THE LISTENER IN (B.C. Mar. 34)
Handbook No. 10.

# BATTERY BOOK

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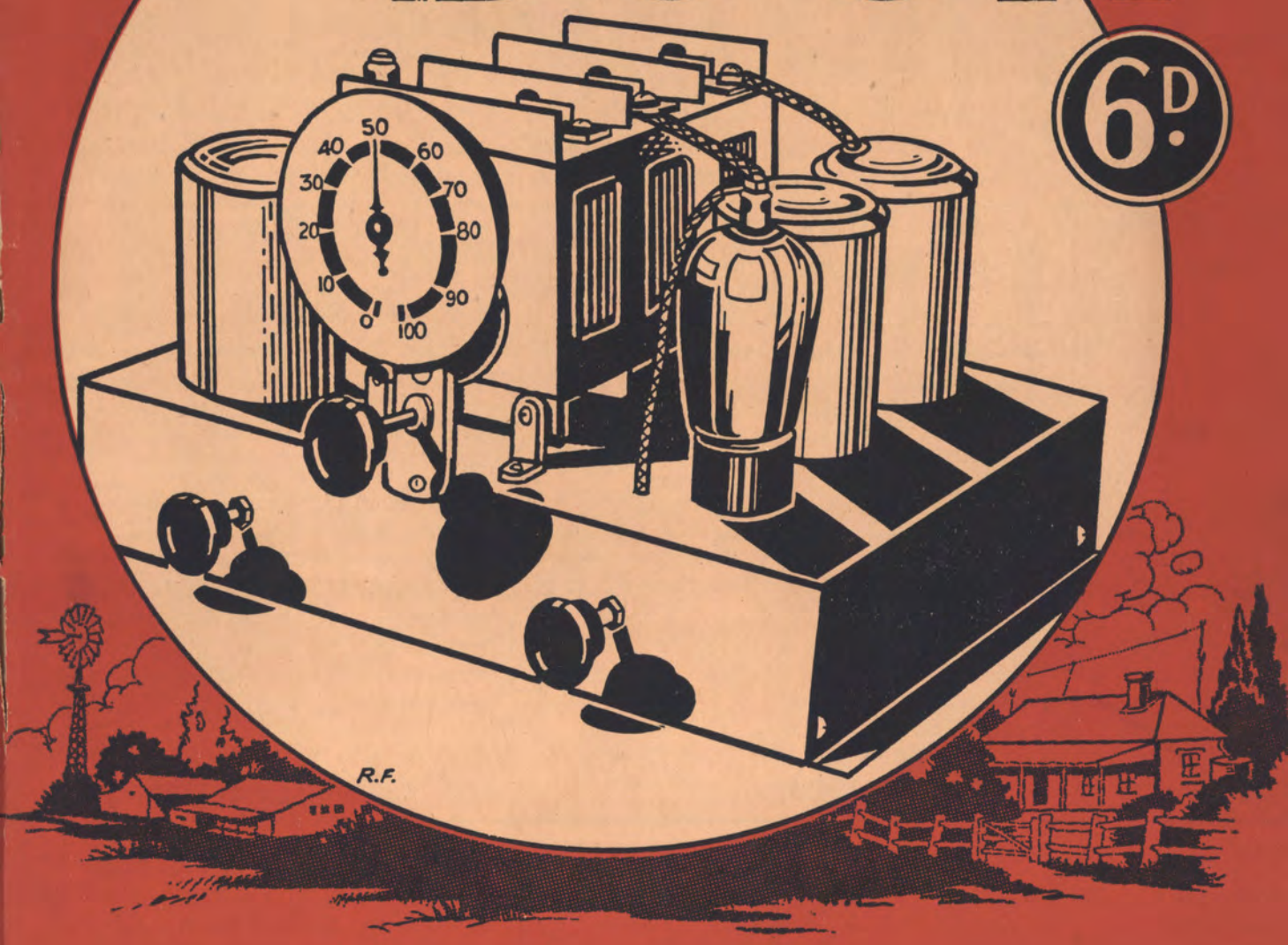


## A Handbook of Modern Battery Radio Circuits

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Short-Wave Receivers.
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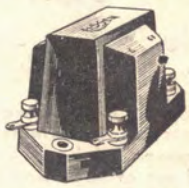

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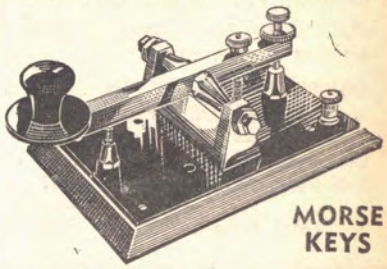

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| **Rola Permag. Speaker** | £2 | 9 | 0 |
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# THE COUNTRYMAN'S DUAL-WAVE "4"

BY A·K·BOX

An outstanding dual-wave battery operated super-heterodyne receiver which gives amazing results on both the broadcast band and the short-waves. The set will tune from 19 to 51 metres on the short-wave band.

THE many reports of outstanding short-wave receptions which come into our Short - Wave Department from country listeners indicate the almost ideal receiving conditions under which these listeners operate. In most cases reception is carried out on simple two or three valve receivers, but, naturally, the best reports are received from owners of sensitive super-heterodynes.

As we have pointed out previously, the possession of a large battery super-heterodyne usually entails frequent replacement of the "B" batteries because such a receiver draws a plate current in excess of that which results in the batteries' best life performance.

On the other hand, however, the super-heterodyne is by far the easiest of short-wave receivers to handle, and, when properly designed, is capable of equally as good reception as is possible from the tuned r.f. plus regenerative detector type of set.

A receiver of this type has recently been constructed in The Listener In laboratory. Employing a total of four valves, it is designed to tune over the short-wave range from 19 to 50 metres, in addition to the usual broadcast range, and is fitted with a most efficient form of automatic volume control which, whilst possessing the attribute of counteracting fading, does not materially affect the receiver's sensitivity.

THE design of a super-efficient battery receiver is not altogether simple because battery valves, much as they have been improved, will not give the same performance as corresponding A.C. operated valves. However, with the aid of the recently developed dual-purpose type battery valves, the way of the set-designer is made smoother and it has become possible to develop battery receivers which compare quite favorably with their A.C. prototypes.

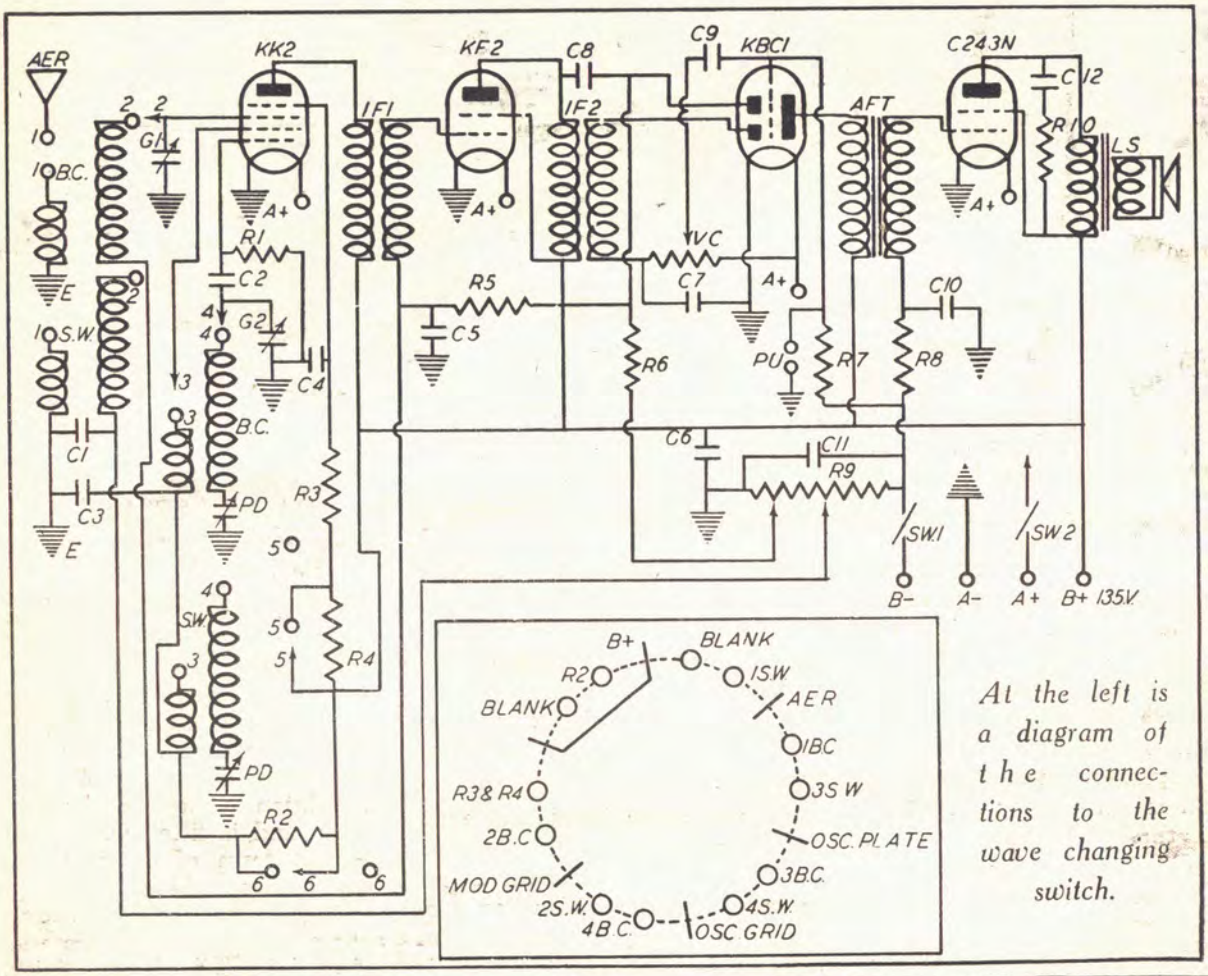
The valves used are all of Philips marque, and are the highly efficient and economical battery types recently developed by this organisation. The latest, and possibly the most outstanding, of the series is the KK2, a two-volt octode mixer valve similar in principle to the famous AK1, but designed to operate from a two-volt filament source. The intermediate frequency amplifier tube is the now well-known KF2, a radio frequency pentode which combines high efficiency with circuit stability.

The second detector tube is a KBC1 diode-triode which combines the function of detection with audio frequency amplification and automatic volume control. The final tube is the C243N pentode, noted chiefly for its high audio power output at exceptionally economical operating conditions. The total filament current required by these four valves in the present circuit is .61 amperes, whilst the "B" battery drain under broadcast reception conditions totals 12 milliamperes.

# The Schematic Circuit and List of Components

## Required to Build the COUNTRYMAN'S DUAL-WAVE FOUR

**AFT.—1-4 Ratio audio transformer.**
**COIL SWITCH.—6 Pole double throw Yaxley.**
**CHASSIS.—16 Gauge aluminium, 12in. x 8in. x 3½in.**
**C1, C3, C4, C5.—1 mfd. tubular condensers.**
**C2.—.0002 mfd. mica condenser.**
**C6, C10.—.5 mfd. tubular condensers.**
**C7.—.00025 mfd. mica condenser.**
**C8.—.0001 mfd. mica condenser.**
**C9, C12.—.02 mfd. mica condensers.**
**C11.—25 mfd. 25 volt electrolytic condenser.**
**G1, G2.—2-gang tuning condenser to suit coil kit.**
**IF1, IF2.—High gain battery type, 455 K.C., I.F.'s.**
**KIT.—Aerial and oscillator coils to suit gang condenser.**
**L.S.—Permanent magnet type loud speaker to match 15,000 ohm load. (Rola).**
**PD.—Two 455 K.C. padders and one .003 mfd. fixed condenser.**
**R1.—50,000 ohm resistor.**
**R2.—35,000 ohm resistor.**
**R3.—25,000 ohm resistor.**
**R4, R8.—100,000 ohm resistors.**
**R5, R6, R7.—1 megohm resistors.**
**R9.—500 ohm, 25 m.a. wire wound resistor.**
**R10.—10,000 ohm resistor.**
**SW1, SW2. — Double circuit battery switch.**
**VC.—500,000 ohm potentiometer.**
**VALVES. — One each Philips KK2, KF2, KBC1, C243N, or Mullard replicas, with socket to suit.**
**Sundries.—Aerial, earth, loud speaker and pick-up terminals, battery socket and plug, belden wire, machine screws, braided belden, tuning dial, three knobs, lead shroud for KBC1, three grid clips, four .30 mfd. trimmers, one bakelite strip.**




*At the left is a diagram of the connections to the wave changing switch.*

Now glance at the circuit diagram whilst we deal with the set's technical highlights and touch upon the purposes of the various circuit components. It will be seen that the receiver is a four-valve super-het in which the KK2 is the mixer tube, the KF2 amplifies the output from the mixer tube at a frequency of 455 k.c., and hands it on to the diode portion of the KBC1 diode triode. This tube's triode portion amplifies the rectified signal and hands it on to the output pentode through the audio transformer AFT.

Only one of the two diode plates in the KBC1 is used for detection, the other being employed as the rectifier of the radio frequency voltage required for automatic volume control. We shall have more to say about the a.v.c. system later on.

The circuit arrangement of the mixer tube may appear somewhat complicated, but in point of fact this is straightforward enough when it is remembered that coil switching must be used to change over from short to broadcast wave-lengths. The coil switch is a single gang Yaxley of the type known as the six-pole double-throw. The controlling elements of the mixer tube are connected to the centre point of each switch section, the broadcast and short-wave coils being connected to the remaining points on each section.

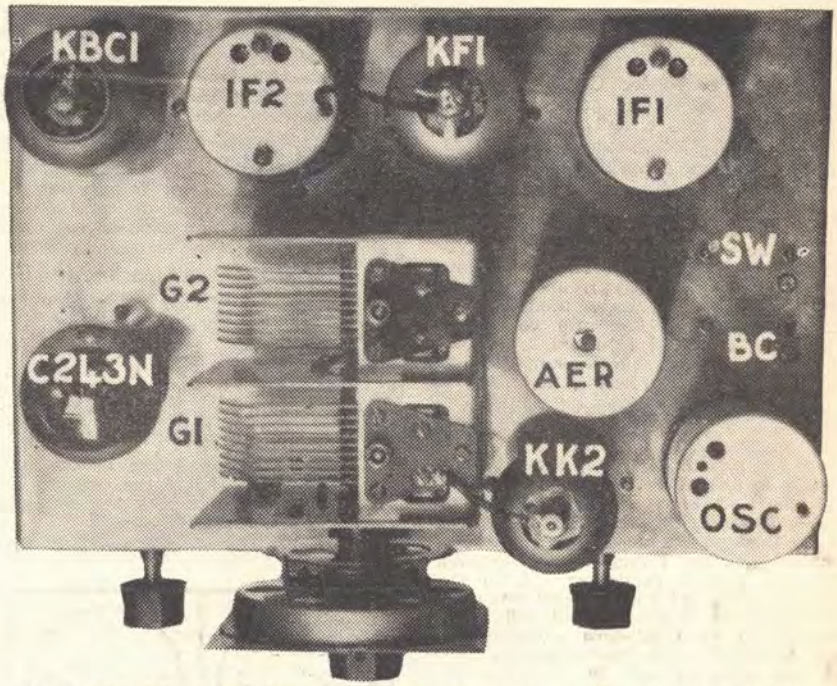
It will be noticed that the connection points to the coils, the aerial, control grid, oscillator grid, and oscillator plate have been numbered to correspond with the keyed diagram of the switch contacts. This should overcome any trouble in wiring the receiver. The KK2 must be operated in its most economical conditions as far as broadcast reception is concerned, and must work at maximum efficiency, irrespective of economy, on the short-waves.

This is done by reducing the oscillator plate and the screen voltages for broadcast reception by means of series resistors connected in the supply lines to these elements. R2, a resistor of 35,000 ohms, serves to drop the supply from 135 volts to the 90 volts required on the oscillator plate for broadcast work. The 100,000 ohm resistor R4 is connected in series with the 25,000 ohm resistor, R3, to drop the screen voltage from 135 to 45 volts for broadcast work. On the short-waves R2 is shorted out, to raise the oscillator plate voltage to 135, and R4 is shorted out to raise the screen voltage to 90. These circuit changes are carried out with sections of our Yaxley switch.

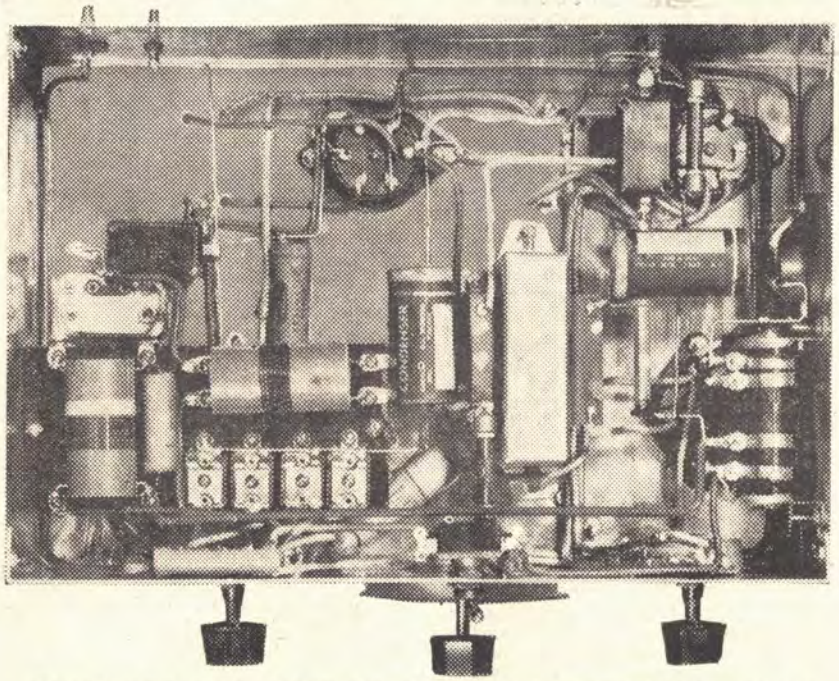
The oscillator grid condenser, C2, has the conventional capacity of .0002 mfd., whilst the grid leak, R1, of 50,000 ohms, is returned to earth in order that a certain amount of bias will be applied to the oscillator grid. The oscillator plate and modulator screen by-pass condensers, C3 and C4, each have a capacity of .1 mfd. The broadcast padder is a conventional 465 k.c. padder, whilst the short-wave padder consists of a similar type adjustable padder connected in parallel with a .003 mfd. condenser.

Note that the earth end of the short wave modulator grid coil is grounded through a .05 mfd. condenser, C1, in order that negative bias may be applied to the KK2. The KF2 stage of the receiver is quite straightforward, except for the application of a.v.c., with which we shall deal later. As the KF2 is a radio frequency pentode, its screening grid receives the same potential as the plate, and is connected to the "B" plus side of IF2. In the second detector stage we find that the detection diode is connected to one side of the secondary of IF2, the return of this transformer being made to the positive filament terminal of this tube through the load resistor, VC, which is a potentiometer and performs also the task of manual volume control.

The by-pass condenser, C7, has a capacity of .00025 mfd. and is connected between the IF2 side of VC and ground. The audio feed to the triode grid of the KBC1 is taken through a .02 mfd. condenser C9, the grid return to the full bias voltage being taken through the 1 megohm grid resistor, R7. The plate of the KBC1 feeds through the primary of the audio transformer, AFT, to the maximum supply voltage. The circuit arrangement of the C243N is conventional, except that the grid return of AFT, which goes to the full bias voltage, is de-coupled by means of the .1 megohm resistor, R8, and the .5 mfd. condenser, C10, in order to prevent audio instability such as "motor-boating." The .02 mfd. condenser, C12, and the 10,000-ohm. resistor, R10, constitute the tone compensation arrangement across the primary




**A top plan view of the Countryman's Dual-Wave Four. All parts are keyed to correspond with the written description of the receiver.**



**This photograph of the finished chassis illustrates the wiring and the arrangement of parts beneath the chassis.**

of the loud speaker transformer, which should be designed for a working load of 15,000 ohms.

A .5 mfd. condenser, C6, is connected between "B" plus and ground. It will be noticed in this circuit that only four battery leads, "A" minus and "A" plus, and "B" minus and "B" plus, are required. As a safety measure, both "B" minus and "A" plus are controlled by a double circuit battery switch, SW1, SW2. The automatic volume control system is extremely simple. Amplified radio frequency voltage fed from the plate of the KF2 to the a.v.c. diode of the KBC1 through the .0001 mfd. condenser, C8, is rectified and returned to ground through the 1 megohm resistor, R6, and portion of the bias resistor, R9.

The resistor, R6, is tapped to R9 at a point .6 of a volt from the negative end. This imposes a delay on the operation of the a.v.c. system so that practically full output is available from the C243N before the a.v.c. starts to work. The control voltage is fed from the diode side of R6 through the de-coupling network, consisting of the 1 megohm resistor, R5, and the .1 mfd. condenser, C5, to the grid return of IF1 and the grid return of the broadcast modulator grid coil. This simple but most efficient a.v.c. system will be found to operate extremely well on both wave-bands.

Before touching upon the constructional features of the receiver it is advisable that we should have something to say about the components used.

On the broadcast side the aerial and oscillator tuning coils should be of the best design. The intermediate frequency transformers should be of the litz-wound type and should be specially designed for use in battery super-hets.

In order to raise the sensitivity of the receiver to the utmost, it was found necessary to transformer-couple the KBC1. The audio transformer should have a step - up ratio of 1 - 4. Another little snag crops up when we use transformer coupling because the overall voltage gain of the audio system can quite easily be 6000 and the KBC1 is a slightly microphonic valve. The result is that we hear a disturbing "ring" in the loud speaker if the set is subjected to the slightest vibration. This is overcome by enclosing the KBC1 in a lead shroud which so damps its microphonic tendencies that the set can be used in an "all-out" condition without trouble.

The aerial and modulator coils, the i.f. transformers, the audio transformer and the valve shroud for the KBC1 used in the original design were all obtained from the Airmaster Radio Co.

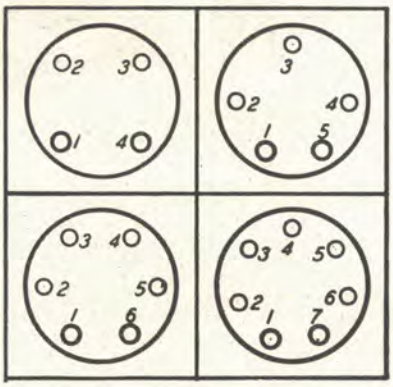
We come now to the question of layout and general chassis construction. The chassis is made of 16 gauge aluminium and measures 12 inches in length, 8 inches in width and 3½ inches in depth. As it is imperative that the leads to the tuning circuits of the KK2 be kept as short as possible, in order that a sufficiently wide band coverage may be obtained on the short-waves, particular attention has been paid to the question of lay-out.

The top view of the chassis shows that the gang condenser, G1, G2, is centrally disposed, the mixer tube, KK2, being mounted close to the G1 section at the right of the chassis. The broadcast oscillator coil, OSC, is to the right of this tube, while the broadcast aerial coil, AER, is behind it and alongside the G2 section of the gang. The i.f. transformer, IF1, is mounted in the right-hand rear corner of the chassis. At the right-hand end of the chassis can be seen the adjustment holes to the two padding condensers for broadcast and short-waves. The KF2 is mounted along the rear edge of the chassis behind the gang condenser, the second intermediate frequency transformer, IF2, being mounted between this tube and the KBC1.

The C243N pentode is mounted at the left-hand end of the chassis near the gang condenser.

On the front of the chassis immediately under the KK2 socket is mounted the wave-change switch. The battery switch is mounted in the front centre of the chassis below the tuning control, and the volume control, VC, is mounted at the front left. Along the rear of the chassis we find the aerial and earth terminals below IF1, and the pick-up terminals below the KBC1 socket. The loud-speaker terminals are at the left. At the left-hand end of the chassis, below the C243N socket, is the four-pin battery socket.

Underneath the chassis we find that




**Care should be taken when wiring the valve and battery sockets in order to ensure that all leads are connected to their correct terminals. Socket connections: THE KK2: (1) "A" negative, (2) Metal Coating, (3) Plate, (4) Oscillator Plate, (5) Oscillator Grid, (6) Screen Grid, (7) "A" Positive. THE KF2: (1) "A" Negative, (2) Screen Grid, (3) Metal Coating, (4) Control Grid, (5) Suppressor Grid, (6) "A" Positive. THE KBC1: (1) "A" Positive, (2) Triode Plate, (3) A.V.C. Diode, (4) Detector Diode, (5) Metal Coating, (6) "A" Negative. THE C243N: (1) "A" Negative, (2) Plate, (3) Control Grid, (4) Screen Grid, (5) "A" Positive. BATTERY SOCKET: (1) "A" Negative, (2) "B" Negative, (3) "B" Positive, (4) "A" Positive. All connections are shown as viewed from below.**

the audio transformer is mounted at the right-hand end, while the "C" bias resistor, R9, has been mounted to the end of the chassis in the front right-hand corner. The only other unit which is mounted to the chassis itself is the bakelite sub-panel which carries the short-wave coils and the trimmer condensers.

This panel measures 5½ inches in length and 2½ inches in width. It is mounted 1¼ inches from the bottom of the chassis by means of two metal spacers. It is imperative that this panel be kept absolutely rigid, otherwise extreme difficulty will be experienced in obtaining definite trimmer adjustments when aligning the receiver. It should be noted that the trimmers on the gang condenser must be removed. Their place is taken by four 30 mfd. trimmers which are bolted to the bakelite strip already mentioned. This strip is provided with two sets of four solder lugs to which stiff wire leads attached to the coils are soldered.

Before we touch upon the construction of the short wave coils we first shall describe the wiring of the receiver.

The valve socket connections and the connections to the battery socket will be keyed in accordance with the R.M.A. system explained last week. Furthermore, we have provided a keyed underchassis diagram of the four sockets used in the receiver, so that checks of our wiring description can be made from this.

Start the wiring of the receiver by running a heavy bare tinned wire from the earth terminal on the chassis to lug No. 1 on all sockets (including the battery socket) except that for the KBC1. The lead in this case will go to pin No. 6. Take a pair of leads down through the chassis from the moving plate lug on each section of the gang condenser and solder them to the earth wire. Connect a short lead from the top fixed plate lug of the G1 section of the gang condenser to the cap of the KK2. From the underneath fixed plate lug on this section of the gang condenser wire a lead to the MOD. GRID lug on the Yaxley switch. Run a lead from the aerial terminal on the chassis to the AER. lug on the switch. Connect the grid end of the modulator grid coil to the 2BC lug on the switch. Join the earth end of the wire and the earth end of the modulator grid coil to the "C" minus lead on IF1 through a braided lead, the braiding of which must be earthed.

Join lug No. 5 on the KK2 socket to one lug of the .0002 mfd. condenser, C2, and to one lead on the 50,000 ohm resistor, R1. The other lead on R1 goes to the ground wire. The vacant lug on C2 carries a lead from the fixed plate lug on the G2 section of the gang condenser and a lead to the OSC. GRID lug on the Yaxley switch. The grid lead on the oscillator coil goes to the 4BC position on this switch, while the other end of this coil is joined to one side of the broadcast padding condenser, PD. The other lug on this condenser and one lug on the short wave padding condenser are joined together and to the earth wire. The .003 mfd. condenser should be connected in parallel with the short wave padding condenser.

Lug No. 4 on the KK2 socket joins to the OSC. PLATE lug on the switch. The plate lead from the broadcast oscillator plate coil goes to the 3BC lug on the switch. The "B" plus side of the oscillator plate coil is joined to the R2 lug on the switch. The two "B" PLUS lugs on the switch are joined together and taken to No. 3 lug on the battery socket. The resistor, R2, is connected between the R2 and "B" PLUS lugs on the switch. From the R2 lug a lead goes to one side of the .1 mfd. condenser, C3, the other side of which is connected to the ground wire.

The No. 6 lug on the KK2 socket carries one lead of the .1 mfd. condenser, C4, and one lead of the 25,000 ohm resistance, R3. The other lead on R3 and one lead of the 100,000 ohm resistance, R4, are joined to the R3, R4 lug on the switch. This completes the switch connections for a moment.

Join a lead to lug No. 7 on the KK2 socket, No. 6 on the KF2 socket, No. 1 on the KBC1 socket. No. 5 on the C243N

socket and one side of the SW2 portion of the battery switch. Take the other lug on this part of the switch to lug No. 4 on the battery socket.

Join the plate lead from 1F1 to Lug No. 3 on the KK2 socket, and join lug No. 2 to the already wired lug No. 1. The "B" plus lead on IF1 joins to the "B" plus lead from 1F2, the "B" plus of AFT, lug No. 4 on the C243N socket and to lug No. 3 on the battery socket.

One lead of the .5 mfd. condenser, C6, also is soldered to this lug on the battery socket. The other lead on C6 goes to the earth wire. The a.v.c. gear, consisting of R5, R 6 and C8, should be mounted inside the can of IF2. One lug of C8 is soldered to the plate lug on the i.f. trimming condenser whilst the other lug carries one lead from both R5 and R6. The leads from these resisting of R5, R6 and C8, should be brought out in metal braided cable. The braiding should be earthed.

First join the grid lead from IF1 to lug No. 4 on the KF 2 socket. Solder the lead from R5 to one lead of the .1 mfd. condenser. C5, and to the joined leads from 1F1 and the broadcast modulator grid coil. The other lead on C5 is earthed. Take a lead through the top of the can for IF2 to join to the plate cap on the KF2. The Lug No. 2 on the KF2 socket should be joined to the common "B" plus lead. Join together lugs No. 3 and No. 5 and connect them to lug No. 1.

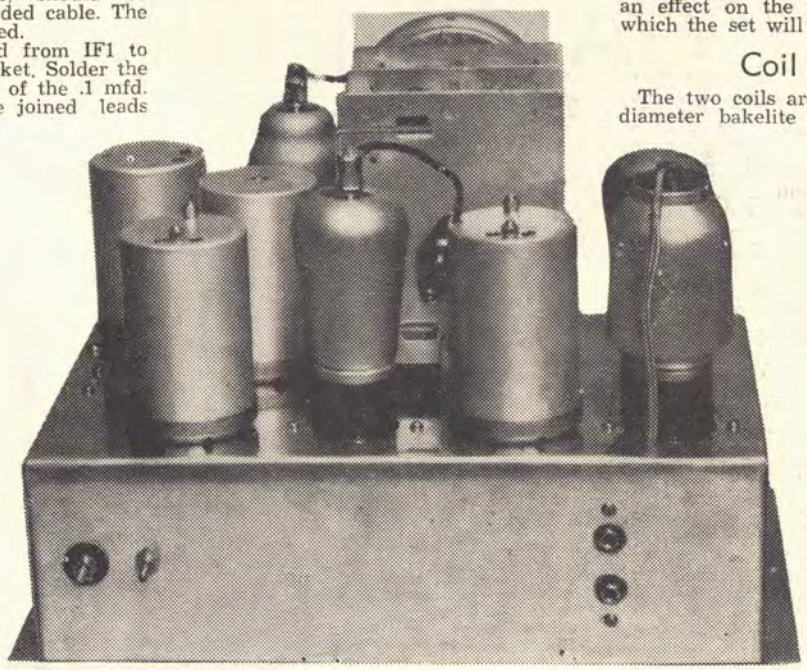
The free end of R6 should be provided with a lead which fastens to clip mounted about one quarter of an inch from the earthed end of the bias resistor, R9. The other shielded lead which comes out of the IF 2 can should be that from the R6 side of C8. This lead goes to lug No. 3 on the KBC1 socket. The grid end of the IF2 secondary winding joins to lug No. 4 on the KBC1 socket.

The other lead on IF2 secondary goes, through metal braided cable, to one outside lug of the 500,000 ohm potentiometer VC and to one lug of the .00025mfd. condenser C7. The other lug on C7 is connected to ground. The other outside lug on VC joins, through braided cable, to the No. 1 lug on the KBC1 socket. The centre lug on VC jons to one lug on the .02 mfd. condenser C9.

The other lug on this condenser joins to a lead which carries the grid clip for the KBC1 and carries also one lead of the 1 megohm grid resistor R7. The other lead on R7 joins to one lead of R8. The other lead on R8 goes to the "C" minus lug on AFT. to which also is soldered one lead of the .5 mfd. condenser C10. The other lead on C10 goes to earth. Lug No. 2 on the KBC1 socket joins to the P lug on AFT. Lug No. 5 on this socket is joined to lug No. 6. The G lug on AFT joins to lug No. 3 on the C243N socket, lug No. 2 going to one of the l.s. terminals, to which also is soldered one lug of the .02 mfd. condenser C12. The other lug on C12 carries one lead of the 10,000 ohm resistance R10. The remaining lead on R10 goes to the other l.s. terminal, which carries also a lead from lug No. 4 on the C243N socket. The junction of R7 and R8 joins to the free end of R9. The positive lead of the 25 mfd. electrolytic condenser C11 is soldered to the earthed end of R9, while the other lead on this condenser joints to the free end. From this latter point on R9 take a lead to one of the lugs on the SW1 portion battery switch and join the other lug to lug No. 2 on the battery socket.

The pickup terminals should now be connected by taking one to the junction of C9 and R7 and the other to the earth wire. This completes the wiring of the receiver itself.

The battery plug should be provided with leads, attached to the "A" and "B" batteries and plugged into its socket. The valves should be plugged into their sockets and the grid and plate leads attached to the cap connections of the valves concerned.



**A rear view of the completed chassis. The aerial, the earth, and the loud speaker terminals are mounted on the side of the chassis. Both the aerial and the loud speaker terminals must be insulated from the aluminium.**

Tune the receiver to the lower end of the dial and adjust the oscillator and aerial trimmers for maximum output. As the receiver is fitted with a.v.c., it is essential that these adjustments be carried out on a very weak signal. Failing this, it is advisable to disconnect the a.v.c. system by breaking the connection between the modulator grid coil, the i.f. secondary and R5-C5. Ground the former pair of leads, leaving R5-C5 free. When maximum adjustment has been obtained on the lower end of the dial tune up to the top end to a station such as 3AR and adjust the padding condenser for maximum volume, meanwhile rocking the gang condenser back and forth over a few degrees to ensure that a peak setting of the padder is obtained. Naturally during these tests and future broadcast operation of the set the wave change switch should be set in the broadcast position. After alignment replace the a.v.c. connections.

When properly aligned and constructed to the specifications given here it will be found that the Countryman's Dual-Wave Four is an amazing performer on broadcast wave lengths. Its sensitivity, ranging from 6 to 10 microvolts, is better than that obtained from many six valve a.c. operated receivers, while its tonal qualities and operating economy leave little to be desired.

With the receiver constructed and made to operate on the broadcast band, we now are ready to wind the short-wave coils, mount them in position and wire them into circuit. It cannot be too strongly stressed that the specifications for these coils be adhered to for the number of turns on the various windings, the spacing between turns, and even the type of wire insulation, the wire gauge, and the insulation between the oscillator grid and plate coils will have an effect on the frequency range over which the set will tune.

## Coil Details

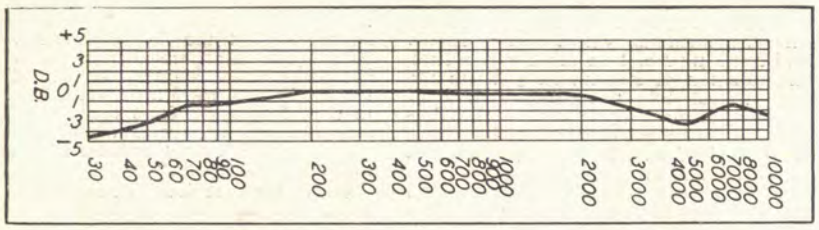
The two coils are wound on one inch diameter bakelite tube. Each former is two inches in length. The grid windings are laid on with 26 gauge enamel - covered wire spaced one diameter between turns. The oscillator grid winding requires 5¾ turns and 7½ turns are needed for the modulator grid coil. The oscillator plate coil consists of 6 turns of 32 gauge enamel or silk-covered wire wound over the bottom end of the oscillator grid coil and separated from it by two thicknesses of writing paper.

The standard aerial winding consists of 20 turns of 32 gauge wire wound hard against the earth end of the modulator grid coil. This aerial winding may be replaced with a high impedance coupling if desired. All windings, including the standard aerial windings, are in the same direction, but the oscillator plate coil is reverse wound. If a high impedance coupler is used in the aerial circuit its direction of winding should be opposite to that of the modulator grid coil, although the link turn should be in the same direction as the latter.

When completed, the coils are provided with stiff tinned wire leads which are soldered to the lugs already provided on the mounting strip. The aerial coil is mounted at the left-hand end of the strip (nearest to the end of the chassis) and in such a way that the aerial winding faces the rear. The oscillator coil is mounted at right angles to the aerial coil and is so placed that its grid end is nearest to the aerial coil. Attention should be paid to the placement of the solder lugs on these coils so that the grid circuit leads are as short as possible.

When the coils have been mounted in position, complete the wiring of the re-

**(Continued on page 17)**

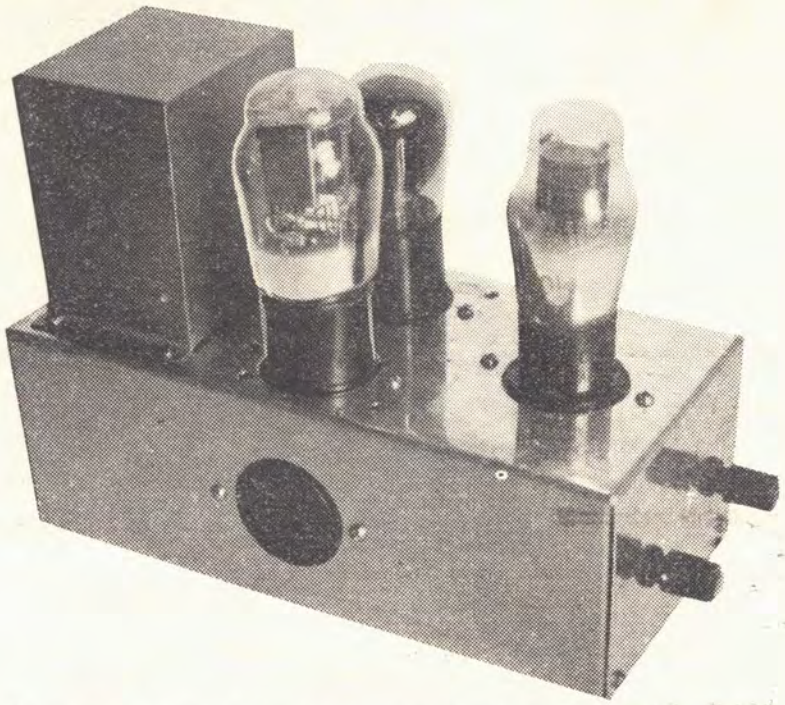



The response curve of the amplifier. These readings were obtained by the aid of a laboratory type of beat frequency oscillator with the amplifier fed into a resistive load.

**By P. R. DUNSTONE**

# A SMALL P.A. BATTERY AMPLIFIER

A compact three-stage battery-operated amplifier employing class "B" amplification in the final stage. This unit is capable of delivering an undistorted output of 1½ watts



The amplifier when completed is both compact in size and attractive in appearance. This photograph shows positions of the battery input socket and the two input terminals mounted on the sides of the chassis.

ONE of the greatest difficulties encountered by the organisers of small social functions and dances is the provision of a sufficient volume of music. The gramophone is not only out of date, but also is quite unsatisfactory for use in all but the smallest rooms. The very nature of most of these functions precludes the employment of an orchestra.

We come then to the combination of a gramophone, a pick-up, and an amplifier and loud speaker system. This is a most satisfactory idea for the man who is able to utilise the electric supply mains, for he can quite simply and cheaply build equipment capable of catering for halls having a seating capacity of from 2000 to 5000.

The countryman, however, is not nearly so favorably situated, for he has the power supply problem with which to contend. In the past the greatest difficulty which confronted him was that of obtaining a moderate power output and at the same time of keeping the battery consumption of the amplifier within reasonable limits.

Today, with the aid of the super-efficient class "B" method of amplification and specially designed valves, it is possible to obtain, from a battery operated amplifier, results which compare very favorably with those of the A.C. operated type, and yet to maintain economical battery operating conditions.

THE basic principle to be kept in mind when designing amplifiers is the amount of power it is desired to deliver to the loud speaker. For home use an amplifier having an output of at least 1 watt would provide sufficient volume for dancing and microphone work, whilst a hall having a seating capacity of, say, 500, will require an output of some 2 watts. From these figures it will be seen that the amplifier described in this article is only of moderate power, it being designed for use in the home or in small halls. The amplifier is both easy to build and extremely simple to put into operation, whilst its constructional cost is reasonably low.

This small P.A. amplifier has been primarily designed for use in country areas where no power is available, but for the benefit of those who are situated in D.C. areas we have included a circuit

diagram of a D.C. power pack which can be built for a few shillings. This replaces the "B" batteries normally required.

On studying the schematic circuit diagram of the amplifier it will be seen that class "B" amplification has been used in the final stage. The use of this necessitates two driver stages in order fully to operate the output valve. The driver stages are resistance-coupled, whilst the output from these two valves is fed through a Class "B" audio transformer to the grids of the B240 tube.

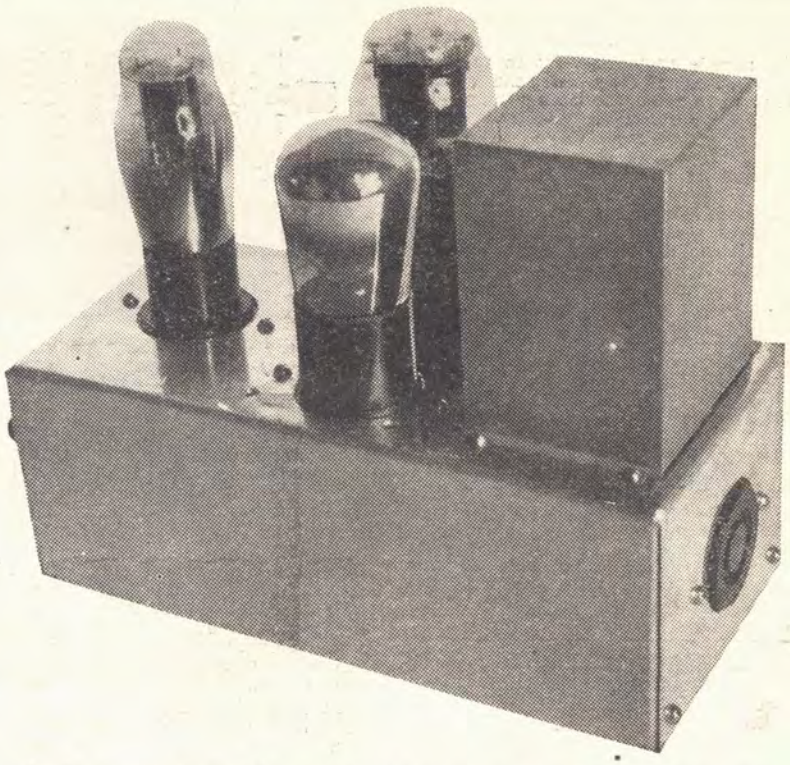
The complete amplifier is built on a 16 gauge aluminium chassis the overall measurements of which are 8½ inches by 4 inches by 3 inches. From these dimensions it will be seen that the amplifier is compact and suitable for portable work.

The response from the amplifier is very pleasing, being very even over a wide range of frequencies. The original amplifier was tested on a standard laboratory type of beat frequency oscillator, very gratifying results being obtained. We have shown the response curve of the amplifier in Fig. 1.

A feature of this design is its low battery consumption. Owing to the Class "B" amplification which has been used, the plate current drain has been reduced to a minimum, the total drain of the amplifier being well within the range of the standard "B" batteries.

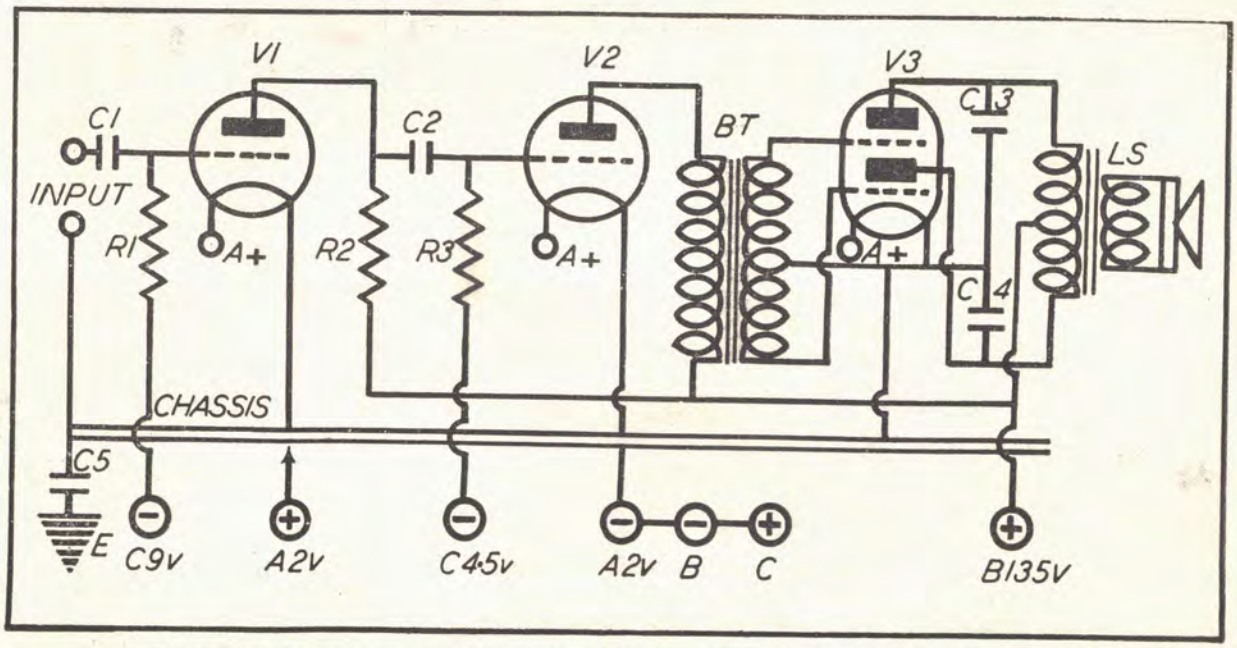
Before describing the construction of this amplifier, it may be as well to deal with the salient points of the valves to be used. It will be seen on referring to the schematic circuit diagram that a type B240 has been employed in the output stage. This tube consists of two high-mu triodes in the one envelope and is designed for class "B" amplification.

The drives valves V1 and V2 are standard high gain triodes of the Philips type B217, and are the most suitable tubes to use in order to obtain the greatest output from the B240.



**Another corner view of the amplifier showing the class "B" audio transformer mounted in the foreground.**

Now let us deal with the actual construction of the amplifier. An idea of the layout of the components can be obtained from the photographs accompanying this article. O top of the chassis it will be seen that the placement of the valves and the transformer is as follows: — The first driver valve, VI, is mounted at the left-hand end of the chassis, whilst the second driver valve and the class B tube are assembled in line in the middle of the chassis. The class "B" audio transformer, BT, is secured at the extreme hight-hand end of the chassis. On the sides of the chassis the input terminals are mounted on the left-hand end, the battery input socket



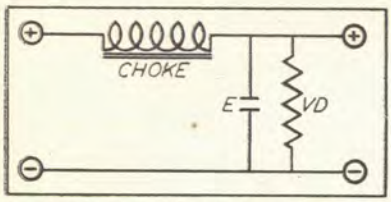

**The circuit diagram of the amplifier. A type B240 valve is used in class "B" amplification in the final stage.**

on the rear side, and the output speaker socket at the right-hand end.

The remaining components in the outfit are wired directly into the circuit, relying upon their connecting "pig-tails" to hold them rigidly in position. When mounting the three valve sockets in position, place a small soldering lug below each of the mounting screws, in order to allow a common earth wire to be carried throughout the chassis. The two input terminals must be insulated from the chassis, the earth return terminal being taken to the chassis through the medium of a .1 mfd. fixed condenser. The inclusion of this condenser in the circuit is to prevent any shocks being obtained from the chassis, when the D.C. power pack is used. If batteries only are to be used, this condenser, C5, can be omitted from the circuit, and the earth terminal wired direct to the chassis.

## Wiring In Words

Commence the wiring of this amplifier by taking a lead from one of the insulated terminals on the side of the chasis to one side of the fixed condenser, C1. The other side of this condenser is wired to one end of the resistor, R1, and to the grid terminal




**The circuit of a D.C. power pack. It is important that this circuit is strictly followed, and on no condition should the builder make one side of the mains common to the chassis.**

on V1 valve socket. The remaining terminal mounted on the side of the chassis is connected to one side of the condenser C5, whilst the other side of this condenser, C5, is joined to the common earth wire.

The other end of resistor, R1, is soldered to a terminal on the battery input socket and is used at the "C" negative 9 volts connection. The plate terminal on V1 valve socket is soldered to one end of R2 and to one side of C2, the other side of C2 being taken to one end of R3 and to the grid terminal on V2 valve socket. The vacant end on R3 is secured to another terminal on the battery input socket and serves as the "C" negative 4.5 volts connection.

The plate terminal on V2 valve socket is joined to the P terminal on the class B audio transformer, B2, whilst the two G terminals on this transformer (BT) are wired to the two grid terminals on the V3 valve socket. The centre tap on the secondary winding of BT is taken to earth.

The two plate terminals on the V3 valve socket are connected to the plate and cathode terminal on the speaker out put socket, whilst the grid terminal on the speaker output socket is soldered to the remaining end on BT and R2 and then taken to a terminal on the battery input socket.

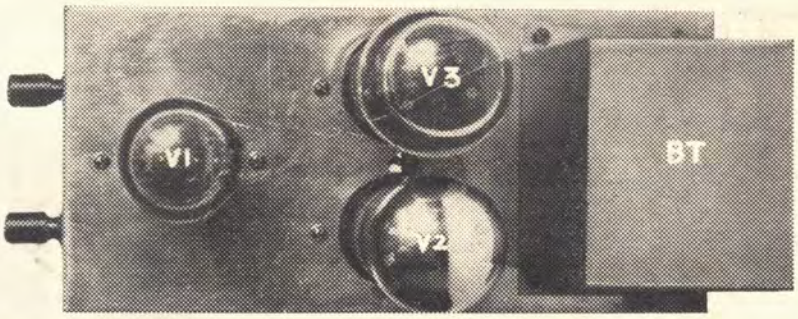
One side of condensers C3 and C4 is wired to the plate terminals on the V3 valve socket and the remaining leads on these two condensers are taken direct to earth.

On the completion of the filament wiring, which necessitates the filaments of the three valves being wired in parallel and taken to two terminals on the battery input socket, this completes the wiring of the amplifier. One side of the filament wiring which is to serve as the "A" negative, "B" negative, and "C" positive, should be connected to the common earth wire.

## Wiring the D.C. Power Pack

No difficulty should be experienced in wiring the power pack, since it consists of only three components. It is important when making this unit that all leads are completely isolated from the chassis. On no condition should the aluminium chassis be used as the negative side of the pack.

The wiring is as follows:—The positive side of the mains is connected to one side of the filter choke, CH, whilst the other side of this choke, CH, is soldered to the positive side of the electrolytic condenser, E, to one end of the voltage divider, VD, and to an insulated terminal which is to serve as "B" positive maximum. The negative side of the D.C. mains is connected to the negative side of the electrolytic condenser and to the remaining end of the voltage divider, VD. This end of VD is taken to another insulated terminal and serves as B negative connection. The 135 volt supply for the amplifier is obtained from a tapping on VD.




**This plan view of the amplifier depicts the arrangement of parts on top of the chassis. The components are keyed to correspond with the written description of the amplifier.**

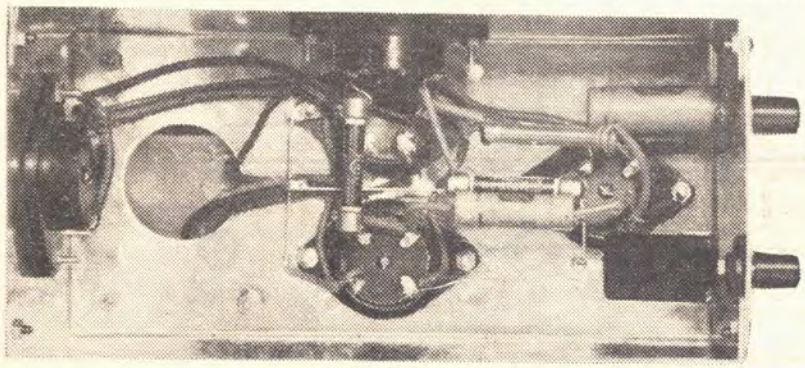
### The List of Parts

**BT; Class B audio transformer (Airmaster).**
**C1, C2; .02 mfd. fixed condensers.**
**C3, C4; .004 mfd. fixed condensers.**
**C5; .1 mfd. fixed condenser.**
**LS; Permagnetic loud speaker to match type B240 valve. (Rola.)**
**R1; 500,000 ohm resistor.**
**R2; 100,000 ohm resistor.**
**R3; 250,000 ohm resistor.**
**Valves: Two B217's and one B240 or Mullard replicas.**
**Sundries: Two terminals, 6 yards of belden wire (different colors), nuts and screws, two five-pin sockets, one five-pin lug, and one aluminium chassis gauge 16 measuring 8½ inches by 4 inches by 3 inches.**
**Additional parts required for building the D.C. Power Pack:—**
**CH; 30 henry low D.C. resistance filter choke.**
**E; 8 mfd. 600 volt test electrolytic condenser.**
**VD; 25,000 ohm voltage divider.**

## Operation

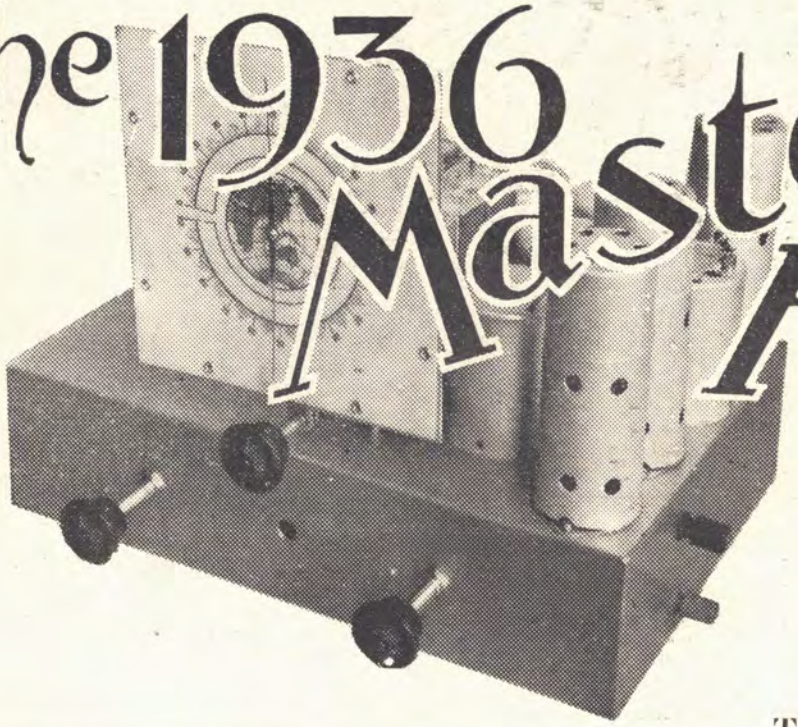
The operation of the amplifier is simplicity itself. Having connected the batteries, speaker and pick-up leads to their respective terminals on the amplifier, plug in the valves and give the outfit its initial test. Should the power output be found to be too high, a volume control can be included in the circuit by the simple expedient of replacing R1 with a 500,000 ohm potentiometer. The wiring of this unit is as follows:—The two outer terminals on the potentiometer go to one side of C1 and the "C" negative 9 volts respectively, whilst the movable arm of the potentiometer is wired to the grid terminal on V1.

The potentional for the various valves are shown on the accompanying schematic circuit diagram. The plates of the three valves require 135 volts; the negative grid bias for V1 is 9 volts, and for V2 is 4.5 volts. The filament supply should be obtained from a two volt accumulator.



**An underneath photograph of the amplifier, showing the mounting positions and the wiring of the parts below the chassis.**

# The 1936 Master Five



By
A. K. BOX

**This five valve super-heterodyne which is fitted with modern valves represents very nearly the ultimate in low cost battery receiver design.**

MODERN receivers are a necessity for the country listener. The recent wavelength allocations although doing much to clear the Australian ether and to permit more stations to be placed on the air, have, in some cases, rendered absolutely useless the five-year-old receivers which previously were serving the purpose for outback listeners.

The modern receiver, with its knife-edged selectivity, amazing sensitivity, and real tone quality, opens up a new radio era for the country listener. Besides giving him the full benefits of a Commonwealth-wide radio network, it also offers him a more economical means of obtaining his radio enjoyment.

Battery consumption has been reduced in all departments. Instead of the 6-volt .25 ampere filament type valves of five-year-old sets, we have two volt valves which require but half this current. Where the "B" battery drain of a five valve old style receiver ranged from 15 to 25 milliamperes, the new type set will do a better job with a current drain of only 10 milliamperes. Better components, too, have prevented the battery leakages which were frequent causes of "B" and "C" battery exhaustion.

An excellent example of modern design methods is featured in the 1936 Master Five which we presently shall describe. A Five valve super-heterodyne, fitted with modern low consumption valves, an efficient radio frequency amplifier stage, and a high selectivity intermediate frequency amplifier this receiver presents very nearly the ultimate in low cost battery receiver design. It is equipped with automatic volume control to minimise the fading of distant stations, and employs a special economy circuit.

THE circuit of the 1936 Master Five, although possessing all modern refinements, is by no means complex. The receiver consists of a radio frequency stage employing a 1C4 r.f. pentode, a combined oscillator and modulator stage using a 1C6 mixer tube, a 175 k.c. intermediate frequency amplifier stage which employs a second 1C6 r.f. penthode, a second detector stage, which uses the diode triode type 1B5 as diode detector, and automatic volume control tube, and first audio amplifier, and a 1D4 audio pentode as the output tube. This series of valves belongs to the economy series, two of the types, the 1C4 and 1D4 being specially developed for Australian conditions in the A.W. Valve Company's Sydney laboratories.

Full automatic volume control, applied to the r.f. detector, and intermediate frequency amplifying stages, is employed to overcome the fading bugbear.

As will be seen from a study of the chassis lay-out, the receiver is very compact in design. The overall chassis measurements are 12¾ inches in length, 8¾ inches in width and 3 inches in depth. The r.f. and tuning circuits all are to the right of the gang condenser, the audio and second detector valves being mounted along the rear left hand edge of the chassis. In the vacant space provided at the left of the gang condenser is mounted the 4½ volt "C" battery used to bias the two audio stages. The aerial and earth terminals are to be found at the front right hand end of the chassis, whilst the loud speaker and battery cable sockets are mounted along the rear.

The two controls on the front of the chassis are the battery switch (right) and the volume control (left). The padding condenser has been mounted on the rear side of the chassis, access to it being had through a suitably placed hole.

As the illustrations of the completed receiver show, the assembly is far from difficult, and should not need further comment, except to mention that the

valve sockets all are arranged so that their filament lugs face the outside of the chassis.

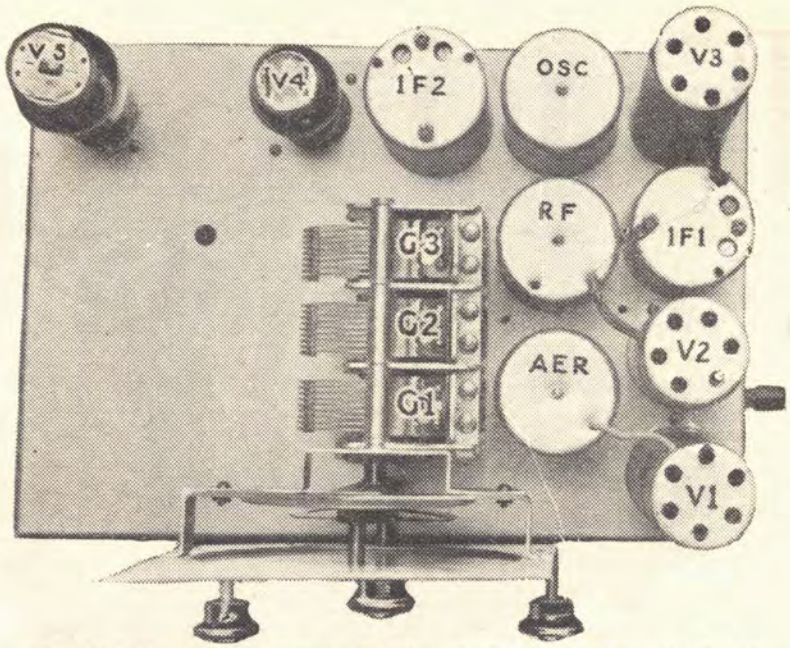
As this receiver has been designed particularly for the novice we intend to depart somewhat from the usual method of handling the wiring description. We shall, in this case, describe the assembly and the wiring of the receiver simultaneously dealing with both in progressive stages. Figures 1 to 4 show these stages. It should be particularly noted that the wiring for each stage is independent of the preceding one, details of which have not been shown in the next diagram.

## First Easy Step

Start the assembly of the receiver by mounting the valve sockets and valve shield bases which are fitted on top of the chassis over the two sockets for the 1C4's and over the 1C6 socket. In bolting the valve sockets to the chassis, place solder lugs under the socket nuts in the positions shown. Next, with 1-inch machine screws and half-inch pillars, mount the gang condenser, but before doing this be sure to solder a six-inch length of covered wire to the fixed plate lug on each section of the gang, and a length of tinned wire to the moving plate connection. The first wiring to be carried out is the earth wiring, in which all solder lugs are joined together by means of tinned copper wire.

Start the earth wire at the solder lug on the socket V5, joining it to the lug on the V4 and V3 sockets in turn. Thence this earth wire joins to the solder lug on the socket V2 and to the corresponding lug on the socket V1. Now join to the earth wire one F lug on all five sockets. It is wise to use insulated wire for this filament connection on the 1C6, 1B5 and 1D4 sockets.

Run a covered wire to the remaining F lug on all five sockets and from this lug on the socket V4 join to one F lug on the battery socket BATT. Join the green lead from 1F1 to the P lug on the 1C6 socket. Solder one lead of the .1 mfd. condenser, C1, to the earth wire and take the other lead of this condenser to the Black lug on the coil AER and to one lead of the .1 megohm resistance, R1. The other lead on R1 joins to the Black lug on the coil RF and to one lead of the .1 mfd. condenser, C2. The other lead on C2 is soldered to the earth wire.




**This plan view of the receiver illustrates clearly the arrangement of parts on top of the chassis. All components are keyed to correspond with the List of Parts and the written description of the set.**

The Red lug on AER is soldered to the earth wire. Join the Red lug on the coil OSC to the SG lug on the socket for V3, to which also is soldered one lead of the .1 mfd. condenser, C4. The other lead on C4 is joined to the earth wire.

The green lead from IF2 joins to the Plug on the socket for V3. The tinned wire lead from the moving plate lug on the gang condenser G1, G2 and G3 is soldered to the earth wire. One lug of the .0001 mfd. condenser, C8, is soldered to the Plug on the socket for V4, the other lug on this condenser being joined to the earth wire. A Red lead about 8in. in length is soldered to the earth wire and pushed up through the hole provided in the chassis. This lead is the "C" positive battery lead.

Join one lead of the .5 mfd. condenser, C10, to the left hand top lug on the battery socket BATT, and from this lug on BATT run a lead to the left hand top lug on the l.s. socket, LS. The other lead on C10 goes to the earth wire.

This completes the first stage of the wiring. Turn now to the diagram Fig. 2.

**This illustration shows the speaker and the battery input sockets mounted on the rear side of the chassis.**

## Second Easy Step

First mount the padding condenser, PD, with one inch bolts and half inch pillars. To avoid cracking the isolantile base of the padding condenser, use bakelite washers between the pillars and the base and between the base and the nuts. Carry on with the wiring by joining the SG lug on the V1 socket to the corresponding lug on sockets V2 and V3.

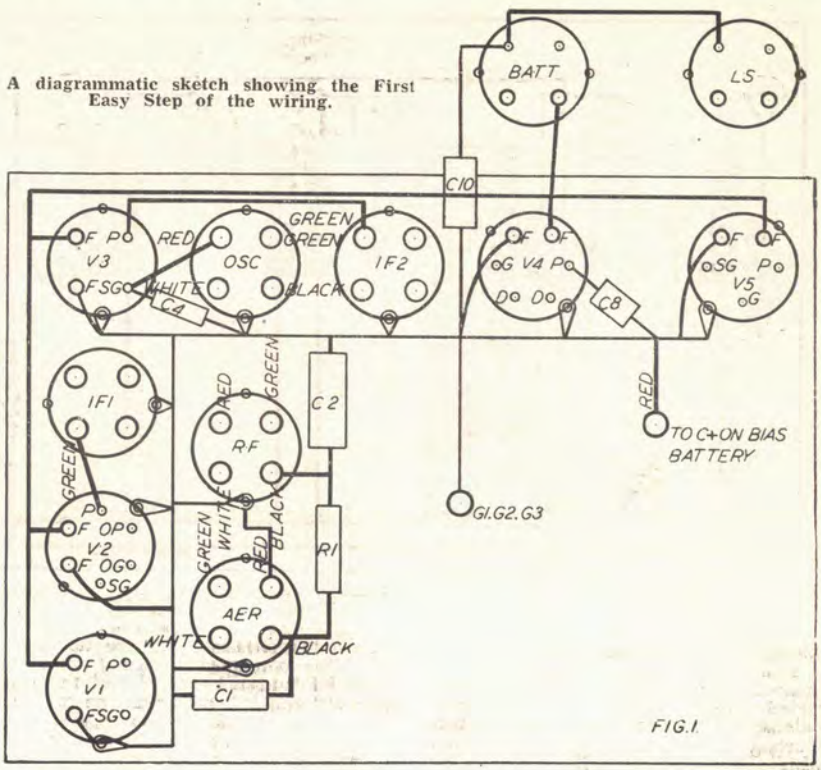
Connect the lead from the fixed plate, G1, section of the gang condenser (front section) to the White lug on the coil AER.

Join the lead from the middle fixed plate section of the gang condenser (G2 section) to the White lug on the coil RF, and join the corresponding lead from the third section of the gang condenser, G3, to the White lug on the OSC coil. The black lead from IF1 joins to the Black lug on the RF coil The Green lug on this coil is wired to the P lug on the socket V1. The OP lug on the socket V2 joins to the Green lug on the OSC coil. The Red lead from IF1 is wired to the Red lug on the RF coil. The fixed plate on the padding condenser, PD, joins to the Black lug on the coil OSC. The other lug on this condenser, PD, is wired to the earth wire.

One lead of the 1 megohm resistor, R5, and one lug of the .001 mfd. condenser, C7, is wired to the D lug, which is nearest to the G lug, on the V4 socket. The other lead of R5 joins to earth, as does to top right hand lug on the battery socket BATT. The Brown lead from IF2, and the remaining lug on C7, are soldered to the other D lug on the socket V4. One lead of the .25 megohm resistor, R7, is soldered to the P lug on the socket V4, the other lead of this resistor joining to the SG lug on the socket V5. From this lug on V5 a lead is taken to the top left hand lug on the loud speaker socket, LS.

The top right hand lug on this loud speaker socket joins to the P lug on the socket V5. Solder one lead of the .5 megohm resistor, R8, to the G lug on V5 socket and attach an eight-inch green wire to the other end of this resistor. This green lead is poked up through the same hole in the chassis as

**A diagrammatic sketch showing the First Easy Step of the wiring.**




was the Red "C" lead, and is to serve as the minus 4½ volt "C" connection.

This completes the second stage of the wiring.

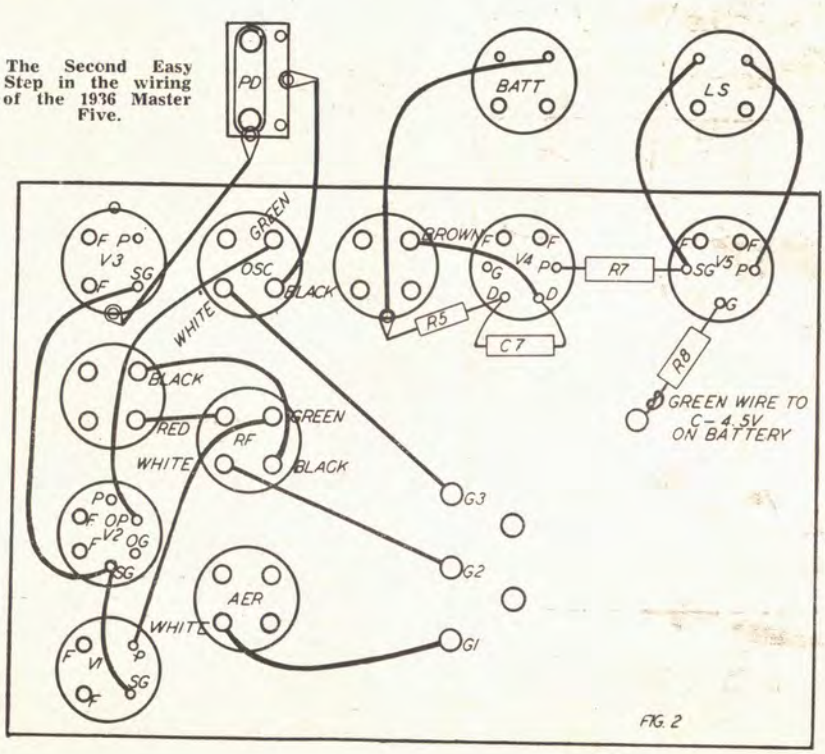
## Third Easy Step

To start the third stage of the assembly and wiring—Fig. 3—first mount the aerial and earth terminals at the right-hand end of the chassis. The red aerial terminal should be insulated from the chassis, whilst the black earth terminal should have its bakelite insulating washer replaced by a large brass washer. The battery switch, S.W., next, should be mounted. Start the wiring by joining the earth terminal to the earth wire and the aerial terminal to the green lug on the coil AER.

Solder one lug on the .0001 mfd. condenser, C3, and one lead of the 50,000 ohm resistance, R2, to the OG lug on the socket V2. The other lead on R2 joins to the earth wire, whilst the remaining lug on C3 carries a lead joining to the white lug on the coil OSC. The red lug on the RF coil carries one lead of the 25,000 ohm resistance, R3, the Red lead from IF2, and a lead which joins to the top left-hand lug on the battery socket, BATT. The remaining lead on R3 joins to the red lug on the coil OSC. From the bottom left-hand lug on the BATT socket a lead is taken to one contact on the switch, S.W. The other diagonally-opposite contact on SW carries a lead which joins to the earth wire.

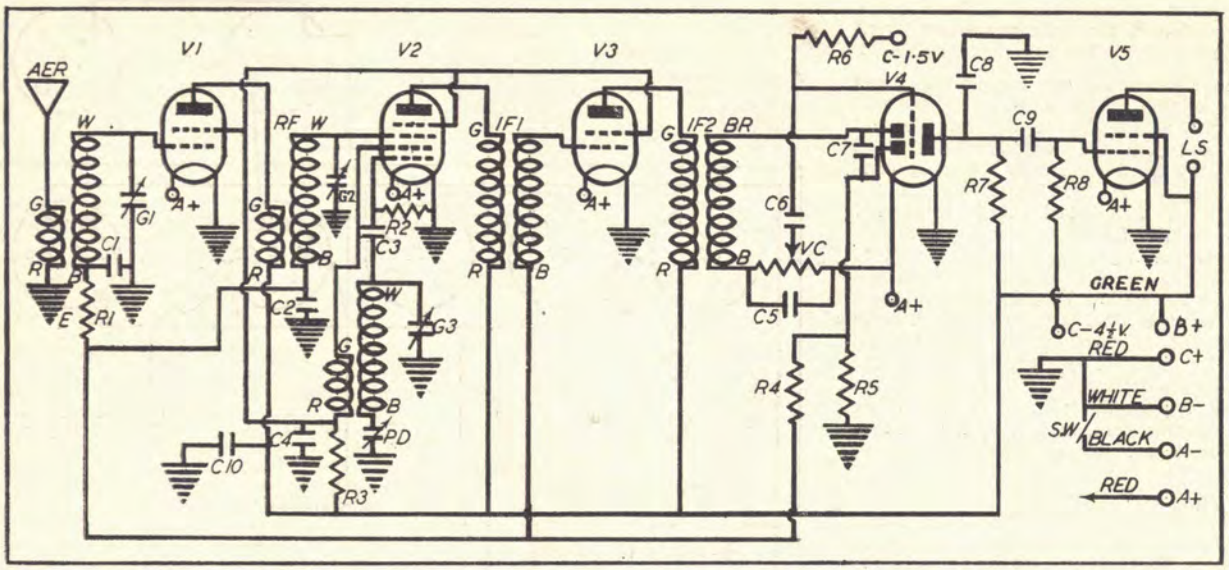
From the D lug on the socket V4, to which already has been soldered one lead of the 1 megohm resistance, R5, join one lead of the 1 megohm resistance, R4. The remaining lead of R4 joins to the Black lug on the RF coil. This finishes the third stage of the wiring.

**The Second Easy Step in the wiring of the 1936 Master Five.**




## Fourth Easy Step

Figure 4 contains details of the fourth and final stage of the wiring. Mount the volume control potentiometer, VC, and connect the .0001 mfd. condenser, C5, across the outside pair of lugs on this control. Join one of the outside lugs of VC to the positive (unearthed) filament lug on the socket V4. The Black lead from IF2 should be joined to the other outside lug on VC. This lead should be enclosed in braided cable, the

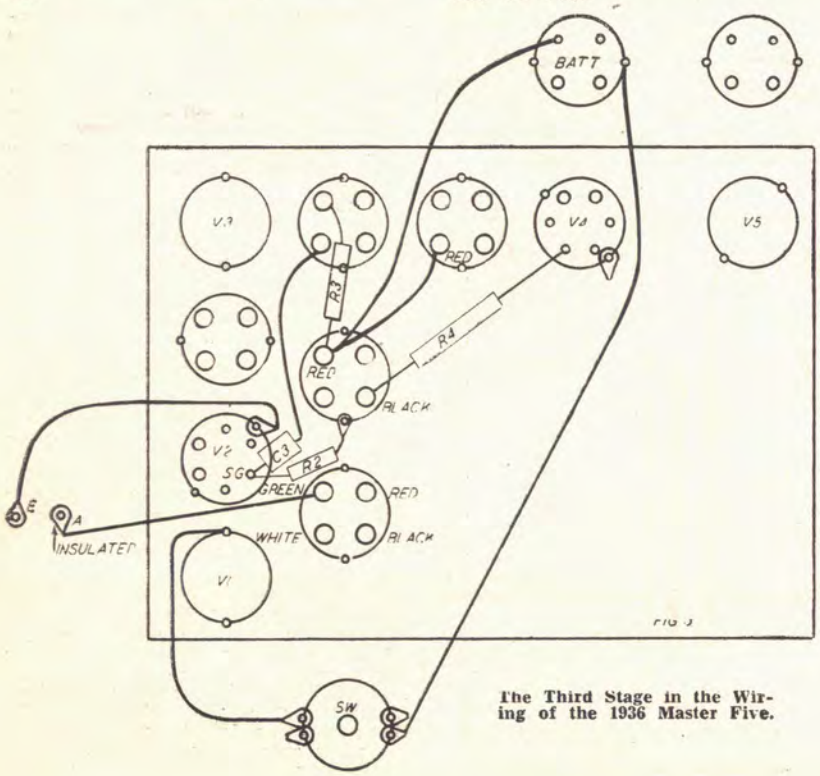



**The schematic circuit diagram of the 1936 Master Five.**

braiding of which is earthed to one of the solder lugs. The centre lug on VC is joined by means of a similarly metal braided wire to one lug on the .001 mfd. condenser, C6. The other lug on this condenser and one lead of the 1 megohm resistor, R6, should be soldered to the G lug on the socket V4.

The other lead on R6 should be provided with an eight inch length of Blue wire, which is pushed through the same chassis hole as the other "C" battery connections and carries the 1½ volt negative "C" supply. One lug of the .01 mfd. condenser, C9, is soldered to the P lug on the socket V4. The other lug on C9 joins to the G lug on the socket V5.

Turn the chassis right side up and fit grid clips to the leads coming out of the AER, RF and IF1 cans. Braid the leads from RF and IF1 and earth the braiding. Mount the "C" battery and make the connections to it. (Red to C plus, Blue to negative 1½, and Green to negative 4½.) Fit the battery plug in position and plug in the loud speaker. Next plug in the valves, place the screening cans over V1, V2 and V3, and attach the grid clips to the respective valves. Connect the Red and Black leads from the battery plug to the positive and negative accumulator terminals respectively and switch on the set. Carefully observe the valve filaments to see if they are alight




**The Third Stage in the Wiring of the 1936 Master Five.**

Remove the Red and Black wires from the accumulator and replace them with the Green and White wires. If the valve filaments still glow something is wrong with the wiring and the set should be carefully checked and the mistake rectified before the "B" batteries are connected. If everything is in order when this test is made, remove the Green and White leads from the battery and connect the "A" and "B" batteries in accordance with the diagram Fig. 5. It is advisable to use the fuse lamp shown in the "B" negative lead, as this renders it almost impossible for valves to be blown out due to accidental short circuits.

Never pull out or push in the battery plug without first disconnecting the batteries. With the set operating satisfactorily we can proceed with its alignment. Tune to a position between 10 and 15 on the dial and endeavor to bring in a station such as 3XY. Control of the tuning position of this station can be obtained by adjusting the trimmer condenser on the Oscillator, G3, section of the gang. Next adjust the r.f. gang trimmer, G2, for loudest signals, and finally adjust the trimmer on the aerial gang. This is merely a rough preliminary adjustment.

If the receiver will not oscillate reverse the Red and Green connections on the oscillator coil. The presence or otherwise of oscillation in the mixer tube can be detected by shorting to earth the fixed plates of the oscillator section of the gang condenser. If a good healthy click is heard in the loud speaker when this is done the valve is oscillating. No click indicates that the tube is out of oscillation. The Red and Green leads on the R.F. coil also can sometimes be reversed with good effect.

## Coil and Resistor Color Codes

Extra to the four color coded lugs each coil has a type code as follows:—

Aerial—Red spot.
R.F.—White spot.
Oscillator—Yellow spot.

These spots are inside the coil formers.

The white leads out of top of the aerial and R.F. coils go to the grid caps for the 1C4 and 1C6 respectively.

**I.F. Transformers.**—The first I.F. stage, which is mounted next to the 1C6, has a black lead brought out of the top. This goes to the grid cap of the second 1C4.

The second I.F. stage has four leads out of the bottom and none out of the top.

**The Color Code is:—**
Black out of top grid.
Black out of bottom A.V.C.
Red—"B" Positive.
Green—Plate.
Brown—Diode.

**Carbon Resistor Color Code:—**

| VALUE. | BODY. | END. | DOT. |
|---|---|---|---|
| .1 megohm | Brown | Black | Green |
| .1 megohm | Brown | Black | Yellow |
| .5 megohm | Green | Black | Yellow |
| .25 megohm | Red | Green | Yellow |
| 50,000 ohm | Green | Black | Orange |
| 25,000 ohm | Red | Green | Orange |

**Battery Cable Connections:—**
Red—"A" plus.
Black—"A" negative.
White—"B" negative.
Green—"B" plus.

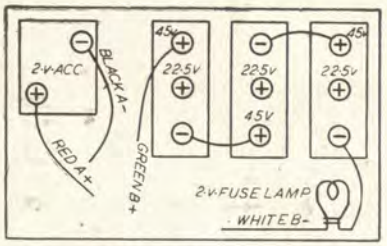
As the receiver is fitted with automatic volume control it is desirable that this be eliminated in order that a definite line-up of the tuning circuits may be obtained. All that is necessary is to unsolder the R4 lead connected to the D lug on V4 and to connect this R4 lead to the earth wire. Having done this, re-tune the set to the station (3XY or one on a similar wave length) already selected, and make very careful adjustments of the RF and AER trimmers until maximum reception is obtained.

It is desirable that these adjustments be carried out with the volume control set well back in order that small changes in intensity may be more easily noticed. When the receiver has been trimmed properly at the bottom end of the dial tune up to 3AR, 7ZL or 2FC, and adjust the padding condenser, PD, until best signal strength is obtained. Start by screwing the padding condenser hard down, and then open it about two turns. As the padding condenser set screw is being adjusted rock the tuning condenser dial back and forth over two or three degrees, noting the padding condenser setting which gives loudest signals and leaving matters at that.

Having aligned the tuning circuits, tune the receiver to a station either right at the bottom or right at the top of the dial, picking one which is not subject to serious fading.

With an insulated screwdriver carefully adjust the intermediate frequency transformers for loudest signals. Note that any adjustments will be fractional and hardly ever will necessitate more than a quarter turn of the trimmer condenser screws on the transformers. Start off with the second i.f. transformer, IF2, and adjust the trimmer condenser on the secondary side, i.e., that connecting to the 1B5 diode-triode tube. Next adjust the primary side of IF2, and then adjust the second of IF1. Don't touch the primary of IF1. These adjustments must be carried out with the transformers still housed in their screening cans. An insulated screwdriver, or one which has a piece of adhesive tape wrapped around its shaft, is necessary to avoid short-circuiting the "B" battery when adjusting the primary of IF2. When these adjustments have been completed unsolder the lead of R4 from the earth wire and replace it on the D lug of V4 from which it was taken.

This completes the whole job, and, if

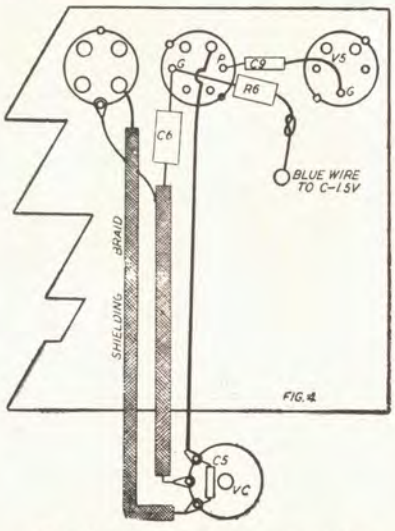



**This diagram depicts the correct hook-up connections for the "A" and "B" batteries.**

the instructions have been followed faithfully, the set builder of The 1936 Master Five will have a receiver of which he can be justly proud. Highly sensitive, selective enough for all present day conditions, exceptionally economical in "A" and "B" battery consumption.

## The List of Parts

**Coil Kit: One special Master Five coil kit, with three gang tuning condenser to suit.**
**C1, C2, C4; .1 mfd. fixed condensers.**
**C3, C5, C8; .0001 mfd. fixed condensers.**
**C6, C7; .001 mfd. fixed condensers.**
**C9: .01 mfd. fixed condenser.**
**C10: .5 mfd. fixed condenser.**
**IF1. IF2; 175 k.c. intermediate frequency transformers.**
**L.S.: Dynamic Speaker to suit ID4 (Rola.)**
**R1; 100,000 ohm resistor**
**R2; 50,000 ohm resistor.**
**R3; 25,000 ohm resistor.**
**R4, R5, R6; 1 megohm resistors.**
**R7; 250,000 ohm resistor.**
**R8; 500,000 ohm resistor.**
**S.W.; Rotary snap switch.**
**VC; 500,000 ohm potentiometer.**
**Valves: Two 1C4's, one 1C6, one 1B5, and one 1D4, with sockets to suit (Radiotron).**
**Sundries: 4 pin socket and plug, 4-way battery cable, 6 yards belden wire, nuts, screws, chassis, measuring 12¾ inches by 8¾ inches by 3 inches, three valve shields, four terminals, dial.**




**The fourth and final stage of the wiring. Note that the two leads taken from the volume control are enclosed in metal braided shielding.**

# COUNTRYMAN'S DUAL-WAVE FOUR

(Continued from page 9)

ceiver as follows: Join the grid lug on the modulator grid coil to the 2SW lug on the wave-change switch. Take the earth lug on this coil to the minus 3-volt lug on the bias resister, R9, and to one lead on the .1 mfd. condenser, C1. The other lead on C1 joins to earth as does the earth lug on the short-wave aerial coil. The aerial lug on his coil is joined to the 1SW lug on the wave-change switch. The grid lug on the oscillator grid coil joins to the 4SW lug on the wave-change switch the other lug on this coil being wired to the unearthed side of the short-wave padding condenser, PD (which has the .003 mfd. fixed condenser connected in parallel with it.) The plate lug on the oscillator plate coil goes to the 3SW lug on the wave-change switch, the other lug on this coil being joined to that lead of the 35,000 ohm resistor, R2, which already carries a wire from the broadcast oscillator plate coil.

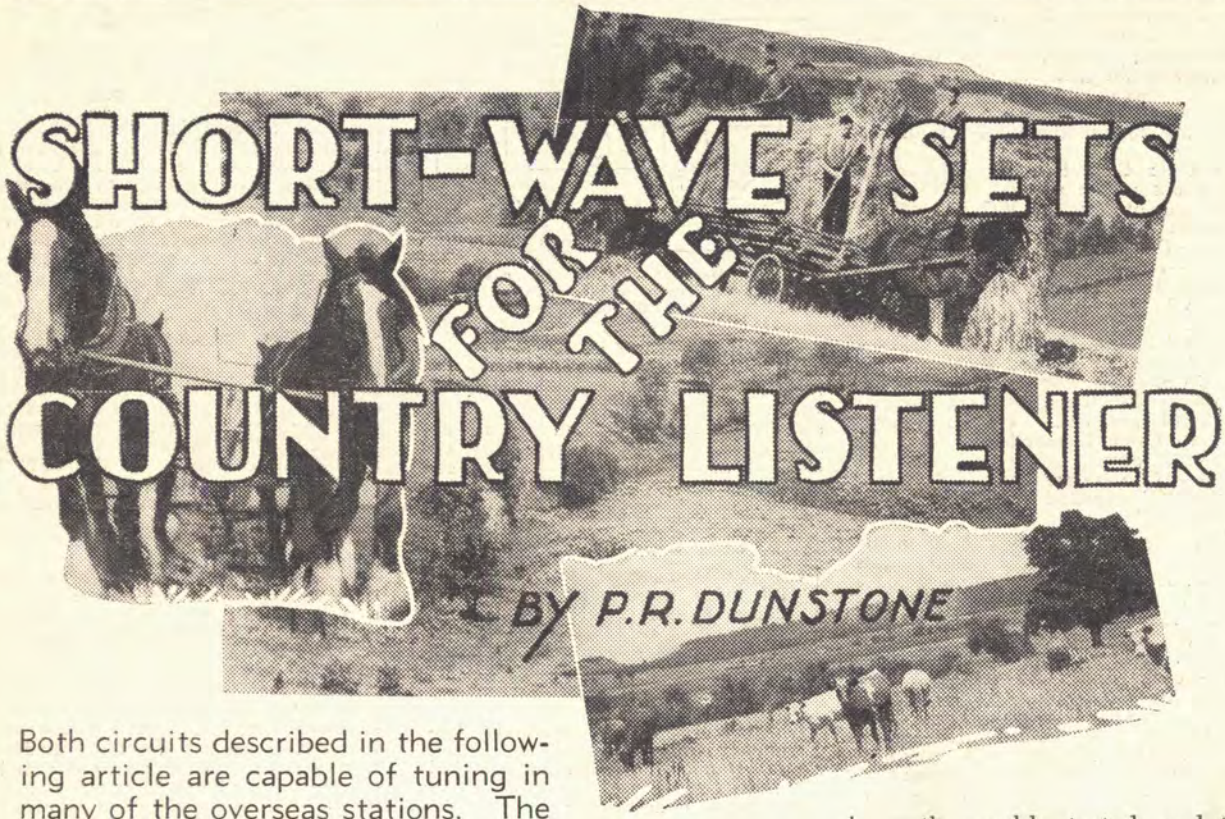
This completes the wiring of the short-wave section of the receiver and all now is ready for the set's try-out on the short wave band. Assuming that the set has already been made to function satisfactorily on the broadcast band, and that the i.f. amplifier has been tuned to peak, set the wave-change switch to the short-wave position and tune the set to the bottom end of the dial. Endeavor to pick up a code or phone station and adjust the oscillator trimmer almost to its "all-out" setting. This adjustment may best be carried out with a screwdriver made of a piece of bakelite. Be sure when making any adjustments to the short-wave trimmers that you do not press down on them, for small capacity changes such as those introduced by pressure can have a devastating effect on the alignment of the receiver.

When the oscillator trimmer has been fixed adjust the s.w. modulator trimmer for loudest signals. Next tune the set to the top end of the band, selecting a code station around 45 metres, and adjust the padding condenser for loudest signals. It will not be necessary to make large adjustments to the gang condenser itself during this adjustment of the padder.

When the receiver has been properly aligned, and providing that the coil specifications have been adhered to, it will be found to have a short wave tuning range from 18.5 metres to 51 metres, thus taking in the four principal short-wave bands

The set's short-wave sensitivity will be found to be phenomenally high on the lower short-wave bands, but, like all dual-wave receivers, to fall off on the upper wave-lengths because of the inefficient inductance-capacity ratio. This failing can be cured to some extent by the use of a high impedance coupling system consisting of a standard high impedance broadcast type aerial bobbin, from which some 140 turns have been removed, and a link coupling of one turn.

Tests with the original receiver have proved it to be exceptionally sensitive on the short-waves — its broadcast performance already has been dealt with— and capable of tuning in overseas stations in both Europe and America at good loud speaker strength. The ease with which these results can be obtained should recommend the Countryman's Dual-Wave Four to expert and novice alike.



# SHORT-WAVE SETS FOR THE COUNTRY LISTENER

BY P.R. DUNSTONE

Both circuits described in the following article are capable of tuning in many of the overseas stations. The sets have been primarily designed to enable the beginner to break into another interesting field in radio.

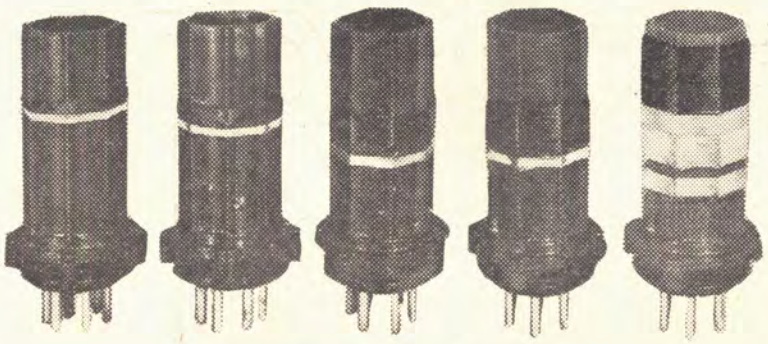
TO many listeners the short-waves have given thrills that are not to be forgotten. There are others, however, to whom the word "short-wave" conveys some highly technical intricacy, which is beyond their understanding. Another fallacy held by many readers is that considerable expense is involved in the building of a set which will tune in overseas transmissions. It is because of these erroneous ideas of short-wave receivers that many radio enthusiasts, who would ordinarily possess a short-wave set are inclined to ignore what is probably one of the most interesting sides of radio.

Although short-wave radio has made great strides in recent years, there is still much to be learned about it. We feel sure that the experimenter who is prepared to build either of the two circuits described in this article will be amply repaid from the entertainment and thrills he will get from the reception of overseas stations.

Both of these receivers have been thoroughly tested, and the results which have been obtained on them are highly satisfactory when one considers the size of the designs.

On studying the schematic circuit diagrams of the two receivers, it will be seen that figure 1

## COIL WINDING DATA



A photograph of the Original Coils.

| W/L Metres | Grid Winding | Reaction Winding | Aerial |
|---|---|---|---|
| 15.7 to 24 . | 4 | 5 | — |
| 24 to 37.5 . . | 7 | 7 | — |
| 37.5 to 62 . . | 13.5 | 9 | — |
| 60 to 90 . . . | 23 | 10 | — |
| 220 to 600 . . | 97 | 25 | 15 |

All coils are wound in the same direction and on Marquis 1¼ inch diameter ribbed formers.

All grid windings are made with gauge 22 enamel covered wire, whilst the reaction coils are wound with gauge 32 D.S.C. wire.

The aerial winding on the broadcast coil is wound with gauge 34 D.S.C. wire.

is a one-valve adaptor which is suitable for plugging into the detector valve socket of a standard broadcast receiver.

By this means it is possible to make use of the audio amplification of the ordinary broadcast set to boost the signals received by the adaptor. The tuning range of this short-wave adaptor covers from 15.7 metres to 90 metres with four coils. A type 30 triode valve is used in a conventional regenerative detector circuit, and the aerial is coupled to the grid of the tube through a 3-plate midget condenser.

In the case of Figure 2, the reader will note that a multi-element valve, the type 19, has been employed. This valve consists of two triodes in the one envelope, and when used in conjunction with a high ratio transformer, astonishing gain can be obtained from this circuit arrangement.

DIFFERING from Figure 1, this set is a self-contained receiver, and has been designed mainly for headphone results.

Before commencing with the constructional description of these sets, it may be wise at this point, in order to avoid the disappointment of readers who may build either of these designs to bring under notice a point which is invariably overlooked by those who are about to break into the short-wave field. This is, that the majority of short-wave listeners do not pay any attention to the various station schedules, with the result that in many cases they become disheartened through lack of results, when often the stations have not been on the air when they have been operating their receivers.

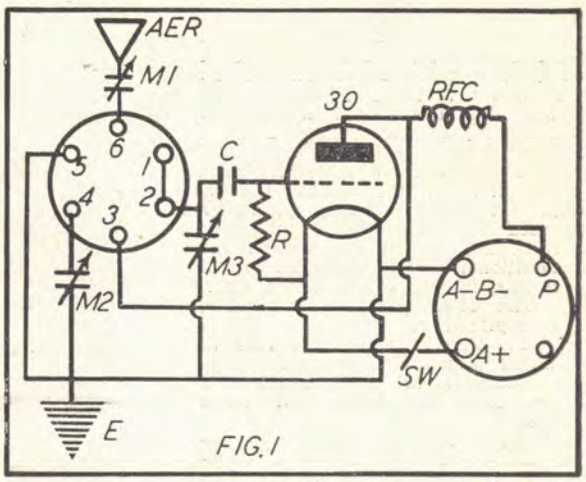
For this reason we strongly advise readers to study the short-wave notes which are published in The Listener In each week, and make certain that they are operating at the correct times for the desired stations.

Another point which must be thoroughly appreciated is that the quality of reception varies according to the season of the year, atmospheric conditions, and the time at which the station is broadcasting. Notwithstanding this, the number of successful receptions definitely compensates for the number of poor ones. If it is found that overseas stations are being received poorly on one band, it is only a matter of plugging in another set of coils when it is quite likely that the reception will be improved a hundredfold.

Briefly, we may say that the final results obtained by a listener on short-waves depend on four things — the receiver used, the accessories, the location, and the skill of the operator. By accessories we mean such things as the aerial and the earth, and the quality of parts used in the set. These items are far more important on short waves than on the broadcast band, and they must be given every attention.

In order to secure the maximum efficiency from these circuits, plug in coils were used in preference to the switching arrangement, for it must be realised that in circuits of this description, where it is of utmost importance to obtain every atom of pick-up and efficiency, that it would not be wise to include a switching system which would result in additional losses due to poor contacts on the switch.

In the circuit in which the type 19 valve is used, an extra coil has been included to allow the receiver to be turned over the broadcast band. Where, with the one valve adaptor, a 23-plate midget condenser is used for tuning over the short-wave bands, it would be impossible to cover the complete broadcast band with a single coil with this size condenser. For this reason a standard single gang Airway condenser has been employed in the circuit of Figure 2.




**The one-valve adaptor circuit using a type 30 tube.**

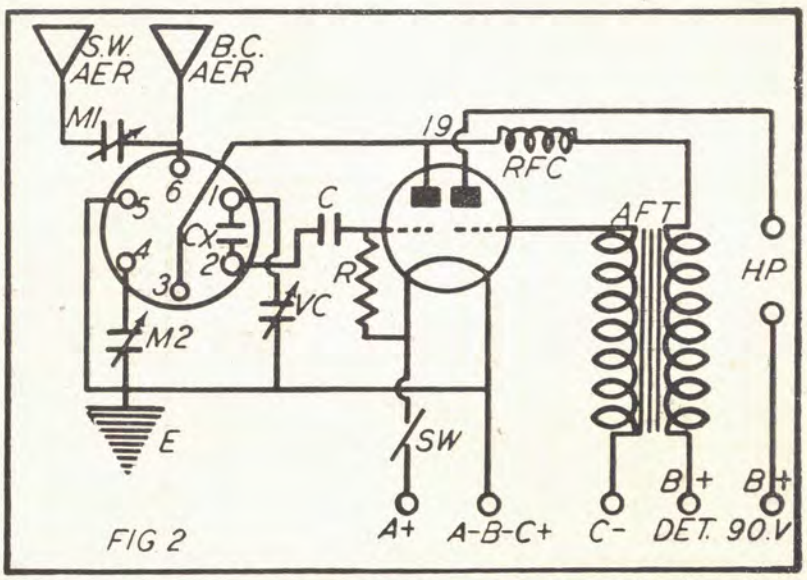
## LIST OF PARTS

**AFT; Audio frequency transformer. Ratio, 5 to 1.**
**C; .00025 mfd. fixed condenser.**
**CX; .00025 mfd. fixed condenser.**
**M1; 3 plate midget condenser.**
**M2, M3; 23 plate midget condensers.**
**R; 5 megohm resistor.**
**RFC; Radio frequency choke.**
**SW; Rotary snap switch.**
**VC; Single gang Airway variable condenser.**
**Valves: Type 30 for adaptor, and type 19 for figure 2 circuit (Ken-Rad, Mullard, Philips, Radiotron).**
**Sundries: Coil formers and wire (see text); 6 yards belden, one 4 pin plug, one vernier dial, three knobs, five terminals, rubber grommet, nuts, screws and general hardware, one six pin socket.**

In order to use the same tuning condenser for the short-waves as that used on the broadcast band a .00025 mfd. fixed condenser, CX, is arranged in the circuit so that it will automatically be connected in series with the larger condenser, VC, when the short-wave coils are plugged into the coil socket.

It is important in small sets of this description that the reaction is working efficiently, for it is due to this feedback in the detector valve plate circuit that the ultimate success of either of these two receivers will depend. It is necessary to arrange the winding of the reaction coils so that the adjustment of the reaction condenser, M2, will take the detector tube in and out of oscillation smoothly, for until this condition is reached, the maximum results cannot be expected from the set.

On referring to the photographs of the original adaptor and the one valve receiver, it will be seen that layout adopted in both cases is practically self-explanatory. In the case of the adaptor, considerable space has been left at one end of the chassis. This space was al-




**This diagram shows how a type 19 valve is used as a detector and audio-amplifier**

lowed as both the adaptor and the receiver were built on the one chassis, it being necessary for the extra space in order to mount the audio transformer.

The chassis is made from gauge 16 aluminium and measures 8 inches by 6 inches by 2½ inches, while the front panel measures 8 inches by 7 inches. Only the coil and valve socket are mounted on top of the chassis. On the adaptor the 23-plate tuning condenser is secured in the centre of the front panel. In the case of the receiver the only additional part mounted on top of the chassis is the audio transformer, AFT. The 23-plate midget condenser, M3, is replaced by the airway single gang, VC. On the right-hand side of the chassis is mounted the three-plate aerial condenser, M1, and on the rear side are seen the aerial and earth terminals.

When assembling the parts of the receiver using the type 19 valve, additional terminals must be mounted on the rear side of the chassis. The correct order of them is (from left to right), the headphone terminals, the broadcast aerial terminal, the short-wave aerial, and the earth terminal.

In both receivers the battery cable and leads to the adaptor socket are taken through a rubber grommet at the right-hand end on the rear side of the chassis.

Looking beneath the chassis, the reaction condenser, M2, and the battery switch, SW, are seen mounted on the front side. With the exception of the radio frequency choke, RFC, all remaining parts are wired directly into the circuit.

Small soldering lugs should be placed at convenient points beneath the chassis, in order to permit a common earth wire to be carried throughout the set, and, finally, direct to the earth terminal. On no consideration should the builder rely upon the actual aluminium for his earth return, as it will be found that after the set has been in operation for a few months that its sensitivity will commence to fall off, due to poor earth returns.

A vernier dial should be mounted on the main tuning condenser on the front panel.

The next step in the building of either of these receivers is the winding of the coils. The same coil data is applicable for the adaptor or the receiver.

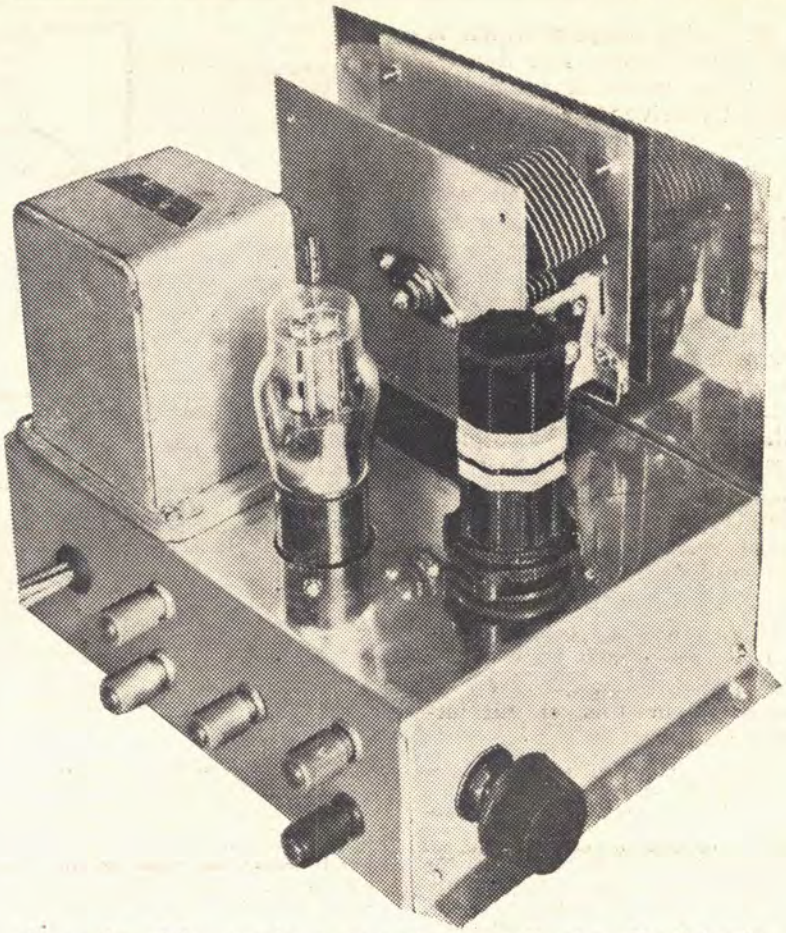
Five coils are required, and they are wound on Marquis ribbed 1¼-inch diameter formers. In the case of the adaptor, only the four coils which cover from 15.7 metres to 90 metres are needed, the additional coil which is used for tuning over the broadcast band being used only in the receiver, using the single gang airway condenser. The coils should be carefully wound and the ends of them well soldered in the prongs at the bottom of the formers.

The number of turns complete with the different wire gauges are shown in the accompanying coil data table.

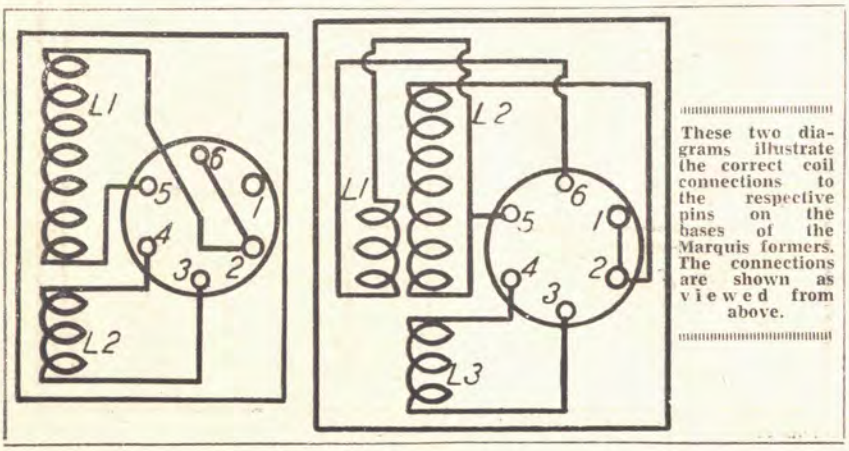
The only windings which may require a little manipulating with are the reaction coils. Due to slight changes in the characteristics of every valve and receiver, it may be necessary to either add or reduce the number of turns on the reaction winding until a condition in which the tube will go in and out of oscillation smoothly is obtained.

The accompanying diagrams showing the correct pins to which the various leads must be taken are drawn as they would appear on looking down on the formers.

A space of approximately 3-16ths of an inch should be allowed between the grid winding and the reaction winding, whilst in the case of the broadcast coil the aerial winding should be wound over the earth end of the grid winding, L2.



**A rear view of the one-valve receiver using a type 19 valve. The high-ratio audio transformer is seen in the background. The terminals mounted on the rear of the chassis are (from left to right): The headphone terminals, the broadcast aerial terminal, the short-wave aerial terminal, and the earth terminal. The three-plate midget condenser is shown mounted on the right hand side.**




**These two diagrams illustrate the correct coil connections to the respective pins on the bases of the Marquis formers. The connections are shown as viewed from above.**

## Wiring in Words

In order not to confuse the builder, we will describe the wiring of both of these receivers, separately. Commencing with the adaptor circuit, Figure 1, a lead should be taken from the aerial terminal on the rear side of the chassis to one side of the three-plate midget condenser, M1. The other side of this condenser, M1, is soldered to No. 6 terminal on the coil socket. No. 5 terminal on the coil socket is wired direct to earth. No. 1 and No. 2 terminals on the coil socket are connected together, and a lead is taken from them to the fixed plates of the 23-plate midget condenser, M3, and to one side of the grid condenser, C.

The remaining side of condenser C3 is soldered to one end of R and to the

grid terminal on the valve socket. The other end of the grid leak, R, is secured to the positive filament terminal on the valve socket. The plate terminal on the valve socket is joined to one end of the radio frequency choke, RFC, and to No. 3 terminal on the coil socket. The remaining end of RFC is connected to the prong on the four-pin plug, which will correspond with the plate terminal on a valve socket.

A lead is carried from No. 4 terminal on the coil socket to the fixed plates of the reaction condenser, M2. One side of the battery switch is secured to the "A" positive terminal on the valve socket, whilst the other side of this battery switch, SW, is connected to the "A" positive prong on the four-pin plug. The negative filament terminal on the valve socket and the negative prong on the four-pin plugs are taken to earth.

A wire should be soldered to the movable plates of the reaction condenser, M2, the tuning condenser, M3, and joined to the common earth wire, to complete the wiring of this adaptor.

## Figure Two

One side of the aerial condenser, M1, is connected to the short-wave aerial terminal, and the other side of this condenser, M1, is soldered to No. 6 terminal on the coil socket. Another lead is taken from No. 6 terminal on the coil socket and secured to the broadcast aerial terminal mounted on the rear of the chassis.

The fixed condenser, CX, is wired between terminals No. 1 and 2 on the coil socket. The fixed plates of the tuning condenser, VC, are joined to No. 1 terminal on the coil socket. One side of the grid condenser, C, is soldered to No 2 terminal on the coil socket and the other side of this condenser, C, is connected to one end of R and to triode grid No. 1 terminal on the valve socket. The remaining end of the grid leak, R, is soldered to the "A" positive filament terminal on the 19 valve socket. A lead is secured to No. 3 terminal on the coil socket and taken to the triode plate No. 1 terminal on the valve socket.

One side of the radio frequency choke RFC is also connected to this plate terminal on the 19 socket. No. 5 terminal on the coil socket is wired to earth. No. 4 terminal on the coil socket is soldered to the fixed plates of the reaction condenser, M2, and the movable plates of this condenser and VC are both taken to earth. The remaining end of RFC is connected to the P terminal on the audio frequency transformer, AFT, whilst the B terminal on this transformer has a length of belden wire joined to it, which serves as the "B" positive detector battery lead.

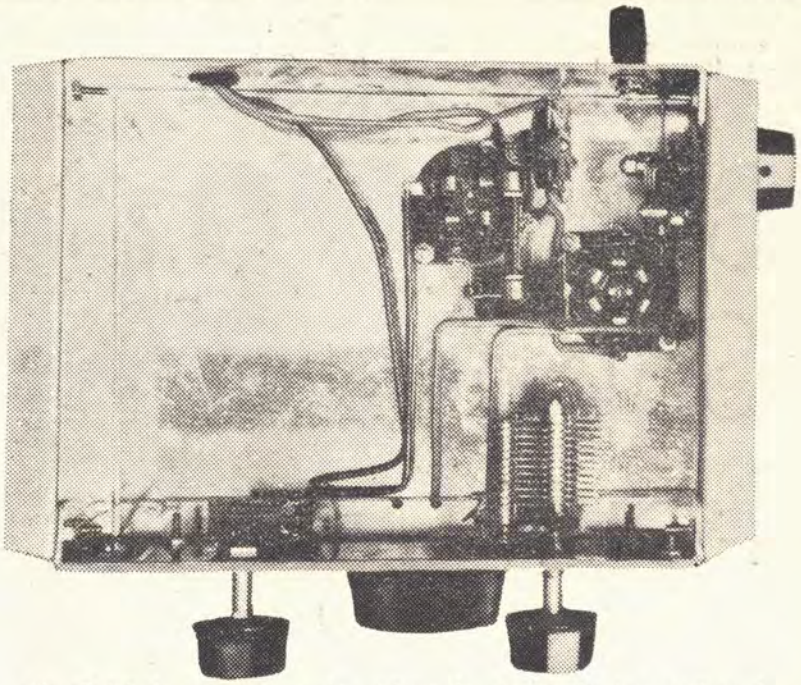
Triode grid No. 2 is soldered to the G terminal on the audio transformer, AFT, and the C or F terminal on AFT is connected to another of belden wire which serves as the "C" negative battery lead.

Triode plate No. 2 is joined to one of the headphone terminals on the rear of the chassis, and the other headphone terminal has another piece of belden wire secured to it. This lead serves as the "B" positive maximum battery lead. One side of the battery switch, SW, is soldered to the "A" positive terminal on the 19 valve socket, whilst another belden lead is connected to the other side of the switch, and serves as the "A" positive battery connection.

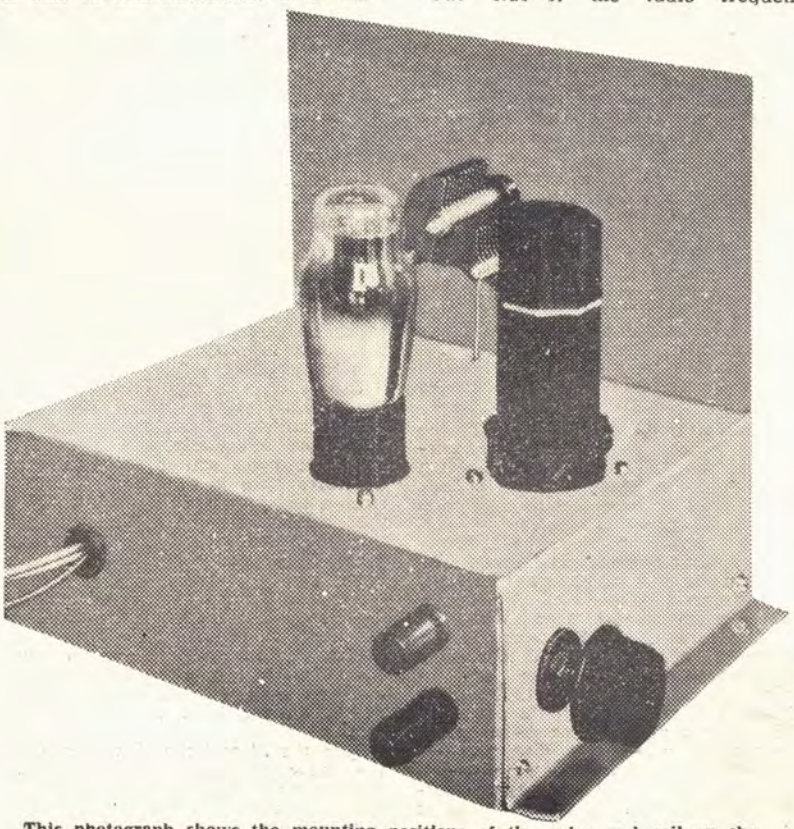
The "A" negative filament terminal on the 19 valve socket is joined direct to earth. A length of belden wire is connected to the common earth wire, and taken through the rubber grommet.

This lead serves as the "A" negative, "B" negative and "C" positive battery connections.

No difficulty should be experienced in placing either of these two receivers in operation. In the case of the adaptor, the valve will receive its "A" and "B" supply from the particular receiver with which it is used in conjunction, but in the case of the receiver (Figure 2), the following voltages are the correct potentials which should be applied to the valve. Two volts are required for the filament, 45 volts for the detector section of the 19 and 90 volts for its audio section. The bias should be 4½ volts.

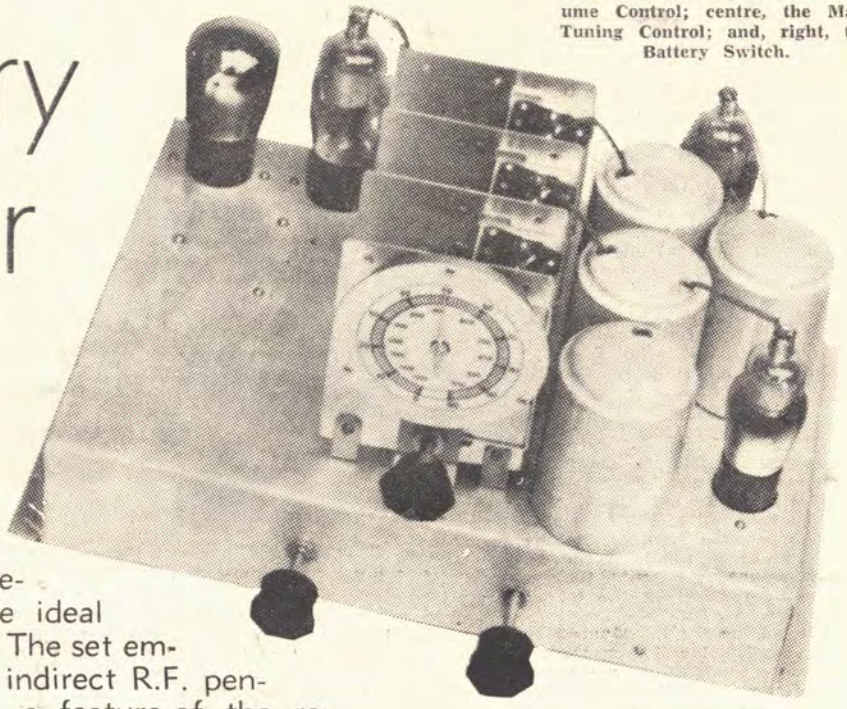


**To all intents and purposes the underneath view of the two receivers is identical. This photograph depicts the layout and wiring of parts below the chassis.**



**This photograph shows the mounting positions of the valve and coil on the short-wave adaptor chassis.**

# The Pre-Selector Battery Super Four



This view of the receiver shows the layout of components on the front and top of the chassis. The three controls are, left, the Volume Control; centre, the Main Tuning Control; and, right, the Battery Switch.

A remarkably sensitive battery operated receiver that should prove ideal for the country listener. The set employs one of the latest indirect R.F. pentodes in the mixer stage, a feature of the receiver's current consumption. The total response of this design is most pleasing.

**By H. R. SETFORD**

DESPITE many opinions to the contrary, a real need exists for high selectivity in battery receivers which are to be used in country areas.

We receive many complaints from country listeners who are unable to obtain selectivity from their present sets. It seems that most of the straight T.R.F. sets described through these columns, when used in areas where provincial "B" Class stations operate, are not sufficiently selective to receive the lower-powered stations without interference.

To aid these listeners, we have developed an economical 4-valve battery superheterodyne which is selective enough to cope with the worst interference likely to be experienced by the country listener, and at the same time which possesses more than sufficient sensitivity for average needs.

In designing a receiver of this type, one of the main considerations is to obtain reasonable power output combined with economical "B" battery consumption.

This has been achieved in this instance by the use of a PM22A pentode in the output stage.

This valve is capable of good power output at low-plate voltages.

In order to obtain the greatest sensitivity for a given number of valves, we resorted to the use of the popular superheterodyne circuit.

Because of the superior gain obtainable from an intermediate frequency of 175 k.c., we selected this frequency in preference to the more common 465 k.c.

In order still further to increase the set's sensitivity, we have applied reaction to the leaky-grid detector by means of the reaction coil and condenser, L6 and R.C.

The choice of 175 kc as the intermediate frequency made necessary the use of a pre-selector before the mixer in order to prevent any double-spotting, and, in addition, to provide that much-needed selectivity.

The mixer valve in this receiver is one of the new 2-volt indirectly heated type 15 R.F. pentodes, operated in an autodyne connection. The use of this valve in preference to the better known pentagrid converters was mainly due to its economy in battery consumption.

The use of the type 15 results in the saving of at least 3 milliamperes of current from the "B" batteries, and when the receiver is operated for long periods this represents a considerable reduction in the total current consumed.

As mentioned previously, the intermediate frequency chosen was 175 k.c. The overall gain at this frequency, even with the pre-selector ahead of the mixer valve, is much greater than that obtainable at any higher frequency.

A type 34 valve is used as an intermediate frequency amplifier, and is coupled to the mixer by I.F.1. Both I.F.1 and I.F2 are wound with litz wire, which offers a much lower resistance to radio frequency currents than the ordinary enamel wire usually employed.

This results in greatly improved selectivity, as well as a decided increase in gain.

It was decided to use leaky grid detection in preference to anode-bend, because of the former's better sensitivity on weak signals, and a type 32 valve is used in this connection.

Reaction is applied to the 32 by means of L6 and R.C. R.C. is a compression type condenser, which is set at an optimum position for all stations. This does away with the necessity for an extra control.

The detector is resistance coupled to the output valve, which is a PM22A penthode, and has a condenser, C7, placed across its output terminals for tone correction purposes.

The volume is controlled by varying the grid voltage of the 34, which, as it is a variable mu tube, enables this to be done most effectively.

The voltage source for this volume control system is a 15 volt "C" battery from a tapping of which also is supplied the grid bias for the PM22A. This battery may be of the light duty type, as there is practically no current drawn from it.

A switch is placed in the common A-B-Cx lead. This switch also breaks the C— lead to prevent this battery from discharging through the volume control. All the battery connections are taken to a six-pin plug, which fits a corresponding socket on the back of the chassis assembly.

Both the 34 and the 32 valves were of the new Radiotron non-microphonic variety, now being manufactured in Australia by the A.W. Valve Co. They proved themselves remarkably free from

the microphonic noises usually associated with this type of valve, and generally gave a highly satisfactory performance.

Considerable time and thought were necessary to produce a chassis which presents a very "clean" appearance and, at the same time, made it possible to keep all leads short and well spaced. If any departure from this design is necessary, the constructor should take particular care to see that the grid and plate leads are kept as short as possible, and that all other wiring is neat and as well spaced as the design allows.

In mounting V.C. make sure that its centre contact or arm is insulated from the chassis, or the control will not function and will result in the shorting of the "C" battery. Be sure, also, that the padder condenser, R.C., are insulated from the chassis. Valve shields were not found necessary in the original model, but it would be advisable for constructors to include them, as they will help greatly in keeping the set stable and free from unwanted feedback.

Particular care should be taken when purchasing the three-gang condenser and the necessary coils that these components are carefully matched.

The oscillator coil specifications are as follow:—

Secondary wound for an intermediate frequency difference of 175 k.c., with a tap taken at the 10th turn from the earth end. The primary should consist of 40 turns of fine wire wound over the earthed end of this secondary coil. Litz wound intermediate frequency transformers are specified, and I.F.2 must have a reaction winding, L.6, wound alongside its grid coil. Mica condensers should be used for both C.4 and C.5.

The other condensers may be of the paper dielectic variety. Select valve sockets which give a firm but smooth contact, otherwise considerable time will be spent in chasing elusive noises.

A six-way multi-colored battery cable will simplify the connection of the various batteries and prevent wrong connections which often result in burned-out valves.

A block type condenser containing three .5 mfd. condensers, C.2, C.8 and C.9, is used in the original receiver, but pigtail type condensers may be used and connected directly to their respective positions, if desired.

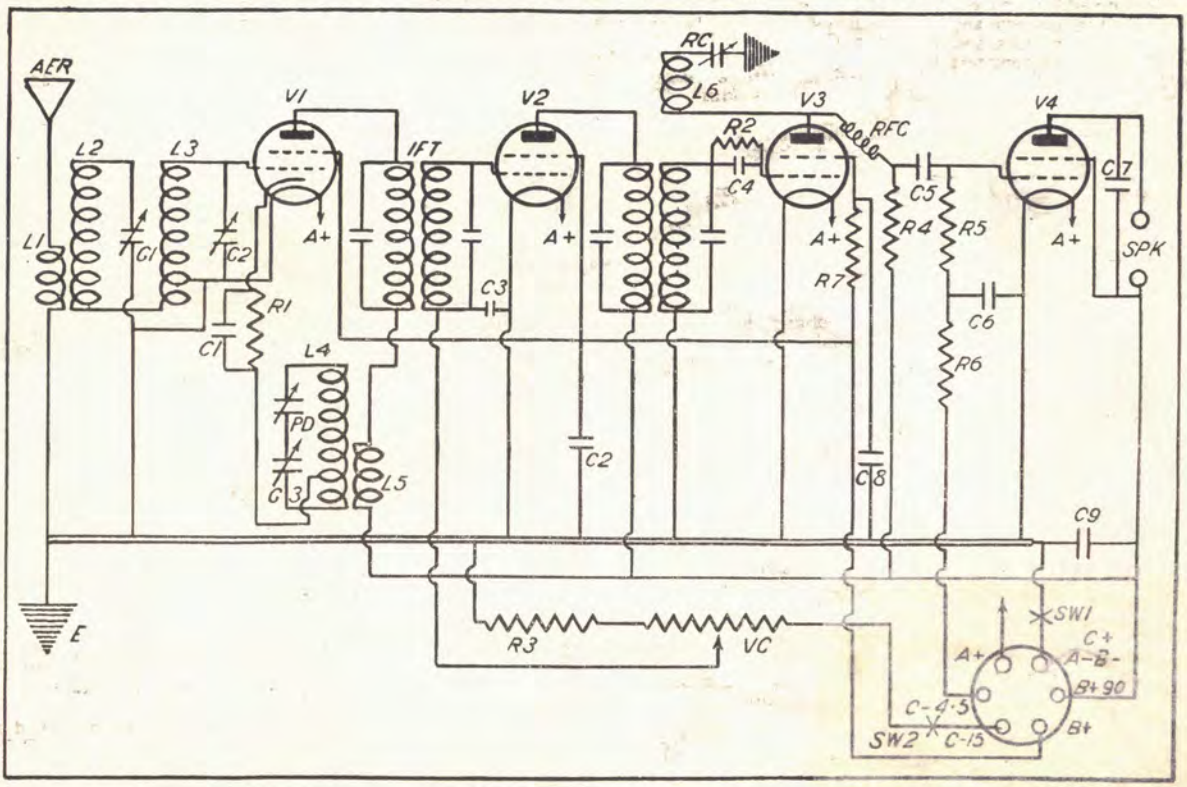
When all the components have been mounted the wiring may be commenced by connecting together one of the filament terminals on each socket with a piece of heavy gauge tinned copper wire. This is then connected to the earth terminal and all minor components requiring an earth connection may be joined to this tinned wire. The remaining filament terminals on each socket are now connected to one of the large pins on the battery socket (see Fig. 1). The other large pin of this socket connects to one side of SW1. The other side of SW1 is wired to chassis. Take the aerial terminals at the rear left of the chassis to their corresponding terminals on L1 and the remaining terminal on L1 to earth.

The beginning of L2 connects to the fixed plates of G1. The other end of L2 connects to the end of L3. The tap on L3 is wired to earth, whilst the beginning of the same coil connects to the fixed plates of G2 and to the grid cap on V1.

The cathode of V1 connects to one side of R1 and C1. The remaining terminals on these components are wired together and go to the tapping "Y" on the oscillator coil. L4. The beginning of L4 con-

## The List of Components and Schematic Circuit Diagram for the Pre-Selector Battery Super Four.

**Coil kit consisting of aerial pre-selector and oscillator coils. (See text).**
**C1, .1 mfd. tubular condenser.**
**C2, C3, C9, .5 mfd. condensers.**
**C3, C6, .1 mfd. tubular condensers.**
**C4, .00025 mfd. mica condenser.**
**C5, .02 mfd. mica condenser.**
**G1, 2 3, three-gang tuning condenser, complete with dial.**
**I.F.1, special litz wound intermediate frequency transformer.**
**I.F.2, special litz wound intermediate frequency transformer with reaction winding. Compression condenser to be supplied to suit this winding.**
**P.D., padding condenser.**
**R1, 450 ohm 20 m/a wire resistor.**
**R2, 3 megohm resistor.**
**R3, 15,000 ohm resistor.**
**R4, R6, 100,000 ohm. resistors.**
**R5, R7, 500,000 ohm resistors.**
**S.W.1, S.W.2, ganged battery switch sockets. 2-5 pin, 2-4 pin, 1-6 pin.**
**Speaker, Permagnetic to match P.M. 22a (Rola).**
**Valves, one each, 15, 32, 34, and P.M. 22a (Ken Rad, Mullard, Philips, Radiotron).**
**Chassis, 14in. x 10in. x 2½in.**
**V.c., 100,000 ohm. potentiometer.**
**Sundries, battery cable, six pin plug, aerial and earth terminals, hook up wire, nuts, bolts, etc.**
**Accessories, 2 volt accumulator, 90 volts B battery. 15 volt C battery.**



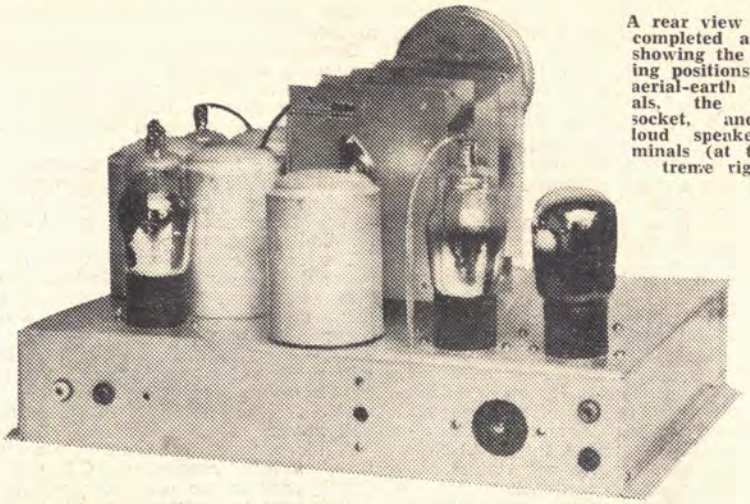
nects to one side of the padder condenser, PD, the other connection of which is wired to the fixed plates of G3. The remaining connection of L4 joins to earth. The top connection of L5 is wired to the B+ terminal of I.F.1, the P terminal of which connects to the P lug on V1. The remaining end of L5 connects to B+ on I.F.2, to one side of R4, and to one of the speaker terminals, which in turn is wired to the B+90 volt terminal on the battery socket.

The B+45 volt contact of this socket connects to one side of R7 and to the screen grid terminals of U1 and V2. From one of these terminals, a .5 mfd. condenser, C2, is wired to earth.

The remaining side of R7 connects to the detector screen grid terminal from which another of the .5 mfd. condensers, C8, is wired to earth. The plate of the intermediate frequency amplifier, V2, is connected to P on I.F.2. The grid lead on this transformer is wired to the joint af the grid leak and condenser, R2 and C4. The remaining contacts of these components connect together and are wired with metal braided wire to the grid cap of V3.

The F connection on I.F.2 is wired to earth. Care must be taken when connecting the reaction winding, L6. The outside connection of this winding joins to P of V3, the inside lead going to one side of RC. The other contact of RC connects to chassis. The P terminal of V3 is also connected to one side of R.F.C., the other contact of which is wired to the remaining side of R4 and one contact of C5. The other contact of C5 connects to G of V4 and one side of R5.

Join the remaining side of R5 to one side of R6 and C6. The other side of C6 connects to chassis while the vacant connection on R6 is wired to C minus 4.5 volts on the battery socket. The remaining contact of this socket is the C minus 15 volts and connects to one side of SW2. The other side of SW2 connects to one of the outside terminals of VC, the other outside terminal of which is wired to one side of R3.



**A rear view of the completed assembly showing the mounting positions of the aerial-earth terminals, the battery socket, and the loud speaker terminals (at the extreme right).**

The remaining side of R3 connects to chassis. The centre contact of VC goes to one side of C3 and also to F on I.F.1. The remaining side of C3 connects to chassis. The plate terminal of V4 connects to the remaining speaker terminal.

The screen contact of V4 connects to the B+90 lug on the battery socket from which the remaining .5 mfd. condenser, C9, is connected to earth. The battery cable may now be wired to the six pin plug.

Great care should be taken with these connections as a mistake here can burn out all the valves and ruin the batteries.

Fig. 2 shows the correct connections and should be followed carefully when wiring either the battery socket on the chassis or the plug to which the cable is attached.

After thoroughly checking all connections and when absolutely certain that everything is correct, the batteries may be connected, the valves inserted in their correct sockets, and the speaker, aerial and earth leads connected.

Turn the volume control to the full on position and switch the set on. On placing the moistened tip of your finger on the tip of V3, a loud humming sound should be heard from the speaker. If the set does not respond to this simple test, switch it off, and again check all connections. Assuming that the set is in order, open out the trimmers on G1 and G2, and turn the dial to the position of 15 degrees and adjust the trimmer of G3 until one of the lower wavelength stations is received.

If the reception of this station is accompanied by a loud squeal, loosen off the adjustments of RC until this ceases. Turn the volume control back until you can just hear the signals and adjust the gang condenser for loudest results.

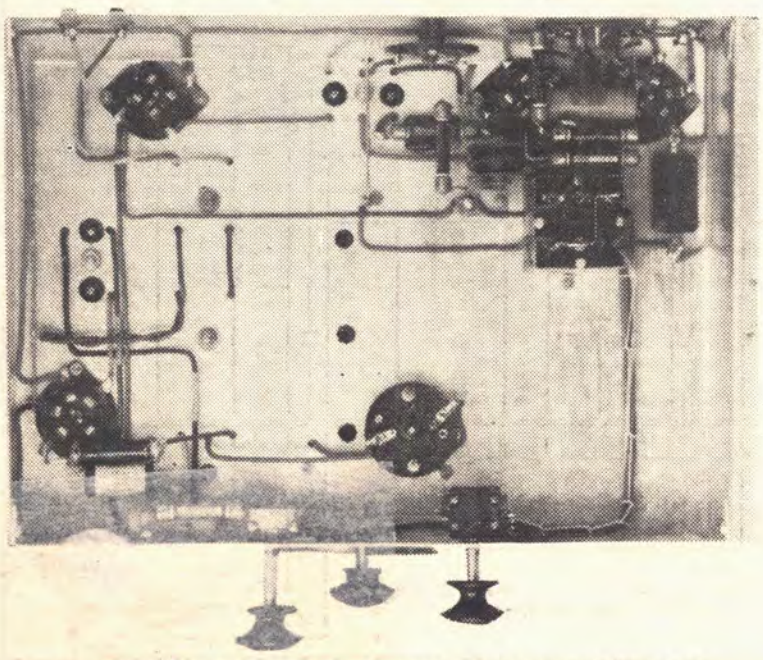
Now tune to 3AR, or, better still, to 2CO, and, with an insulated screwdriver, adjust the padder condenser. Gently rock the condenser dial over 2 or 3 degrees while performing this operation, to make sure that you are correctly tuned to the station, as any adjustments to the padder slightly alters the tuning.

When the padder has been adjusted for loudest signals, return to the lower station and try a slight readjustment of G1 and G2. On no account touch the trimmer of G3 after the padder has been adjusted, or else the whole of the adjustments will have to be repeated.

The intermediate frequency transformers will have been peaked at the factory, but in most cases a slight readjustment will improve the sensitivity of the set.

Tune in a station at the centre of the band, and with the volume control well back, adjust the trimmers of IF2 for best results. Do likewise with the trimmer for the grid of V2, but on no account touch the one for the plate of V1 or the whole cascade will be thrown out of line.

When all these adjustments have been carried out, the receiver should be in a fairly sensitive condition, and this may be still further improved by tuning a station well down on the dial and screwing the trimmer of the RC in until the receiver begins to oscillate.



**This photograph of the receiver illustrates the layout and wiring of parts beneath the chassis.**

(Continued on Page 44).


# The FIVE ONES Super-Het

A High Gain Five-Valve Super-heterodyne receiver which is capable of providing excellent reception in most country areas.

By A. K. BOX

MUCH of the difficulty experienced by country listeners in separating the transmissions of powerful broadcasters is undoubtedly due to the employment of hopelessly out-of-date receivers. On the other hand, with the present favorable receiving conditions due to Sun-Spot activity, it is found that even reasonably selective super-heterodynes are incapable of discriminating between stations separated from each other by as much as 10 kilocycles.

This difficulty has in some areas become more pronounced since the Postmaster-General's Department decided to alter the transmitting wave lengths of many of the Australian stations, and listeners are finding it well nigh impossible to separate two powerful broadcasters such as 5CK and 3AR.

Such a state of affairs would appear to reflect upon the technical capabilities of the set designer, but a little thought will show that this is not quite the case. To examine the position fully, let us take the example of a standard super-heterodyne receiver.

Contrary to the idea held by most home set-builders, the super-heterodyne depends for its selectivity upon the design of the intermediate frequency amplifier. Radio frequency amplification ahead of the mixed valve will increase the receiver's signal sensitivity, reduce the possibility of image interference, and improve the signal to noise ratio.

With a.c. operated receivers it is quite a simple matter to design, say, a seven valve super-heterodyne which employs an r.f. stage and two intermediate frequency stages. Such a design could be made so selective as to respond to sidebands only two kilocycles in width.

The battery receiver problem is not so easy to solve because, in the first place, the battery receiver must be economical to operate. This is not possible if a large number of valves is to be used. The battery set-designer, if he wishes to produce a highly selective receiver, must watch his P's and Q's because, in his efforts to achieve selectivity, he is liable to lose every other attribute of the ideal battery set.

THE receiver we shall now describe is one which has been designed to meet the requirements of the country listener who demands a highly selective receiver, which at the same time is sensitive, economical, and possesses reasonably good tonal qualities.

A glance at the schematic circuit diagram will show that it is a five-valve super-het. employing a mixer tube, two intermediate frequency amplifier tubes, a diode second detector and driver audio tube, and a final output pentode.

This set-up, we contend, offers the maximum performance obtainable from a given five battery valves. As selectivity was the set's chief requirement, the r.f. stage, which normally would be used, has been replaced by a second intermediate frequency amplifying stage. The intermediate frequency amplifier operates on a frequency of 175 k.c., because the lower intermediate frequency is inherently more selective than is the 465 k.c. i.f.

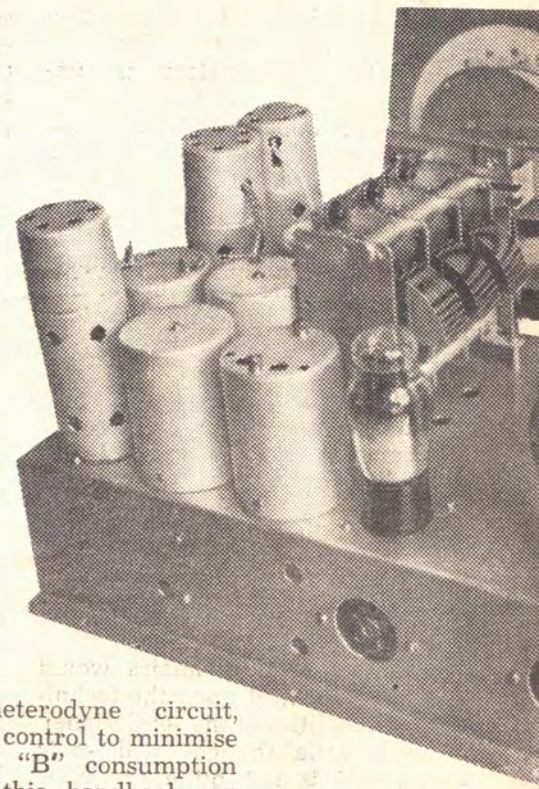
Due to the fact that no radio frequency stage is used ahead of the detector valve, the signal to noise ratio is not all that it might be, but efforts have been made to raise this ratio as much as possible. Image interference is reduced by the employment of a pre-selector circuit ahead of the modulator tuning, so that not only does the receiver possess good signal selectivity, but it has a high image ratio.

The signal to noise ratio difficulty has been tackled in [illegible] ways, first by the employment of impedance aerial coupling to tail off of [illegible] end of [illegible] by the [illegible]


# Ultra Modern HIGH GAIN V

# AUTOMATIC Volume Control

This modern receiver—the Velco Master Battery Five—opens a new radio era for the country listener. Knife-edged selectivity, amazing sensitivity and REAL tone quality will give the full benefits of the Commonwealth-wide radio network, and provide a more economical means of obtaining radio enjoyment.



## An Amazing BATTERY 5

Five employs an ultra-modern super-heterodyne circuit, tion valves. With automatic volume control to minimise it is particularly economical, the "B" consumption uctional details are given in this handbook, or int—FREE.

, Melb., Prahran, and Camberwell.

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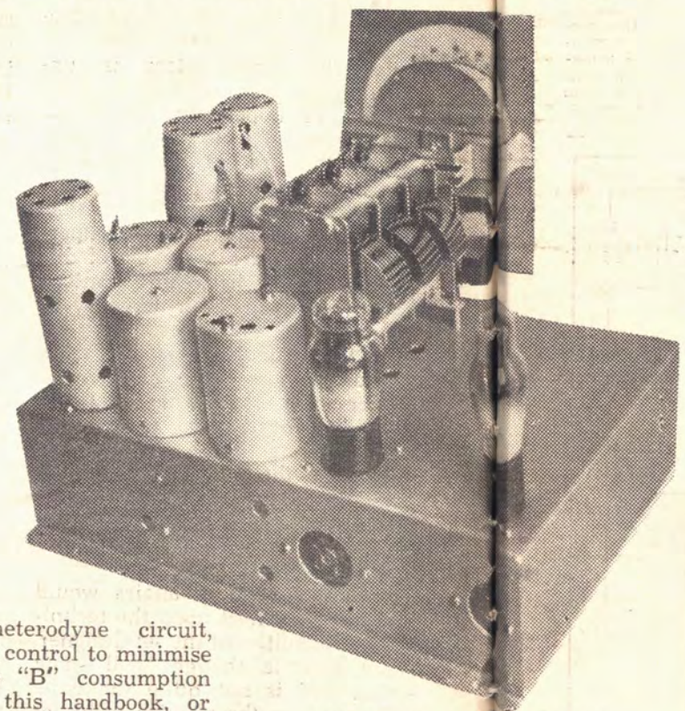

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# THE FIVE ONES

(Continued from Page 25)

sensitivity and is provided with a fixed negative bias of 3 volts from the "C" battery.

This scheme could have the disadvantage that a large signal could be fed into the i.f. amplifier tube when, by the action of automatic volume control, this tube was operating in a heavily biassed condition, but this state of affairs would be likely to take place only when the receiver was being operated in close proximity to a power local broadcaster.

The performance figures of the receiver include a signal sensitivity of 5 microvolts per metre, a power output of between 300 and 350 milliwatts, and a "B" battery consumption of 15 milliamperes.

Before we touch upon the circuit design details it would be as well to go into the question of the valves used in the receiver. All are of the two-volt filament type and are of Radiotron manufacture. Three of them are of an entirely new design which has been specially developed for Australian conditions in the laboratories of the Amalgamated Wireless Valve Co.

The mixer tube is a 1C6, a valve which is becoming more popular amongst battery set-builders than the earlier 1A6. The 1C6 requires a greater filament current than the 1A6, and also takes sligtly more "B" battery current, but it is a far more stable oscillator and is not likely to cease functioning until the "B" battery voltage has fallen to a very low level.

The two intermediate frequency amplifier tubes are the new 1C4's. These valves have similar, although improved, characteristics to the American type 34. Their most important improvements are lowered plate consumption, a higher amplification factor, and the capability of operating at maximum without the necessity for any "C" bias. This latter point is of particular advantage when the valves are to be used in automatic volume control circuits for one of the greatest snags of battery operated a.v.c. is that of obtaining the necessary fixed bias on the controlled tubes.

## List of Components

**Chassis.—16 Gauge Aluminium, measuring 14in. x 10in. x 2½in.**
**C1, C2, C5.—.1 mfd. Tubular Condensers.**
**C3.—.0002 mfd. Mica Condenser.**
**C4, C6, C7.—.5 mfd. Tubular Condensers.**
**C8.—.05 mfd. Tubular Condenser.**
**C9, C10.—.0005 mfd. Mica Condensers.**
**C11, C13.—.02 mfd. Mica Condensers.**
**C12.—.0001 mfd. Mica Condenser.**
**G1, G2, G3. — Three Gang Tuning Condensers to suit Coil Kit.**
**IF1, IF2, IF3.—175 K.C. Litz Wound I.F. Transformers.**
**L1, L2, L3, L3A, L4, L5.—High Impedance Aerial, Pre-Selector, and Oscillator Coils for 175 k.c.**
**L.S.: Loudspeaker to suit 1D4 (Rola).**
**PD.—175 k.c. Padding Condenser.**
**R1.—250 Ohm Carbon Type Resistor.**
**R2.—50,000 Ohm Carbon Type Resistor.**
**R3.—20,000 Ohm Carbon Type Resistor.**
**R4, R8.—5000 Ohm Carbon Type Resistors.**
**R5, R7, R12. — 250,000 Ohm Carbon Type Resistors.**
**R6.—60,000 Ohm Carbon Type Resistor.**
**R9, R10, R13. — 500,000 Ohm Carbon Type Resistors.**
**R11.—1 Megohm Carbon Type Resistor.**
**SW.—Battery Switch.**
**Valves.—1 each Radiotron types 1C6, 1B5, 1D4, and two 1C4's, with sockets to suit.**
**Sundries.—Wire, Battery, and l.s. terminals, 7 pin socket and plug, 3 grid clips, braided wire, knobs, and dial.**

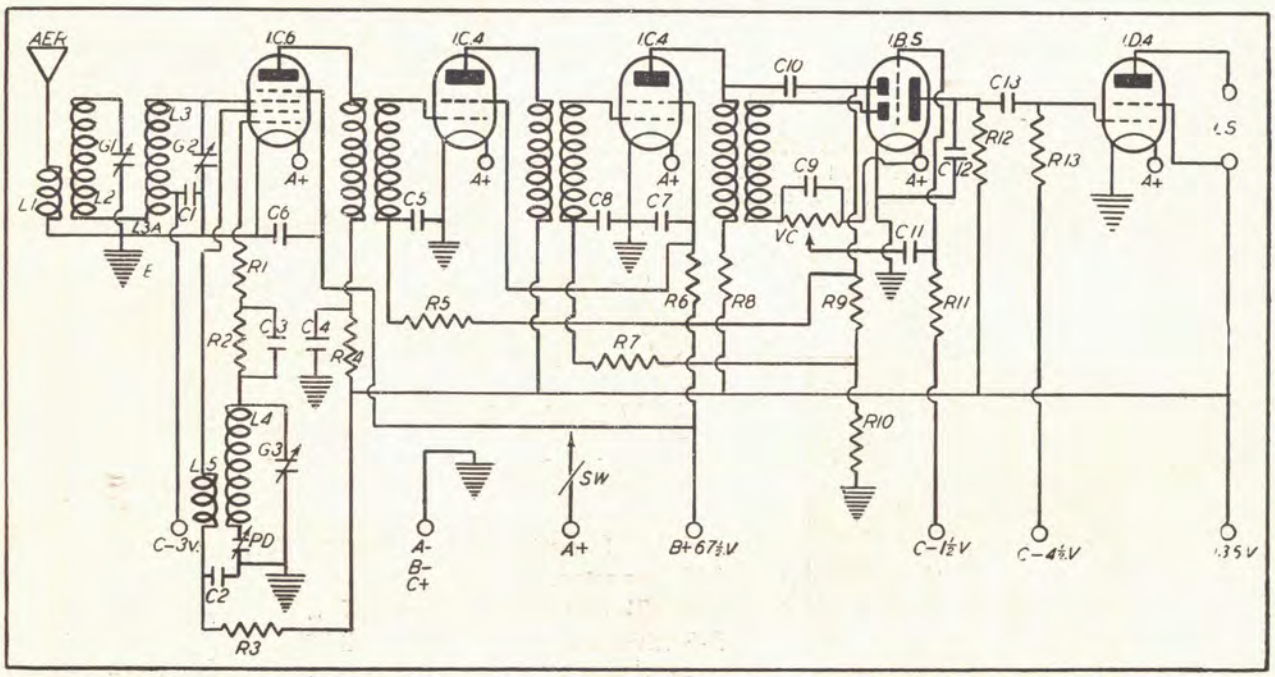
The combined second detector, automatic volume control tube, and driver audio amplifier, is a type 1B5 which replaces the earlier 25S. This is a diode triode tube, the triode section of which has an amplification factor of 20, and a plate impedance of 35,000 ohms.

The final valve is the new 1D4, the second of the locally designed types of battery valves. The 1D4 is a battery pentode having a plate impedance of 150,000 ohms, an amplification factor of 330, and a power output of 350 milliwatts at 135 volts plate voltage.

At this plate voltage it requires a negative bias of 4.5 volts and draws a plate and screening grid current totalling 7.5 m.a. This valve is undoubtedly a most useful contribution to battery receiver design. It offers a greater power output at 135 volts than can be obtained from the 33 at 90 volts, yet takes less current at 135 volts than does the earlier valve at 90 volts. Furthermore, tests have shown its tone qualities to be excellent. As its power sensitivity factor is higher than the 33 the 1D4 requires less driving than the American type valve.

With the possible exception of the 1C6, which draws a total plate current of 6.5 m.a., at 135 volts the valves in this receiver are exceptionally economical. The overall gain of the receiver, as evidenced by its high sensitivity, has not been obtained at the expense of battery economy nor has its selectivity been obtained at the expense of sensitivity.

Let us run through the schematic circuit diagram and explain the whys and wherefores of the various components. L1 is a high impedance winding which is mounted inside the former for the aerial coil, L2, and is loosely coupled to it by a single link turn. L2, the aerial coil, is tuned by the G1 section of the gang condenser. L3 is the pre-selector coil which is of similar dimensions to L2 and has, in addition, a three-turn coupling winding, L3A, which joins to L2. L3 is tuned by the G2 section of the gang condenser. As it is neces-




**The circuit diagram of the Five Ones Super-Het. The design of this receiver includes a stage of pre-selection and automatic volume control.**

sary for bias to be applied to the modulator grid of the 1C6, it is impracticable directly to earth L3-L3A. The earth connection is made through the .1 mfd. condenser, C1, the "C" bias voltage being fed into the tap point of L3-L3a.

The oscillator grid of the 1C6 has a 250 ohm resistor, R1, connected in series with it to suppress whistles arising from oscillator harmonics. The oscillator grid leak, R2, has a resistance of 50,000 ohms, whilst the oscillator grid condenser, C3, has a capacity of .0002 mfd. The oscillator grid coil, L4, is tuned by the G3 section of the gang condenser and has the padding condenser, PD, connected between its low potential point and earth. The oscillator plate coil, L5, is by-passed to earth by means of the .1 mfd. condenser, C2, and is fed with the maximum potential of 135 volts through the 20,000 ohm dropping resistor, R3.

The screening grid of the modulator section of the 1C6 is fed with the full 67½ volts screen supply and is by-passed by the .5 mfd. condenser, C6. The oscillator plate supply is drawn from the 135 volt "B" battery tap through the 5000 ohm decoupling resistor, R4, which is by-passed by the .5 mfd. condenser, C4. This resistor and the 5000 ohm. resistor, R8, connected in the plate lead of the second i.f. valve, were found to be necessary to avoid instability. Between the 1C6 and the first i.f. 1C4 is the first intermediate frequency transformer, IF1. This and the other two transformers are of the high-gain litz-wound type.

The screening grids of the two intermediate frequency amplifier tubes are connected together and fed from the 67½ volt screen supply through a 60,000 ohm de-coupling resistor, R6, which is by-passed by the .5 mfd. condenser, C7. This has been done not only to limit the gain of the intermediate frequency amplifier, but to obtain the most economical operation of these tubes. In the 1B5 second detector we find that the volume control, VC, is the conventional 500,000 ohm potentiometer which serves as the diode load. It is by-passed by the .0005 mfd. fixed condenser, C9. The arm of the volume control, VC, is taken to the triode grid of the 1B5 through the .02 mfd. condenser, C11. Bias for this triode grid is supplied from the 1.5 volt tap on the "C" battery through the 1 megohm grid resistor, R11. The plate of the 1B5 is by-passed to ground by means of the .0001 mfd. condenser, C12.

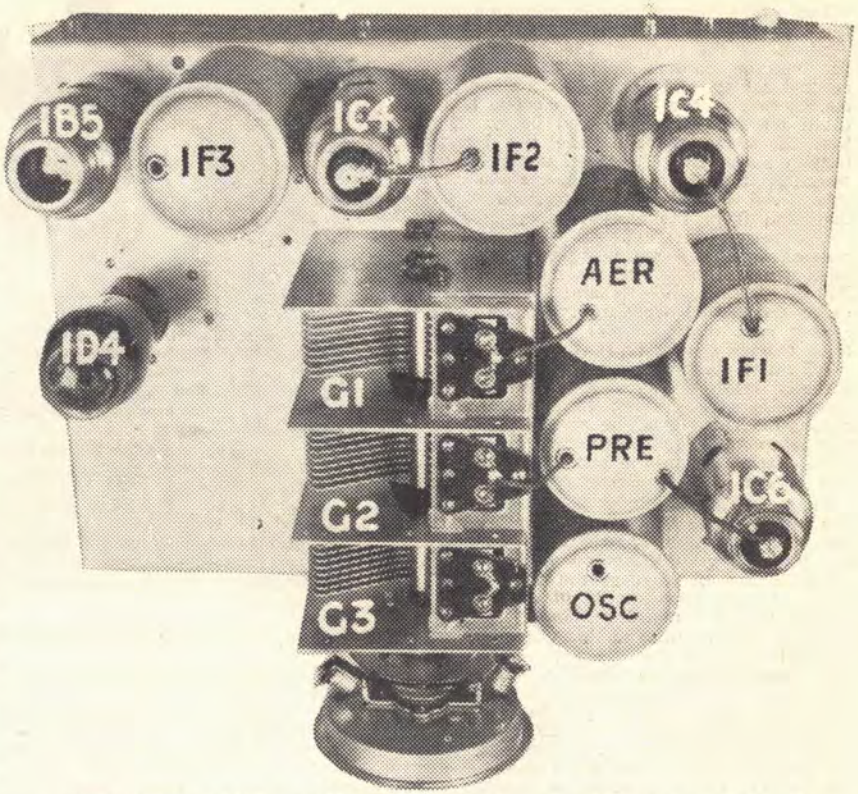
This valve is resistance coupled by means of the 250,000 ohm plate resistor, R12, the .02 mfd. coupling condenser, C13, and the .5 megohm grid resistor, R13, to the grid of the 1D4 pentode. Bias for the 1D4 is fed from the 4½ volt bias tap through R13.

The automatic volume control system is quite straightforward. Amplified radio frequency voltage is fed from the plate of the second intermediate frequency amplifier tube to the a.v.c. diode of the 1B5 through the .0005 mfd. condenser, C10. The a.v.c. voltage divider, consisting of the two 500,000 ohm resistances R9 and R10, is connected between the a.v.c. diode and ground. Full control voltage is fed to the grid of the first i.f. valve through the 250,000 ohm decoupling resistor, R5, which is by-passed by the .1 mfd. condenser, C5.

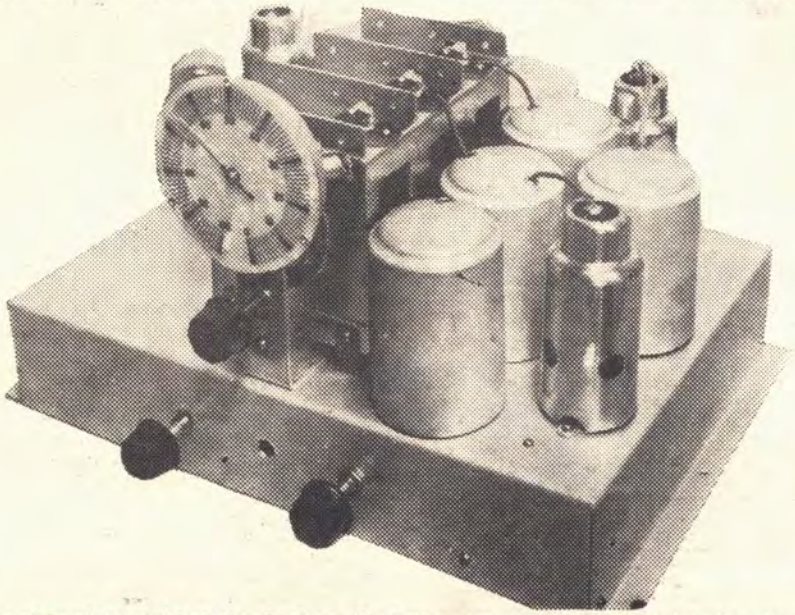
The second i.f. valve receives only half the control voltage tapped off at the junction between R9 and R10. This voltage is fed to the tube's grid through the 250,000 ohm recoupling resistor, R7, which is by-passed by the .05 mfd. condenser, C8.

The set is built up on an aluminium chassis measuring 14 inches in length, 10 inches in width, and 2½ inches in depth.

The top chassis layout is as follows:— The gang condenser is centrally disposed, and at its right, from front to back, we have the oscillator, preselector and aerial coil cans in the order mentioned. To the right of these cans is the 1C6 mixer valve, in the front right-hand corner of the chassis. Along the right-hand end of the chassis, next to the mixer valve, is the first intermediate frequency transformer, 1FI, and the first i.f. valve in the right-hand rear corner of the chassis. Along the rear edge of the chassis, from right to left, we have the second intermediate frequency transformer, IF2, the second intermediate frequency valve, the third intermediate frequency transformer, IF3, and the second detector valve.




**This plan view of the receiver illustrates the arrangement of parts on top of the chassis. All components are keyed to correspond with the written description.**



**This view of the finished chassis shows the layout and wiring of parts below the chassis.**

The audio output tube is mounted at the left-hand end of the chassis. The controls on the front of the chassis are the volume control, left, main tuning control centre, and battery switch, right. At the rear of the chassis the aerial and earth terminals are mounted below the first i.f. valve socket, while the 7-pin battery socket and the two loud speaker terminals are mounted at the right-hand end. All but the earth terminal are insulated from the chassis.

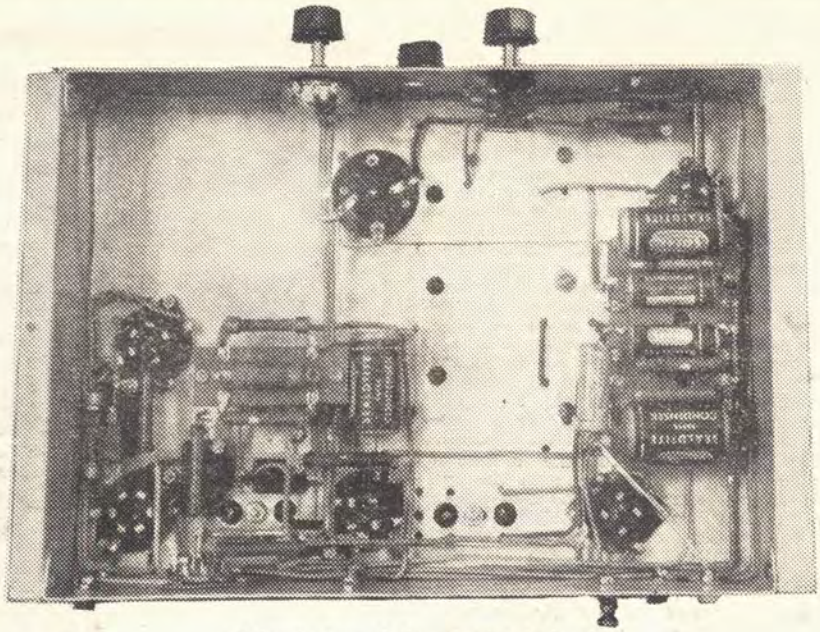
Underneath the chassis it will be noticed that two mounting strips have been used. The first of these carries C6, R3, C2, C1, C5, R5, C4 and R4, in the order mentioned (looking from the 1C6 socket side of the strip). The smaller strip carries R6, C8 and R7.

All other components have been wired directly into circuit. The mounting strips are spaced from the chassis by means of 1-inch machine screws. When the components and the two strips have been assembled on the chassis, the wiring of the set may be started.

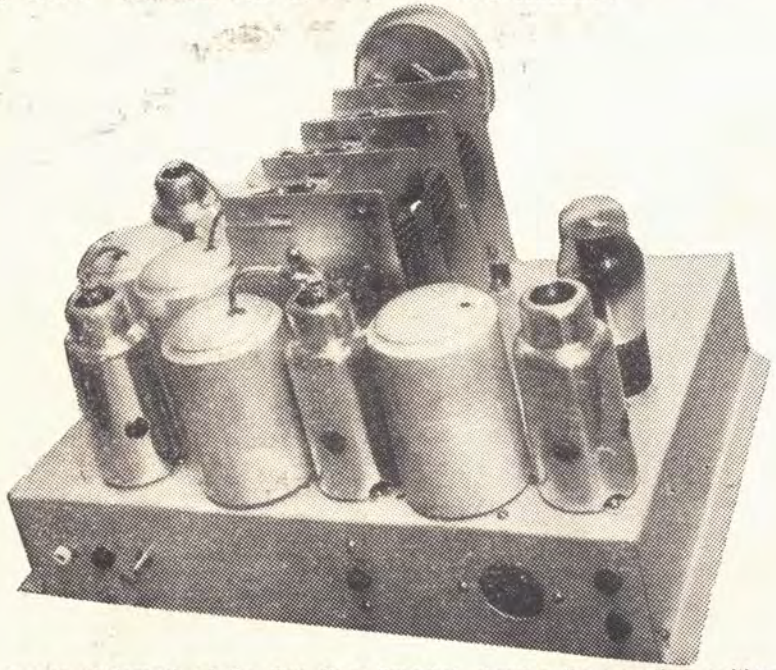
First run a lead from the A positive lug on the battery socket to one lug on the battery switch. From the other lug on the battery switch run a lead to one filament lug on each of the valve sockets. A bare wire should now be used to join up the remaining filament lug on each of the sockets, and this wire should be continued to the earth terminal on the chassis and to the "A"-"B"-"C" plus lug on the battery socket. Next wire the aerial coil to the aerial terminal on the chassis and do likewise with the earth wire. The top end of L2 should join to the fixed plate lug on the G1 (back) section of the gang condenser. The other end of L2 joins to the bottom end of L3A. The top end of L3 joins to the fixed plate lug on the G2 (centre) section of the gang condenser, from which section a lead also is taken to the control grid (top pip) of the 1C6.

The tap point between L3 and L3A carries one lead of the .5 mfd. condenser, C1, and a lead which goes to the C minus 3 volt lug on the battery socket. The other lead on C1 is connected to the ground wire. The modulator plate of the 1C6 joins to the plate lug on IF1. The screening grid lug on the 1C6 socket has soldered to it one lead of the .5 mfd. condenser, C6, and a lead which terminates at the 67½ volt. lug on the battery socket.

The oscillator grid lug on the 1C6 socket has one lead of the 250 ohm resistor, R1, soldered to it. The other lead on this resistor joins to one lead of the 50,000 ohm resistor, R2, and one lug of the .0002 mfd. condenser, C3. The other lug on C3 and the other lead on R2 join together and to the top of the oscillator grid coil, L4. From this point on L4 a lead is taken to the fixed plate lug on the G3 (front) section of the gang condenser.



**A front view of the completed chassis.**



**A rear photograph of the Five Ones Superhet, showing the mounting positions of the aerial-earth terminals, the loud speaker terminals, and the battery input socket on the side of the chassis.**

The other end of L4 joins to one side of the padding condenser, PD, the other side of this condenser being earthed. The oscillator plate lug on the 1C6 socket is joined to the plate lead on L5. The other end of L5 carries one lead of the .1 mfd. condenser, C2, and one lead of the 20,000 ohm resistor, R3. The other lead on L2 goes to earth. The remaining lead on R3 joins to one lead on the 5000 ohm resistor, R4, and to the 135 volt lug on the battery socket.

The other side of R4 carries one lead of the .5 mfd. condenser, C4, and joins to the "B" plus side of IF1. The other lead on C4 goes to ground. G lug on IF1 carries a lead which goes to the control grid (top pip) of the first i.f. valve. The "C" minus lug on this i.f. transformer has soldered to it one lead of the 250,000 ohm resistor, R5, and the .1 mfd. condenser, C5. The other lead on C5 joins to earth.

The screening grid lugs on the two intermediate frequency valves are joined together, to one lead of the .5 mfd. condenser, C7, and to one lead of the 60,000 ohm resistor, R6. The other lead on C7 joins to earth, whilst the remaining lead on R6 goes to the 67½ volt lug on the battery socket. The plate lug on the first i.f. valve socket joins to the plate lug on IF2. The "B" plug lug on IF2 goes to the 135 volt lug on the battery socket. The grid lug on I2 joins to the grid (top pip) on the second i.f. valve. The "C" minus lug on IF2 carries one lead of the .05 mfd. condenser, C8, and one lead of the 250,000 ohm resistor, R7. The other lead on C8 joins to earth.

The plate lug on the second i.f. valve joins to the plate lug on IF3. The "B" plus lug on this i.f. transformer carries one lead of the 5000 ohm resistor, R8. The other lead on R8 is wired to the 135 volt lug on the battery socket. From the plate lug on the second i.f. valve socket a lead goes to one lug on the .0005 mfd. condenser, C10. The other lug on this condenser is wired to the a.v.c. diode lug on the 1B5 socket. Note the socket connection diagram Fig. 2 and see that no mistake is made in this connection. From the a.v.c. diode lug a lead goes to one lead on the .5 megohm resistor,

**(Continued on page 48)**


# KK2
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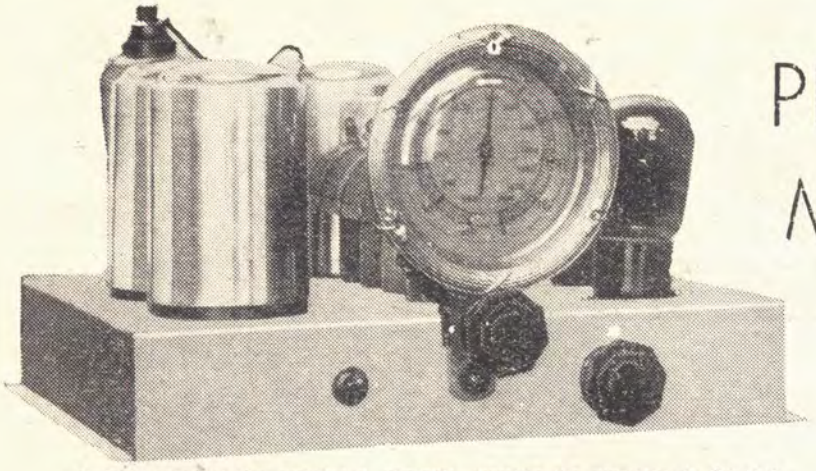


A front view of the completed assembly showing the positions of the two controls and battery switch.

# THE PRE-SELECTED MELODIOUS THREE

Simplicity of design, a minimum number of components, and complete constructional details, make this set an ideal battery receiver for the country set builder.

**By P. R. DUNSTONE**

IT will be seen on referring to the the schematic circuit of this set, that a pre-selector has been included in the radio frequency stage, with the result that the selectivity of the receiver has been sharpened considerably. The difficulty which then confronted the designer was that, by including this extra tuned circuit, it was obvious that a certain amount of signal input had to be sacrificed, and it was therefore necessary to make another improvement in the original design in order to obtain the same output from the set. This problem was overcome by increasing the primary winding on the radio frequency coil L4 to 60 turns, thus giving much greater transference of signal voltage to the secondary winding of this coil. A reverse-wound reaction coil is also included on the R.F. coil former, and is wound over the bottom of the secondary winding L5. By winding this regeneration or feed-back coil in the opposite direction to that of the remaining two windings on the R.F. coil former, the snag of aligning the three-gang tuning condenser G1, 2, 3 is offset, and, provided the coil details, which will be supplied hereunder, re coil winding data, are followed, the builder should not experience any difficulty in aligning this model.

In addition to the high step-up received from the large primary winding, L4, the coupling coil in the pre-selector circuit, L3A, consists of 8 turns; this is 5 extra turns in respect to a standard pre-selector filter coil. Here, again, a much greater transference of energy is obtained, and it can be seen from these minor remarks that any volume loss by the inclusion of the pre-selector circuit has been adequately compensated for by extra step-ups provided in other sections of the circuit.

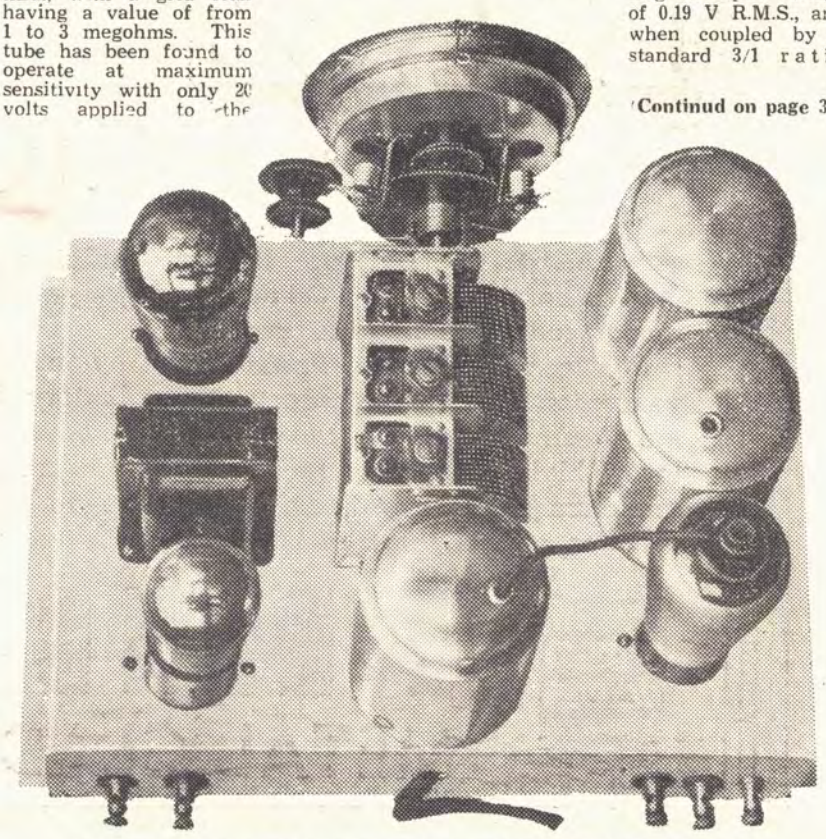
A feature of this design is the Mullard battery-operated valves which have been included. These tubes are of the latest design and can be operated at their peak efficiency at a remarkably low "A" and "B" battery current consumption.

The SP2 screen-grid valve which has been used in the radio frequency stage is a highly sensitive tube, and the only constructional feature in which it differs from the standard two volt pentodes is that it is fitted with a six-pin base. These extra two pins are connected to the suppressor grid inside the tube and to the metal coating on the outside of the valve. A feature of this metal coating is that it replaces the valve shield, and the tube can be operated without a shield and the user need entertain no fear for inter-coupling or feedback with any other section of the circuit.

Standard with the construction of these Mullard valves, the plate of the tube is taken to the top of the valve, not as is the practice with the American valves, where the control grid is taken to the top of the glass bulb.

In the detector circuit, a type PM1HL triode valve has been used. This tube is of standard design, and has a four-pin base. This general purpose valve is ideally suited for operation as a leaky grid detector. When used as such, the grid condenser should have a capacity ranging between 0.0001 mfd. to 0.00025 mfd., with a grid leak having a value of from 1 to 3 megohms. This tube has been found to operate at maximum sensitivity with only 20 volts applied to the plate. When used under these conditions the plate current is approximately 0.4 m/a. The valve is capable of handling an input voltage of 0.19 V R.M.S., and when coupled by a standard 3/1 ratio

(Continud on page 34)



This top plan photograph of the original receiver will assist builders in laying out the parts.

# Mullard
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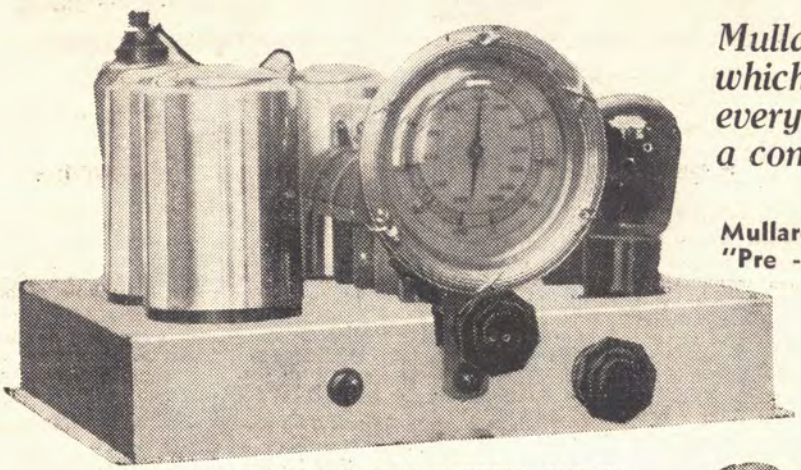

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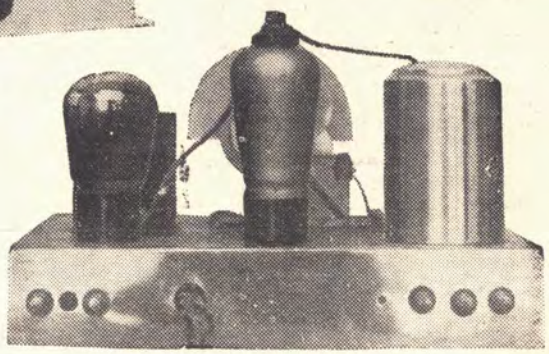

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audio transformer the PM1HL will deliver a peak voltage of 6.5 volts to the succeeding stage, assuming 80 per cent. modulation. This tube similar to the SP2 requires a potential of two volts for the filament.

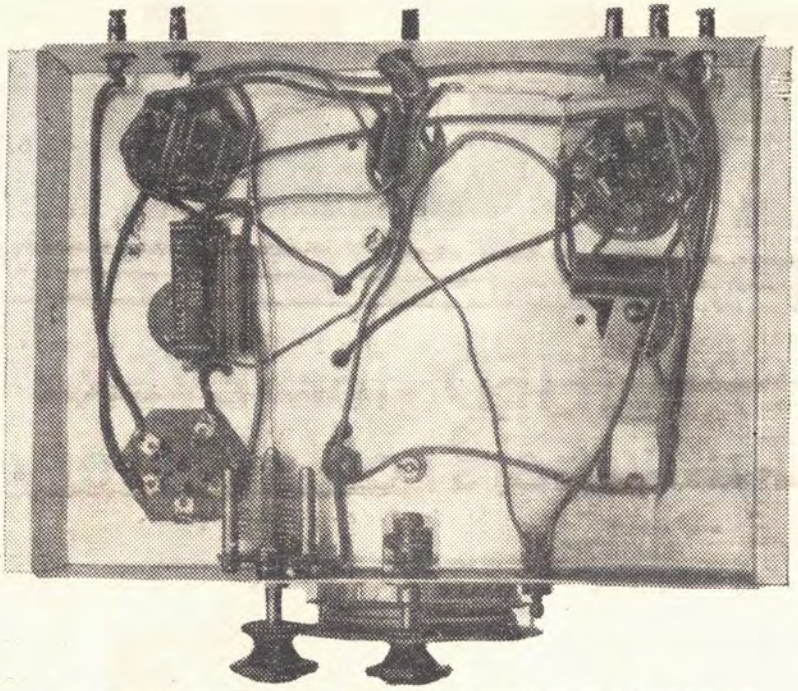
With regard to the PM22A, this valve is a remarkable pentode, inasmuch as it is capable of supplying a reasonably high output for a given signal input. The PM22A is superior to other types of pentodes in that it is capable of supplying sufficient volume for the average room and at the same time the plate current can be kept comparatively low.

## Tone Control Desirable

It was found that, when this valve is used in conjunction with certain types of speakers, it is sometimes desirable to incorporate a tone control in order to emphasise the bass response. This may be achieved by connecting across the plate and screen, or, alternatively, between plate and chassis of the set a variable resistance of 50,000 ohms in series with a fixed condenser of 0.01 mfd. This device has the additional advantage of limiting the rise in plate voltage if the speaker should be inadvertently disconnected. In the original design we have omitted this tone control from the circuit, and it may be added or omitted as the particular builder desires. In the writer's opinion, the inclusion of this tone control is most desirable.

Another feature of the design is the automatic bias on the PM22A valve. This practice is becoming very popular with battery set builders, since it not only eliminates the use of an additional bias battery, but at the same time plays a very important part in the reproduction of the receiver after the "B" batteries begin to age.

As has been frequently outlined before, the bias potential is received from the voltage drop across resistor, R1, the value of R1 being calculated to develop the necessary 3 volts negative potential for biassing the grid of the PM22A. When using this system of biassing it is obvious to the reader that as the "B" battery voltage is reduced by age and use, an according reduction in bias voltage takes place, with the result that the "B" batteries can be operated to the very limit of their useful life, and with the correct negative potential always being applied to the grid of the output tube. The reproduction or tonal response from this receiver is not unduly affected at the lower voltage.



**An underneath picture of the wired set. This view illustrates the mounting positions and the wiring below the chassis.**

The accompanying photographs of the original receiver should be self-explanatory and the mounting of the components will offer no difficulty to the average set builder.

## Coil Details

It is advisable for the coils to be of commercial manufacture, since it will ensure perfect matching and enable maximum sensitivity to be received from this circuit. However, for the benefit of builders who are desirous of winding their own coils, the following complete data is given:—The coils are wound on 1¼ inch diameter Marquis coil former and, with the exception of the reaction winding, all coils are wound with gauge 30 enamel-covered wire. The reaction winding, L5, is made with 36 D.S.C. wire.

Coil L2 requires 115 turns.

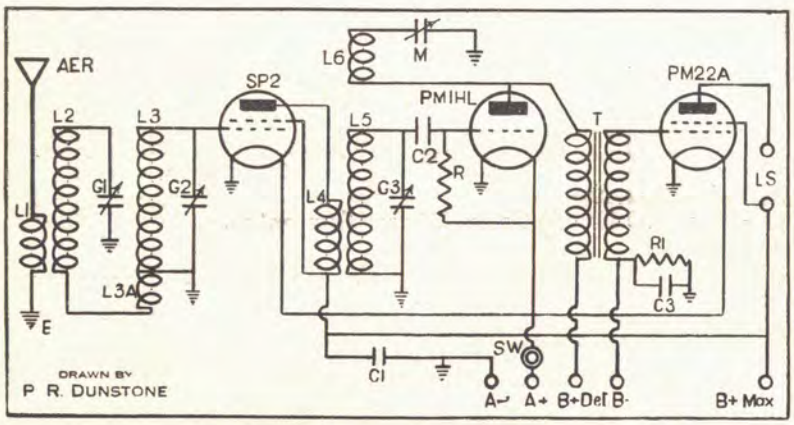
Coil L1 needs 30 turns wound on 1½ inch diameter former, and is slipped over the top of L2.

Coil L3 has 117 turns wound on the 1¼ inch former. A tapping is made at the 117th turn and a remaining 8 turns are wound on the former and serve the place of L3A coil.

(Continued on Page 48)

# Schematic Circuit and List of Components

## Required to Build This Receiver

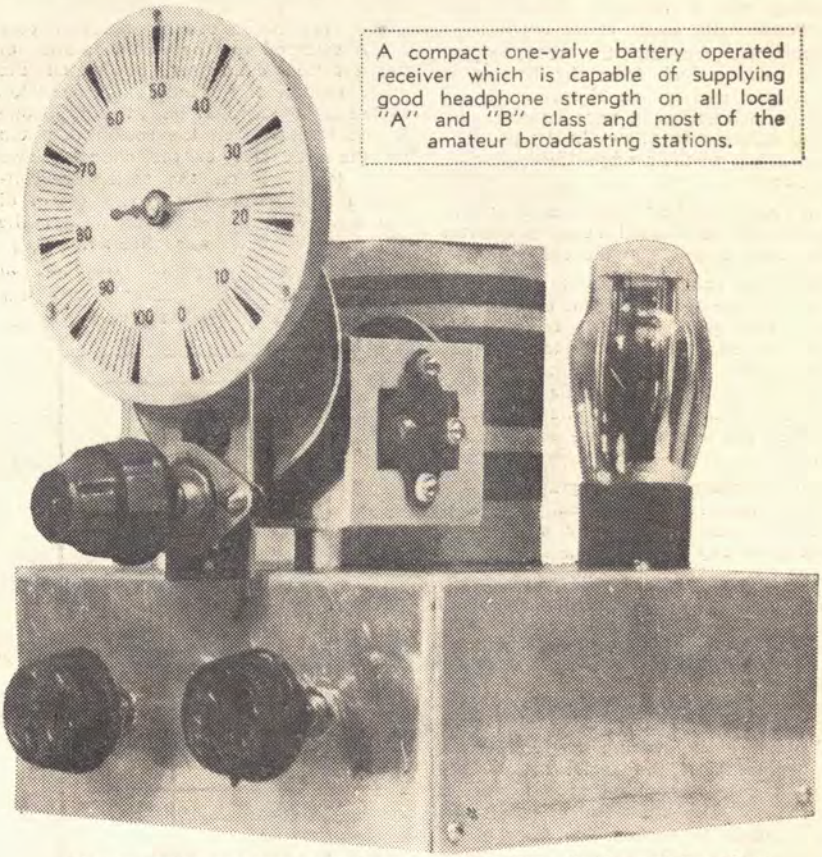



**C1, 0.5 mfd. fixed tubular condenser.**
**C2, 0.0001 mfd. fixed mica condenser.**
**C3, 24 mfd. 25-volt test electrolytic condenser.**
**Chassis: 11 inches by 8 inches by 2 inches. Aluminium gauge 16.**
**G1, 2, 3, Three-gang variable condenser (See text.)**
**L1, 2, 3, 3A, 4, 5, 6, Coil Kit. (See text.)**
**L.S.: Loudspeaker to suit PM22A (Rola).**
**M, 23-plate midget condenser.**
**R, 2 megohm carbon resistor.**
**R1, 1000 ohms resistor.**
**SW, Toggle snap switch.**
**T, Audio frequency transformer, ratio 3/1.**
**Valves: SP2, PM1HL, and PM22A. (Mullard).**
**Sundries: Belden wire, spaghetti, nuts, screws, aero dial, five terminals, 3 yards of 6-way battery cable, etc.**

# A ONE VALVE RECEIVER for the BEGINNER

By P. R. DUNSTONE

A compact one-valve battery operated receiver which is capable of supplying good headphone strength on all local "A" and "B" class and most of the amateur broadcasting stations.



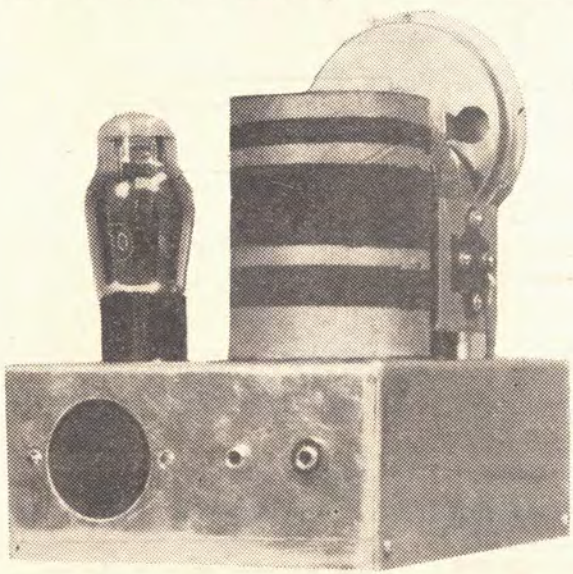
**The one-valve receiver is built on an aluminium chassis, and has three controls mounted on the front. They are (left) the reaction control (centre) the main tuning control, and (right) the battery switch.**

FEW circuits have been changed and experimented with as much as the original Reinartz, which consisted of a single coil tapped to obtain regeneration by means of a variable capacity. The popularity of this circuit has probably been due to the simplicity of its design, which enabled every radio enthusiast to build it with little cost and trouble. However, with all its changing and switching, this circuit has retained its name as an efficient regenerative detector, and even today hundreds of radio sets are still employing the basic principle of the Reinartz detector.

The publication of this simple one-valve battery operated receiver is in reply to many requests from readers who are desirous of building a small one-valve set which is capable of supplying good headphone strength on all local stations.

The only departure in this circuit from the Reinartz which was published years ago is that it employs one of the latest two-volt series battery operated valves. This increases the sensitivity of the set considerably, and at the same time reduces the battery consumption to a minimum. The set can be operated from a plate voltage as low as 22½ volts and still supply satisfactory headphone results, although for best signals the use of 45 volts is desirable.

The choice of two aerial couplings is given in this article, in order to permit the builder to select the most suitable coupling for his particular requirements.



**On the rear side of the chassis are mounted the aerial, earth and input socket. This input socket carries the "A" and "B" battery leads and the two headphone terminals.**

In the schematic diagram of the circuit an aperiodicly coupled aerial is shown. This consists of a small aerial winding. The other diagram illustrates how the aerial can be connected direct to the grid winding. The second method will undoubtedly give a far greater pick-up, but unfortunately this system is not practical when the receiver is to be operated in areas which are troubled with interference from broadcasting stations.

On studying the schematic diagram, it will be seen that it is a conventional arrangement, and that the grid circuit consists of a coil, L2, which is tuned by a variable condenser, VC, and fed to the detector's grid through the condenser C. In order to prevent an excess gathering of electrons on the grid of the tube a leak or resistance is shunted between the grid and the "A" positive.

The function of the plate circuit is as follows:—The audio frequency pulsations received on the plate of the valve pass through, HP, to the positive terminal on the "B" battery. The point HP is the connection for either a pair of headphones, or the primary of a transformer, should a stage of audio amplification be added to the receiver.

The alternative path to earth is through the reaction coil, L3, and the reaction condenser, M. This reaction coil is, of course, magnetically coupled to the grid coil, L2. The reason the RF current should take one path and the audio current another is that the headphones in one lead present an almost insurmountable barrier to the radio frequency current, whilst the audio current will pass through and do its legitimate job of energising whatever reproducing device may be connected to HP. Conversely, the condenser, M, cannot pass audio currents. These thus are forced through HP, whilst the RF will pass freely through M to earth. In consequence radio frequencies can circulate freely through M and L3, and produce the desired feedback effect.

## Winding the Coils

We have used a piece of 2¾-inch diameter coil former in preference to the smaller types in order to obtain the maximum results from the circuit. The coils comprise an aerial winding, a grid

winding, and a reaction winding, and are wound with gauge 26 d.c.c. wire.

Commence winding the reaction coil about half an inch from the bottom of the former, and lay on 20 turns, leaving about 6 to 8 inches of wire on each end of the winding to allow the leads to be taken direct to their respective points in the circuit.

The grid winding requires 48 turns, and should be started about a quarter of an inch away from the reaction coil.

The aerial coil consists of 15 turns, and is wound about a quarter of an inch above the grid winding. Should the aerial be coupled directly to the grid winding, this latter coil is not necessary, and tappings should be made at the 5th 10th, and 15th turns on the grid coil. All coils are wound in the same direction.

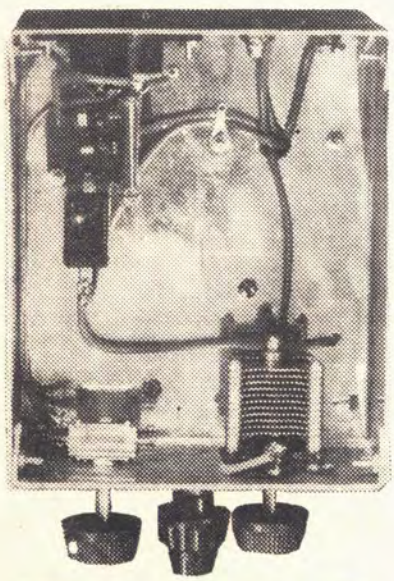
The accompanying photographs of the original model are practically self-explanatory, and the builder should not experience any difficulty in the mounting of the parts on the chassis.

The chassis is made from gauge 16 aluminium, and measures 6½ inches by 5½ inches by 2½ inches.

## Wiring in Words

Commence the wiring by connecting the beginning of the aerial coil to the aerial terminal mounted at the rear of the chassis. The other end of this winding is taken to earth. The start of L2 winding is soldered to the fixed plates of VC and to one side of the fixed condenser, C. The other side of this condenser, C, is fastened to one end of the grid leak, R, and to the grid terminal on the valve socket, V1.

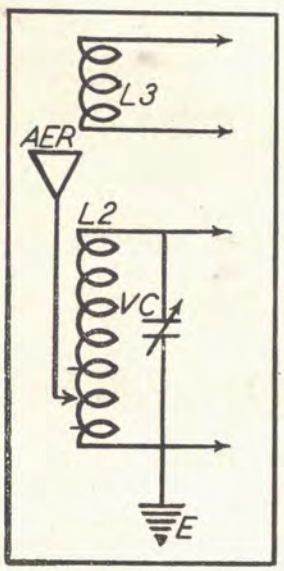
The remaining end of R is connected to the positive filament terminal on the valve socket, V1.



This photo shows the wiring and mounting positions of the parts below the chassis.

The other end of L2 is taken to earth. The beginning of the reaction coil, L3, is soldered to the fixed plates of the reaction condenser, M, whilst the other end of this winding is connected to the plate terminal on V1, and to one of the terminals on the socket mounted on the rear side of the chassis. Two other terminals on the socket are connected together, and serve the places of the other headphone terminal and the "B" positive battery connection.

Another lead is taken from one of the terminals on the socket to one side




An alternative aerial coupling circuit for the one valve set.

of the battery switch, the other side of this switch is taken to the positive filament on the terminal of the valve socket. The remaining terminal on the valve socket V1 is soldered to the two remaining terminals on the socket mounted at the rear of the chassis, and act as the "A" and "B" negative battery connections.

## LIST OF PARTS

**C—0.00025 mfd. fixed mica condenser.**

**M—23 plate midget condenser.**

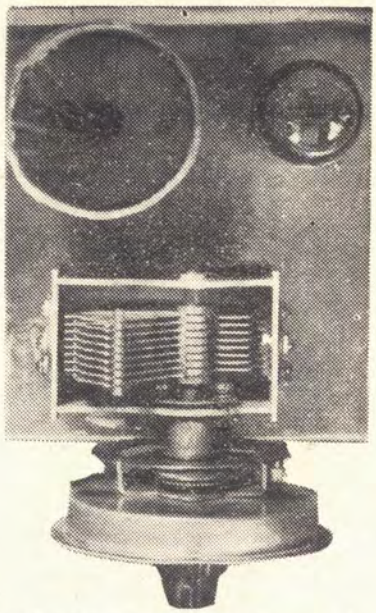
**R—2 megohm carbon resistor.**

**SW—Battery switch.**

**VC—0.0005 mfd. variable condenser with vernier dial.**

**Valve—Type 30 with socket to match. (Ken-Rad, Mullard, Philips, Radiotron.)**

**Sundries — One piece of coil former, measuring 2¾ diameter, 3 inches long, one reel of 26 d.c.c. wire, 6 yards of beldon wire, two terminals, one six pin valve socket with plug to match, screws, nuts, two lengths of spaghetti.**



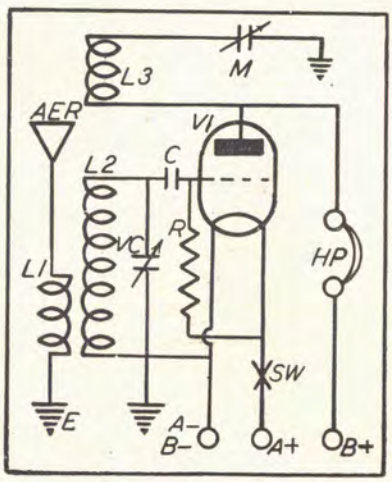
Only the coil, tuning condenser and valve socket are mounted on top of the chassis.

## Operation

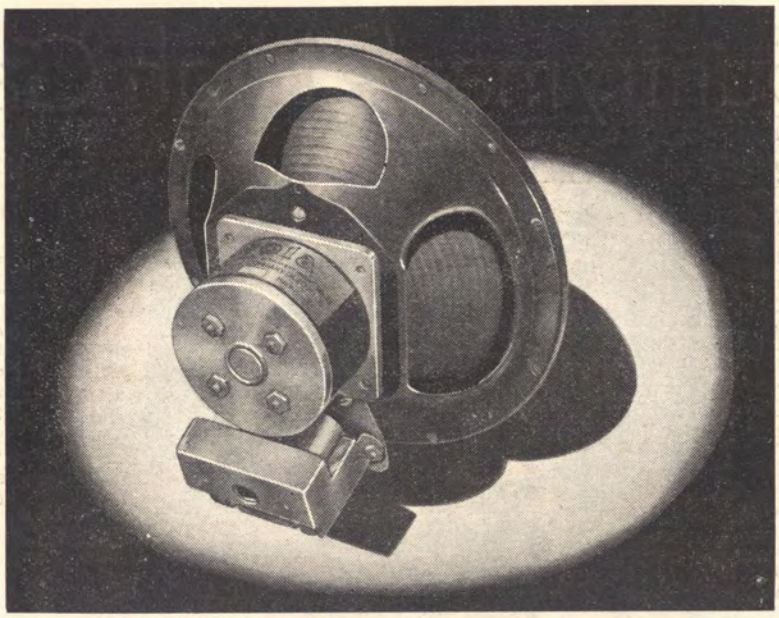
Having rechecked the wiring with the circuit diagram, solder the phones and four leads to the socket plug and push it into position.

When the batteries, aerial and earth leads are connected to their respective points, switch on the receiver and rotate the dial of VC until signals are heard. For best results, the reaction should be adjusted until the receiver is just on the verge of oscillation.

This one valve receiver should provide hours of amusement to the novice who is interested in radio, and provided the directions given in this article are followed, he should be able to tune in all the local "A" and "B" class stations and many of the amateur stations at good headphone strength.




The schematic circuit of the one-valve receiver. This diagram illustrates how an aperiodic coupled aerial coil is used.



# NO OTHER BATTERY SPEAKER HAS WON SUCH UNIVERSAL PRAISE AS

# Rola

## P.M.8-20

Though the wonderful Rola model has been on the market but a short time, it has been adopted wholeheartedly by thousands of enthusiastic users, and has been incorporated in their receivers by a number of manufacturers. After years of scientific research and experimenting the Rola P.M.8-20 was presented in answer to the public demand for a better battery set Speaker. Subsequent sales and results have proved that the world-wide Rola organisation has pioneered the greatest advance ever made in Battery Set Speaker construction in the Rola P.M.8-20.

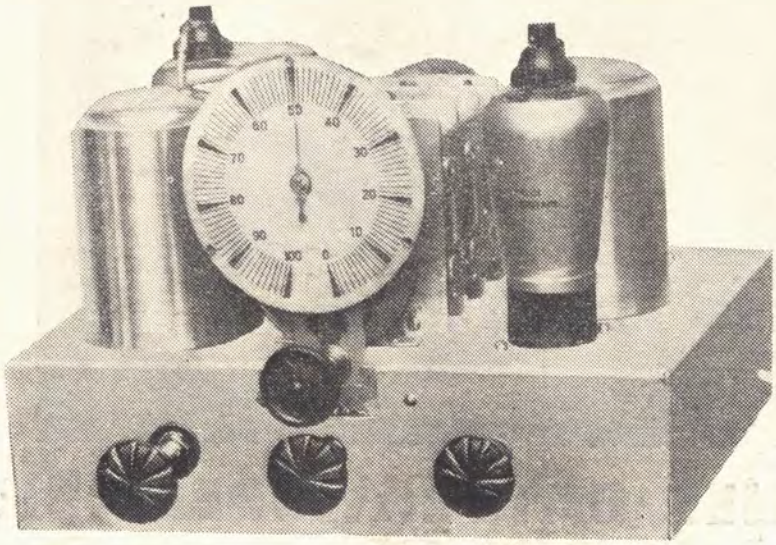
This speaker incorporates many new features all pioneered by Rola to provide outstanding performance — a new design Permanent Magnet, giving 50 per cent. higher flux density; an entirely redesigned diaphragm — the specially moulded cone keeps its shape permanently and is not affected by humidity or extreme of temperature — Patented Rola dust-proofed air gap and sealed transformer. This new 8in. speaker gives greater sensitivity and more faithful reproduction than any other battery set speaker. Ask your dealer to let you hear a Rola P.M.8-20. Its performance will amaze

*The Hallmark of a Good Set*

ROLA CO. (AUST.) PTY. LTD. 81-83 CITY ROAD, SOUTH MELBOURNE, S.C.4.

# The Countryman's High Gain "4"

The receiver is built on an aluminium chassis, and complete shielding of the coils and valves is absolutely necessary for stable operation.



A photograph of the finished chassis. The controls are, from left to right: the volume control, the battery switch, the tuning control and the reaction control.

**This sensitive four valve battery operated receiver employs two stages of tuned radio frequency, a regenerative triode detector and one pentode audio stage. A feature of this set is the remarkably low battery consumption.**

THE problem of low battery consumption is undoubtedly one of the main ones encountered by the owner of a battery operated receiver, but in keeping with the trend of radio, valve manufacturers have in the last year perfected valves to such an extent that it is now possible to build a four valve receiver with a total current consumption far below that of the average two valve battery operated set of a few years ago.

With these advancements in modern battery valve design, farmers, and country residents generally have had the opportunity of using larger receivers than they had previously ever dared to operate on account of the expenditure involved in the upkeep of the batteries.

## Stability Problem

The receiver we propose to describe in this article has been primarily designed for listeners who are situated in areas where reception is poor, and for this reason we have included two stages of tuned radio frequency, and have applied reaction to the detector stage.

With this circuit combination the maximum sensitivity for a given number of valves is obtainable.

However, in a set of this type the main problem which presents itself is: "How can we keep the sensitivity of the receiver at a high level and at the same time make the set stable for maximum efficiency and simplicity of operation?

One of the most important points in securing this stable condition is the actual placing of the wiring. It is essential to make all plate and grid leads as short as possible, and to take the filament wiring of the four valves around the side of the chassis. In addition to these precautions it was found that the plate wiring had to be completely shielded with braided wire.

After ensuring perfect stability in the radio frequency end of this receiver, it was found that a slight audio frequency oscillation was present, and it was necessary to de-couple the grid circuit of the PM22A stage with a 500,000 ohm carbon resistor and a .5 mfd. fixed condenser.

## Circuit Details

On reviewing the schematic circuit of this receiver the reader will note that the latest type of variable mu battery operated valves have been used in the radio frequency stages of the set.

The VP2's are particularly suited for this type of work, inasmuch as they have a variable mu characteristic which is admirable for the radio frequency side.

**BY P. R. DUNSTONE**

These valves will operate efficiently with only 90 volts applied to the plate and screen. A potential of two volts is required for heating the filaments. A feature of these tubes is that a metallic coating is sprayed on the valves when being manufactured. This serves the place of the valve shield.

So much for the actual valves used in the radio frequency stages. The coils are of the high gain type and have their primary winding wound on a celluloid tubing which is slipped over the centre of the grid windings, thus giving a maximum transference of signal voltage. Passing from the R.F. stages we come to the detector stage. Here a type PM1HL valve has been used. This tube, a standard triode, is ideally suited for operation as a leaky grid detector, and is capable of working with as little as 20 volts on the plate. The tube is similar to the variable mu valves, inasmuch that it requires two volts for the filaments and has the metallic coating which prevents feed-back from other stages. It may be interesting to note at this juncture that only the latest PM1HL's have this coating, earlier types being unshielded.

As mentioned earlier in the article, the detector stage has regeneration applied to it through a feed-back coil which is controlled by a 23-plate midget condenser. The signal is passed from the plate of the detector valve through the resistance coupling unit which consists of R3, R4, and C4, to the grid of the final stage.

In this output stage a type PM22A valve has been used, and although this tube is capable of supplying only half a watt output, it has a big advantage over a number of other pentodes, inasmuch that its consumption is remarkably low.

In common with most pentodes, the PM22A was found to reproduce the "Highs" too prominently, so it was necessary to limit the high audio frequency response by connecting an 0.01 mfd. condenser between the plate and screen of the valve. With this capacity in circuit it was possible to reduce the tonal pitch to a much more pleasing level.

The total current consumption of this model is very low, the four valves drawing no more than 11 m.a., with the result that a design similar to this can be used in country districts without rapid battery replacements.

## Coil Data

Considerable care should be taken in the winding of these coils, since it is around this section of the circuit that the final results mainly depend.

The coils are wound on standard Marquis 1¼in. diameter coil formers, and provided the directions are closely followed, no difficulty should be experienced in their construction.

Specifications for ready-wound coils should be supplied to one of the radio stores, which will order them from a coil manufacturer.

These coils embody a slight departure from the standard aerial and R.F. coils, and on no condition should the standard type be accepted for this design.

Before commencing to wind the coils on the three formers, fasten soldering lugs to the bottom skirt of the former in such a manner as to allow the various ends of the windings to be soldered to the lugs, thus using them as terminal points for the coil connections.

The whole seven windings are made with gauge 30 enamelled covered wire, and are all wound in the one direction.

Begin winding the grid coil on the aerial former about an eighth of an inch from the top of the Marquis former. This coil requires 115 turns, and both ends of the coil are taken to soldering lugs at the bottom of the former. For the aerial winding L1, 20 turns should be placed on the former, with a tapping at the tenth in order to allow an alternative aerial tapping. This winding, L1, should be spaced about ⅛in. from the bottom of the grid winding, L2.

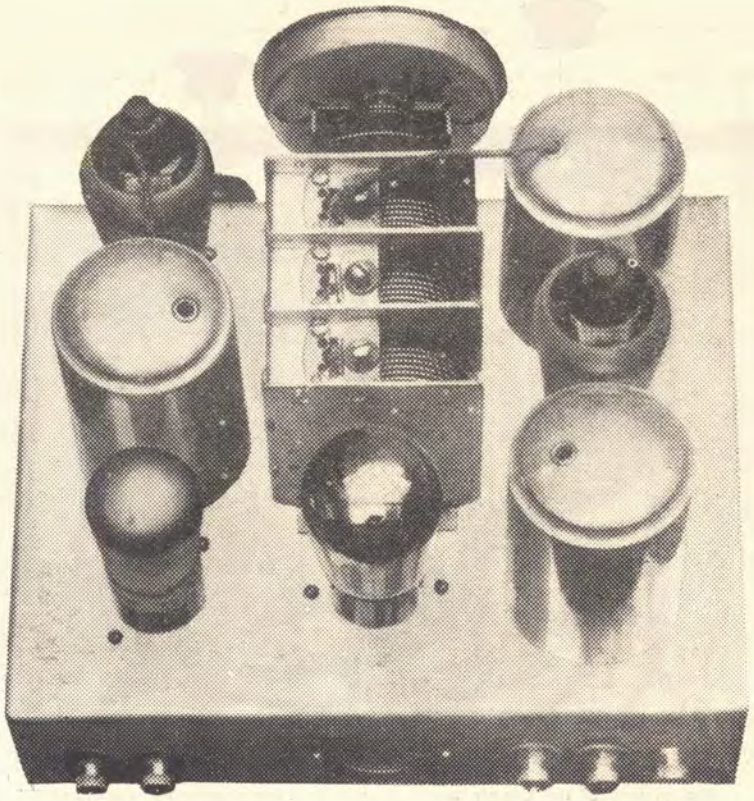
Starting with the next coils, L3, L4, the grid winding, L4, is commenced ⅝in. from top of the former, and require the same number of turns as that of L2. With regard to the primary winding, this consists of 20 turns wound on a celluloid former, which is slipped over the top of the grid winding L4 in such a manner as to permit L3 to be placed at any position over the secondary winding.

The final coils to be wound are L5, L6 and L7. These are very similar to L3 and L4, as the primary and secondary windings, L5 and L6, remain the same as those on the preceding R.F. coil, L3 and L4. The only difference is that this former has a reaction winding wound below the grid winding, L6. The reaction coil requires 40 turns, and is spaced about ⅛in. from the bottom of L6.

With regard to this particular winding it may be found that it is necessary to experiment with the number of turns on it, since it will be found that in some cases a few turns removed will give a more smooth regeneration control, the actual number of turns being largely governed by the characteristics of the particular receiver under test.

## Layout of the Chassis

The actual chassis measures 10½ inches by 8½ inches by 2½ inches, and is made from gauge 16 aluminium. On glancing at the top or plan view of the receiver it will be seen that the aerial coil is erected at the extreme right-hand near corner of the chassis, while in front on this coil the first VP2 valve socket is mounted. The mounting of the four valve sockets should be such that the filament terminals are facing the sides of the chassis. This permits all the filament wiring to be carried out round the sides, thus keeping it away from r.f. parts of the circuit. When assembling these sockets include a soldering lug beneath each of the machine screws holding the sockets to the aluminium chassis. This allows a common earth wire to be taken throughout the set, and direct to the external earth terminal mounted on the rear side of the chassis.



**This top view of the completed chassis illustrates the arrangement of the valves, the coils, and the three-gang tuning condenser.**

### LIST OF PARTS

**C1, C2, C6, 0.1 mfd. fixed tubular condensers.**
**C3, 0.00025 mfd. fixed condenser.**
**C4, .02 mfd. fixed condenser.**
**Coil kit. (See text.)**
**Chassis: Aluminium gauge 16; measurements, 10½ by 8½ by 2½ inches.**
**G1, G2, G3. Three gang variable condenser.**
**L.S., Loud-speaker to suit PM22A (Rola).**
**M, 23 plate midget condenser.**
**RFC, Radio Frequency Choke.**
**R1, 50,000 ohm carbon resistor.**
**R2, 2 megohm carbon resistor.**
**R3, 100,000 ohm carbon resistor.**
**R4, R5, 500,000 ohm carbon resistors.**
**SW1, SW2, Double pole rotary snap switch.**
**VR, 500,000 ohm potentiometer.**
**Valves: Two VP2's, one PM1HL, and one PM22A or Philips replicas.**
**Sundries: Aero dial, three knobs, four feet of 5-way battery cable, five pin valve socket with plug to suit, five terminals, belden wire, soldering lugs, etc.**

Continuing with the actual mounting of the components in the right-hand front corner, the coil can containing coils L3 and L4 is mounted. In the front centre of the aluminium chassis the three gang tuning condenser, G1, 2, 3, is mounted, while to the left of this condenser is fastened the second VP2 valve socket. Behind this socket the remaining coil can containing L5, L6 and L7 is mounted, while at the rear the detector valve socket is screwed to the chassis.

Directly behind the three gang tuning condenser the final or output valve is fastened; this completing the mounting of all the parts above the chassis.

At the front of chassis the potentiometer, VR, is mounted a little to the left of the tuning condenser, with the battery switch fastened directly below the three gang, whilst the reaction condenser is mounted to the right of the variable condenser.

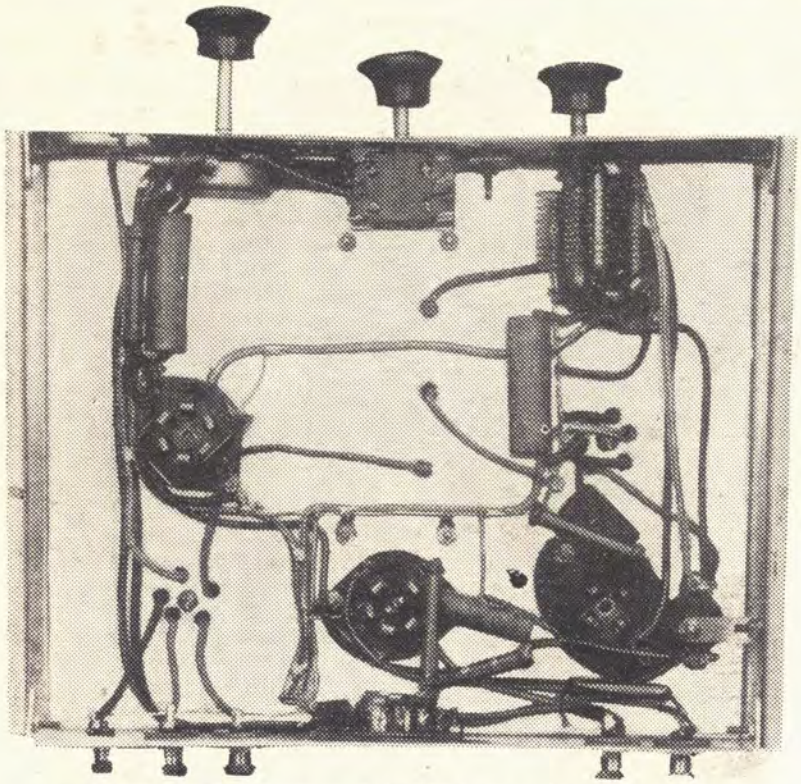
On the rear side of the chassis five terminals and the battery input socket are the only components mounted to the aluminium.

The two aerial and two loud speaker terminals must be insulated from the chassis.

## Wiring in Words

As mentioned earlier in the article, all plate leads should be carried in braided belden wire, the braid being earthed at all convenient points on the chassis.

Commence the wiring by taking two leads from the two aerial tappings on the coil, L1, to the two insulated terminals at the rear of the chassis. The



**This picture of the Countryman's High Gain Four shows the placement and wiring of parts below the chassis.**

end of L1 coil is taken to the common earth lead which is soldered to the lugs beneath the valve sockets and taken to the external earth terminal. The beginning of L2 is fastened to the fixed plates of G1 and to the grid of the first VP2 valve socket. The remaining end of L2 is taken to the movable arm of VR. The movable arm of VR is by-passed to earth by the condenser, C1.

The plate terminal of the first VP2 valve socket is connected to the start of the primary winding, L3, and the other end of this winding is soldered to the screen terminal on the first VP2 socket and to one of the terminals on the battery input socket. This terminal will serve as the "B" positive 90 volt battery connection.

The start of L4 is taken to the fixed plates of G2 and to the grid terminal on the second VP2 valve socket, whilst the end of this winding is taken to the movable arm of VR.

The plate terminal of the second VP2 valve socket is soldered to the beginning of L5, whilst the remaining end of this coil is connected to the screen terminal on the VP2 valve socket and to the "B" positive 90 volt terminal on the battery input socket.

The beginning of the coil L6 is fastened to the fixed plates of G3 and to one side of the fixed condenser, C3. The other side of C3 is soldered to one end of R2 and to the grid of the PM1HL valve socket. The other ends of this resistor, R2, and coil, L6, are taken direct to earth. The plate terminal on the detector valve socket is connected to the bottom of the reaction winding L7, the top of this winding being taken to the fixed plates of the reaction condenser, M, and to one side of RFC.

The other end of RFC is connected to one end of R3 and C4. The other end of R3 is connected to the "B" positive 90 volt terminal on the battery input socket. The remaining end of condenser C4 is soldered to one end of R4 and to the grid terminal on the PM22A valve socket. The other end of resistor R4 is connected to one side of C6 and to one end of R5. The other side of C6 is taken direct to earth, whilst the remaining end of R5 is taken to another terminal on the battery input socket and serves the place of C negative 3 volts bias battery connection.

The plate terminal on the PM22A valve socket is connected to one side of C5 and to one of the loud speaker terminals, whilst the remaining speaker terminal is soldered to the other side of C5, to the screen terminal on the PM22A valve, and to the "B" positive 90 volt terminal on the battery input socket.

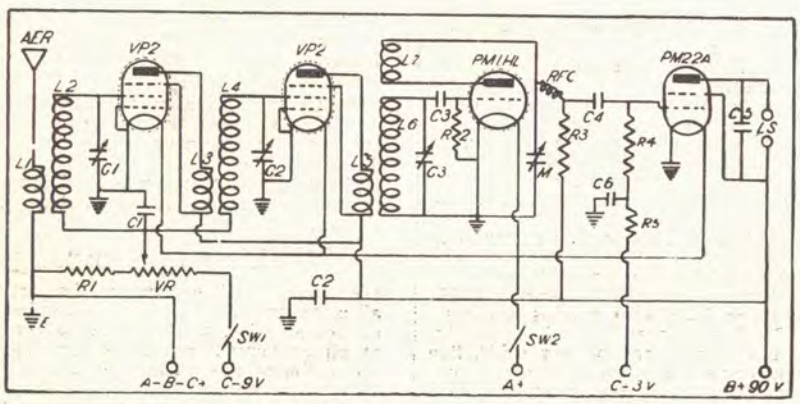
This "B" positive 90-volt terminal on the battery input socket is by-passed to earth by the condenser, C2.

One of the outer terminals of VR is soldered to one end of R1, and the other end of this resistor, R1, is taken to earth.

The remaining terminal on VR is taken to one section of the double pole rotary snap switch, and the other side of this section on the switch is taken to another terminal on the battery input socket, and serves the place of C negative 9 volt bias battery connection.

One of the filament terminals on the four valve sockets is taken direct to the common earth wire, whilst the remaining terminals on the four valve sockets are connected in parallel and to one side of the remaining section of the double pole rotary snap switch. The other side of this switch is taken to one of the remaining terminals on the battery input socket.

This terminal acts as the "A" positive battery connection. The remaining terminal on the battery input socket is taken direct to the common earth wire.




**The schematic circuit diagram of the receiver is keyed to agree with the wiring description and constructional data.**

## Operation

The only careful adjustment necessary is the setting of the three trimmers on G1, 2 and 3, and the correct placing of the primary windings, L3 and L5.

The primary windings, L3 and L5, should be set at approximately the centre of the grid windings, and the cans replaced. Particular caution should be taken when removing these cans to ensure that all "B" battery current is disconnected from the receiver, otherwise one is likely to cause a "B" battery short through the plate lead touching the aluminium frame.

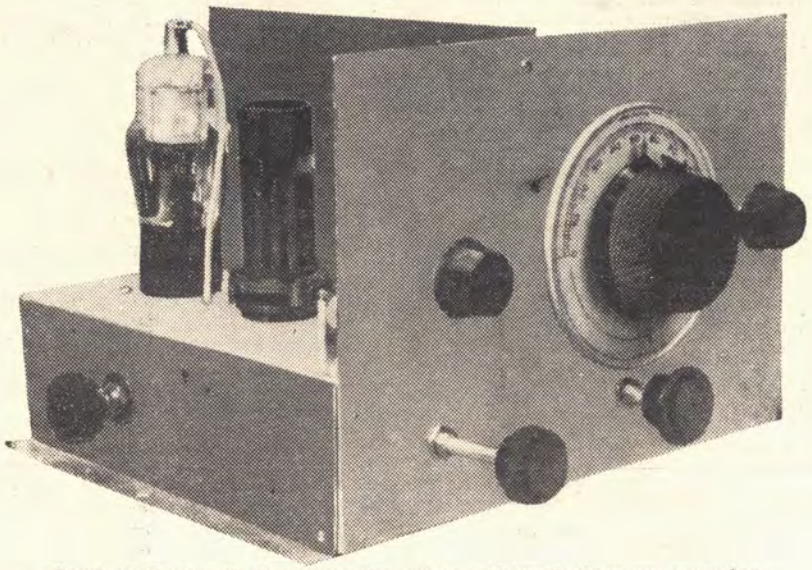
The aerial, earth, loud speaker and batteries should then be connected to the receiver, and the gang condenser turned to some station operating on a low wave length, say 3AW or 3KZ. The trimmers should then be adjusted for maximum signal strength, making adjustments with the volume control, in order to receive the signals at a low level, in order to notice any slight increase in signal strength with each adjustment of the trimmers.

When the receiver is operating in the average country districts an aerial measuring 60 to 70 feet over all will be found suitable. It is essential that a good earth connection is installed to receive good all-round results.

# THE D.X. THREE

A sensitive and economical three-valve battery operated receiver which is capable of bringing in overseas stations at excellent strength.

**By H. R. SETFORD**



**Front panel view of the completed receiver. Although there are a number of controls to operate the tuning in of overseas stations is extremely simple.**

RECENT articles on short wave receivers have evoked such enormous interest, and such a wealth of enquiries for battery operated receivers, that we feel certain the set we propose to describe will prove exceptionally popular.

The receiver is a sensitive, economical battery operated model, capable of bringing in overseas stations at excellent strength.

The tuning range is from 20 to 100 metres, and this tuning spectrum is covered by the use of plug in coils, three for each tuned stage.

The receiver is readily adaptable to headphone reception, as a volume control connected in the grid circuit of the pentode valve allows any degree of signal level to be obtained.

THE radio frequency amplifier is a type 32. This valve is of the screen grid type and has a theoretical amplification factor of 610.

Although practical design does not allow this high amplification to be obtained, the circuit used in this receiver results in high gain from the R.F. stage.

The aerial is coupled to the grid of the 32 through condenser C2, whilst the grid of this valve is tuned to the frequency of the incoming signal by the coil condenser combination, G1-L1.

In order that this radio frequency stage should be absolutely stable, it was found necessary to apply a slight negative bias to the grid of the 32.

This was accomplished by returning the low potential end of L1 to earth through condenser C10 and applying 1½ volts negative to the grid of this valve through the coil, L1.

The screen supply for this valve is taken from the 45 volt tap on the "B" battery and is by-passed to earth by condenser C2.

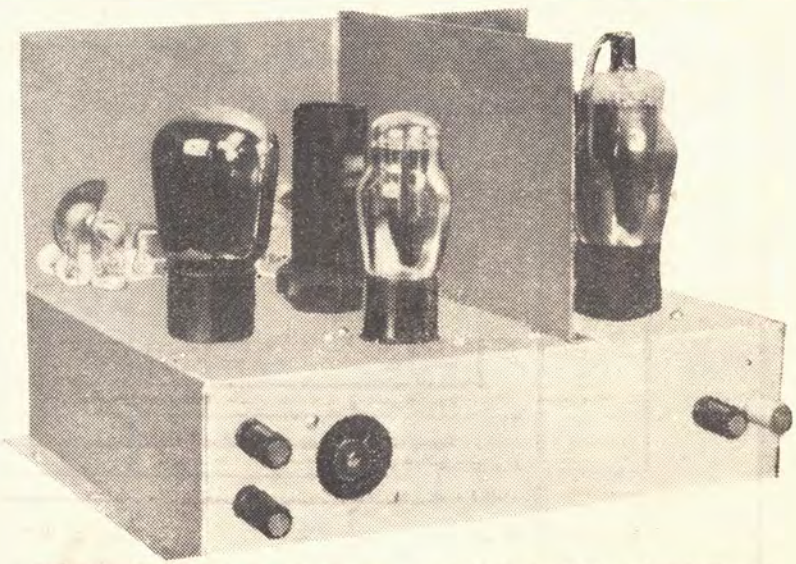
A modified form of the tuned anode system is used to couple the plate of the 32 to the grid of the detector valve.

The "B" positive supply for the plate of the R.F. valve is fed through the coil, L2, and is isolated from the grid of the detector valve and earth by condensers C4 and C3, respectively.

On no account must the grid leak, R1, be connected across the grid condenser, for this will result in a high positive potential being placed on the grid of the detector valve.

A type 19 valve performs the dual function of regenerative detector and first stage audio frequency amplifier.

This valve consists of two high-mu triodes in a single envelope, but with a



**On the rear side of the chassis are mounted the headphone terminals, the battery input socket and the aerial-earth terminals**

common filament. It fits the standard six-pin socket.

The detector valve is made to regenerate by coupling the reaction winding, L3, to the grid coil, L2.

Condenser C5 is necessary to prevent the detector plate from becoming shorted to earth through the reaction winding.

Regeneration is controlled by variation of the plate supply voltage to the detector valve by the potentiometer, RC, shunted across the "B" supply.

Condenser C7 by-passes the arm of this component to earth and effectively prevents noises in this resistor from marring reception.

Connected in parallel with the detector stage tuning condenser G2 is a small trimmer condenser, T.

This allows of extremely fine adjustment of the detector tuning circuit and assists considerably in holding weak signals.

The detector valve is resistance coupled to the grid of the driver valve, which in turn is resistance coupled to the grid of the pentode output valve.

This valve, a type C243N, is capable of supplying a comparatively large undistorted output at low plate voltages.

The volume is controlled in the grid circuit of the output valve by means of the potentiometer, VC, which takes the place of the grid resistor for this stage.

## Review of Components

In view of the important part which the tuning condensers play in the operation of short-wave receivers, a few words on the condensers used in the receiver will not be amiss.

The condensers are Radiokes isolantite type midgets.

These condensers are designed especially for short-wave work, and insulation losses are reduced to a minimum by the use of isolantite insulation.

This particular insulator is very efficient at the higher frequencies.

The main tuning condensers are 14-plate midgets, and have a maximum capacity of 100 mmfd. (.0001 mfd.).

C1 is a 3-plate midget condenser having a maximum capacity of 20 mmfd.

The note splitting condenser T is a reconstructed 3-plate midget which is altered in the following manner:—

Remove one of the fixed plates from the condenser by holding a hot soldering iron at the junction of this plate and its support.

The single rotor is now moved away from the remaining fixed plate until a space of three-sixteenths of an inch separates them.

The regeneration control, RC, and the volume control, VC, are moulded carbon type potentiometers.

All the fixed condensers for this receiver, with the exception of C2 and C7, should be of mica dielectic type.

The resistors should be either of the carbon or metallised variety.

Valve and coil sockets should be selected which give a smooth wiping contact to their respective components.

The chassis on which this receiver is constructed is of aluminium, and measuses 10 inches by 9 inches by 2½ inches.

A dividing screen is placed across the chassis 4 inches from one end to isolate the R.F. portion of the receiver from the detector and audio stages.

The front panel is also of aluminium, and measures 10 inches by 7 inches.

## Assembly

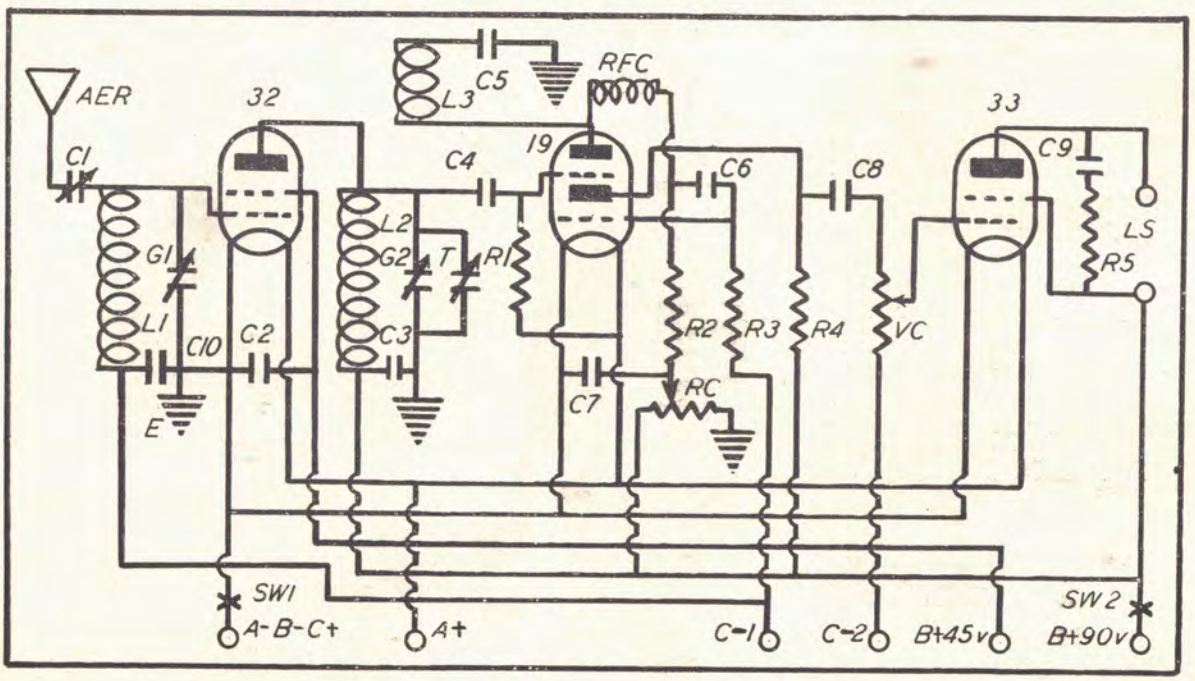
The assembly of the various components on the chassis may now be carried out. The R.F. tuning condenser is mounted centrally on the front panel, and situated in the smaller compartment.

The detector tuning condenser is mounted approximately the same distance from the screen as the R.F. tuning condenser, but on the right of this screen.

The trimmer condenser is also mounted on the front panel alongside the detector tuning condenser.

## The List of Components and the Schematic Circuit Diagram for the D.X. Three

**C1: 3 plate midget condenser.**
**C2, C7: .5 mfd. fixed tubular condensers.**
**C3, C6, C8: .02 mfd. fixed condensers.**
**C4, C5: .00025 mfd. fixed mica condensers.**
**C9: .01 mfd. fixed condenser.**
**G1, G2: 14 plate midget condensers.**
**L1, L2, L3: Short-wave Coils. (See Text).**
**L.S.: Loudspeaker to suit 33 (Rola).**
**R1: 2 megohm resistor.**
**R2, R3, R4: 250,000 ohm resistors.**
**R5: 10,000 ohm resistor.**
**RC: 500,000 ohm potentiometer.**
**RFC: Radio Frequency Choke.**
**SW1, SW2: Double Pole rotary snap switch.**
**T: 2 plate midget condenser. (See Text).**
**VC: 500,000 ohm potentiometer.**
**Valves: Types 32, 19, 33, Ken-Rad, Mullard, Philips, Radiotron.**
**Sundries: Four terminals, one six pin socket and plug, 6 yards of belden wire, one vernier dial, five knobs, nuts, screws, one aluminium chassis measuring 10 inches by 9 inches by 2½ inches. Sheet of aluminium for screen 4 inches by 9 inches and aluminium front-panel 7 inches by 10 inches.**



Mounted directly beneath this condenser is the volume control, VC.

Great care must be taken in mounting both this control and the regeneration control RC to see that their arm contacts are insulated from the chassis.

The regeneration control may be seen mounted directly under the R.F. tuning condenser.

The R.F. coil socket is bolted to the chassis directly behind its associate tunting condenser, and as close as possible to this component, in order that the leads to the coil may be kept short.

Towards the rear edge of the chassis and in line with this coil socket is the R.F. valve socket. The aerial coupling condenser is mounted beneath the chassis on the left-hand short side. This component, as well as the aerial and the two phone terminals, must also be insulated from the chassis.

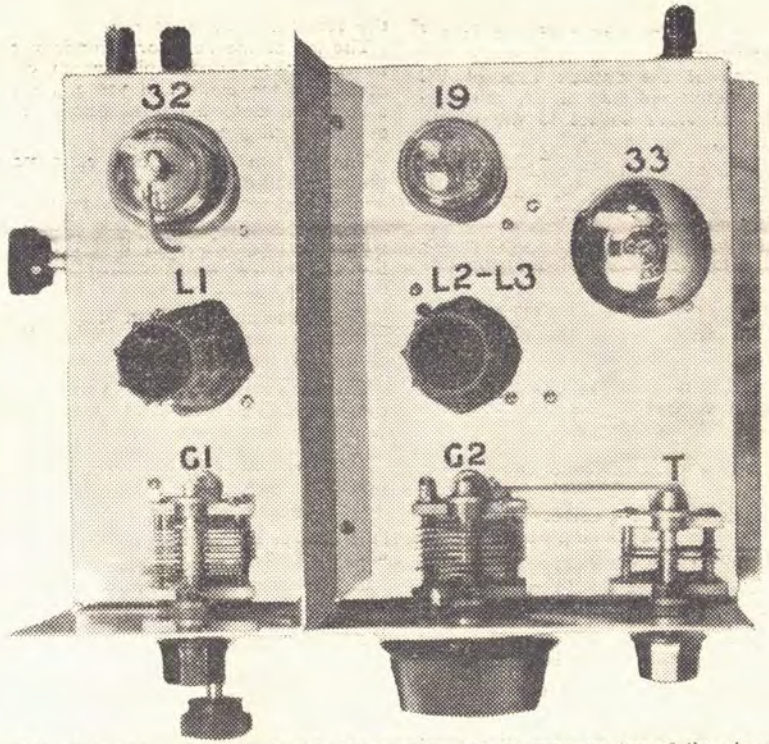
The aerial and earth terminals are those mounted on the rear edge of the chassis slightly to the left of the R.F. valve socket.

The two phone terminals are also on the rear edge of the chassis at the extreme right.

The battery socket is mounted to the left of these terminals.

The detector valve socket is mounted toward the back of the assembly in line with its tuning condenser, whilst between these two components is mounted the detector stage coil socket.

The assembly is completed by bolting the pentode valve socket in position on the rear right of the chassis.




This plan view of the set depicts the arrangement of parts on top of the chassis.

## Wiring

The wiring should be commenced by connecting together one filament terminal of each of the three valve sockets, and joining them to the "A" positive terminal of the battery socket.

The remaining filament terminals of these four sockets join to earth.

Solder a lead to the aerial terminal, and connect it to the moving plates of the aerial coupling condenser, C1.

The fixed plates of this condenser connect to the fixed plate lug of the R.F. tuning condenser, to one filament terminal of the R.F. coil socket, and to the grid of V1.

The screen contact of V1 connects to the "B" positive 45 terminal of the battery socket.

The plate of the R.F. valve socket joins to one of the filament terminals of the detector coil socket, to the fixed plates of the detector tuning condenser, to the fixed plates of T, and to one side of C4.

The remaining side of C4 connects to the grid contact of No. 1 section of the 19 valve socket, from which R1 connects to "A" positive.

The unconnected filament terminal of the detector coil socket connects to "B" positive 90 on the battery socket, whilst C3 connects from this point to earth.

The plate terminal of No. 1 section of the type 19 socket connects to one contact of RFC, and to one of the small pins of the detector coil socket.

The remaining contact of this socket joins to one side of C5, the other side of which connects to earth.

Solder one side of C6 to one side of R2, and to the remaining contact of RFC.

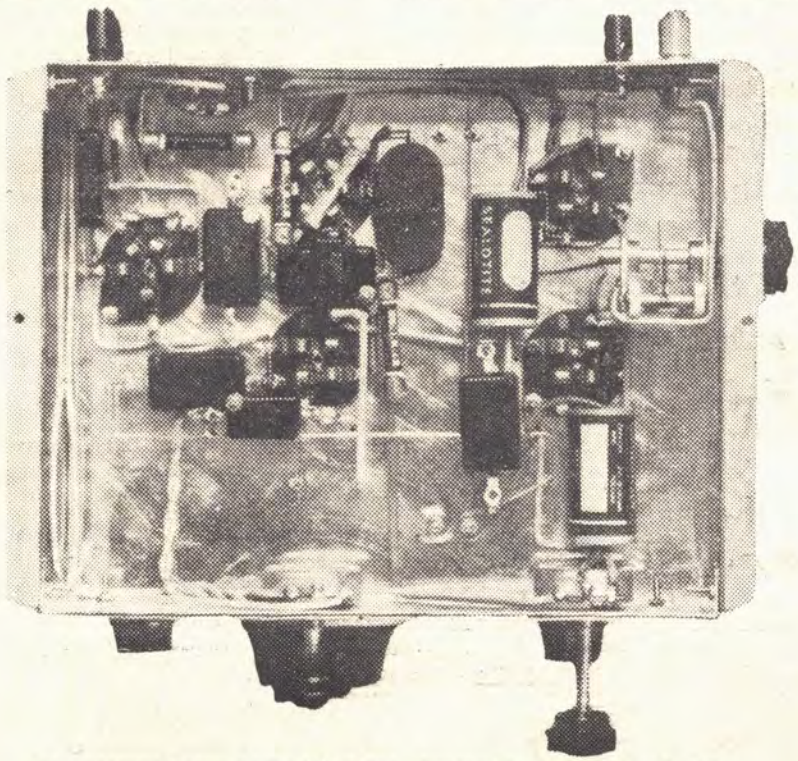
The arm of RC joins to the unconnected side of R2, from which C7 connects to earth.

One of the outside contacts of RC connects to "B" positive 90, whilst the other connects to earth.

The remaining side of C6 connects to the grid of section No. 2 of the type 19 valve socket, and to one side of R3.

Connect together the remaining side of R3, the unconnected filament terminal of the R.F. coil socket, and one contact of C10, and join them to the "C" negative terminal of the battery socket.

The remaining side of C10 connects to earth. The plate contact of No. 2 section of the type 19 socket connects to one side each of R4 and C8.



An underneath view of the DX Three, showing the placement and wiring of parts beneath the chassis.

The unconnected side of R4 connects to "B" positive 90, as also does one of the phone terminals.

Join one of the outside lugs of VC to the unconnected side of C8, and wire the pentode valve socket to the centre arm of VC.

The remaining outside contact of this component connects to "C" negative 3 volts on the battery socket.

The plate terminal of the pentode socket joins to the unconnected phone terminal.

Condenser C9 and resistor R5 are connected in series across the phone terminals.

The wiring is completed by connecting the screen contact of the pentode valve socket to "B" positive 90.

## The Coils

The coils for this receiver are wound on 4 pin formers having an outside diameter of 1¼ inches.

The coils for the 70-100 metre band are wound with 30 gauge enamel wire.

The R.F. coil has 17½ turns, whilst the Detector grid coil has 16 turns.

The reaction coil should consist of 10 turns of the same gauge wire wound alongside the detector secondary and spaced ⅛ inch from it.

The top of the R.F. secondary connects to the filament pin, which is joined to the fixed plates of the R.F. tuning condenser.

The end of this winding connects to the remaining filament pin.

The top of the detector secondary connects to the filament pin which corresponds to the contact of the coil socket that is wired to the fixed plates of the detector tuning condenser.

The bottom of this coil connects to the remaining filament pin, whilst the end of the reaction winding nearest the secondary connects to the small pin which corresponds with that contact of the coil socket which connects to condenser C5.

The remaining end of the reaction winding connects to the other small pin of the former.

The R.F. coil for the 40-70 metre band consists of 13¼ turns of 24 gauge enamel wire.

The detector grid coil for this band has 12½ turns of the same gauge wire.

The reaction winding on this coil should be 10 turns of the 30 gauge enamel wire.

The 20-40 metre R.F. coil has 8½ turns of 18 gauge enamel wire slightly spaced, whilst the detector coil should consist of 8 turns of the same gauge wire.

Five and a half turns of 30 gauge wire constitute the reaction winding for this coil.

In order to cover the widest range with a minimum number of coils, the tuning bands of this receiver only just overlap, so the individual constructor will have to adjust the coils until the coils provide a continuous tuning range.

Tuning with short-wave receivers of the same type even with the same set of coils often varies considerably. This is particularly noticeable on the higher frequencies.

The reaction windings should also be adjusted carefully to give smooth oscillation over the whole tuning range of the receiver.

Some constructors may desire to tune below 20 metres; those who desire to do so should construct another set of coils. Start by winding a coil slightly smaller than the one for the 20-40 metre band and gradually remove or space the turns until a station at the low end of the dial with the 20-40 metre coils in circuit is received at maximum with the smaller coil.

It will be noticed that the coils for the R.F. stage vary slightly in size from those for the detector circuit.

This is due to the loading effect of the aerial. If it is found that, at a particular position of the detector tuning the R.F. condenser will not peak, the R.F. coil should be adjusted in order that it may do so.

## Operation

When all wiring has been checked and found correct, the batteries may be connected, the valves inserted in their correct sockets and the aerial, earth and Phone leads connected to their respective terminals.

Plug a set of coils into the receiver and turn VC toward maximum.

The detector valve should be heard to oscillate smoothly as RC is rotated.

Should the detector valve fail to oscillate the connections to the coil socket and the coil pins should be checked to make certain that they are connected as described.

If these connections are in order and the valve still refuses to oscillate it will be necessary to add turns to the reaction coil.

It will be noticed that only one vernier dial is employed, and that this controls the detector tuning. The detector tuning is very critical, but the R.F. stage tunes fairly broadly, and for this reason a knob is quite sufficient in this position.

Judicious use of the note splitter condenser T will enable the user to get maximum results from weak signals.

In some cases it is desirable to have the detector valve oscillating and to tune to zero beat with this condenser.

A station may often be identified in this way when the usual manner of adjusting the detector to the verge of oscillation fails.

This receiver has been tested on an efficient aerial and earth system in the metropolitan area and the results obtained were remarkable.

London, Paris, Germany, Holland and many other stations were received at maximum strength.

The receiver should commend itself to those who are looking for an efficient, economical battery-operated short-wave receiver suitable for both phone and loud-speaker operation.

# The Pre-Selector Battery Super 4

(Continued from page 24)

Turn back a half turn from this setting and try tuning over the whole band. The ideal adjustment is to have RC as close to the oscillating point as possible without the second detector actually oscillating on any station. It is impossible, no matter how carefully all these adjustments are carried out, perfectly to align this receiver by ear. Those constructors who desire the best results from this, or any other Super-Heterodyne receiver will find it well worth the few shillings necessary to have the set aligned by an expert, and with the aid of a signal generator.

A few words regarding the battery consumption of the receiver will not be out of place at this juncture.

The current drawn by the filaments of the four valves is .54 of an ampere, which is well within the discharge rate of even small accumulators. The "B" battery consumption of the original model was approximately 12.5 milliamperes when operating full out on local stations.

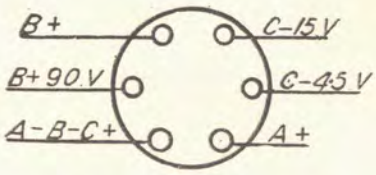
When operated at night in the suburban area with a permagnetic speaker and an aerial approximately 40 feet in length, the receiver performed remarkably well.

The dial was absolutely crowded with stations, and the selectivity compared more than favorably with AC operated receivers of the same type.

The receiver can be thoroughly recommended to country listeners in need of a good selective and sensitive receiver capable of reproducing interstate programmes, and yet possessing that very desirable characteristic, economy of operation.

BATTERY SOCKET

**Bottom View**




BATTERY PLUG

**(Looking down on the pins)**

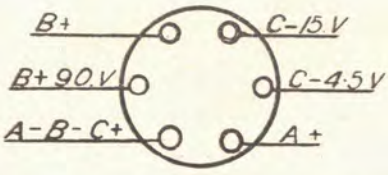
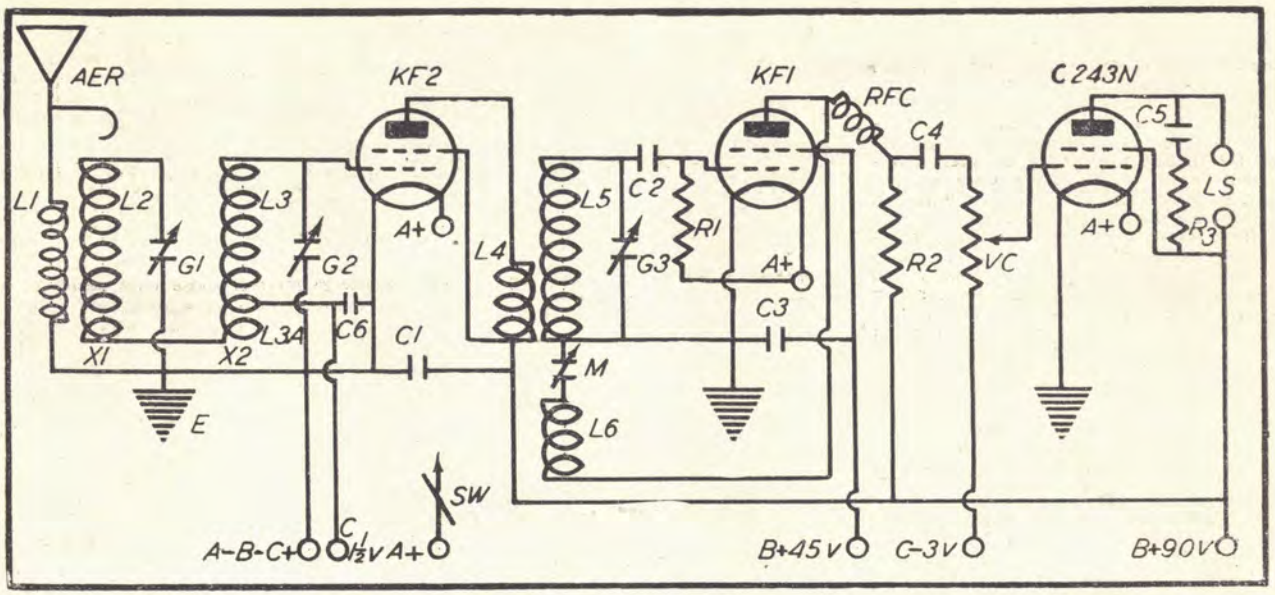



**Fig. 1: These two diagrams show the connections to the battery socket and plug respectively.**




**As the circuit diagram shows, this receiver employs a pre-selector stage ahead of the r.f. amplifier.**

# The Re-Allocated Three

## A highly selective tuned r.f. receiver for the country listener.

By A. K. Box

AS we have remarked many times before, the lot of the country radio listener is one which might well be envied by his city cousin. Away from all sources of electrical interference, and from the high buildings which screen radio signals, he gets results which make the city man gasp.

Realising this, and that the chief problem of the country listener is economical reception, we have designed a simple receiver which is selective enough for even the most congested receiving areas, yet is so economical in operation that it might almost be operated from light duty batteries.

IT is essentially a home constructor's receiver, for the tuning coils must be made instead of being purchased from the nearest radio dealer. These coils, however, are extremely efficient and truly can be classed as the heart of the design.

### Circuit Details

Later we shall deal fully with the construction of these coils, but meantime we shall review the circuit and its components. A glance at the schematic circuit diagram will show that a three-gang tuning condenser, G1, G2 and G3, is used to tune tne three windings, L2, L3 and L5. L2 is the aerial secondary winding, L3 the pre-selector winding, and L5 the detector grid winding. At the bottom end of L3 is an auxiliary winding, L3A. This consists of three turns, and is used as the coupling between the aerial coil and the pre-selector coil.

The aerial primary winding, L1, is a basket weave type of coil, and is used to provide the high impedance method of aerial coupling which ensures that the receiver's sensitivity will be relatively even throughout its tuning range. This primary is coupled to the high potential end of the secondary, L2, by means of a single link turn.

The radio frequency valve is a Philips KF2, a two-volt radio frequency pentode which combines high efficiency with remarkable stability.

The detector valve is another Philips tube, the KF1. This is a screen grid tube designed particularly for detection. As maximum sensitivity is desired the KF1 is operated as a grid leak detector. The output valve is a Philips 243N pentode, which is capable of giving reasonable power output with extreme economy in "B" battery consumption.

The "A," "B" and "C" battery requirements of the receiver are exceptionally modest. A 2 volt accumulator type "A" battery will be required for the filament supply. Two 45 volt heavy duty type "B" batteries will be necessary for the "B" supply, and a single 4½ volt "C" battery will suffice for "C" bias. The plate consumption of the receiver will range from 6 to 8 milliamperes depending upon the strength of the received signal.

A study of the various illustrations of the original receiver will show that the lay-out has been planned to ensure that the maximum efficiency shall be obtained from the ensemble. The three-gang condenser, G1, G2 and G3, is mounted centrally on the chassis. The pre-selector coil and the r.f. tube KF1 are mounted at its right. A small aluminium screen measuring 4⅞ inches in width and 5¼ inches in height is mounted between the rear of the gang condenser and the rear of the chassis. This shield has a half-inch wide flange along its shorter edge, and is mounted to the chassis by bolts placed through holes drilled in this flange. Another small scrap of aluminium is used to make a bracket which holds the shield to the top of the gang condenser.

### Coil Data

Three separate coil formers are required. Each should be 2¾ inches in diameter and 3¾ inches in length, and should be made of high-grade yellow bakelite. The wire used for the windings, L2, L3, L3A, and L5, is 26 double cotton covered, while for L1, L4 and L6, 34 gauge double silk covered wire should be used.

The aerial winding, L2, has 59 turns, the grid windings, L3 and L5, consist of 50 turns of wire, while an additional three turns for L3A is laid on at the bottom of L3. All windings are started one inch up from the bottom of the coil formers, the top end of each winding being the high potential or grid end. It is particularly important that the instructions for the winding of these coils should not be departed from in the slightest degree.

When the three main windings have been put on their respective formers and the auxiliary winding, L3A, has been attached to the bottom of L3, the winding of the reaction coil, L6, can be started on the bottom end of the former carrying L5. This winding, unlike all

other windings except L1, is in the reverse direction to the grid windings. It should be separated from L5 by 1-16th of an inch and may consist of seven turns of 34 gauge wire.

The R.F. primary winding, L4, consists of 30 turns of 34 gauge wire wound in the hollows existing between adjacent turns of 26 gauge wire on the grid winding, L5. This primary winding, L6, should be started in line with the bottom (earth) end of L5. This completes two coils. The third, L1-L2, may be finished by winding the primary, L1, and mounting it inside the former on which L2 is wound. As each coil is finished it should be doped by immersion in a molten (nearly boiling) solution composed of nine parts of beeswax and one part of resin.

The high impedance coil, L1, consists of two windings each of 140 turns. These windings are of the basket weave type made by arranging nine pins equidistantly around a half-inch diameter wooden dowel and winding the wire alternately over one pin and under the next until the total of 140 turns is laid on.

It should be particularly noted that these 140 turn coils are wound in an anti-clockwise direction (opposite direction to that in which the grid coils were wound) because if this is not done the aerial system will refuse to function.

Follow the same procedure with the second 140 turn coil. When the two coils have dried and hardened slip them over a piece of bakelite or wooden rod which should be long enough to ensure that when its base is screwed to the chassis the top coil will be in line with the top turn on the grid winding.

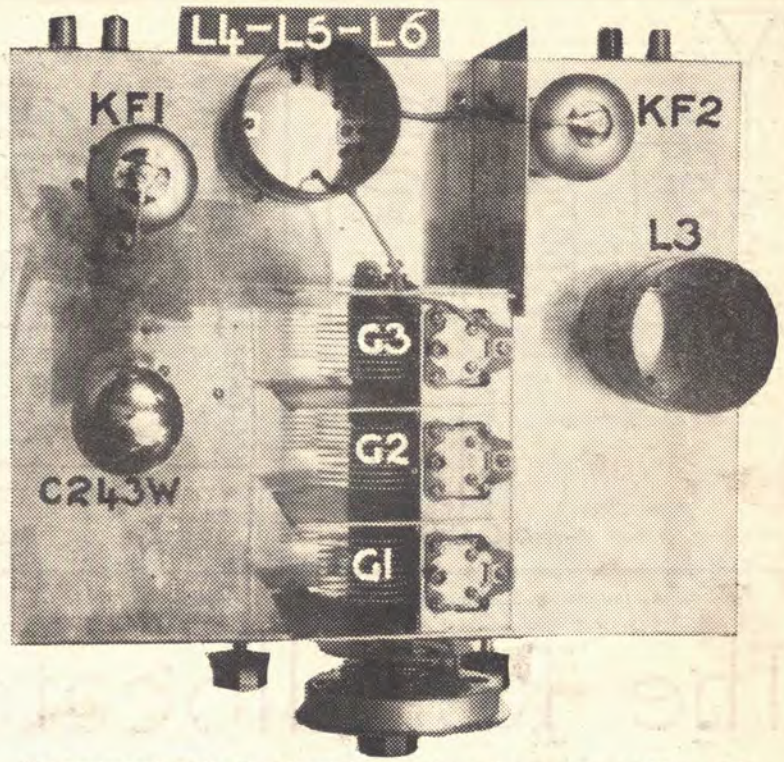
The outside lead of the top coil will go to the aerial, and the inside lead of this coil will join to the outside lead of the lower coil. The inside lead of the lower coil connects to earth. Remember when mounting the dowel rod inside the grid coil former that it should be central with respect to the grid coil and of sufficient length to ensure that the top 140 turn winding is parallel with the top turn on the grid coil.

The next job is to wind one turn around the top of the coil former for the grid coil, L2. This should be laid right alongside the top turn of the grid winding. One end of this single turn is left free while the other connects to the aerial lead on L1.

## Wiring In Words

This is started by connecting the aerial terminal on the chassis to the aerial lead from L1 and by taking an earth lead (bare tinned wire) from the earth terminal to the earth lead on L1, and around the chassis, so that suitable earth connections can be easily made. This earth lead can quite easily be soldered to one of the filament lugs on each of the three valve sockets. A lead should be taken from it to the filament negative lug on the battery socket. The top end of L2 should be connected to the G1 fixed plate lug on the gang condenser by means of a lead taken up through the chassis just under this gang condenser.

The other end of L2, the X1 tap, should be joined to the bottom end of the three-turn winding, L3A, at X2. The junction between L3 and L3A should be connected to one lead on the .5 mfd. condenser. C6, and to the "C" minus 1½ lug on the battery socket. The top of L3 should join to the fixed plate lug on the G2 section of the gang condenser




**This photograph of the Re-Allocated Three shows the mounting positions of the various components on top of the chassis. All parts are keyed to correspond with the written description of the receiver.**

by means of a lead taken underneath the chassis to the control grid lug on the KF2 socket. From this point on the KF2 socket a lead runs to the G2 section already mentioned. The remaining

### List of Parts

**Chassis: 14in. x 11in. x 4in. 16 Gauge Aluminium.**
**C1, C3, C6: .5 mfd. Tubular Condensers (Solar).**
**C2: .00025 mfd. Mica Condenser (T.C.C.).**
**C4: .02 mfd. Mica Condenser (T.C.C.).**
**C5: .01 mfd. Mica Condenser (T.C.C.).**
**G1, G2, G3: .00042 mfd. Three Gang Condenser (Airway).**
**L1 to L6: Special Coils (see Text).**
**LS: Loudspeaker to suit C243N (Rola).**
**RFC: Radio Frequency Choke.**
**R1: 2 Megohm Resistor (I.R.C.).**
**R2: 100,000 ohm Resistor (I.R.C.).**
**R3: 10,000 ohm Resistor (I.R.C.).**
**SW: Battery Switch (Marquis).**
**VC: 500,000 ohm Potentiometer (Yaxley).**
**Valves: One each Philips KF1, KF2, and C243N or Mullard replicas.**
**Sundries: Wire, machine screws, one 6 pin socket, six pin battery plug, 4 terminals, aluminium screen, coil formers and winding wire.**

connection on C6 should join to the earth wire. Join together the vacant filament lug on each of the 3 valve sockets and take a wire from this lug on the KF2 socket to one side of the battery switch, SW. The other side of this switch is wired to the "A" plus lug on the battery socket.

The top (plate end) of L4 joins to the plate (top) pip on the KF2 by means of a metal braided wire, which passes through the dividing screen. The braiding on this wire should be earthed. The other lead on L4 joins to the screening grid lug on the KF2 socket, and to the "B" plus 90 volt lug on the battery socket. One lead of the .5 mfd. condenser, C1, is soldered to the screening grid lug on the KF2 socket, the other lead on this condenser being joined to the ground wire.

The top (grid) end of the winding L5 joins to one side of the .00025 mfd. fixed condenser, C2, and to the fixed plate lug on the G3 section of the gang condenser. This latter connection is taken from the coil to the condenser above the chassis. The remaining lug on C2 and one lead on the 2 megohm grid leak, R1, are soldered to the control grid lug on the KF1 socket. The other lead on R1 joins to the positive filament lug on this socket. The remaining lead on L5 joins to the ground wire.

The top lead (nearest to the grid winding) on L6 joins to the plate lug on the KF1 socket, the other lead of this coil going to the fixed plate lug of the midget condenser, M. One lug on the radio frequency choke coil, RFC, joins to the plate of the KF1, while the other lug goes to the junction of the 100,000 ohm resistor, R2, and to one lug of the .02 mfd. condenser, C4. The other lead on R2 joins to the "B" plus 90 volt lug on the battery socket.

The remaining lug on C4 is wired to one of the outside lugs on the volume control, VC. The other outside lug on this control is connected to the C minus 3 lug on the battery socket. The centre lug on VC connects to the control grid on the 243N socket. The plate lug on this socket is wired to one of the l.s. terminals and to one lug on the .01 mfd. condenser, C5. The other lug on C5 is joined to one lead on the 10,000 ohm resistor, R3. The remaining lead on

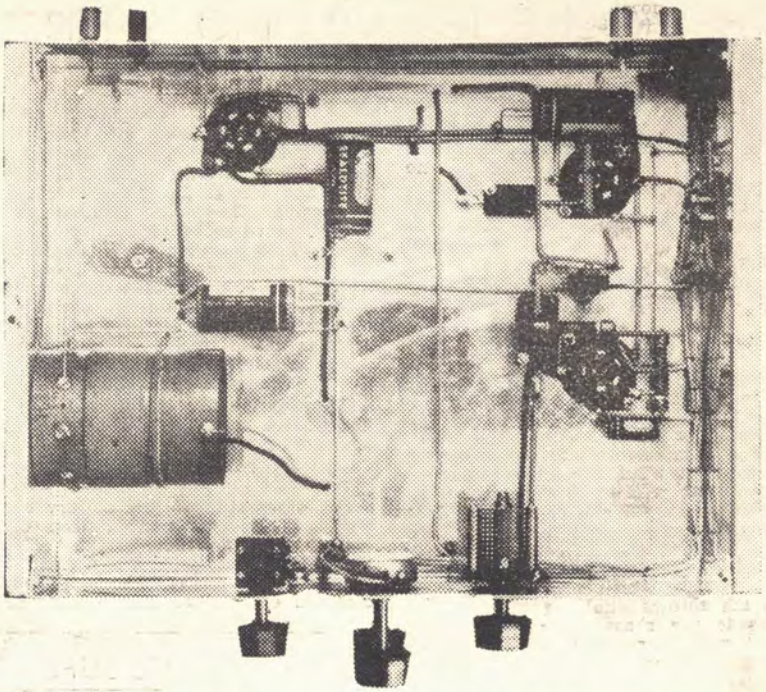
R3 and the screen grid lug on the 243N socket are connected together and to the remaining l.s. terminal. From this l.s. terminal a lead is taken to the "B" plus 90 volt lug on the battery socket.

Solder one lead of the .5 mfd. condenser, C3, to the screening grid lug on the KF1 socket and take a lead from this point to the "B" plus 45 volt lug on the battery socket. The remaining lead on C3 is connected to the ground wire. On the KF1 and KF2 sockets there are two lugs which have not yet been wired into circuit. These are for the suppressor grid and metal coating connections on each tube. Wire the two of them together on the KF1 socket and join them to the earth lead. Do likewise with the two remaining lugs on the KF2 socket.

This completes the wiring of the receiver, and, provided that everything has been followed exactly to schedule, we are ready to go ahead with the testing and alignment of the receiver.

The procedure to be followed in aligning the receiver is first to tune it to the low end of the dial and, with the reaction condenser advanced, endeavor to pick up a station such as 3XY, 3AW, 7UV or 3GL. Having brought the station in, adjust the trimmer condensers on the G1, G2 and G3 sections of the gang in the order mentioned until loudest signals are obtained.

In order that the tuning range shall be as wide as possible, endeavor to keep the trimmer condensers well open. If they are screwed down hard the wavelength to which the receiver will tune with the condenser full out will be unduly high and the stations operating between 1400 and 1500 k.c. will be missed. With the receiver correctly aligned at the low end of the dial tune up to the top end and pick up 3AR, 5CK, 2CO or 2FC.



**This illustration shows the placement and wiring of the parts below the chassis. The aerial coil is seen mounted on the left-hand side.**

Try the effect of further adjustments to the trimmers. If a trimmer has to be screwed further out to bring the station up to full strength it will be found that the bending outward of the split vane section nearest the "full-in" position of that particular section of the gang will help matters.

# THE PRE-SELECTED MELODIOUS THREE

(Continued from Page 34)

Coil L5 requires 125 turns.

Coil L6 is wound over the earth end of L5 and needs 30 turns. This coil is wound in the reverse direction to the other coils.

Coil L4 is wound on a 1½ inch former and requires 60 turns. This former is slipped over the top of the secondary winding, L5.

The foregoing coil data is to match the Capitol three-gang tuning condenser.

## Wiring in Words

Having mounted the components in their particular positions on the chassis, the next step in the construction of this receiver is the wiring. Before the actual wiring of components into the circuit is commenced it would be advisable for a common earth wire to be run around the inside of the chassis and connected direct to the earth terminal at the rear of the chassis. This earth wire can be supported from the chassis by means of small soldering lugs which are fastened beneath the screws holding the valve sockets to the chassis. By this procedure it will be possible for good earth connections to be made, and not have to rely upon the actual aluminium chassis.

Commence the wiring by taking a lead from the aerial terminal mounted at the rear of the chassis to the beginning of the aerial coil, L1. The other end of this coil, L1, is connected to the earth.

The beginning of the grid winding on this former, L2, is joined to the fixed plates of the G1 section of the three-gang tuning condenser. The start of the L3 coil is soldered to the fixed plates of the G2 section of the tuning condenser, while the end of this winding, which is actually L3A, is fastened to the remaining end on L2 coil. The tapping, eight turns from the bottom of L3A coil, is connected to the earth wire. The end of L3 is connected to the G2 condenser and is then taken to the grid of the SP2 valve. The plate of this tube, SP2, is soldered to the start of L4 winding. The screen terminal on the SP2 valve socket is joined to the other end of L4 coil. A lead is taken from this end of L4 coil to the loud speaker terminal which is connected to the screen of the PM22A valve socket. This lead is by-passed to earth by condenser, C1. The beginning of L5 coil is taken to the fixed plates of G3 section of the three-gang condenser and to one side of the fixed condenser, C2. The other side of this condenser, C2, is connected to one end of R, and to the grid of the PM1HL valve socket. The other end of L5 coil is taken to earth. The movable plates of the three-gang tuning condenser, G1, 2, 3, should be connected to the common earth wire.

The start of L6 winding is soldered to the fixed plates of the reaction condenser, M. The movable plates of this condenser are joined to the earth wire. The other end of this coil, L6, is taken to the plate of the detector valve socket and to the P terminal on the audio transformer, T. The B terminal on the audio transformer, T, is connected to one lead of the battery cable and serves the place of B positive detector battery connection. The G terminal of the audio frequency transformer, T, is soldered to the grid terminal on the PM22A valve socket. The F, or C terminal of the audio transformer T, is connected to one side of the resistor, R1, and to the negative end of condenser C3. The other ends of these two components are taken direct to the earth wire. Another battery cable lead is taken from this F or C terminal of T, and acts as the B negative battery connection. The plate terminal on the PM22A valve socket is connected to one of the loud speaker terminals mounted on the rear side of the chassis. The screen lead of the PM22A valve socket is joined to the remaining loud speaker terminal. Another lead from the battery cable is joined to this loud speaker terminal and serves the place of "B" positive maximum battery connection.

The negative filament terminals on the three valve sockets are connected direct to the earth wire, while the positive terminals are joined together and taken to one side of the battery switch, SW.

The other side of this battery switch, SW, is joined to another lead of the battery cable and acts as the "A" positive battery connection. A lead from the battery cable is connected to the common earth wire and is used as the "A" negative battery connection. The remaining end of the resistor, R, is connected to the positive filament terminal on the detector valve socket, PM1HL.

Having re-checked the wiring of the set with the schematic circuit accompanying this article, connect the "A" and "B" batteries to their respective points. For the filament battery a 2-volt accumulator will be required, while for the "B" supply two 45-volt heavy duty "B" batteries are most suitable. The "B" positive detector battery connection should be fastened to a battery tapping ranging between 22½ and 45 volts, the best results being found by experiment with the particular receiver. The "B" positive maximum battery lead is taken to the positive 90 volts. Connect the aerial, earth and loud speaker leads to their respective terminals on the chassis and switch on the receiver. The set should then be tuned to some station operating on a wave length in the vicinity of station 3AR, and the trimmers on top of the three-gang condenser should then be adjusted for maximum sensitivity. These adjustments should be made with the detector valve just on the verge of oscillation. It is desirable that a good aerial and earth be used in conjunction with this receiver.

# THE FIVE ONES SUPERHET—

(Continued from page 30)

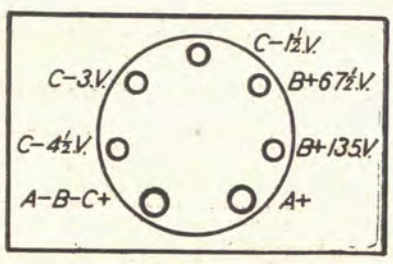
R9, and to the vacant lead on the 250,000 ohm resistor, R5. The remaining lead on R9 is connected to one lead on R10 and to the vacant lead on the 250,000 ohm resistance, R7. The remaining lead on R10 joins to the earth wire. The detection diode plate lug on the 1B5 socket is wired to G lug on IF3, the "C" minus lug on this transformer being wired (in metal braided cable) to one of the outside lugs on the volume control, VC.

The other outside lug on this control is joined to "A" positive. The .0005 mfd. condenser, C9, is soldered to these two lugs on VC. The centre lug on VC is joined by means of a metal braided cable to one lug on the .02 mfd. condenser, C11. The other lug on C11 joins to the triode grid lug on the 1B5 socket, to which lug a lead of the 1 megohm grid resistor, R11, also is wired. The other lead on R11 joins to the "C" minus 1½ volt lug on the battery socket. The triode plate lug on the 1B5 socket carries one lead of the 250,000 ohm resistor, R12, one lug of the .0001 mfd. condenser, C12, and one lug of the .02 mfd. condenser, C13. The vacant lug on C12 is joined to the ground wire. The vacant lug on R12 goes to the 135 volt lug on the battery socket. The vacant lug on C13 and one lead of the .5 megohm resistor, R13, are joined to the control grid lug on the 1D4 socket. The other lead on R13 joins to the "C" minus 4½ volt lug on the battery socket.

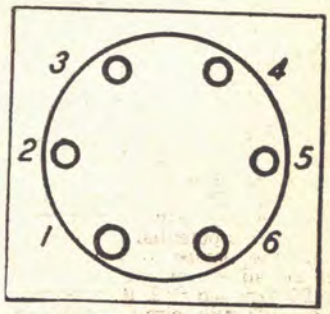
One of the l.s. terminals on the chassis carries a lead which joins to the plate lug on the 1D4 socket, whilst the other l.s. terminal joins to the screening grid lug on this socket and to the 135 volt lug on the battery socket. This completes the wiring of the receiver. It is necessary now to wire the battery plug in such a way that its connections agree with those made to the battery socket.

This done, plug in the valves, attach the battery wires to the "A," "B," and "C" batteries, plug in the loud speaker, and attach the aerial and earth. The alignment of the receiver is quite simple, but because the set is fitted with A.V.C. it may be necessary to handle it a little

**(Continued on Page 50)**



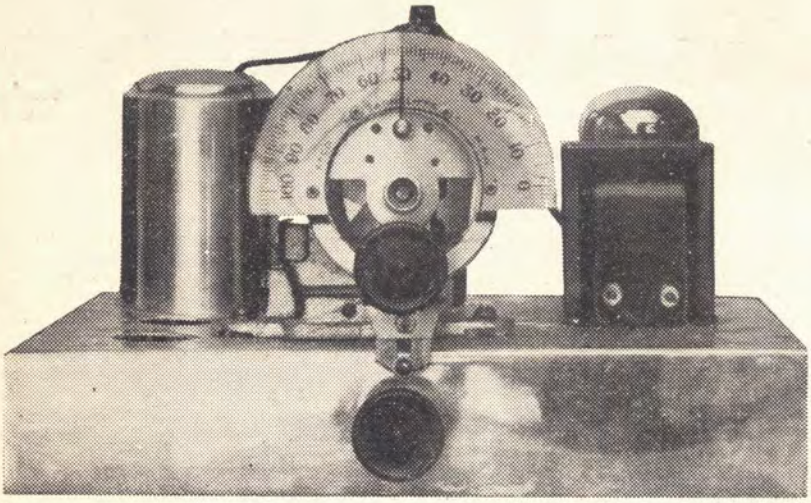

**The connections to the battery socket shown above should be checked very carefully with those taken to the battery plug. Failure to do this may involve disastrous short-circuits.**




**Socket Connections of the 1B5—This underneath socket view of the 1B5 shows the filament terminals at the bottom. The connections are: 1, Filament +; 2, Triode Plate; 3, A.V.C. Diode; 4, Detection Diode; 5, Triode Grid; 6, Filament—.**

# THE . . . BEGINNER'S BATTERY TWO

Simple to operate, easy to tune, and inexpensive to build—These characteristics make this two valve battery-operated set an ideal receiver for the novice to break into set construction.



A front view of the finished assembly. The top control is used for tuning the receiver, whilst the lower knob is the reaction control.

A two valve set employing a regenerative detector which is fed through an audio frequency transformer to a pentode output valve. As two of the latest type of battery operated valves are used in this design the consumption of this set is remarkably low. In addition to this, automatic bias is applied to the output tube, thus reducing the number of batteries used in conjunction with the receiver.

By H. BAKER

IN the modern trend for large and expensive sets of the super-heterodyne variety, the needs of the novice, and more especially the country novice, have been rather overlooked. His yearning for the description of a small one or two valver, which promises good results yet is simple to construct, easy to get working, and, above all, is economical to operate, is the motive for this article.

Many novices have considered the use of the screen grid battery tube as a possibility for a detector, but have hitherto been deterred by one or two of its disadvantages.

Although the screen grid tube is extremely sensitive, it requires relatively large "B" battery voltages to overcome the enormous resistance offered by the plate-matching impedance in the "B" positive lead. The screen grid voltage also is extremely critical, and the adjustment of this potential is certainly not a job for the novice to undertake.

With the advent of the new Mullard Series, PM22A and SP2, it is possible to build a high-gain circuit, requiring a comparatively small "B" voltage, no screen voltage adjustments, and a current drain of only a few milliamperes.

Such is the receiver illustrated in this article. Absolutely simple, the circuit is one which can be followed easily by the novice and, when built up, the receiver can be expected to provide a remarkably good performance. A glance at the schematic diagram will indicate one or two points worthy of comment.

First, we find that the screen grid tube is used with transformer coupling. In ordinary circumstances it would be impossible to do this and still obtain a proper impedance match and a consequent maximum transfer of energy between the valve's plate and the load into which it is to work. To overcome this difficulty, the screen grid is tied to the plate. This, although lowering the gain of the tube, results in an amplification factor, which is well above those obtainable from an ordinary triode.

It can be appreciated in these circumstances that the overall gain of the high gain triode and the transformer would compare favorably with that of a screen grid tube with resistance coupling.

We now can realise the purpose of the whole circuit—screen grid tube results without tricky adjustments.

As far as the layout of the components is concerned, there is little to be said. The illustrations of the finished set make these details clear.

The chassis is cut from a sheet of aluminium, and measures 11in. x 8in. After the chassis has been bent and drilled, the next step in construction is to mount the components. The beginner is advised not to depart from the original layout. Make all nuts and bolts tight. It is good practice to put spring washers under each nut to ensure that it will remain tight indefinitely.

We are now ready to begin the wiring of the receiver.

The wiring is quite straight-forward, and as long as the original instructions

## LIST OF PARTS

**C: 0.00025 mfd fixed mica condenser.**
**C1: 0.1 mfd fixed tubular condenser.**
**C2: 0.01 mfd fixed tubular condenser.**
**L1, L2, L3: Aerial coil with reaction winding.**
**LS: Loudspeaker to suit PM22A (Rola).**
**M: 23 plate midget condenser.**
**R: 2 megohm carbon resistor.**
**R1: 20,000 ohm carbon resistor.**
**R2: 600 ohm wire wound resistor.**
**SW: Battery switch.**
**T: Audio frequency transformer. Ratio, 5 to 1.**
**VC: 0.0005 mfd. variable tuning condenser.**
**Batteries: One 2 volt accumulator, two 45 volt light duty "B" batteries.**
**Valves: One SP2 and one PM22A, or Philips replicas.**
**Sundries: Hook-up wire, chassis, screws, nuts, soldering lugs, battery cable.**

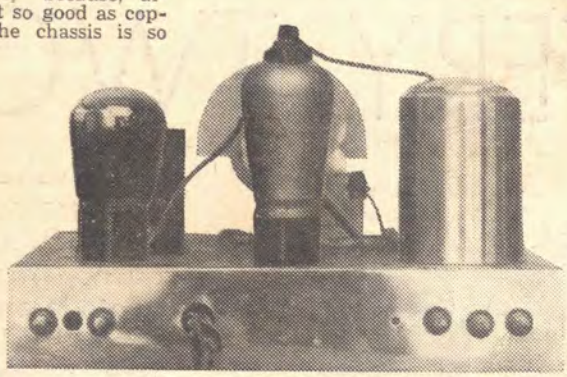
are adhered to, no trouble will be encountered.

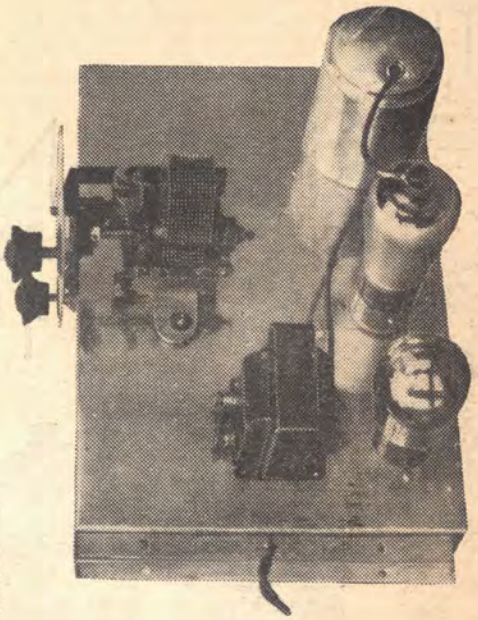
Start by connecting the three aerial tappings to their respective terminals, and connect the lower end of the aerial coil to the earth terminal, which also goes to the lower end of the grid coil. Connect the fixed plates of the tuning condenser to the upper end of the grid coil, and thence through the grid and condenser to the control grid of SP2. No wire need be joined to the variable plates of the condenser, because, although aluminium is not so good as copper for a conductor, the chassis is so small that the higher resistance of the aluminium makes little or no difference. The same applies to the 23-plate midget reaction condenser.

From the fixed plates of this condenser, a wire goes to the top end of the reaction winding the bottom of which goes to the plate of the SP2, to the screen grid of the same tube, and to the P terminal on the audio-tranformer. The B positive terminal on the transformer is connected through a 50,000 ohm. resistor to the B positive terminal on the chassis. A .5 mfd. condenser, C, between the B positive terminal on the transformer and earth effectively by-passes the detector "B" supply.

Now run a pair of leads from the filament terminals of the SP2 to the filament terminals on the PM22A, and earth one of them From the other, run a lead to the switch, SW, the other side of which goes to the A positive terminal on the chassis. The A negative terminal is also earthed. The G terminal on the audio transformer goes to the grid of the PM22A, the plate of which goes to one of the LS terminals. The screen grid of the PM22A goes to the other LS terminal, and thence to the B positive terminal on the chassis. A .01 condenser, C2, is placed across the LS terminals. The B negative terminal goes to the C negative terminal on the transformer.

**Right: A top plan view of The Beginner's Battery. Two, showing the layout of parts on the chassis. Below: A photograph of The Beginner's Battery Two, showing the mounting positions for the Aerial-earth and Loud Speaker terminals.**





This completes the wiring of the receiver.

Points which should be remembered are:—

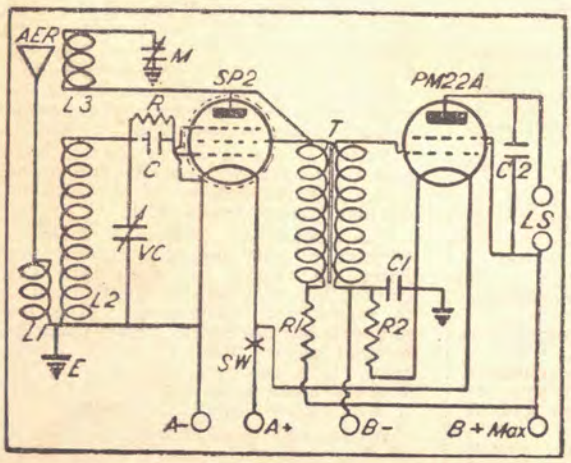
1. Make sure that all terminals, except the earth terminal itself, are suitably insulated from the chassis.
2. Solder all connections with care and guard against "dry joints."

To put the receiver into operation plug the valves into their respective sockets, connect up the "A" and "B" batteries to their correct terminals and attach the phones or loud speaker. Switch on S.W. and rotate the 23-plate midget condenser until the SP detector goes into oscillation, a condition which will be accompanied by a "plop," a whistle, or a howl, depending upon the extent to which the reaction control is advanced.

Turn back the reaction control until the receiver is just in the verge of oscillation and rotate the dial of the main tuning condenser until a broadcasting station is received. Try the three different aerial tappings to find out whiich gives best results.

On completion of the set a few minutes' test showed the high gain of the circuit, its utter simplicity, its extraordinary economy, and revealed the new Mullard series in its true perspective.

If the set builder adheres to the instructions set out here, he will find that the majority of the Australian stations will be tuned in after dark.




**Schematic diagram of The Beginner's Battery Two. Note that the SP2 detector valve is wired as a triode.**

## THE FIVE ONES (Continued from Page 48)

more carefully than usual. If a signal generator is not available the best plan is to disconnect the .0005 mfd. condenser, C10, from the plate of the 1C4 I.F. tube and from the A.V.C. diode lug on the 1B5 socket. This lug then should be joined to the other diode lug on the 1B5 socket. The end of R9 which was connected to C10 may be left on this condenser.

Control of the I.F. amplification can be obtained by connecting a "C" battery in series between the end of R10, which at present is connected to earth, and earth. The positive side of the battery will go to earth and the negative will join to R10.

Start the alignment of the receiver by tuning to a station well down the wave-length scale. Stations such as 3XY or 3GL should be used, the lower down the dial the better. Adjust the aerial and pre-selector trimmers in turn for greatest signal strength. Then tune the receiver to the top end of the dial around 500 metres and endeavor to pick up 2FC or 3AR. On either of these stations adjust the padding condenser, meantime "rocking" the gang condenser back and forth over a few degrees until the padding condenser setting which gives loudest signals is obtained.

When the receiver has been adjusted at the top end of the dial return to the lower end and try the effect of slight readjustments to the aerial and preselector trimmers only. When this stage has been reached it will pay to tune the set to a fairly weak, but steady, station and adjust each of the I.F. trimmers for maximum signal strength. Start at the second detector trimmer and work back to the grid trimmer for the first I.F. tube. Don't touch the primary trimmer on the first I.F. tube.

Judging by the excellent results we obtained with the original, we believe that the countryman who builds this receiver will be pleased with its sensitivity, its selectivity, and its tone quality. Its speedy A.V.C. system and its battery economy should make it an ideal receiver for present day country listening.

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