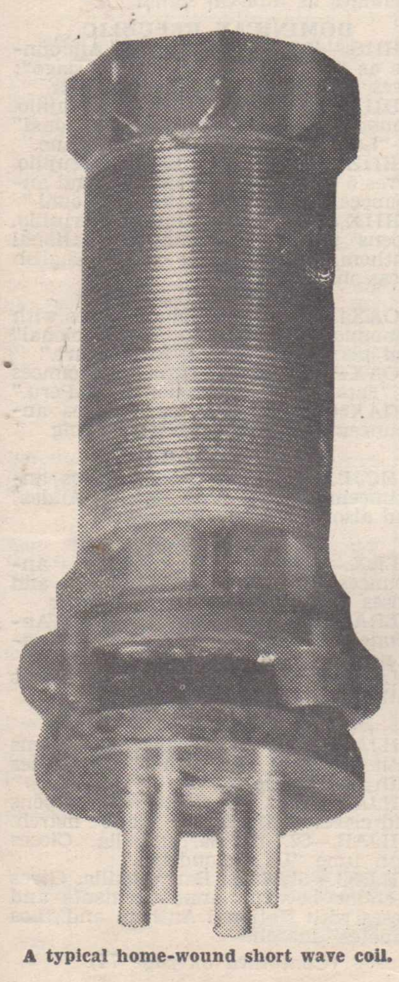
ANOTHER most important thing in the efficiency of the coil is the type and gauge of wire used in its construction. Generally speaking, the best wire to use in the making of short wave coils is enamel covered wire of heavy gauge. Most effective results judged by the Q factor of the coil, are obtained when the length of the winding is approximately half the diameter of the coil former. Thus it can be seen that it does not pay to use heavy gauge wire for coils which require a large number of turns.

With coils having a very few turns for very high frequency reception, the use

(Continued on page 81)



A commercial air-core short wave coil.



A typical home-wound short wave coil.

T.R.F. COILS

Wave Range.	Aerial Coil Primary.	Aerial Coil Secdry.	R.F. Coil Primary.	R.F. Coil Secdry.	Reaction.	Wire Gauge.
150 mmfd. Capacity.						
12 to 21 metres	2	3	2	3	2½	16 enamel
19 to 32 metres	3½	6	3½	6	4	18 enamel
30 to 52 metres	8	15	8	15	8	22 enamel
48 to 83 metres	10	26	10	26	9	24 enamel
75 to 115 metres	12	33	13	33	11	24 enamel
100 mmfd. Capacity						
12 to 18 metres	2	3	2	3	2½	16 enamel
17.5 to 25.5 metres	3¾	7	3¾	7	4½	18 enamel
25 to 37 metres	5	10	5	10	6	18 enamel
36 to 54 metres	7	16	7	16	8	22 enamel
53 to 82 metres	10	25	10	25	10	24 enamel
80 to 110 metres	12	34	12	34	11	24 enamel
75 mmfd. Capacity						
12 to 16.5 metres	2	3	2	3	2½	16 enamel
16 to 23 metres	3½	7	3½	7	4½	18 enamel
23.5 to 33 metres	4½	11	4½	11	6	18 enamel
32.5 to 49 metres	6	17	6	17	8	22 enamel
49 to 74 metres	8	25	8	25	10½	24 enamel
72 to 95 metres	10	35	10	35	12	24 enamel
50 mmfd. Capacity						
12 to 16 metres	2	3	2	3	2½	16 enamel
15.9 to 21 metres	3½	6	3½	6	4	18 enamel
20.5 to 31.5 metres	5	10	5	10	5	18 enamel
30 to 42 metres	7	16	7	16	7	22 enamel
41 to 62 metres	8	23	8	23	10	24 enamel
61 to 90 metres	9	36	9	36	12	24 enamel

All coils are wound on formers having an outside diameter of 1¼ inches. Reaction windings are made with 34-gauge d.s.c. wire.

SUPERHETERODYNE COILS

Band.	AER. Pri.	AER. Sec.	R.F. Pri.	R.F. Sec.	OSC. Pri.	OSC. Sec.
1	9	33	25	33	9	35½
2	5½	15¼	11	15	4½	15½
3	2½	5¾	4½	5½	1¾	5¾

Wavelength Range.—Band 1: 170 to 57 metres. Band 2: 59 to 25 metres. Band 3: 27.5 to 11.5 metres.

These ranges are covered with condensers having maximum capacities of 180 mmfd. Where bandspread is required, a value of 35 mmfd. is suggested.

The coils are wound on 1¼ inch diameter 4-pin formers, which should be made of a high grade non-conductor.

Use 28 gauge enamelled copper wire spaced to 32 turns per inch (space between turns slightly greater than actual wire diameter) for the secondaries of Band 1 coils. For Band 2 secondaries use 20 gauge tinned copper wire spaced to 10 turns per inch (nearly three times diameter of wire between turns). For Band 3 secondaries use 18 gauge tinned copper wire spaced 6 turns per inch (nearly three times diameter of wire between turns).

All primary windings are made with 30 gauge d.s.c. wire, and are inter-wound between the secondary windings. Starting from the earth end of the grid windings the primaries are wound in the same direction as the secondaries.

Identification of Overseas Stations

Verification Cards — Sending Reports — Short-Wave Broadcasting Bands — R and Q Signals — List of Signature Tunes — Foreign Language Pronunciation Guide.

ONE of the greatest thrills of short wave reception is the logging and identification of overseas stations. The logging of these stations is a comparatively easy matter provided that the short-wave listener possesses a sensitive receiver, knows how to tune it, and uses it with discretion so far as listening hours on each particular wave band are concerned.

The actual identification of the overseas broadcasters presents a little more difficult problem particularly in these bellicose days when the majority of European and some of the American stations are broadcasting in a number of languages besides their native tongues.

However, with a little patience the consistent listener will usually be rewarded in his efforts to identify even these latter stations.

Verification Cards

A SIDELINE which provides additional interest for many short-wave listeners is the sending of reception reports to overseas broadcasters with the object of receiving in return a Q.S.L. or verification card acknowledging the listener's reception of the broadcaster concerned.

In order to have a chance of receiving a verification card from an overseas station the reporting listener must provide definite evidence that he heard the station concerned at the hour which he claimed to have tuned it in.

The report should embody the following details:—

(A) Station call and wavelength and/or frequency on which it was heard.
(B) The time the station was heard. Australian time and local or G.M.T.
(C) Times and other details of particular items or announcements heard.
(D) Strength at which the station was heard—R scale of Audibility.
(E) Intelligibility of the transmission —Q scale of Readability.
(F) Presence of static, fading, or interference by another station during the transmission.
(G) Details of local weather conditions at the time of reception. Comparison of the station's signal strength with that of other broadcasters operating from the same area.
(H) Details as to the type of receiver and aerial system used by the listener.

Too much detail of this nature cannot be included in the report, for the latter is used extensively by the station engineers to determine the operating characteristics of the station.

Report should be mailed in a stamped and addressed letter and return postage should be supplied. Australian stamps will not do for this and the simplest way out of the difficulty is to obtain International Reply Coupons from your local post office. A coupon suitable for use within the British Empire costs 3d., whilst one for foreign countries costs 7d.

Most, but not all, international broadcasting stations verify reports. The B.B.C. does not verify nor do some of the South and Central American stations. Reports sent to overseas amateurs are often unanswered. However, if the reports are accurate and contain sufficient detail to warrant verification the S.W. listener can be fairly certain of receiving a Q.S.L. card in return.

R and Q Signals

R (Strength)

R1—Faint Signals, Barely Perceptible.
R2—Very Weak Signals.
R3—Weak Signals.
R4—Fair Signals.
R5—Fairly Good Signals.
R6—Good Signals.
R7—Moderately Strong Signals.
R8—Strong Signals.
R9—Excellent Signals.

S (Intelligibility)

S1—Unreadable Signals.
S2—Barely Readable, occasional words only.
S3—Readable with considerable difficulty.
S4—Readable with practically no difficulty.
S5—Perfectly readable.

*Note. — S signals are sometimes referred to as Q signals and carry the indication QSA1-2, etc.

Signature Tunes

THE following list of signature tunes, etc., should prove of use in identifying many of the stations which do not use English very frequently in their announcements.

SOUTH AND CENTRAL AMERICA

CUBA

COCQ.—33.98 m. and 47.17 m., Havana. Opens and closes with Spanish tune "Siboney." English used occasionally.

COBC. — 32.04 m., Havana. Opens with Spanish tune and uses slogan, "El Progresso Cubano."

COCX.—32.61 m., Havana. Opens with march and gives slogan, "Casa Lavin," and broadcasts calls CMX and COCX in Spanish.

COHI.—46.58m., Santa Clara. Opens with march and various calls, COHI, COCH, etc. Usually plays a few bars of "Popeye the Sailor" in the first few minutes of each session.

COCO.—34.48 m., Havana. Opens and closes with call in English.

COCD.—48.88 m., Havana. Opens and closes with "In a Clock Store."

COCW.—47.39 m., Havana. Opens with Mexican tune, "Estrellita."

COBZ.—33.13 m., Havana. Opens and closes with record, "Popular Melodies." Slogan is "Radio Salas."

COKG.—33.52 m., Santiago. Opens and closes with tune, "La Congo." Interval signal 3 strokes on gong.

COGF.—25.42 m., Mantanzas. Opens and closes with "Vals Diana."

COSTA RICA

TIPG.—31.19 m., San Jose. Gives English announcement on opening and uses slogan, "La Vox de la Victor."

TIEP.—44.84 m., San Jose. Opens with slogan, "La Vox del Tropico."

TI2XD.—25.06 m., San Jose. Opens with march, "Don Quixote."

VENEZUELA

VY5RN.—59.58 m., Caracas. Interval signal, 4 chimes. Uses bugles and whistles on opening.

YV1RX.—61.35 m., Maracaibo. Announces as "Ondas del Lago" and closes with a march.

YV2RN.—61.6 m., San Cristobal. Opens and closes with the march, "El Capitan." Interval signal 6 strokes on gong.

YV1RY.—61.1 m., Coro. Opens and closes with the march, "Three Colors." Interval signal 4 marimba chimes.

YV1RV.—62.53 m., Maracaibo. Announces as "Ecos del Zulia."

YV4RQ.—59.76 m., Puerto Cabello. Announces as "Radio Telefunken" and gives a few bars of a march on opening

YV4RP.—60.85 m., Valencia. Opens with a march and uses 3 chimes.

YV1RL.—61.73 m., Maracaibo. Announces as "Radio Popular" and uses 4 chimes as interval signal.

DOMINICAN REPUBLIC

HI1S.—46.76 m., Santiago. Announces as "Radio RCA Victor, Santiago"; gives three chimes at quarter hour.

HI1N.—48.04 m., Ciudad Trujillo. Announces as "Broadcasting Nacional" or "La Vox del Partido Dominicano."

HI1Z.—47.51 m., Ciudad, Trujillo. Gives 5 chimes and siren wail, and announces as "Broadcasting Nacional."

HI1X.—47.32 m., Ciudad Trujillo. Opens with the Dominican National Anthem and also gives call in English occasionally.

PERU

OAX4J.—32.12 m., Lima. Closes with announcement "Radio Internacional" and plays "Goodnight, Sweetheart."

OAX4T.—31.38 m., Lima. Announces as "Estacion Radio Nacional del Peru."

OAX5C.—31.91 m., Ica. Gives announcement in English on closing.

ECUADOR

HCJB.—24.08 m., Quito. Gives announcement "La Vox de los Andes" and also announces in English.

ARGENTINE

LRX.—31.06 m., Buenos Aires. Announces as "Radio el Mundo" and closes with slow orchestral number.

LRA.—30.96 m., Buenos Aires. Announces as "Radio Estado" and occasionally in English.

LSX.—28.93 m., Buenos Aires. Closes with march "San Lorenzo."

COLOMBIA

HJAE.—62.05 m., Cartagena. Opens with "Song of the Islands" and closes with "Alohe Oe."

HJAP.—60.92 m., Cartagena. Opens and closes with "Double Eagle" march.

HJAB.—62.7 m., Barranquilla. Closes with tune "La Golondrina."

HJAG.—61.16 m., Barranquilla. Gives 1 chime between announcements and closes with National Anthem and "Los Cadetes" march.

(Continued on page 74)

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IDENTIFICATION OF OVERSEAS STATIONS—Contd.

HJFK.—30.83 m., Pereira. Opens with a slow Spanish tune and gives slogan "La Vox de Amagos."

HJFH.—61.54 m., Armenia. Opens with march "Spanish Soldiers" and gives 3 chimes.

HJCD.—48.7 m., Bogota. Opens and closes with the selection "Rio Rita."

MEXICO

XEQQ.—30.99 m., Mexico City. Opens and closes with "Bolero" and gives call letters in English.

XEWW.—31.57 m., Mexico City. Opens and closes with call in English.

XEXA.—48.58 m., Mexico City. Opens with selection "March of the Toys."

XEBT.—49.94 m., Mexico City. Closes with "Liebestraum" (Liszt).

XEWI.—25.21 m., Mexico City. Closes with announcement in English and slogan "My Voice to the World from Mexico."

XEUZ.—49.04 m., Mexico City. Uses slogan "Radio Nacionals." Gives 5 chimes and occasionally announces in English.

XEBR.—25.38 m., Hermosillo. Opens and closes session with the waltz "Over the Waves."

PANAMA

HP5K.—50.00 m., Panama City. Opens with the waltz "Merry Widow."

HP5A.—25.64 m., Panama City. Opens and closes with "Anvil Chorus."

HP5J.—31.28 m., Panama City. Opens with the march "Blackhorse Troop" and closes with "Discipline Honor and Abregacion."

HP5B.—49.73 m., Panama City. Opens and closes with the march "Panama."

CHILE

CB96O.—31.25 m., Santiago. Closes with a slow piano tune, name unknown.

CB97O.—30.83 m., Valparaiso. Closes with "Pomp and Circumstance."

CB118O.—25.06 m., Santiago. Closes with "Taps" on bugle.

CD1190.—25,19 m., Valdivia. Closes with organ selection. Gives time signal and chimes.

URUGUAY

CXA2.—31.35 m., Montevideo. Announces on opening as "CXA2, Radio Continental."

CXA8.—31.12 m., Montevideo. Announces in English on closing as "Radio Balgrano"; also uses about three other languages.

MISCELLANEOUS

"Radio Martinique".—30.92 m., Fort-de-France, Martinique, F.W.I. Opens and closes with "La Marseillaise"; uses six chimes.

CHNX.—48.93 m., Halifax, N.S., Canada. Opens and closes with "Oh Canada" and gives chimes every 15 minutes.

PRA8.—49.92 m., Pernambuco, Brazil. Opens with studio clock striking hour. Gives slogan "Vox del Norte" occasionally.

PJC1.—50.5 m., Curacao, D.W.I. Opens with four strokes on an electrical gong and repeats in 5 minutes.

ZIZ.—46.99 m., Bassetterre, St. Kitts. Opens with "Rule Britannia." Closes with "God Save the King."

HRP1.—47.22 m., San Pedro Sula, Honduras. Opens with "Boy Scouts" march and closes with Honduras National Anthem.

CR6AA.—39.4 m., Lobito, Angola. Interval signal is 3 notes A C B on piano. English occasionally used.

CRY9.—49.34 m., Macao. Gives announcement in English approximately every 15 minutes.

RNE.—25.00 m., Moscow. U.S.S.R. Opens and closes with "Internationale." When English is used the call is "This is Moscow calling."

HSP6.—37,65 m., Bangkok, Thailand. Opens with clock striking, then gives call in English and French.

ZNS.—49.25 m., Nassau, Bahamas. Opening signal St. Margaret's Chimes, London; also Big Ben. Closing "God Save the King."

"Radio Czechoslovensko."—31.36 m. Interval signal is 8 chimes.

WPIT.—All frequencies. Opens and closes with "Stars and Stripes For Ever."

WGEO/WGEA. — All frequencies. Opens with Spark discharge and closes with "Star Spangled Banner."

WBOS.—31.35 m. Opens and closes with "Stars and Stripes For Ever."

WCBX.—All frequencies. Opens and closes with "Star Spangled Banner."

EUROPE

HAS3.—19.52 m., Budapest, Hungary. Opens with bells ringing. Interval signal is "Musical Box Melody."

HVJ.—19.84 m. and all other freq., Vatican City, Italy. Interval signal, clock ticking and announcement, "Laudetur Jesus Christus," "Radio Vaticano."

CSW4.—19.71 m. and all other freq., Lisbon, Portugal. Opens and closes with the Portuguese National Anthem.

2RO3.—31.15 m., Rome, Italy. Interval signal is bird whistling. Closes with Italian Royal March and Giovinezza.

OZF.—31.51 m., Copenhagen, Denmark. Opens with one gong stroke and closes with tune "There is a Winsome Land."

SBP.—25.63 m., Motala, Sweden. Gives announcement in English two minutes before opening each session.

ORK.—29.04 m., Ruysselede, Belgium. Closes with Belgian National Anthem, "La Brabanconne."

LKQ.—25.57 m., Oslo, Norway. Opens with march and gives time signal exactly on hour or half hour.

This table of alphabetical and numerical pronunciations of the four major European languages will assist the short wave listener in the identification of foreign broadcasters.

	FRENCH	SPANISH	PORTUGUESE	GERMAN
A	ah	ah	ah	ah
B	bay	bay	bay	bay
C	say	say-thay	say	say
D	day	day	day	day
E	ay	ay	ay	ay
F	ef	effay	effay	ef
G	zhay	hay	hay	gay
H	asch	ah-hay	ah-hay	hah
I	ee	ee	ee	ee
J	zheep	ho-tah	ho-tah	zhay
K	kah	kah	kah	kah
L	el	ellay	ellay	el
M	em	emmay	emmay	em
N	en	ennay	ennay	en
O	o	o	o	o
P	pay	pay	pay	pay
Q	coo	coo	coo	coo
R	air	erray	erray	err
S	ess	essay	essay	ess
T	tay	tay	tay	tay
U	eu	oo	oo	oo
V	vay	vay	vay	fow
W	doublevay	doobleyay	dooblvay	
X	eeks	ekis	ekis	ecks
Y	egrek	egreyeyah	egreyeyah	egrek
Z	zed	zed	zed	tset
1	unh	uno	um	ine
2	dur	doce	dois	zwi
3	trwa	trace	tres	dri
4	katth	kuahtro	quattro	feur
5	sank	sinko	sinko	finf
6	seece	sase	sase	sex
7	saat	sate	sate	seeben
8	hweet	ocho	oito	oct
9	nerf	nu-avy	nove	noin
10	deece	de-uz	deuz	zane
11	onze	onse	onze	elf
12	doze	do-ce	doze	twelf
13	traze	trece	tres	trizane
14	katorz	catorce	katorz	feurzane
15	kanz	quince	quinze	finfzane
16	saze	dieciseis	dezeseis	sexzane
17	deece-satt	dieciseite	dezeseite	seebenzane
18	deece-hweet	dieciocho	dezoito	octzane
19	deece-neuf	diecinuahvy	dezanove	noinzane
20	vant	vane-tah	vinte	tswansig
30	trahnt	tranetah	trinta	drysig
40	karant	quarantah	quarantah	feurzig
50	sankant	sinquenta	sincuenta	finfsig

Automatic Volume Control

Cause of Fading—Functions of A.V.C.—Simple and Delayed A.V.C. Systems—Time Constants.

BEFORE discussing the practical application of Automatic Volume Control let us consider just what it is, how it works and why it is necessary. A radio signal propagated from a transmitting aerial may reach the receiver by two paths. In the first case if a receiver is situated near the transmitting station it will pick up what is known as the ground wave of that station. The actual area of this ground wave varies considerably, depending upon the frequency of the radiated signal.

However, the ground wave provides a constant signal and does not fade as is the case with the sky wave which travels upwards towards the Heaviside and other layers and is then reflected by these layers back to earth. These reflecting waves vary in height above the earth's surface and as these changes take place the reflected wave is not concentrated in a single beam as it would be if the layers remained at a fixed height.

The result is that if the whole of the components of the reflected wave are not within the range of the receiver's aerial a drop in signal strength results which is commonly known as fading.

Unless conditions are exceptionally good fading is present to a more or less marked degree on all distant signals.

In order to overcome the effects of this fading and obtain a constant volume level from the received signal the sensitivity of the set must be varied in accordance with this signal. This is precisely the aim of A.V.C.

A.V.C. circuits are arranged to automatically reduce the total amplification of the signal with increasing strength of the received station's carrier wave. Thus, when the signal strength of a distant station drops due to the effects of fading the sensitivity of the receiver increases and tends to overcome this.

Theory of A.V.C.

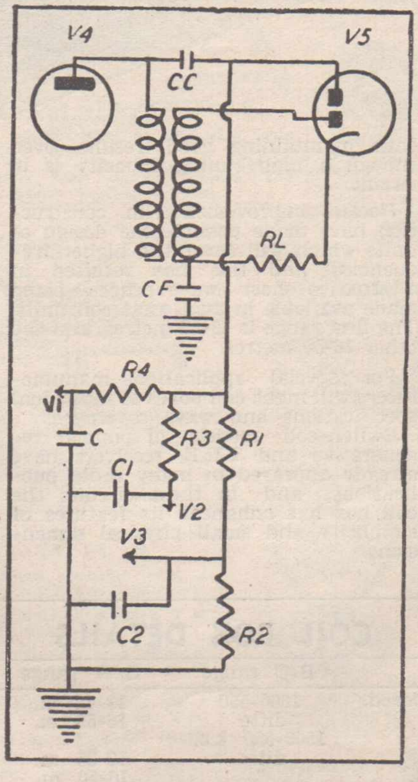
TECHNICALLY the A.V.C. system is so arranged that large signal inputs produce a large negative potential, which, when applied to the control grids of the amplifying valves cuts down their gain and so maintains the set's output at a fixed level for the maximum large signal input. When the signal level drops, less negative bias is applied to the valves so that they in turn are able to amplify the signal to a greater degree than they were permitted to amplify the strong signal.

The A.V.C. system is so proportioned that this see-saw action can follow rapid changes in signal strength such as encountered with fading signals. Theoretically this system is ideal, but in practice there are a number of snags to be guarded against. The A.V.C. action must take place on the "Mean" carrier strength and not on the rapid changes in intensity which take place when the carrier is modulated by audible tones.

For this reason the A.V.C. action has to be faster than the frequency of the lowest audible tone it is desired to reproduce and the Time Constant of the A.V.C. system must be so worked out that the rapidity with which it functions is greater than that of the lowest reproduced frequency. These factors, however, need not concern the average home constructor as these points are taken care of when the circuit of a receiver is being designed.

Simple A.V.C.

A.V.C. systems may be divided into two classes, simple A.V.C. and Delayed A.V.C. Simple A.V.C. works in the following way: In any diode detector circuit there is developed across



A Delayed A.V.C. Circuit suitable for three controlled stages.

the load resistor a voltage which is proportional to the carrier strength of the diode. The diode end of the load resistor is negative with respect to earth and therefore a negative A.V.C. voltage may be applied to the control grids of the R.F., Mixer or I.F. amplifier valves by connecting a suitable resistance filter to this point and feeding this negative potential to the grid return circuits of these valves.

The main disadvantage of this simple A.V.C. circuit is that even though no signal is tuned certain unavoidable noise voltages are produced in the receiver and this together with static and other extraneous noises combines to produce a voltage across the diode load resistor and so reduce the overall amplification of the receiver.

This may be overcome to some extent by attention to the bias values in the controlled stages, but a similar difficulty arises when a weak signal tuned in. The effect of the signal again reduces the sensitivity of the receiver, which is not desirable.

Delayed A.V.C.

TO overcome these disabilities the delayed A.V.C. system was produced. In this case delay refers to voltage delay and not time delay due to the charging of the by-pass condensers. A delayed A.V.C. system is one which does not come into operation until the carrier strength reaches a predetermined level.

Delayed A.V.C. also allows of a higher A.V.C. voltage being produced as the rectification efficiency is better and a higher value of diode load resistor is possible. Again where the A.V.C. diode voltage is obtained from the plate circuit of the I.F. amplifying valve a higher R.F. voltage is applied than if this voltage were taken from the secondary of the I.F. transformer.

A further advantage in feeding the A.V.C. diode from the plate of the preceding valve is that it reduces the loading effect of the A.V.C. system on the I.F. transformer secondary. Delay is introduced into the A.V.C. circuit B by applying a negative potential to the A.V.C. diode. The effect is that the received signal must first overcome this initial voltage before the A.V.C. commences to function.

In most cases a delay of 3 volts is sufficient to provide good results. A simple way to obtain this delay in circuits using diode-triode or diode-pentode types of valves is to return the A.V.C. diode load resistor to earth. This applies a negative potential, equal to the voltage developed across the cathode bias resistor, to the A.V.C. diode plate.

If less delay is required the diode load resistor may be tapped on to the cathode resistor at some predetermined voltage setting. However, if this is done a positive potential is applied to the grids of the controlled valves, and the fixed bias for them must be increased by the voltage between the cathode tapping and earth if the correct bias ratings are to be maintained.

A typical delayed A.V.C. circuit is shown and may be adapted for sets with or without an R.F. stage. The value of CC should be .0001 mfd. and must be a good quality mica insulated unit. The resistors R1 and R2 each have a value of 500,000 ohms, while

(Concluded on page 82)

Coil Boxes and Switching Units

Commercial Type Coil Boxes — Designing a Coil Box Receiver — Switch Connections — Checking the Alignment.

AS the commercial broadcast coil supplanted the home-wound component, commercially constructed short wave coils are displacing, except in a few cases where other than standard windings and inductance values are required, home-constructed coils. At the same time the plug-in type of former is giving way to the coil box in which coils to cover a number of bands are mounted on a metal framework, and coil selection made by means of a multi-contact switch.

The experimenters' early attempts to scrap plug-in coils, and use in their stead inductances which were changed by means of home-constructed switches,, were not very successful. The use of switches has at all times provided a convenient way of making and breaking circuits, but the early switches were inefficient, particularly when used in circuits carrying radio frequency currents.

Constant use resulted in worn parts and faulty contacts and long leads and inadequate shielding of coils and their connections resulted in stray capacities which meant a decrease in sensitivity and frequency coverage.

The reduction in the size of coils, accompanied by an increase in efficiency, which came with the introduction of the pi system of winding and the iron core, better insulation, as a result of the introduction of trolitul and other high-dielectric plastics, and a general improvement in switch design made an efficient coil box possible.

Good insulation in switches and coil formers minimises losses in these units. Small coil dimensions resulted in a considerable reduction in the lengths of leads, and, therefore, stray capacities. Sturdy switches having silver-plated points, have put an end to the problem of high resistance contacts.

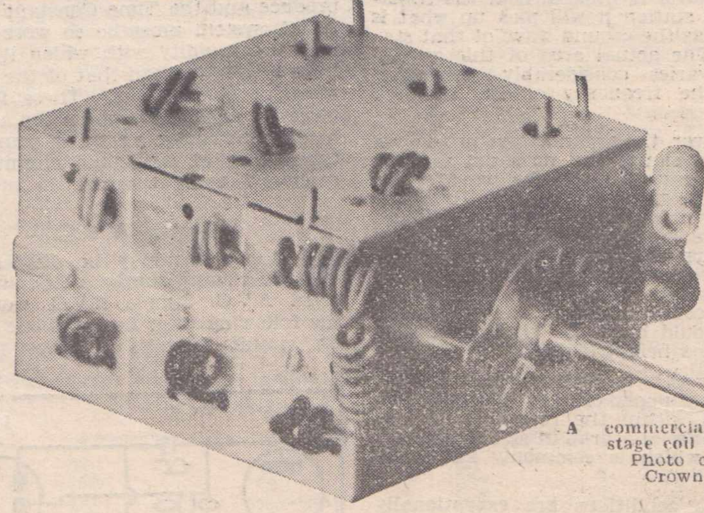
Many types of coil boxes are available today which are more efficient than coils of the plug-in type. The reasons for this increased efficiency are that most formers designed for plug-in coils are constructed of poor insulating material, and, in most cases, work loose in their sockets after a few months' use.

The improved efficiency has permitted the successful use of a standard broadcast condenser to cover the main short wave bands, at the same time maintaining good results even though a high tuning capacity is in circuit.

Recent improvements in construction have made possible the design of units which will cover the higher frequencies, and this has resulted in alternative short wave ranges being made available in dual-wave coil units. The first range is 13-32 metres, and the other 16-50 metres.

For special applications manufacturers will make coil boxes to individual specifications and wave coverages.

Switch-coil models of popular regenerative and T.R.F. receivers have already appeared in many radio publications, and in these circuits the coil box has enhanced its features of simplicity and small physical dimensions.



A commercial three stage coil box. Photo courtesy Crown Radio.

Tricky Switch Connections

IF the experimenter is not desirous of having a unit constructed to his specifications, he may wind the necessary coils and mount them on a commercial wave-change switch. Where matching is unnecessary, as in the case of receivers of types other than the superheterodyne, little difficulty should be experienced in obtaining high efficiency.

The only problem, and it should be one that confronts him only on first use of a multi-point switch, is where the various leads should be connected. The factory made coil box is supplied with all internal wiring completed In all cases the only connections to be made by the set builder are those to external components and to facilitate this a color code has been adopted, a copy of which is usually supplied with the unit.

Those using these switches for the first time should note that the moving arm connection points are on the opposite side of the insulation forming the switch base to those of the fixed contacts, and are located alongside the switch mounting posts.

The order in which the moving arm will contact the fixed points is readily seen by an inspection of the unit.

COIL BOX DETAILS

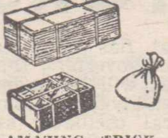
Type No.	Coils Used	B/C range	S/W range	Gang.	Dial
"H" D13.	"Permatune" Iron Cored.	1600-550	13-42 m.	S/C "H"	"Crown" "H" type
"H" D36.	ditto.	ditto.	16-50 m.	ditto.	ditto.
"F" D36.	"	1500-550 k.c.	"	S/C "F"	"Crown" "F" type
"F" D32.	"	ditto.	12-35 m.	ditto.	ditto.
"F" DC2/16.	Air core pi wound.	"	16-50 m.	"	"
"H" DC2/16.	"	1600-550 k.c.	"	S/C "H"	"Crown" "H" type
"H" DC2/13.	"	"	13-42 m.	"	"

The above table shows the type numbers and tuning ranges of the Crown range of coil boxes and switching units.

DW4	Air core, trolitul insulation, pi-wound	1500-550 k.c.	13-32 m. (or 16-50 m.)	S/C "H" or "F"
DW5	Air core, trolitul insulation, pi-wound includes R.F. coil	1500-550 k.c.	13-32 m. (or 16-50 m.)	S/C "H" or "F"

The above table shows the type numbers and tuning ranges of the Aegis range of coil-switch units.

PRESTO, THE MAGIC BOX.

2/9  2/9

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Mapps Radio Time Switch and Clock combined, 22/6. Automatically switches on your radio at any desired time. A handy, reliable timepiece.

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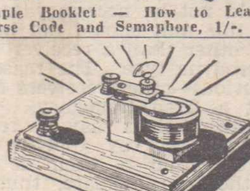
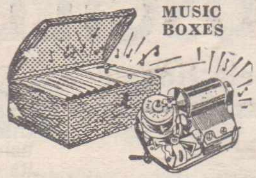
American Auto-Radio Remote Controls, complete with flexible cables, 25/.

Simple Booklet — How to Learn Morse Code and Semaphore, 1/-.



Like a Flash, De Luxe Professional Type, Highest Tone Adjustable Buzzer, 15/ (as illustrated). Ship's Operator Type, Sharp Tone, High Pitched Adjustable Buzzer, on bakelite base, 8/6.

MUSIC BOXES



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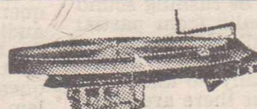

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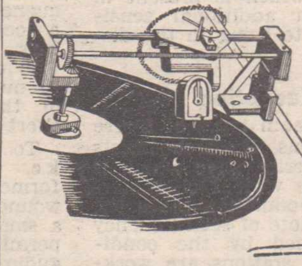

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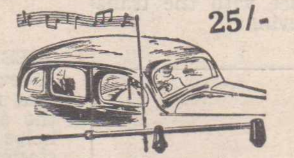

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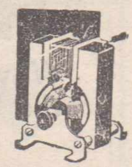

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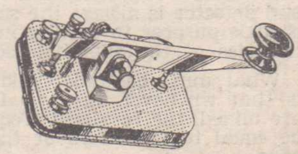

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HETERODYNE OSCILLATORS

Why a Heterodyne Oscillator is Used — Selecting the Beat Note — Special Coils Unnecessary — Forms of Coupling.

BEFORE discussing the purpose and principles of operation of the beat frequency oscillator let us briefly review the superheterodyne circuit in order to determine how the unit got its name.

The principle of operation of the superheterodyne is that an incoming signal when picked up, is mixed with another signal which is generated locally, to provide a signal of what is known as intermediate frequency. This signal is then demodulated by the second detector valve in the set and fed into a standard audio system. By using matched coils and condensers it is possible to ensure that no matter what the frequency of the incoming signal the intermediate frequency fed to the second detector is always the same. There is little purpose in delving into the intricacies of the superheterodyne here.

What must be understood, however, is that whenever any two frequencies are mixed, the resultant frequency will be equal to their sum or their difference

Remember this and you will be able to solve many problems that confront those not well versed in radio theory. Remember, too, that this rule is applicable whether the mixing is of two signals of radio or two signals of audio frequency.

The mixing of frequencies is referred to as "beating" one frequency against the other, hence the term "beat frequency."

When no modulation in the form of speech or music is applied to a station's carrier wave little indication of the station's activity is given on a receiver. In some cases a low hum or rushing sound is heard, but this results from partial modulation as a result of improper filtering and lack of shielding in the transmitter. Theoretically no indication should be available, but there are limits beyond which unwanted noises cannot be further reduced.

The listener has very little difficulty in determining whether or not a local station is on the air, but when the station is a distant one, any partial modulation is counteracted by the background noise which is present in the receiver when additional sensitivity is necessary to bring in the distant station.

Code Reception

THERE are two main types of Morse code transmissions. The first consists of a modulated carrier wave which is broken up into the various characters by keying. The modulation takes the form of an audio note of set frequency which is determined by the conditions under which stations are working. The second and more general method consists of a keyed unmodulated carrier. To make reception of transmissions of this type possible it is necessary that some audio note should be produced which will be interrupted in accordance with the transmitter operator's keying.

From what has been learnt about the principles governing the mixing of frequencies it will be understood that this may readily be accomplished by using a local oscillator and beating its output against the superhet.'s intermediate frequency. As pointed out earlier, the input to the second detector of a superheterodyne is constant and represents the intermediate frequency, varied slightly because of the audio frequencies superimposed on it. In the case of a code transmission of this type, there is no audio frequency on the carrier, hence our problem becomes an easy one. All that is necessary is a small oscillator which will produce an audio note to our liking when its output is fed into the superheterodyne's second detector circuit. The circuit of an oscillator of this type is shown in the diagram

Assuming that the intermediate frequency of the receiver is 465 kilocycles, a local oscillator of 464 k.c's. or 466 k.c's. will provide an audio note of 1000 cycles, a note which is pleasant to most ears. This is the frequency of the tuning signal of Daventry's short wave transmitters.

To make matters easier a 465 k.c. intermediate frequency transformer can be used in place of a home wound coil and across this is wired a small variable condenser which will permit the operator to adjust the audio note to his own requirements. The small trimmer on the transformer may be used to adjust its frequency to somewhere near that of the receiver where some slight departure has been made from the standard of 465 kcs.

Advantages of B.F.O.

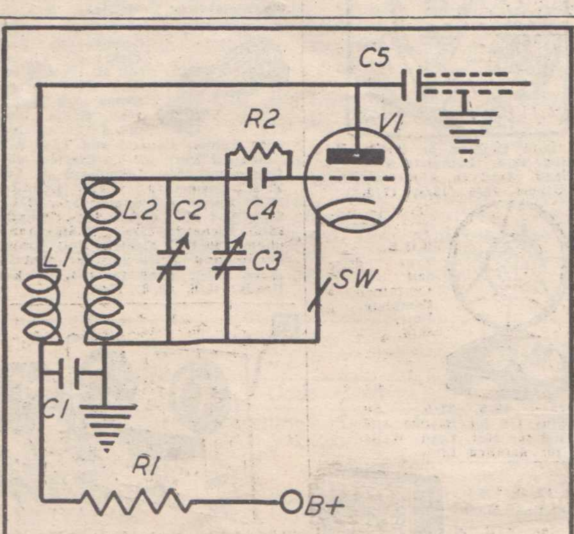
BESIDES permitting the reception of several thousands of code stations, the beat frequency oscillator unit increases the apparent sensitivity of a set and helps one to find the weaker broadcast stations by giving to their carrier waves an audio note. It will prove an adjunct to any receiver and its small dimensions and lack of controls will enable the reader to find room for it in all but the smallest of cabinets. The small variable condenser, used to vary the pitch of the signal, need not be touched once the listener has found a frequency to his liking.

It should not be necessary to point out that this unit should not be used with any other than a receiver of the superheterodyne type. The reason for this is obvious—other receivers do not detect at a fixed frequency.

Code transmissions may be received on these receivers by applying sufficient regeneration to their detectors, causing them to oscillate, thus producing an audible note by beating the local oscillation against the carrier of the incoming signal.

No difficulty will be experienced in building the B.F.O. unit. The number of components is small, and will cost very little. Almost any type of valve other than a power valve may be used, but to make use of the power supply of the receiver with which the oscillator will be used it will be necessary to select a valve requiring the same filament or heater voltage as those in the receiver.

(Continued on page 85)



CIRCUIT DIAGRAM and PARTS LIST

- C1.—.01 mfd. tubular condenser.
- C2.—See text.
- C3.—Three plate midget condenser.
- C.4.—.00025 mica condenser.
- C5.—M.E.C. trimmer condenser.
- L1, L2.—Standard 465 k.c. intermediate frequency transformer with can.
- R1.—30,000 ohm carbon resistor.
- R2.—10,000 ohm carbon resistor.
- SW.—Single pole single throw toggle switch.
- V1.—See text.
- SUNDRIES.—One valve socket, hook-up wire, nuts and bolts, one knob, solder lugs, and small chassis (where no space is available on receiver chassis).

RADIO TEXT BOOKS and MAGAZINES

	Price	Postage
Radio Amateur Handbook (Q.S.T.) 1940	10/-	10d.
Jones Radio Handbook ("Radio" California), 1940	12/-	10d.
Radiotron Designers' Handbook, 1940 (Over 300 Pages of up-to-date technical data, published by A.W.A. No set owner should be without a copy.)	3/-	4d.
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Radio Laboratory Handbook (By Scroggie, of "Wireless World." An invaluable handbook for all the radio industry.)	13/-	6d.
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Wireless Servicing Manual (Cocking)	7/6	5d.
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	Price	Postage
Amplifier Handbook, 1940, by Radio-craft	2/3	3d.
Australian & N.Z. Radio Call Book (Only a few copies of this left)	1/-	3d.
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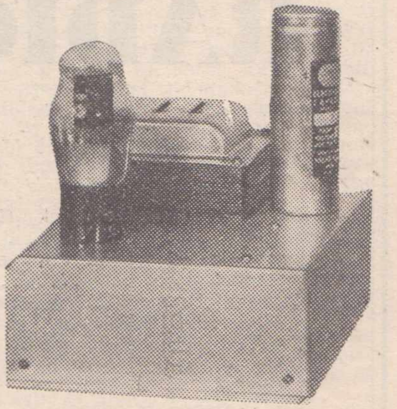
POWER SUPPLY SYSTEMS

Available Supply Methods — The Air Cell — Use of Accumulators — Vibrators and Gene-motors— Mains Power Units — Special Filters.



Photograph of a compact A.C. mains unit for use with a short-wave receiver.

NOW-A-DAYS the question of power supply for short and dual wave receivers is usually dealt with in the design of the receiver, be it Battery, vibrator, A.C. or D.C. operated.

The straight battery operated receiver requires the use of both "A" and "B" batteries. Dealing first with the matter of "A" supply batteries, we find three general types in popular use, the accumulator, the dry cell and the air cell. The first-mentioned suffers from the disability of having to be recharged periodically, besides being messy to use and handle. The dry cell type of battery has become more popular since the advent of the 1.4 volt valve. However, very few short or dual wave receivers are at present using these valves, so, for the purpose of this article, we will disregard this form of "A" battery supply.

We come then to the Air Cell. The one great advantage of the Air Cell is that once put into operation it is unnecessary to touch it again until it requires replacement.

The Air Cell

ALTHOUGH rather bulky in size, and having a limited output of 600 milliamperes at 2 volts, the Air Cell is probably the most satisfactory for the country listener situated away from charging facilities.

Before connecting an Air Cell to an existing receiver, a series resistor must be connected in one of the leads to the set, to limit the current flow, as, for the first few hours of the cell's working life the voltage is higher than normal.

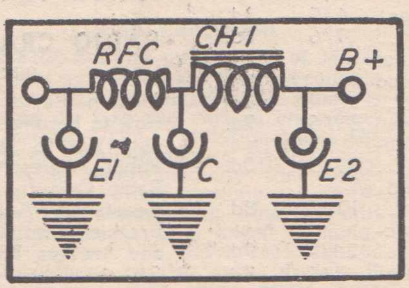
For the "B" supply the set user has the choice of accumulators, dry batteries, or the more modern methods of vibrator or genemotor units. So far as the accumulator "B" battery is concerned, the bulkiness of this form of supply, as well as the charging difficulties, preclude its use, except in remote cases where charging facilities are readily available.

The dry battery type of "B" supply is quite satisfactory, providing the discharge rate of the batteries are kept within the manufacturers' limits.

This should not exceed 6 milliamperes in the case of light duty batteries, 12 to 14 milliamperes for the heavy duty type, and 16 to 20 milliamperes for the triple capacity units. Of late the genemotor and vibrator type "B" supply systems have become very popular. Of the two the vibrator is the most popular as besides being more efficient than the genemotor, it draws less current and so operates for a longer period for each accumulator charge.

The vibrator type of power supply is that used with the so-called battery-less type of receiver. There are two types of vibrator supply systems, the non-synchronous, and the synchronous. The first-mentioned usually employs a valve rectifier, such as the OZ4, while the latter type delivers a pulsating D.C. output, which only requires filtering.

The majority of the vibrators used in battery-less receivers are of the synchronous type, with built-in filters, and arranged as integral parts of the receiver, or with a plug and socket connection. This type of vibrator usually has an output of approximately 150 volts at 20 to 30 milliamperes, but special heavy duty types, capable of providing outputs of 300 volts at 100 milliamperes are obtainable. A 6-volt accumulator is generally employed with vibrator sets, and the filaments of the 2-volt valves are arranged in various series parallel wiring arrangements to work from this 6-volt source.

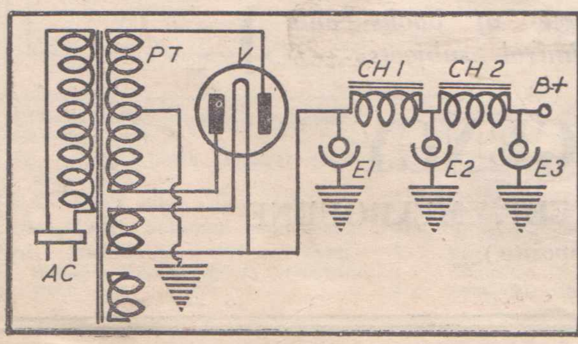


Typical circuit of a filter for a vibrator type power supply.

Mains Power Units

We come finally to the most generally used forms of power supply, those obtained from the A.C. and D.C. mains. With D.C. supply systems it is only necessary to interpose a suitable filter choke and filter condensers between the power line and the receivers plate supply connection.

The filter choke should have a low D.C. resistance and an inductance of from 10 to 30 henries. The D.C. resistance of filter chokes for use in D.C. or A.C.-D.C. sets should never exceed 100 ohms as the voltage drop becomes excessive. For A. C. sets always choose transformers which have a current rating higher than that actually required. Good load regulation characteristics are also desirable.



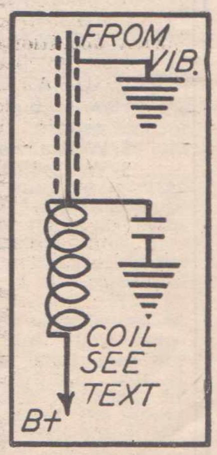
← Circuit of a mains operated power supply unit using condenser input and a double choke arrangement for good filtering.

Filter Circuits

THE next most important part of the power supply is the filter circuit. Two types of filter circuits are in general use. These are the condenser input type of filter, and the choke input type. For ordinary receiver work the condenser input type of filter is usually employed. The choke input type being used mainly where exceptional regulation characteristics are necessary.

Filters for use with vibrator type power supplies usually have specially designed R.F. filter circuits, connected before the main filter to eliminate harsh and other extraneous noises produced by the vibrator. In some receivers noise peaks on the short wave bands may be troublesome, in which case a tuned filter may have to be connected in series with the "B" positive supply lead The inductance may be of very small dimensions. i.e.. 5 or 6 turns of 26 enamel wire on a 3-8 inch diameter former, but the by-pass condenser value must be experimented with until the noise is eliminated. The circuit of the filter is shown in Fig. 1.

In some cases the power supply for short wave receivers is made up as a separate unit and connected to the set by means of a cord and plug arrangement. The photograph of such a unit is shown.



Circuit of a hash filter for connection in the "B" positive lead of a vibrator power supply.

COILS AND COIL TABLES (Continued from page 71)

of heavy gauge wire suitably spaced to enable the "form factor"—length to diameter ratio—to be retained, the Q factor will be high.

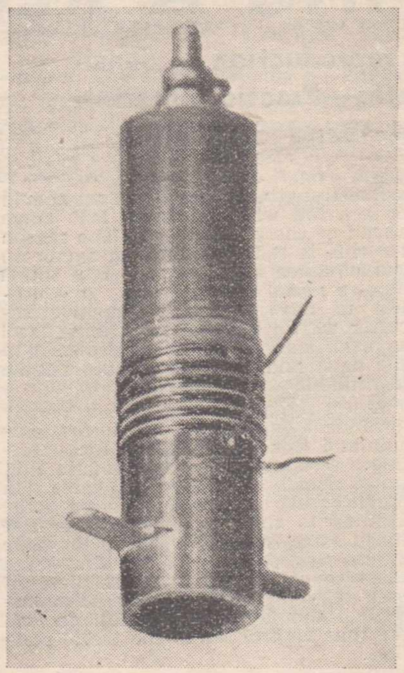
Shield Spacing

WHERE shielding is necessary in a short-wave receiver the shielding should not be brought closer to the winding than one diameter of the former on which it is wound. In all cases the grid or "hot" end of the coil should be mounted as far away from the chassis and shielding as possible. Several tables are shown giving coil winding details for both T.R.F. and superheterodyne types of receivers with various sizes of condenser capacities.

No data is given for standard coils for use with ordinary dual wave receivers as so many efficient types of commercial air and iron core coils are available for this purpose that it is cheaper to purchase these than to wind one's own. The actual placement of the windings on the former may be of interest.

Interwound Primaries

Modern practice is to interwind the aerial and plate windings in the grooves formed by the heavy gauge secondary of grid coils. All of the windings are wound in the same direction and the primaries are wound at the earth ends of the secondaries. The reaction windings in the case of coils for T.R.F. sets are wound at the earth end of the former and spaced slightly from the secondary.



A Permeability tuned iron core short wave coil.

Although the approximate number of turns for the reaction windings are given in the table it will probably be necessary to trim these slightly in order to obtain smooth control of regeneration for the particular valve and chassis layout employed. The above remarks apply also to the winding of the coils for band spread superheterodynes except that in this case the plate winding of the Oscillator coil is interwound with the grid turns.

In some cases this plate or feedback winding is reverse wound in order to minimise the effect of a large feed back coil. In the tables the wire winding gauges shown are for the grid or secondary windings, the aerial and plate windings being wound with 32 or 34 gauge D.S.C wire. The coils may be wound on plug-in formers or arranged for use with a wave change switch.

The illustrations show several types of short wave coils, a plug-in home wound unit, two commercial coils, one an air core unit, and the other a permeability tuned iron core one. Although this latter type of coil is not generally available with reaction windings it is a simple matter to add this winding and the coil could then be used for t.r.f. type sets using standard tuning condensers.

BAND SPREAD TUNING (Continued from Page 70)

For average use, we suggest 100-150 mmfd. as suitable values for the bandsetter condenser, and 15 mmfd. for the band spreader.

Some solution to the foregoing difficulties have been provided, as illustrated in Fig. 3. Two band spread condensers are used. C2 is used on the higher frequencies, and C3, a large capacity, on the lower frequencies. Sometimes C2 is left in circuit, with its plates in mesh to provide additional capacity in the circuit when low frequency operation is desired. However, this system introduces losses in long leads to the switch, and means in some cases that an additional tuning dial must be employed.

Figure 4 illustrates the most popular method. C2 is tapped across the coil, thereby making it possible, by adjusting the tappings on individual coils, to govern the amount of spread to suit one's requirements, thereby taking full advantage of those benefits that band spread has to offer. In this circuit, C2 need not be of low capacity. A value of 150 mmfd. for C1 will permit a tuning range of 10-180 metres, and a value of 25-100 mmfd. will prove suitable for spreading all bands within this range. Adequate spreading is assured on the lower wavelengths by tapping the coil a very short distance from the lower end.

Fig. 5 illustrates the series capacity method in which two condensers are wired in series across the coil. The principle of operation of this method is that while the minimum capacity across a coil varies but little with variation of the bandsetting condenser, the maximum capacity available may vary greatly. This system is very difficult to calibrate and is little used.

To simplify operation ganging of spreading condensers is frequently resorted to where it is desired to apply bandspread to two or more tuned circuits.

Mechanical and electrical bandspread is now incorporated in all communications type and amateur experimental receivers and is rapidly becoming a feature of the commercial dual-wave set.

Adding Band Spread to Commercial Sets

The owner of a commercial dual wave receiver may take advantage of band spread's benefits by wiring a ganged condenser of low capacity in parallel with the regular tuning condenser. 15 mmfd. per section will cover the ranges covered by commercial dual-wave coil units but, where spreading is desired on wavelengths from 75 to 200 metres, it is advisable to increase this capacity to 50 mmfd. The leads from the low capacity condensers to the regular tuning condensers must be kept as short as possible to eliminate stray capacitance effects.

In cases where band spreading condensers are added to a receiver and room is not available for an additional vernier dial the fitting of a slow-motion drive to the condenser's spindle will suffice.

In cases where there is room on the chassis the high capacity condenser may be moved and the new midget put in its place to permit the use of the regular tuning dial for purposes of calibration, the original condenser being fitted with a smaller slow motion control.

The time and trouble taken to fit band spread to any short wave set will be amply repaid. Users of commercial or home constructed sets using large tuning condensers will be amazed at the number of stations being missed or interfered with by more powerful neighbors which can be tuned once band spread is incorporated. Summing up the various systems we find that the two most popular ones are the parallel system and the tapped coil system.

For the average home constructor the parallel system is effective and easy to use beside being simple to fit to existing sets, whilst for the more advanced experimenter the tapped coil method permits of 100 per cent. spread on each band providing time and care is taken in the adjustment of the coil tappings.

SELECTING A RECEIVER

Wave coverage — Tonal reproduction — Sensitivity—Signal to Noise Ratio—Practical Tests—Frequency Stability—Band Spread.

IN selecting a receiver for the reception of short-wave transmissions be they amateur or broadcast, certain important features should be checked before a choice is made. In the first place, of course, the prospective purchaser must decide on the price class from which the selection is to be made.

Once this has been decided, several important questions arise. If the receiver is required solely for short-wave work it is desirable that it be provided with full band spread over the wave bands on which reception is intended. On the other hand, if a dual wave receiver is under consideration, some efficiency must be sacrificed to enable good reception of the broadcast band stations.

In most cases the modern dual-wave set tunes over the broadcast band, and the more important short-wave broadcasting bands. A few triple-wave sets are available, and these are to be preferred if the listener desires to cover the majority of the short-wave bands now in use. Dual-wave sets at present cover from around 12.5 metres to 41 metres, or, alternatively, from 16 metres to 50 metres.

Here again the purchaser must decide for himself the coverage most suitable to his needs. Generally speaking, the first mentioned coverage will be found the most useful, as stations can be received on the 13-metre band when most of the other bands are badly affected by static and seasonal conditions.

The 49-metre band which is missed out in this case does not provide the same reliable conditions as the higher frequency bands except on odd occasions when freak conditions prevail.

The summary of commercial receivers shown on page 64 will assist intending purchasers to decide on the type of receiver for their requirements. The band coverages are given in megacycles, but these may be converted to metres by applying the wave-length frequency charts on pages 21 and 22.

As an example 22 M/c. equals 22,000 k.c. By applying the chart and tracing this figure on it the corresponding wave length in metres will be shown in the opposite column.

Signal to Noise Ratio

THE band coverages decided upon the receiver's performance comes under consideration. The majority of modern sets in conjunction with reliable and well-baffled speakers give excellent tonal reproduction, and here again it is up to the purchaser himself to decide the one which best suits his taste. Certain other factors, however, should be carefully investigated before a receiver is selected on its tone quality and appearance alone.

High sensitivity is essential in any receiver which is required to receive overseas stations at good entertainment strength. If possible a set should be selected which uses an R.F. stage ahead of the mixer valve. The reason for this is that the limiting factor to the effective sensitivity of any set is its own signal to noise ratio. It is useless to have a highly sensitive receiver with a high inherent noise level as weak stations would be drowned in the hash and noise and would not be identifiable.

A sets signal to noise ratio is greatly dependent on the gain in the first circuit and this is the reason for selectting a receiver having a high gain R.F. stage ahead of the mixer valve. A rough check, but one which gives some idea as to the efficiency of the first tuned stage in a receiver, can be made by shorting the grid of the first stage valve to earth with a short piece of bare wire. In this test the volume control should be turned full on and the tone control set to the treble position.

If the gain in the stage is high a distinct drop in the inherent noise will take place when the circuit is shorted out. If necessary, this test may be made with the mixer and I.F. stages, also in each case the efficiency being judged by the drop in noise level when the stage is shorted out.

Frequency Stability

THE next most important thing to look for in a set is frequency stability. Elaborate precautions are being taken in current models of dual and triple wave sets to ensure frequency stability.

Special mixer valves have been developed, and the use of air trimmers and rubber mounted chassis contribute largely to efficiency in this regard. A simple test which can be made for frequency stability is as follows:—After allowing the receiver to warm up for several minutes, tune in to a fairly weak overseas station, which is reasonably steady.

It should not be necessary to touch the controls of the set once the station has been tuned, and any drifting denotes instability in the receiver's oscillator circuit, which would cause considerable inconvenience when listening to short wave signals. Mechanical stability can be checked by tuning the receiver to a station, and jarring the cabinet and chassis of the set with the hand.

In the case of communication type receivers using a beat oscillator, an excellent check for stability may be made by turning the beat oscillator on and tuning in to a steady signal. Turning the manual gain control rapidly, particularly if it controls the R.F. or I.F. valves, should not vary the tone of the beat by more than a few hundred cycles.

Band Spread

IN any receiver to be used mainly for short wave reception, band spread is a very desirable feature. A number of the 1940 releases of dual wave sets have band-spread systems fitted. By band-spread we mean the electrical or mechanical spreading of individual receiving bands over a large portion of the dial scale. Communications type sets have full band-spread over their full frequency coverage, and this allows many weak signals, which would not be audible on the average dual wave set, to be received.

However this disadvantage is difficult to overcome with the ordinary dual wave sets as if the tuning circuits are designed for band spreading the higher frequencies the coverage on the broadcast band is effected. Most people buy this type of set primarily for the reception of local and interstate stations on the broadcast band and consequently the short-wave reception has to take second place.

However, now that receivers are available with band spread advantage should be taken of this feature, particularly if it is intended to concentrate on the short wave bands. The home constructor with the aid of the circuits and the articles on bandspread and coils should be able to choose a circuit and construct a very efficient short wave set fulfilling the above requirements. The circuits shown are complete in themselves, but the more technically minded will readily realise that the features in any one circuit may be combined with those of another and in this way a circuit arrived at which will satisfy the most ardent short wave fan.

Newcomers to the ranks of short wave listeners would be well advised to start off on a simple set and gradually advance to the more complicated receivers as the experience gained with the smaller sets will assist materially in building and getting the best results from the multi stage superheterodynes.

AUTOMATIC VOLUME CONTROL

(*Continued from page 75*)

R3 and R4 each is of 100,000 ohms resistance. The condensors C and C1 should have a value of .05 mfd. while C2 may be .005 mfd.

The RF valves grid return should connect to the junction of R4 and C and that of the mixer valve to R3 and C1. The grid return of the first I.F. transformer joins to C2 and the junction of R1 and R2. If an R.F. stage is not used the resistor R4 and the condenser C are omitted and the other connections made as described.

A.V.C. is essential in the modern short wave superheterodyne, and although it is rather difficult to apply to straight T.R.F. sets, is sometimes used in multi stage sets of this type.

Amplified A.V.C. and other variations such as separate A.V.C. rectifiers are sometimes used, but the circuit shown will, in most cases, fill the bill as far as the average home constructor is concerned. The constants have been selected to provide correct time constants, and for this reason the values of the resistors and condensor should be as specified.

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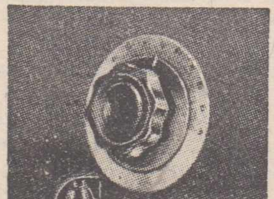

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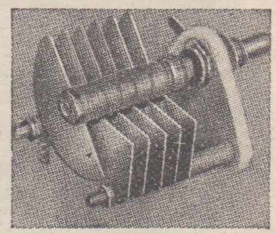

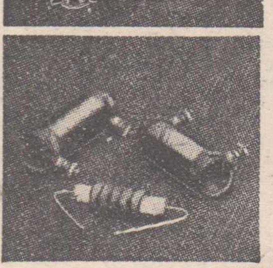

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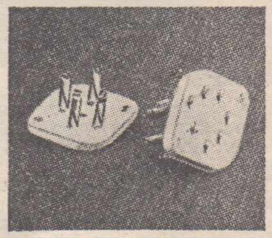

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COMMUNICATIONS RECEIVERS

STRICTLY speaking, a communications receiver is any receiver that is used as part of a transmitting station's equipment for communication purposes. Manufacturers have constructed receivers which embody almost every refinement that engineers have developed in an attempt to improve the lot of the professional and amateur operator. It is to this type of set that the name communications receiver is now applied. It is not essential that the set should be a factory made product, but, if home constructed, it is necessary that it should possess many of the features of the commercial receiver.

The main characteristics of the average communications set are that it must cover an extended frequency range, and, furthermore, do this without the necessity to change a number of plug-in coils. It must be accurately calibrated to permit reception of any station, once its frequency is known. In addition, it must incorporate both mechanical and electrical systems of bandspread and circuits designed to eliminate unwanted noises and station interference.

The use of components of premier quality in modern circuits ensures maximum sensitivity, selectivity, and stability, the three essentials of a good receiver.

To the novice, the terms, Crystal Filter, "Single Signal" Reception, and Noise Silencer are meaningless, and it is for him that we give a short description of each one.

The property of a quartz crystal which enables it to oscillate on a predetermined frequency with little drift is often availed of in superheterodyne intermediate frequency stages. By using a crystal whose frequency is the intermediate frequency, bandwidth in that stage may be reduced from several kilocycles to a few cycles. In this application, the crystal stage is known as a crystal filter.

When a beat frequency oscillator whose frequency is 466 k.c. beats against an intermediate frequency of 465 k.c., and an adjacent channel station on 467 k.c., the result is interstation interference. By eliminating the beat note formed with the 467 k.c. signal, interference-free reception is possible. This system of dispensing with one beat note is known as single signal reception.

Noise silencers take many forms, but in most cases consist of valve rectifiers, which cut off certain frequencies. Because of the fact that most unwanted noise is of a definite frequency, it is possible to eliminate most noise, and allow legitimate signals to pass.

Special aerial coupling units and inbuilt noise silencers reduce interference from static and electrical sources to a minimum, and provide a high signal-noise ratio. Inter-station interference is minimised by the employment of crystal filters, audio frequency impedance bridges and "single signal" circuits.

These refinements are not necessary in the average short wave set, in fact their inclusion would reserve short wave listening for the rich man, but every feature essential to perfect reception must be incorporated in sets used for commercial communications purposes, where, as is often the case, human life depends on their successful operation.

TROUBLE SECTION—Contd.

corresponding drop in the oscillator grid potential.

Another important thing to remember with mixer tubes for short wave use is the necessity for adequate filtering of the plate supply voltage. In Fig. 3 the filter condensers C consist of a high voltage 8 or 10 mfd. electrolytic condenser and a .1 to .5 mfd. paper condenser. Such large capacities are unnecessary with battery operated receivers so the electrolytic may be eliminated.

Although considerably more selective than the tuned r.f. type of receiver or the simple regenerative detector the high sensitivity short wave super-heterodyne may fail to give adequate separation of two powerful stations. This is due to what is known as the Image effect in which a station appears at two points on the dial. These points will be separated by a frequency equal to twice the intermediate frequency, i.e., 930 k.c. for a 465 k.c. super-het.

The cause of these images is lack of selectivity in the signal selecting circuits. The trouble is encountered most in standard five-valve supers which have no r.f. amplifying stage ahead of the mixer tube. Again the lower the intermediate frequency the more prevalent the trouble from images, and the higher the frequency to which the receiver is tuned, the greater the likelihood of repeats.

HETERODYNE OSCILLATORS

(*Continued from page 78*)

No difficulty will be experienced in building the B.F.O. unit. The number of components is small, and will cost very little. Almost any type of valve other than a power valve may be used, but to make use of the power supply of the receiver with which the oscillator will be used it will be necessary to select a valve requiring the same filament or heater voltage as those in the receiver.

In the diagram shown, a triode valve of the 56, 76, 6C5 variety is employed. If a pentode is used, a lead should be taken from its grid to B+, and by-passed with a .1 or .5 mfd. tubular condenser. Care must be taken to see that the valve manufacturer's ratings are not exceeded by applying too high a voltage to the screen. It is advisable to make the B+ connection to a point on the receiver's voltage divider, or else use a suitable dropping resistor in series with it.

The simplest way to use a multi-grid valve is to connect all its grids together, and treat it as a triode.

The coil used in the design is a standard 465 k.c., intermediate frequency transformer. The trimmer, which is connected across the L1 section, should be removed from the transformer whilst the remaining trimmer on the transformer acts as the condenser, C2, shown in the circuit diagram. The tuning condenser, C3, is a three plate midget. This small capacity is greater than is needed, and it will probably be found that better control of the oscillator's note will be obtained if the midget is converted to a two plate double spaced condenser. The grid leak and condenser should be mounted on the transformer, which is completely enclosed in an aluminium can.

The shielded coupling lead which connects the oscillator to the receiver is bared for about 1½ inches at the end, so that when placed alongside the control grid or diode lead of the last I.F. stage of the set, it will introduce the local oscillation into this circuit.

The stronger the signal the closer should be the coupling. However, it will be found that too much coupling will cause the automatic volume control to take effect, and thereby decrease the receiver's sensitivity.

The beginning of the coil L2 is soldered to one lug each of the condensers C2, C3 and C4, and to one end of the grid leak R2.

The other lead of the grid leak and the fixed condenser C4 are then joined together and taken to the control grid on V1. The remaining end of the coil L2 and the unconnected lugs of the condensers C2 and C3 are wired to earth. The beginning of the winding, L1, is connected to the plate terminal on V1 socket and to one side of the fixed condenser C5. The other side of C5 is connected to a short length of shielded cable which is coupled to the I.F. stage of the receiver. It is important that the shielding around this wire should be earthed.

The remaining end of L1 is soldered to one side of the fixed condenser C1 and to one end of the resistor R1.

The other side of this resistor is taken to B positive of the receiver. The vacant lug of condenser C1 is earthed and the cathode tap on V1 is taken through the switch SW to earth. The two heater terminals on V1 are taken to the filament supply of the receiver by a pair of tightly twisted leads. If a metal type tube is used it is necessary that the shield pin should be earthed.

In operation both the oscillator chassis and the receiver chassis should be connected together by a common earth wire.

The M.E.C. trimmer C5 should be unscrewed almost to the "full out" position.

As mentioned before the unit is not difficult to place in operation, and it is tuned by C3, which is adjusted to provide a pleasant audio beat note.

CONVERTERS—Continued

If it is not known whether the aerial coil of the broadcast set is of the high or low impedance type this may be found by the trial and error method once the converter is roughly aligned. With the volume control of the set turned well up it should be possible to tune in a station on the converter and to adjust the single trimmer of IF for loudest signals. Retune the converter to a station on the 13 or 16 metre bands and adjust the trimmers on the G1 and G2 sections of the gang condenser for loudest signals. The oscillator or G3 section trimmer and the iron core of the oscillator coil will control the position of the lowest band and should be set so that the 13 metre band comes in at about 15 degrees on the dial scale. Retune the converter to the 31 metre band and adjust the cores of the aerial and R.F. coils for best results. Retune once more to the 13 metre band and try the effect of very slight adjustments to the G1 and G2 section trimmers.

The adjustment of the trimmer should then be checked for best results on weak oversea broadcast and the dial position of the broadcast set logged so that each time the converter is used it may be tuned to this dial setting. This completes the adjustment of the unit and it should be possible to tune in the oversea stations at excellent strength. The converter may be used with any reasonably sensitive broadcast set of four or more valves and can be relied upon to give excellent results over the whole of its tuning range.

SINGLE STAGE CONVERTER

FOR those who wish to construct the unit as a single valve job the aerial and earth connections are shown dotted in the diagram. Of course, the aerial coil will take the place of the R.F. coil shown, but the connections will be the same as drawn. If the coils tuning from 16 to 50 metres are used it will be necessary to connect the correct size of padded condenser as specified by the makers of the coils between the earth end of the oscillator coil and earth. The same basic circuit may be used no matter what coils are to be employed. Some constructors may wish to make a de-luxe job of it and use bandspread together with a switching arrangement or plug-in coil for various bands. Bandspread is fully discussed in page 70. However, details for using bandspread in this unit may be of interest. To do this two three gang tuning condensers will be necessary. One must have a capacity of approximately 180 mmfd. and the other a capacity of 35 mmfd. The first mentioned is the band setting condenser whilst the smaller capacity one is the band spread tuner. In practice the band set condenser is tuned to the lower edge of the band on which reception is intended and the smaller unit used to tune this band over the full coverage of the condenser. In order to avoid unnecessary expense the larger capacity unit may be an ordinary type gang condenser with matched fixed condenser connected in series with each section to allow of the stated maximum capacity of 180 mmfd. With a 435 mmfd. gang condenser the series capacity should be .003 mfd. The smaller unit should be built up with ganged midget condensers and provided with a good type of vernier dial.

The battery operated converter illustrated in Fig. 2 will provide results comparable with those of the A.C. version. The valve heater voltage source may be a standard accumulator, dry cell or air cell, and the high tension supply may be derived from batteries or a vibrator unit. The requisite voltages will be determined by the types of valves employed, ratings being taken from a chart of valve characteristics. Illustration 3 in Fig. 2 shows the valve heater connections where the battery voltage does not exceed the maximum ratings of the valves used, while the connections in cases where the battery voltage exceeds those ratings is shown in Illustrations 1 and 2. Without the dropping resistor, RX, the application of excess voltage to the tubes would ruin them within a very short time.

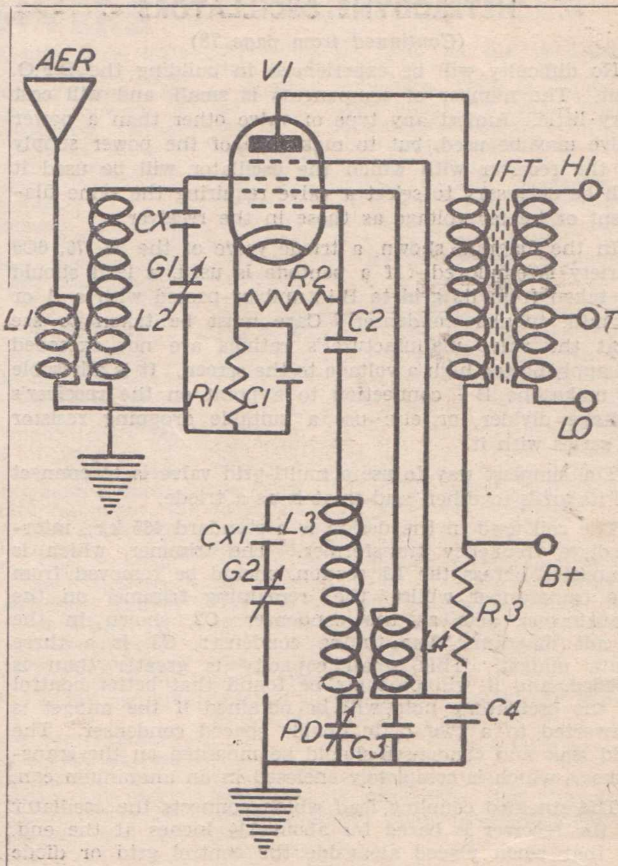
The value of the resistor is a function of the current passing through it, and consequently will vary with the type of valves and the number, whether one or two, employed. Its value in ohms is found by dividing the voltage drop required, by the current passing through it in amperes.

As an illustration, we will assume that we have a two-volt cell from which we want to feed a valve requiring a voltage of 1.5 volts and a current of .25 amps. The required drop in voltage is .5 (2—1.5). Dividing this by .25, the current to be drawn through the resistor, we get an answer of 2, which is the value of the resistor in ohms.

Should two valves be used in the circuit, each of which draws .25 amps and requires the same voltage, a different value of resistor will be required. The voltage drop will remain the same, .5, but the current will be .25 plus .25 or .5 amps. .5 (the voltage drop), divided by .5 (the total heater current) equals 1 the new value of RX, expressed again in ohms.

In every case in which a dropping resistor is required, it is necessary to select a component capable of carrying the total current required, and it is advisable to allow a slight margin above this figure to meet possible contingencies.

Battery tubes whose heaters operate at potentials of 1.4 and 2 volts are less efficient in some applications than those requiring higher voltages. One case is that of high frequency oscillator in a short wave superheterodyne set. In this position the low voltage tubes work well down to frequencies of 11-12 megacycles, but an increase in frequency is followed by a rapid decrease in the oscillator's radio frequency output. A solution to this difficulty, and one that is used in many receivers of the commercial radio services, is to connect a triode valve in parallel with the existing oscillator circuit. By connecting plate to plate, and grid to grid, the circuit's output is increased, which results in much improved oscillator efficiency.



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G1, G2: Gang condenser (see text).
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R2: 50,000 ohm 1 watt carbon resistor.
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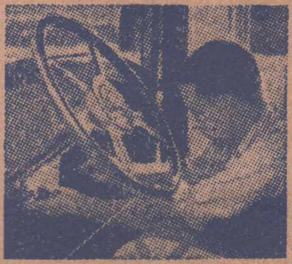

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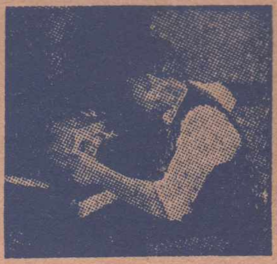

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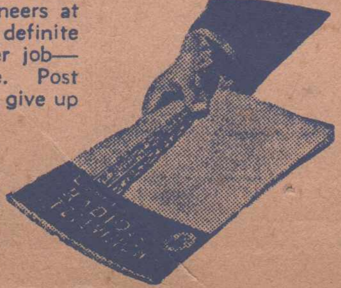

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