

# The Wireless World

THE PRACTICAL RADIO JOURNAL  
24<sup>th</sup> Year of Publication

No. 762.

FRIDAY, APRIL 6TH, 1934.

VOL. XXXIV. No. 14.

Proprietors: ILIFFE & SONS LTD.

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GLASGOW: 26B, Renfield Street, C.2.

Telegrams: "Iliffe, Glasgow." Telephone: Central 4857.

PUBLISHED WEEKLY. ENTERED AS SECOND CLASS MATTER AT NEW YORK, N.Y.

Subscription Rates:

Home, £1 1s. 8d.; Canada, £1 1s. 8d.; other countries abroad, £1 3s. 10d. per annum.

*As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.*

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## EDITORIAL COMMENT

### B.B.C. Unpopularity: The Remedy

#### Means of Appeal Imperative

THE B.B.C. has just successfully weathered another storm of public criticism. Looking back over our files, we find that just a year ago, to be precise, in our issue of March 3rd, 1933, we congratulated the B.B.C. on the result of a debate in the House of Commons on the constitution and conduct of the Corporation. On that occasion, too, we reported that what was "heralded in some quarters as likely to develop into an earthquake which would shake the foundations of the Corporation, fizzled out instead like the proverbial damp squib."

On the present occasion, whilst we are glad that no irresponsible efforts have been allowed to disturb the present conduct of the B.B.C.'s affairs in general, we trust that the Corporation will not deceive itself with the idea that a great victory has been won. There can be no victory where the aggressor attacks without ammunition and the recent attacks upon the B.B.C. must certainly be regarded as in this class. As far as we have been able to judge, there has been very little substance in most of the particular criticisms with which the Corporation has been assailed on this latest occasion.

Nevertheless, there is undoubtedly a strong feeling of antagonism towards the B.B.C. It is not directed against the present officials, nor against their internal administration, nor even against the programme policy. The resentment goes deeper and is directly attributable to the splendid isolation which the Corporation enjoys under its present constitution.

The revenue which the B.B.C. receives is contributed by the public, yet the

public has really no voice in the conduct of its affairs; the Board of Governors is appointed by the Government, yet the Government admits that it has little authority to direct the B.B.C.'s policy and is in no way responsible for the actions of its principals; the Corporation is not hampered by any of the restrictions in regard to trading and other matters which would circumscribe the activities of any Government department, yet it has a monopoly (which it may direct to its own advantage) and enjoys most of the privileges of Governmental association.

We may liken the Corporation to a ship at sea which has so far succeeded in avoiding disaster, not by reason of the seaworthiness of the vessel but because of expert piloting by an able captain and crew. The vessel may be regarded as the constitution of the B.B.C., and the captain and crew the present staff and directing officials.

The public cannot tolerate the knowledge that under the present constitution of the B.B.C. there is no higher authority to which appeal can be made against decisions by its officials.

Some years ago we suggested that the formation of a Ministry of Broadcasting might provide the ideal control of the B.B.C. This proposal still appears to have many points of advantage. Alternatively, the Postmaster-General could be given equivalent powers of authority.

Once such an authority were constituted we venture to suggest that irresponsible bickering over B.B.C. activities would cease, whilst serious criticism would receive proper attention. The very knowledge that a safety valve had been provided would relieve many critics of the urge to kick at the B.B.C., which at present possesses them just for the reason that, as constituted at present, the Corporation always has the last word.

# THE TECHNIQUE OF Single-span Tuning

## The Aerial and Reaction Circuits

By W. T. COCKING

IT will be remembered that the chief point in single-span tuning is the ability to cover a wide waverange with only a single small condenser, and that a contributory cause of this is the use of an aerial system which is aperiodic over a wide range. The design of such an aerial system offers special problems, and it is important to understand the factors involved.

The manner in which the energy picked up by the aerial is transferred to the first valve of the receiver must be such that the efficiency of transference is high over

the receiving range and low over the second channel range. For broadcast reception with an intermediate frequency of 1,600 kc/s, the efficiency must be high over the 150-1,500 kc/s band and low over the range of 3,350-4,700 kc/s, while it is advantageous if it be also low at 1,600 kc/s.

It is obvious that high efficiency over

the receiving range means increased signal strength. High efficiency in itself, however, is of secondary importance, for the most important factor is a high ratio of efficiency in the receiving range to efficiency in the second channel range. The primary function of the aerial coupling is to reduce second channel interference to negligible proportions.

An aperiodic aerial system commonly employed in S.W. receivers and illustrated in Fig. 1 is of little use for single-span tuning, therefore. The inductance  $L$  is a choke of high impedance, and if a suitable component be used, the voltage applied to the grid of the valve is nearly equal to that set up in the aerial by a signal. The efficiency, moreover, can be made very nearly constant over the whole of the 150-1,500 kc/s band. Unfortunately, however, the efficiency is still high over the 3,350-4,700 kc/s band so that there is little discrimination against second channel interference. The variation of efficiency with frequency follows the lines indicated by curve B of Fig. 2, whereas an ideal

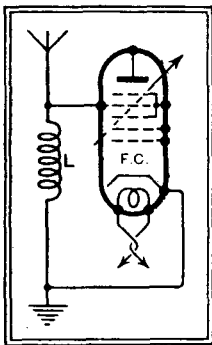


Fig. 1.—A common aperiodic aerial circuit.

system would give a response such as that of curve A.

The circuit of Fig. 1, however, will give different results if it be used with a moderate, instead of a high, value for  $L$ . The aerial possesses inductance, capacity and resistance, and if the value of  $L$  be so chosen that the resonant frequency of the system as a whole occurs towards the middle of the received band some discrimination against second channel interference may be expected.

When the values are selected so that the efficiency over the received range does not vary excessively a response curve such as C of Fig. 2 is obtained. Clearly there is a considerable improvement, but the second channel rejection is insufficient for a satisfactory performance.

### Choosing the Aerial Circuit

The next step is obviously to a low-pass filter such as that shown in Fig. 3. A properly built and terminated filter having a sufficient number of sections will give a response curve approximating to curve A of Fig. 2 and have an efficiency of 50 per cent. reckoned on the present basis. In practice, however, a filter of this type gives only moderately good results for the efficiency varies greatly over the pass range due to the fact that correct termination is hardly possible.

For correct results a filter requires to be terminated by resistances, and the aerial

does not even approximate to a resistance. A practical form of filter, therefore, gives a response indicated by curve D of Fig. 2. Although this is not of the type required, it is capable of giving moderately good results, and it is by no means useless. For the best results, however, a better form of aerial circuit is required.

Now the arrangement of Fig. 1, when tuned to the middle of the received band offers the most promising performance, although in itself it is not good enough. It is obvious, however, that if by any

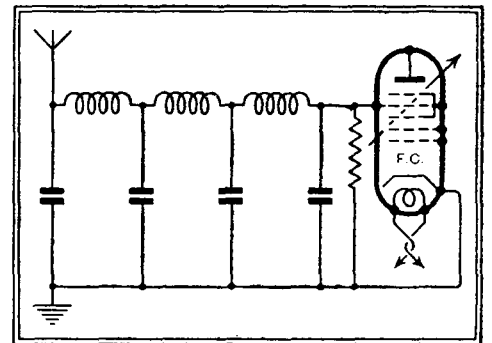


Fig. 3.—A low-pass filter which leads to moderately good results.

means a curve such as E of Fig. 2 could be obtained, the results would be very greatly improved. Although the efficiency would not be uniform over the range, it would not vary greatly, and the efficiency over the second channel range would be low.

A curve of this type is the same as that given by the familiar band-pass filter comprising two tightly coupled tuned circuits. This immediately gives the clue to the system, and one could use a circuit such as that shown in Fig. 4. The capacity of  $C_1$  would be made equal to the aerial capacity, and  $L_1$  equal to  $L$  plus the aerial inductance, while  $R_1$  would be adjusted to prevent the efficiency at the peaks rising excessively to give a very uneven response over the waveband. The circuit capacity being fixed by the aerial capacity, the inductance is determined by the tuning range required, and is chosen so that it resonates with the capacity at the middle of the band. The mutual inductance between  $L$  and  $L_1$  is then given a value such that one peak in the response curve comes

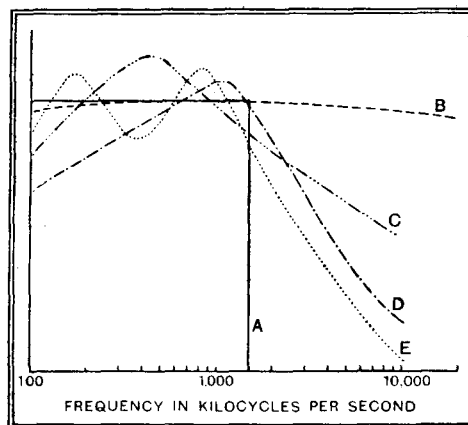


Fig. 2.—Curves illustrating the characteristics of different types of aerial coupling. Curve A is the ideal.

**The Technique of Single-Span Tuning—**

at about 400 kc/s while the other falls at about 1,200 kc/s. The response is then as indicated by curve A of Fig. 5.

An examination of this curve reveals two defects—the response falls off at the

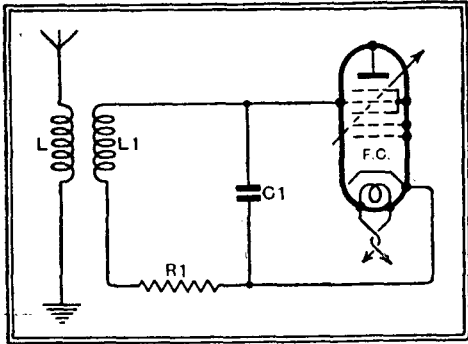


Fig. 4.—A coupled aerial circuit of the band-pass type gives a good performance.

lowest frequencies, and only a moderate attenuation is secured in the second channel region. A little thought shows that these defects are due to the type of coupling adopted, for the reactance of an inductance increases with frequency. It would appear, therefore, that a capacitively coupled filter would be capable of a better performance. Such a filter is illustrated in Fig. 6. Curve B of Fig. 5 shows the performance, and demonstrates that the theoretical considerations are borne out in practice. A curve of this nature is highly satisfactory, and the variation in response over the whole waveband is limited to within  $\pm 8$ db, while the relative attenuation in the second channel is always over 40 db. An attenuation of this order is sufficient in practice, because signals on the 3,350-4,700 kc/s band are themselves usually considerably weaker than those in the broadcasting range.

**Reaction and Selectivity**

So much for the aerial circuit. Let us now consider some of the problems attendant upon the attainment of adequate selectivity. Operating at a given frequency there are two ways of obtaining high selectivity, a large number of tuned circuits of moderate efficiency may be used, or a small number of high efficiency. Considerations of cost, space, and ease of initial adjustment preclude the use of more than a moderate number of tuned circuits. It is, however, impossible to obtain tuned circuits of high enough efficiency at a high operating frequency without going to extremes in the matter of avoiding incidental losses. It is by no means rare to find that the losses in a valve-base alone are sufficient to halve the selectivity of an efficient circuit, and it is obviously out of the question to employ decapped valves in a receiver for general use.

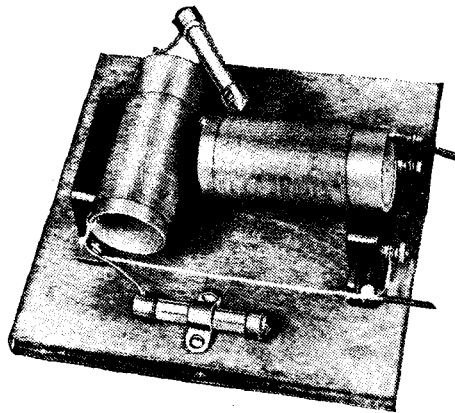
We must, therefore, have recourse to the benefits of reaction if sufficient selectivity for distant reception is to be obtained economically. In the case of a detector set, reaction leads to little difficulty; this is hardly the case, however,

where a high degree of pre-detector amplification is used.

If the full benefits of reaction are to be secured, it must be obtained from a valve to which only weak signals are ever applied. This means that the detector cannot be used to provide reaction, since modern practice dictates that it be supplied with a large input. The weakest signals are obviously to be found in the coupling between the frequency-changer and the first valve of the I.F. circuits, so that reaction would naturally be applied at this point. Even at this point, however, quite large potentials may be found when receiving a station spaced from a local by only a small amount, and such potentials tend to overload the valve providing reaction and prevent the full benefit being obtained from it.

**Variable Selectivity**

As much selectivity as possible, therefore, should be obtained prior to the reaction circuit, and the valve providing reaction should have linear characteristics so that it can handle a large input. In



An experimental form of the capacity-coupled aerial system of Fig. 6.

practice, therefore, two coupled circuits are used between the frequency-changer and the I.F. valve, and reaction is applied to the secondary, while the valve providing reaction is of the small power class.

Since a special valve is used for reaction it would be natural to suppose that the I.F. amplifier is arranged in normal fashion and the grid of the reactor valve connected in parallel with that of the first I.F. valve. This is not the case, however,

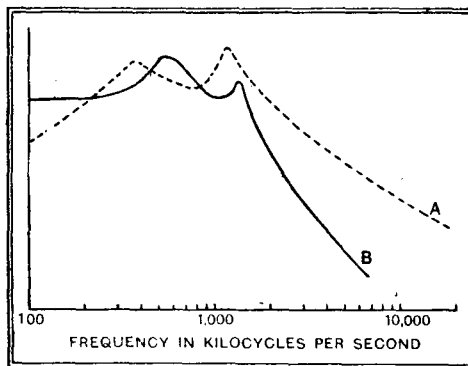


Fig. 5.—The response of coupled aerial circuits. Curve A is for an inductively coupled system and Curve B for a capacity coupled system such as that of Fig. 6.

for such an arrangement leads to very unsatisfactory results. It must be remembered that the best screen-grid valve is not perfect, and there is always some coupling existing between its grid and

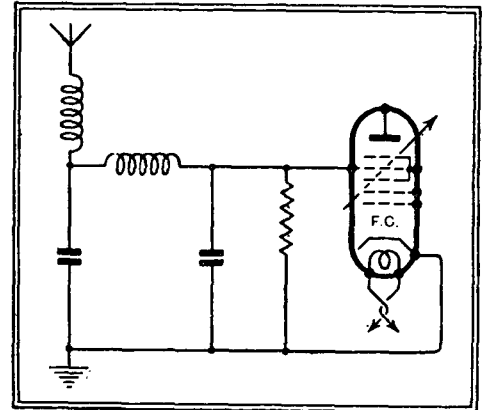


Fig. 6.—The final form of aerial circuit is really a two-stage capacity-coupled band-pass filter.

anode circuits. If the resistance of the grid circuit be reduced sufficiently, therefore, self-oscillation will occur. Consequently, if reaction be applied from a reactor valve, self-oscillation of the I.F. amplifier will occur before reaction is pressed to the degree necessary to make the reactor itself generate oscillations.

These difficulties are very largely overcome, however, by connecting the reactor valve in the I.F. chain. The reactor valve, or as it is perhaps more correctly termed in its new position, the buffer valve, is coupled to the frequency-changer by a pair of tuned circuits to the secondary of which reaction is applied from its anode circuit. The I.F. amplifier proper follows the buffer valve, and the first valve is coupled to it by an aperiodic coupling. Provided that proper precautions to reduce avoidable stray couplings are taken, the net result is a circuit in which reaction affects only the pair of circuits between the frequency-changer and the buffer valve.

**Reaction and A.V.C.**

The next point about reaction is that as normally applied it requires skilled operation. Reaction does not increase selectivity by reducing interference but only by increasing the strength of a wanted signal relative to the interference. Coupled circuits, on the other hand, reduce the interference without affecting the wanted signal to the same degree. In practice, therefore, where reaction is used to obtain selectivity, it is usually necessary to reduce the amplification, otherwise the only results are to increase the strength of the desired station beyond the value required, and to leave the interference unaffected. This difficulty of operation is got over automatically by using A.V.C., for an increase in the setting of the reaction control then automatically reduces the interference and sharpens the tuning. The application of reaction makes no difference to signal strength, but only affects selec-

**The Technique of Single-span Tuning**—tivity and quality, and the reaction control thus really becomes a selectivity control in more than name.

The practical result of including variable selectivity is to improve the quality of reproduction, for on no station need the selectivity, and hence the sideband cutting, be greater than is dictated by the amount of interference present on that station. When conditions are good, therefore, selectivity may be reduced and

a better high-frequency response obtained.

It will be seen, therefore, that the problems involved in the production of a receiver operating on the single-span principle have been both many and varied, and not confined alone to the development of the tuning method. To secure a wide tuning range and a satisfactory performance with freedom from ganging has necessitated research into many matters at first sight unconnected with the principle.

## In Next Week's Issue :—

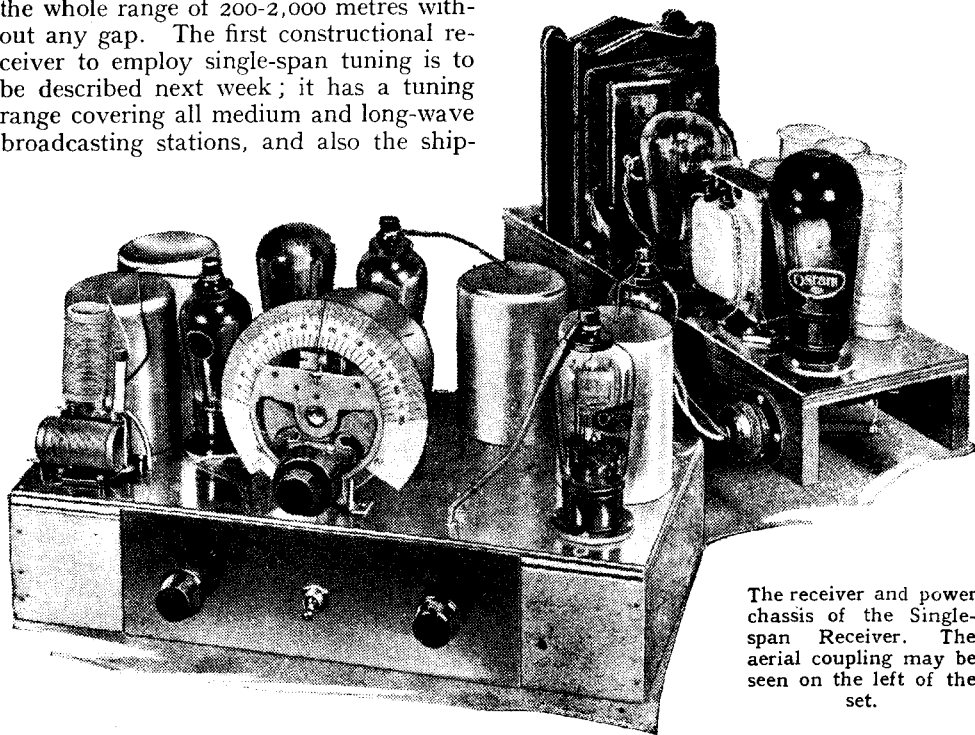
The Wireless World

# Single-span Receiver

A Quality Set with Full Waveband Coverage and No Ganging

RECENT issues of *The Wireless World* have contained details of the new principle of single-span tuning which obviates the necessity for any ganging and provides single-dial tuning over the whole range of 200-2,000 metres without any gap. The first constructional receiver to employ single-span tuning is to be described next week; it has a tuning range covering all medium and long-wave broadcasting stations, and also the ship-

a duo-diode-triode. This valve is resistance-coupled to an output triode delivering some 2,500 milliwatts to the energised moving-coil loud speaker. An indirectly heated mains rectifier is used.



The receiver and power chassis of the Single-span Receiver. The aerial coupling may be seen on the left of the set.

ping and aircraft bands which are missed with all ordinary sets.

Tuning is carried out by a single small condenser fitted with a dual-ratio dial permitting rapid searching, yet accurate tuning. No ganging is involved, and no matched coils are required, so that the construction of the various coils is well within the capabilities of the amateur. The initial adjustments are few in number and consist merely of tuning the I.F. circuits to the same frequency and adjusting a single trimmer to ensure the correct waveband coverage being obtained.

The valves are arranged as a heptode frequency-changer followed by a buffer valve and two I.F. valves, while signal rectification, delayed A.V.C., and first stage L.F. amplification are obtained from

Provision is made for operating the set to reproduce records, and the manual volume control is operative on both radio and gramophone. The quality of reproduction obtainable is of an unusually high order, due largely to the inclusion of variable selectivity—a new feature which permits the best compromise between selectivity and quality to be obtained under all conditions.

Only four controls are fitted to the set—the tuning control covering 200 to 2,000 metres, the selectivity control, the manual volume control, and the radio-gramophone switch.

On test the receiver proved capable of a high standard of reproduction with adequate volume for most purposes. The sensitivity was sufficient for the daylight

reception of numbers of Continental transmissions, while the selectivity proved sufficiently high for general reception under modern conditions. Second channel and similar whistles were completely absent as well as cross-modulation, and the hum level was negligibly small.

### LIST OF PARTS

After the particular make of component used in the original model, suitable alternative products are given in some instances.

#### RECEIVER UNIT

- 1 Variable condenser, 0.00016 mfd. Polar Type "E"
- 1 Dial, slow motion type
- 2 Bulbs, 6 volts 0.15 amp. Polar Micro-drive semi-circular
- 1 Slow motion reaction condenser, 0.0002 mfd. Bulgin 615
- 1 Tapered volume control, 250,000 ohms Eddystone 957
- (Claude Lyons, Rothermel, Watmel) Magnum
- 1 Double-pole change-over switch Bulgin S.98
- 3 Valve holders, 5-pin Clix Chassis Mounting Standard Type
- 2 Valve holders, 7-pin Clix Chassis Mounting Type
- 1 Compression Condenser, 100 mmfds. Colvern
- 4 Microdensers, 100 mmfds. Eddystone 900
- 6 Fixed condensers, 0.1 mfd. 200v. working T.C.C. 51
- 2 Fixed Condensers, 0.01 mfd. T.C.C. Type "M"
- 2 Fixed Condensers, 0.001 mfd. T.C.C. Type "M"
- 5 Fixed Condensers, 0.0001 mfd. T.C.C. Type "M"
- 2 Fixed Condensers, 0.0005 mfd. T.C.C. Type "M"
- 1 Fixed Condenser, 0.0002 mfd. T.C.C. 34
- (Dubilier, Graham-Farish, Peak, T.M.C. Hydra, Telsen)
- 2 Electrolytic Condensers, 50 mfd. 12v. working T.C.C. 501
- (Dubilier)
- 2 Metallised Resistances, 250 ohms 1 watt Dubilier
- 3 Metallised Resistances, 2,000 ohms 1 watt Dubilier
- 1 Metallised Resistance, 10,000 ohms 1 watt Dubilier
- 1 Metallised Resistance, 20,000 ohms 1 watt Dubilier
- 2 Metallised Resistances, 50,000 ohms 1 watt Dubilier
- 3 Metallised Resistances, 100,000 ohms 1 watt Dubilier
- 1 Metallised Resistance, 1 megohm 1 watt Dubilier
- 2 Metallised Resistances, 2 megohms 1 watt Dubilier
- 1 Metallised Resistance, 4,000 ohms 3 watts Dubilier
- 1 Metallised Resistance, 6,000 ohms 3 watts Dubilier
- (Eric, Graham-Farish, Claude Lyons, Seradex, Watmel)
- 1 Resistor, 30 ohms Bulgin A.R.30
- 1 Resistor, 50 ohms Bulgin A.R.50
- 1 Screened H.F. Choke Bulgin H.F.8
- 1 5-way Connector Wilburn
- 1 5-pin Plug British Radio Gramophone Co. (Bulgin)
- 1 5-way Cable with twin 70/36 leads Goltone (Harbros)
- 4 Knobs Bulgin K.6
- 4 Ebonite Shrouded Terminals, A., E., Pick-up (2) Belling-Lee Type "B"
- 4 Coil Screens, 3½ x 2½ ins. diam. White Bros. & Jacobs
- 1 Coil Screen, 4 x 3½ ins. diam. Colvern
- Materials for Coils:
  - 12 ins. Paxolin tube, 1 in. diam. Wright & Weaire
  - 2½ ins. Paxolin tube, ½ in. diam. Wright & Weaire
  - Quantity No. 32, 36 and 38 D.S.C. wire.
- or 1 Set of Coils
- 1 Length Screened Sleeving Harbros
- 2 ozs. No. 20 Tinned Copper Wire, 8 lengths Systoflex, wood, etc.
- Plymax Baseboard, 8 x 15 x ½ in. Peto-Scott
- Screws:—
  - 14 ½ in. No. 4 R/hd.; 36 ½ in. No. 4 R/hd.
  - 8 ½ in. No. 4 R/hd.; 2 ½ in. No. 4 R/hd.
  - All with nuts and washers.
  - 1 ½ in. No. 6 B.A., with metal thread and nut and washer.
- Valves:—1 Ferranti VHT4, 1 Ferranti VPT4, 1 Osram or Marconi ML4, 1 Osram or Marconi VMS4, 1 Osram or Marconi MHD4.

#### POWER UNIT

- 1 Mains transformer, primary, 200 to 250 volts, 50 cycles; secondaries, 350-0-350 volts, 100 m.a.; 4 volts, 2.5 amps., centre-tapped; 4 volts, 1 amp., centre-tapped; 4 volts, 5 amps., centre-tapped
- Hayberd Type W.W.7 (B.S.R., British Radio Gramophone Co., Bryce, Challis, Davcuset, Claude Lyons, Rich and Bundy, Sound Sales, Vortexion)
- 1 Smoothing choke, 10 henries Wearrite H.T.11 (Bulgin, Davcuset, Ferranti, Sound Sales.)
- 1 Fixed condenser, 0.01 mfd. T.C.C. Type "M" (Dubilier, Graham-Farish, Telsen)
- 1 Electrolytic condenser, 4 mfd., 440v. working T.C.C. 802
- 3 Electrolytic condensers, 8 mfd., 440v. working T.C.C. 802 (Dubilier, Peak, Telsen)
- 1 Electrolytic condenser, 50 mfd., 50v. working T.C.C. 521 (Dubilier)
- 1 Metallised resistance, 10,000 ohms, 1 watt Dubilier
- 1 Metallised resistance, 100,000 ohms, 1 watt Dubilier
- 1 Metallised resistance, 250,000 ohms, 1 watt Dubilier
- 1 Metallised resistance, 700 ohms, 2 watts Dubilier
- (Eric, Graham-Farish, Claude Lyons, Seradex, Watmel)
- 4 Valve holders, 5-pin Clix Chassis Mounting Standard Type
- 1 5-pin Plug British Radio Gramophone Co. (Bulgin)
- 1 Loud speaker with 2,500 ohms field with triode type transformer. Celestion Type E.8 (Magnavox, Rola)
- Quantity No. 22 tinned copper wire, 2 lengths Systoflex, wood, etc.
- Plymax Baseboard, 15 x 5 x ½ in. Peto-Scott
- Screws:—
  - 18 ½ in. No. 4 R/hd.; 12 ½ in. No. 4 R/hd.
  - All with nuts and washers.
  - 2 ½ in. No. 6 BA with metal threads and nuts and washers.
- Valves:—1 Osram or Marconi PX4; 1 Osram or Marconi MU12.

# Below 150 Metres

*LONG distance reception at all times of the day with the simplest of receivers, thousands of stations from which to choose, a general atmosphere of novelty—these are among the inducements which the writer holds out to those who hesitate to try their luck on the short wavebands. Few who read this article will deny that short wave work can be an ideal adjunct to listening on the long and medium wavelengths*

By MEGACYCLE

**T**HE wavelengths below 150 metres are not, in the opinion of the writer, getting a square deal, and the reason for this can only be that the average enthusiast simply does not realise how much of interest he is missing.

It is the purpose of this article to outline, without exaggeration, showmanship or superlatives of any kind, the very real attractions of short-wave work to-day.

Short waves, at the moment, are the home-constructor's paradise. The very simplest of apparatus, designed with intelligence, will give excellent results.

True, there is a certain new technique to be acquired, but this is surely an additional attraction rather than a disadvantage.

A friend of the writer's, whose experience on the ordinary broadcast waves dates back to the days of Writtle, recently took up short-wave reception for the first time, and confessed that he was recapturing the thrills of his early days in radio, simply by virtue of the "strangeness" of everything.

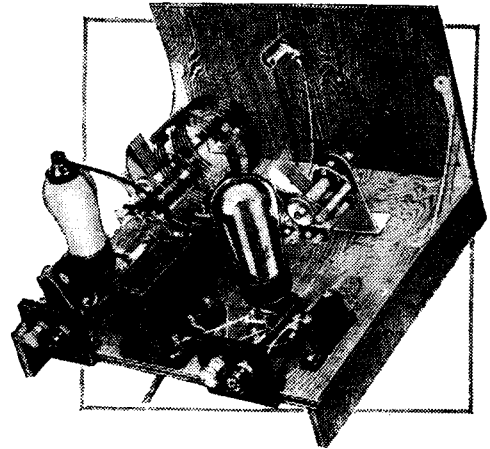
(estimate) he will be able to hear stations in Australasia, Asia, South Africa, South America and other remote parts. North Americans there are in plenty, but, in recent years, these have been available also to the listener on the broadcast bands.

The writer has not yet come across an authentic case of the reception of either South Africa or Australasia on the broadcast waves; yet this is a daily occurrence with the average owner of a short-wave set.

## The Attractions of Short Waves

Below 100 metres there are, in active operation, over 100 broadcast stations, mostly grouped into five wave-bands in the regions of 49, 31, 25, 19 and 16 metres. In addition, however, there are numbers of commercial radio-telephone stations which radiate experimental programmes from time to time. As a matter of fact some of these people provide the most interesting items of all, if only on account of their spontaneous and impromptu nature!

Then the reader who is familiar with the Morse code will have available, in addi-



Simplicity of construction is an attractive feature of short wave apparatus. The photograph is of the Short Wave Two described in *The Wireless World* of Nov. 4th 1932. It covers a wave range of 15 to 80 metres, and consists of a screen grid detector and pentode output.

pecially in the U.S.A. on the 84- and 21-metre bands.

So much for the stations that one may expect to hear on the short waves. Consider them as Attraction No. 1, although, unfortunately, there are occasional black sheep whose transmissions are anything but attractive.

The next point to consider is that of the general characteristics of short waves. There is a vast difference in the behaviour of two transmissions, for example, one being on 80 metres and the other on 19 metres. The latter will be almost a "day-light signal," while the former, if from a great distance will probably be heard only after dark.

This brings us to the important fact that *some* particular part of the short-wave spectrum is likely to be interesting at whatever time of day we happen to be listening. As a concrete example, the American station W3XAL, Bound Brook, N.J., may be heard on 16.87 metres from mid-day until 5 or 6 p.m. From 4 p.m. until 9 p.m. or later, one can listen in comfort to W2XAD, Schenectady, on 19.56, or W8XK, Pittsburgh, on 19.72; and then, with an intermediate stage on either the 25- or the 31-metres band, one can settle down at 11 p.m. and listen for hours to the 49-metre American stations.

### Round the Clock

In the writer's opinion this is the most attractive feature of all—the fact that every hour of the day holds something of interest. By the time one has owned a short-wave receiver for a month or so and accumulated a little practical experience, one knows where to listen and when.

To some, no doubt, the fact that simple gear is nearly always successful would be a great attraction. A straightforward receiver of the detector-and-L.F. type will yield surprising results. After prolonged trials of superheterodynes and multi-stage H.F. receivers, the writer has settled down once more to the homely two-valver.



Short-wave gear can be easily rigged up in a confined space and is ideal for use on field days. The amateurs in the picture were photographed while taking part in inter-Empire tests organised by the Radio Society of Great Britain.

Let us consider, first, the things that are available to the short-wave listener exclusively. On the five principal short-wave broadcast bands, during a week's listening (at a very conservative

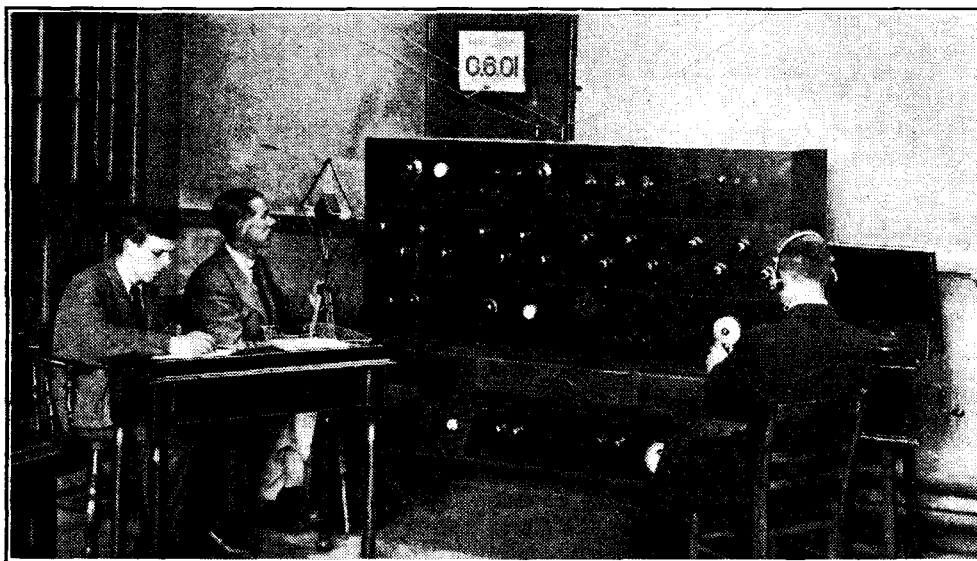
tion to these stations, all the vast number of amateur transmissions grouped in the three wave-bands centring round 84, 42 and 21 metres. Quite a number of amateurs are using telephony nowadays, es-

**Below 150 Metres—**

Similarly, the most modest of aerial systems seems to work excellently. One hears much talk about screening effects on short waves, but it is the practical experience of most of the old-stagers that the most unlikely-looking locations will often produce the best results. The fact remains that a small indoor aerial will often score over a large outside affair on account of the improved signal-to-noise ratio obtainable.

Perhaps the thought of encountering unknown difficulties frightens listeners away from the short waves?

Let it be quite clear that there is absolutely nothing that one need be scared of. All that the short waves call for are a little extra care in design and construction, and a little extra skill in operation.



A typical amateur short-wave transmitting and receiving station, G 601, operated by the boys of King Edward's School, Stourbridge.

Both of these requirements might be profitably employed on the broadcast bands, but they certainly are an absolute necessity if one seeks success below 100 metres.

When one is dealing with frequencies of the order of 15,000 kc/s (as one is on 20 metres) one has to take little precautions in receiver design. Unnecessarily long wiring in one of the H.F. circuits, for example, will make all the difference between success and failure, although on 1,000 kc/s (300 metres) its effect would probably pass unnoticed.

**“Converted” Sets**

It is an interesting fact that once one has settled down to the technique of short-wave receiver design, one almost invariably finds that one can build a very much better broadcast receiver than before. A broadcast receiver “converted” to receive short waves very often leaves a lot to be desired in the matter of efficiency; but a short-wave set converted for the broadcast waves is almost invariably a huge success.

Surely we may add this to our list of attractions—the fact that one *has* to use intelligence and good workmanship, and that they receive their due reward, where-

as on the broadcast waves one very often finds that the untidy and “slapdash” home constructor obtains results far ahead of his deserts!

With regard to operation, nothing need be said beyond the bare statement that one has to cover a much greater wave-band with each coil than one has been accustomed to. For this reason a good slow-motion dial is a necessity, while a steady hand and a delicate touch are very desirable. (Here, again, however, we might say that these things *should* be cultivated even on the broadcast waves.)

**A Summing-Up**

Let us summarise these good reasons for taking an interest in short-wave work.

1. There are thousands of stations

operating below 100 metres that one can never hope to hear on any other wavelength.

2. Long-distance reception is possible at practically any time of day or night by correct choice of wavelength.

3. The simplest of receivers and aerial systems is successful; a short-wave set, not being expensive, may therefore be used as an addition to the broadcast receiving gear that one already possesses.

4. There is a general atmosphere of novelty that more than compensates one for the well-known feeling of being lost!

5. Intelligent designing and operating usually reap their own reward.

Now, to be fair, we must deal with the disadvantages attendant upon short-wave work. First and foremost comes the bugbear of varying conditions. Anyone with the slightest experience of short waves knows what that word “conditions” implies. There are days, and sometimes weeks, when the long-distance stations become weak and unreliable. Fortunately for us, the days of complete “fade-outs” seem to have been banished by the general use of high power and the general improvement in transmitter and receiver efficiency.

Personally, the writer must confess to a

feeling that these varying conditions are an attraction rather than a disadvantage—one never knows quite what is going to happen! If one could receive the same stations consistently, day in and day out, they might begin to pall on one, but the erratic behaviour of some of them makes it quite an exciting business to hear them at all. That, however, is but a personal opinion, and “conditions” must undoubtedly go down on the “debit” side of the balance sheet.

Next is the vexed question of “man-made interference.” Tramway companies are fitting silencing systems that are doubtless very efficient on the broadcast bands, but the short-wave man, being in the minority, continues to suffer from devastating crackles and arcs.

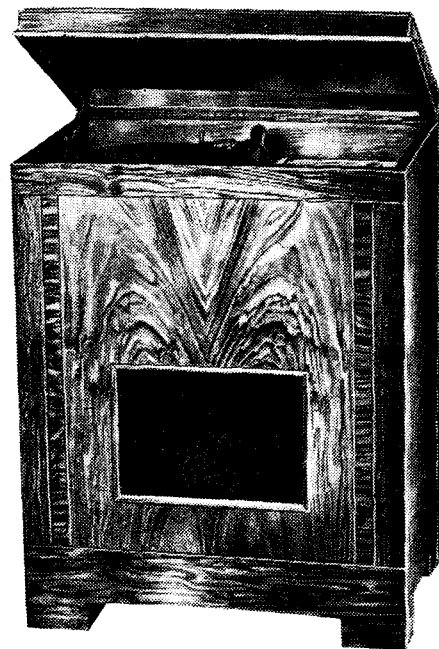
Motor-car ignition is rather apt to be troublesome to those who live near main roads, and any large electrical apparatus can cause severe disturbances over a small radius.

The reader should bear in mind, however, that we are considering short-wave work as an adjunct to his ordinary broadcast reception—not as a substitute. He therefore has everything to gain and very little to lose.

The best recommendation that one can make to anyone who feels that he might possibly be interested in short-wave work is this: get in touch, if possible, with an acquaintance who owns a short-wave receiver and let it speak for itself.

**Ekco R.G.84 Radiogram**

REMARKABLY good value for money is provided by this latest addition to the Ekco range of receivers. The new model, which costs 21 guineas, incorporates a five-



The walnut cabinet is finished in two tones with a semi-matt surface.

valve superheterodyne chassis with A.V.C. similar to that of the Type 74 receiver. A Collaro induction motor is included, and all the controls are mounted inside the cabinet.

# HINTS and TIPS

## Practical Aids to Better Reception

AN indication of accurate tuning which most of us employed, consciously or sub-consciously, in the days when extreme reaction was the only real aid to sensitivity, may still be turned to good account when operating a modern single control superheterodyne.

Users of such sets, when tuning to an unmodulated carrier wave before the start of the programme, should realise that slight detuning will generally produce a high-pitched hiss. The presence of this hiss on each side of the tuning point corresponding to exact resonance is an excellent guide, and by its help one should generally be able to tune almost literally "to a kilocycle."

### A Tuning Hint

A MILLIAMMETER, wired in series with the detector anode circuit, enables one to keep a watch on the behaviour of the tuning system, and, indeed, of the H.F. portion of the set as a whole. Those who have become accustomed to rely on the indications provided by a detector anode current meter will generally wish to embody a similar arrangement in sets which include a diode valve detector or a Westector metal rectifier.

### Rectified Current Meter

In the great majority of cases it is hardly practicable to obtain a direct indication of the output of a diode. Rectifiers of this type work into a load of extremely high ohmic resistance, and the current that flows in the output circuit is so small that a highly sensitive instrument, such as a micrometer, is necessary to detect it. For the benefit of those few who have a sufficiently sensitive measuring instrument, or are willing to obtain one, it may perhaps be worth while to point out that it should be connected in series with the diode load in the manner indicated in Fig. 1.

With earlier forms of diode detection it was customary to rely upon an indirect reading of the rectifier output by observing the changes in anode current of the valve immediately succeeding the diode. This succeeding amplifying valve was usually so connected that the rectified carrier wave was applied directly to its grid, and so its standing anode current varied in sympathy with the strength of incoming signals. Nowadays it is usual—and in some cases it is absolutely necessary—to isolate the succeeding L.F. valve from the diode, so far as D.C. changes of potential are concerned, by interposing a condenser as in Fig. 1. This means that the steady anode current of the succeeding valve will not be affected by the rectified output of the detector.

In such cases it will generally happen that the set includes automatic volume control, and it may be remembered that variations in current of the controlled valve or valves provide a direct indication of changes in detector output.

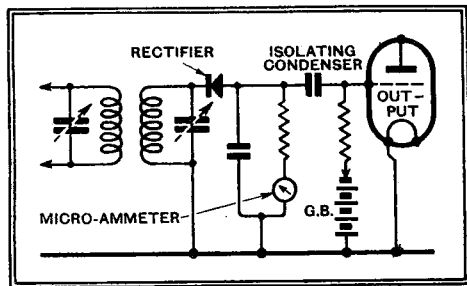
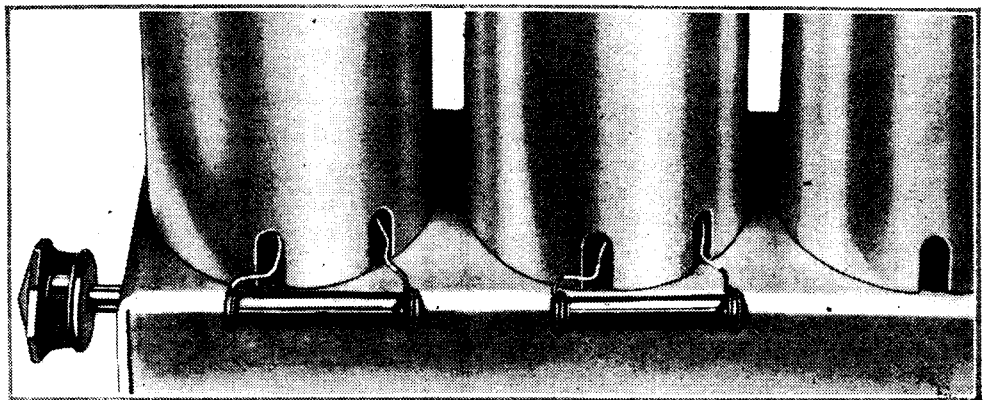


Fig. 1.—A micro-ammeter or sensitive galvanometer connected as a tuning indicator. An arrangement of this kind is applicable either to a diode valve or an H.F. metal rectifier.

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upon is "taking charge" of the tuning of the set as a whole. All risk of uncertainty in such cases is removed by connecting across all the circuits, other than the one being worked upon, a resistance of 5,000 ohms, or sometimes a little less. It is almost essential that this resistance should be of the composition or metallised type, with a low self-capacity, and it should be connected as close as possible to the component (coil or condenser) with which it is to be associated. In most cases it is a matter of indifference whether one joins it across the tuning coil or the condenser, but in a



Shunt resistances temporarily connected across tuning coils as an aid to making initial adjustments.

few cases (e.g., in tuned anode circuits) there is no choice but to connect it across the coil.

WHEN a mains receiver with indirectly heated valves shows a serious falling-off in performance after, perhaps, a quarter of an hour's work, it is to be suspected that grid emission is taking place in one or more of the valves. Due to the transference of an excessive amount of heat from the cathode to the grid, the latter may be emitting electrons. Confirmatory evidence that grid emission is really the trouble is obtained if the set again works normally after cooling down.

### Grid Emission

Deliberately Flattened Circuits

Reference to this subject reminds us of an earlier application of the principle of deliberately reducing the effectiveness of a tuned circuit as a purely temporary measure. When carrying out the operation of trimming a set it is often of great importance that one should know that the particular circuit that is being worked

up the filter by fixed resistances. Although it may seem rather a drastic procedure to flatten tuning deliberately, there can be little doubt that the operation of "trimming" is greatly facilitated by these means.

Fortunately, improvements in valve manufacture have largely removed this trouble, and it is not often met with nowadays. When the symptoms of grid emission are noticed, it is to be suspected that for some reason or another the valve heaters are being operated at an excessive temperature, and in the case of an A.C. mains set it is worth while checking the connection of the mains to the tapped primary of the power transformer. If, for example, a 240-volt A.C. supply were connected to the terminals appropriate for a 200-volt supply, a considerable voltage rise would take place.

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