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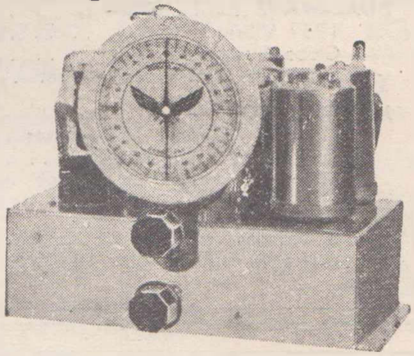


Here is a Phenomenally Selective Universal Receiver, designed particularly for City Reception, but capable, with slight modifications to its alignment adjustments, of giving equally satisfactory results in Country Areas where D.C. power is available.

THIS is the story of a receiver designed for the definite purpose of city reception. Although several novelties have been incorporated, its general design is straightforward and the receiver represents a definite step forward in universal set design.

Reception in the City itself is usually confined to broadcasts of racing and other sporting events from the local stations. Musical reproduction does not count seriously because most of the City set-users are interested only in sporting talks and descriptions.

What does count, though, is selectivity, ease of control, and freedom from the ever-present electrical interference racket.

Thus, when designing a receiver for use in "pubs and clubs," as one technician succinctly put it—particular care must be taken to see, first, that the sensitivity is sufficient for the needs of the user; second, that the selectivity is such as to ensure freedom from station interference and cross modulation effects, and, third, that the circuit design will take care of the heavy electrical interference likely to be experienced in city areas.

In the present set all these needs have been fully met, with the result that the receiver gives a performance equal to that of a standard super-het operated in a suburban locality.

THIS has been a most interesting receiver to design. It also has been productive of many headaches.

The first consideration in planning the set was that of flexibility of service. Part of the city of Melbourne has already been changed from direct to alternating current supply, but there is still a large section operating on direct current. Later this will be changed over so that, in planning the receiver, it was found necessary to make it a universal type to take care of any subsequent alterations to the power supply system.

This entailed no difficulties, however, for the Universal series of Philips valves lent themselves admirably to this type of circuit. The next thing to plan for was a low noise level. Now, it is well known that the higher the signal level at the mixer tube, the lower will be the background noise. For this reason a stage of r.f. amplification was included ahead of the mixer. The r.f. stage had a further advantage in that it improved the signal selectivity of the set. Even in the r.f. stage it was desirable that the signal reaching the grid of the tube should be as high as practicable, if noise was to be kept within reasonable limits.

For this reason iron-cored tuning coils, possessing an aerial-to-grid gain of up to 24, were used. The r.f. coupling was effected by means of a similar iron-cored coil.

The next step was to sharpen the selectivity still further by careful arrangement of the intermediate frequency amplifier. Iron-cored coils were used here because of their high gain and high selectivity. Further to improve the selectivity a band-pass stage was incorporated in the i.f. amplifier.

The second detector and audio system was quite straightforward, but attention had to be paid to the automatic volume control system to see that it did its part in overcoming the effects of local electrical interference.

So far, the circuit design was straightforward. The receiver was built and wired. Then the trouble began. In The Listener In laboratory it was found that a strong whistle was present on all stations. This defied all efforts to remove it despite the fact that the grid leads were shielded against pick-up, the power lines provided with a first-class filter, and the tubes and associated wiring heavily shielded.

A check up of the trouble showed that it was due to interference between 3DB and 3AR. The frequency separation between these two stations is exactly 450 k.c., a figure which is approximately equal to the intermediate frequency first used in the receiver—455 k.c. The result was that not only was there a whistle on all stations, but 3DB could be heard at excellent strength on 3AR's carrier, whilst 3AR could be heard at good strength on 3DB's carrier.

This gave us some real headaches before the problem was solved. The only way to go after it at first was to increase the receiver's selectivity still further. The original band-pass stage had been so tuned that the band width was 6 k.c.—3 k.c. on each side of the carrier. The band-pass unit was then aligned dead on the frequency so that the pass was reduced.

This resulted in a band-pass of 1.85 k.c. overall, or 925 cycles on each side of the carrier.

The trouble, however, was still not eliminated, and we were being forced to a re-consideration of the whole design when the new 6.3 volt series Philips tubes were announced. The particular advantage of this new series of tubes lay in the fact that the r.f. penthode, the EF5, had a much longer grid base than the CF2 we had been using in the r.f. and i.f. stages. The effect of this was that the new tube was much less prone to cross-modulation effects of the type we were experiencing than was the CF2. Due to their characteristics it was possible to replace the two CF2's in the r.f. and i.f. stages with the new EF5s without making any circuit changes whatsoever. The result was all that could be desired, for the last trace of cross-modulation and station interference disappeared even when the receiver was used directly under 3DB's aerial.

This left only one problem to be whipped. In spite of the reduction of the set's sensitivity, consequent upon the sharpening of the r.f. circuits by reducing the coupling capacities, it was still around 14 microvolts overall, and was high enough to make the receiver very susceptible to electrical interference pick-up. As originally constituted, the receiver's a.v.c. system had been

SCHEMATIC CIRCUIT DIAGRAM AND LIST OF PARTS

Required to Build the Phoenix Super Six

AER, R.F., OSC.—Iron-cored Aerial and R.F. coils, Air-cored Oscillator Coil. (Airmaster.)

B—Baretter. (Philips.)

C—Aerial and R.F. Coil Coupling Condensers.

C1: .0005 mfd. mica condenser. (T.C.C.)

CH: 20 Henry Low Resistance Filter Choke. (Airmaster.)

Chassis: Aluminium, measuring 14½ inches by 9 inches by 2¾ inches.

C2, C20: .01 mfd. mica condensers. (T.C.C.)

C3, C4, C6, C7, C10, C15, C18: .1 mfd. tubular condensers. (T.C.C.)

C5, C11, C13: .0001 mfd. mica condensers. (T.C.C.)

C8: .005 mfd. mica condensers. (T.C.C.)

C9: .05 mfd. tubular condenser. (T.C.C.)

C12, C16: .02 mfd. mica condenser. (T.C.C.)

C14, C17: 25 mfd. 25 volt electrolytic condensers. (T.C.C.)

C19: .04 mfd. tubular condenser. (T.C.C.)

DS: Dynamic Speaker to suit CL2 Pentode. (Rola.)

E1, E2: 8 mfd. 500 volt electrolytic condensers. (T.C.C.)

G1, G2, G3: Three gang type F Stromberg Carlson condenser (with trimmers).

IF1, IF2, IF3: 455 k.c. iron-cored band-pass type I.F. transformers. (Airmaster.)

Line Filter: Standard R.F. Filter. (Airmaster.)

L.S. Field: 7500 ohm speaker field winding.

PD: Padding condenser.

PL: Philips type 8064 dial lamp.

R1, R5: 250,000 ohm resistor. (I.R.C.)

R2: 50,000 ohm resistor. (I.R.C.)

R3: 350 ohm 50 m.a. W.W. resistor.

R4: 25,000 ohm resistor. (I.R.C.)

R6: 30,000 ohm resistor. (I.R.C.)

R7, R8, R13: 500,000 ohm resistors. (I.R.C.)

R9, R11, R12: 100,000 ohm resistors. (I.R.C.)

R10: 2 megohm resistor. (I.R.C.)

R14: 400 ohm 50 m.a. W.W. resistor.

R15: 120 ohm 100 m.a. W.W. resistor.

R16: 20,000 ohm resistor. (I.R.C.)

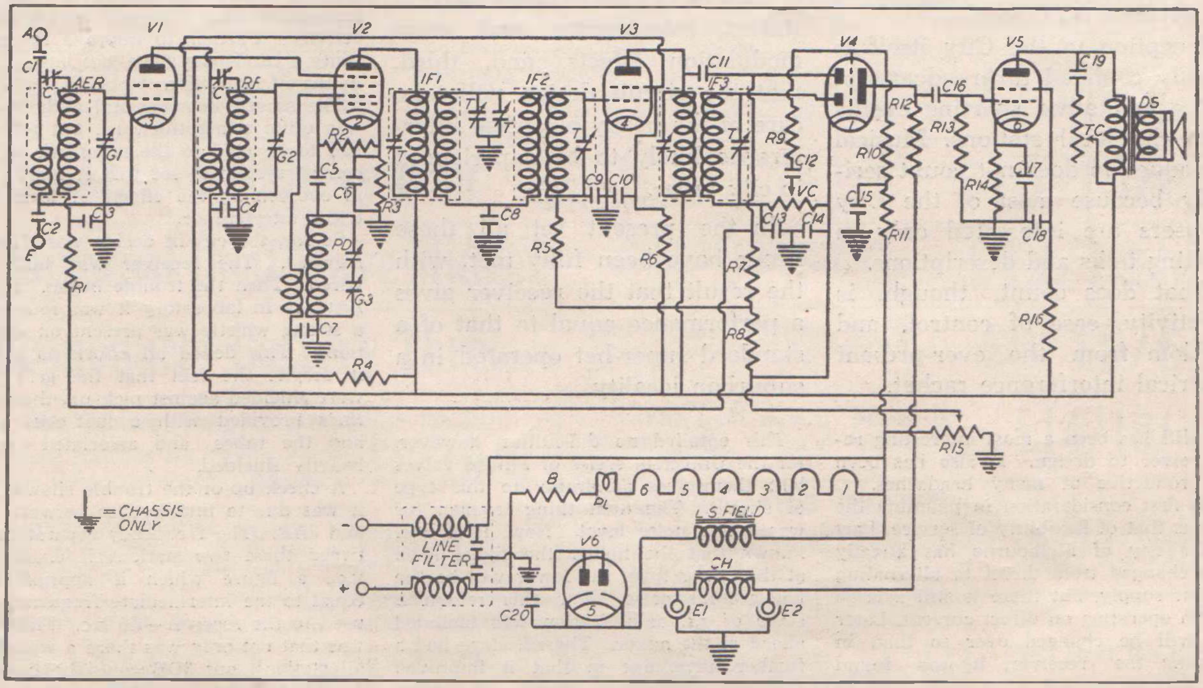
TC: 20,000 ohm potentiometers. (Ferranti, I.R.C.)

T: I.F. transformer trimmers.

Valves: One each Philips types, CK1, CBC1, CL2, CY2, and C1, and two EF5's. (Philips.)

VC: 500,000 ohm potentiometer. (Ferranti, I.R.C.)

Sundries: Aerial and earth terminals, 7 "P" type sockets, one 4-pin socket, 5 grid clips, hook-up wire, braided wire, braided power cable, machine screws and nuts, earth wire, dial light mounting, tuning dial.



planned to have a slight delay voltage, so that control did not start until half the available audio output was fed to the speaker. It was found, however, that when this delay was eliminated the set's effective noise-level was reduced greatly.

We then embarked on some aerial experiments.

Now, as most city set users know, it is extremely difficult to receive 3AR, although 3LO and the local commercial stations come in well. In this set we had no trouble with 3AR, but felt that if we could gild the lily by boosting the sensitive at the low-frequency end of the dial it would be a good idea. Furthermore, there was this noise problem to overcome.

After a number of experiments with noise reducing aerials, we finally used a flat-top section resonated to the 100th harmonic of 3AR. This measured 5.2 metres in length, and was erected as high above the building level as possible. The connecting lead-in took the form of a twisted pair—ordinary lighting flex was used. One lead of the pair was soldered to one end of the flat top, while the other lead was left disconnected at the aerial end. At the receiver the lead, which was attached to the aerial, was connected to the aerial terminal, while the other lead was connected to the ground terminal.

This arrangement worked perfectly. It cut the signal strength only to the slightest degree, and this loss was compensated for at the low-frequency end of the dial by the gain of the resonant aerial. The noise was reduced at least 95 per cent., so that we had at last achieved that rare thing in city receivers—a sensitive yet silent set which could bring in all the locals at full volume yet without interference.

The receiver was then given further final tests. On the roof of The Herald building, directly under 3DB's aerial, it brought in the locals, 7NT and 3GI, in daylight, at full speaker strength, and without interference. Used in the Victorian Cricket Association building opposite, it gave even better results, and, in a final test in another building which was much lower than the surrounding ones, and thus right in the interference zone, it still behaved perfectly, although the pick-up and consequently the signal volume was not quite so strong as in the higher locations.

A front view of the completed receiver. The three controls seen mounted on the side of the chassis are (from left to right) the tone control, the main tuning control and the volnme control.

Although the present set has been designed expressly for city receiving conditions, there is no reason why its general principles cannot be applied to country reception. The high degree of selectivity may not be needed, but this is quite easily adjusted by means we shall explain later.

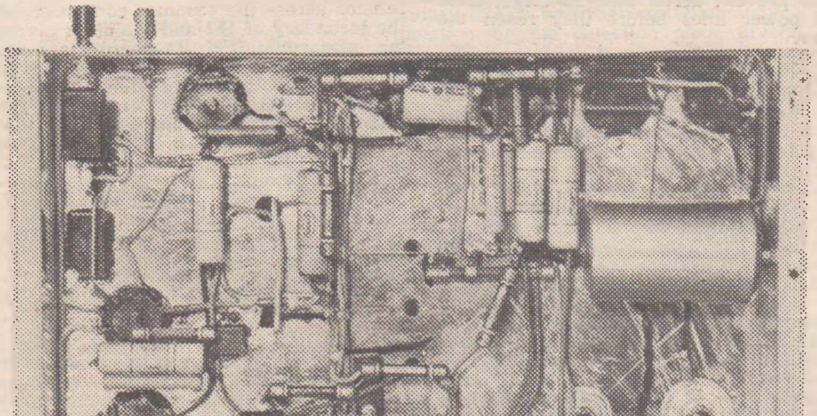
A general review of the circuit and a listing of the values of the component will assist the prospective set builder.

The valve line up used in the original set is as follows: The r.f. valve, V1, and the i.f. valve, V3, are EF5's. The mixer tube, V2, is a CK1. The detector, a.v.c., and first audio tube, V4, is a CBC1, the output pentode, V5, is a CL2, while the rectifier, V6, is a CY2. The baretter tube, b, is a C1. All valves except V1 and V3 belong to the Philips 200 m.a. Universal series. The remaining two tubes are included in the new 6.3 volt series. The dial light, PL, is also a special Philips type 8064. It is essential that this type dial light, if any, be used because the unreliable operation and incorrect current ratings of the standard type of dial light render their use in this receiver impracticable.

The aerial and r.f. coils are standard Airmaster iron-cored high gain coils. The oscillator coil is made to match these, but is not iron-cored. It has the padding condenser, PD, built into the coil can. The three i.f. transformers, IF1, IF2 and IF3 are standard 455 k.c. iron-cored Airmaster types, but should be specified for band-pass use because the trimmer condensers on the primary and secondary of IF2 and IF1 respectively have to be directly earthed while the coil returns are left free to join to the coupling condenser, C8.

The aerial and earth terminals are insulated from contact with the metal chassis being connected to the aerial and earth sides of the aerial coils through the .0005 mfd. condenser, C1, and the .01 mfd. condenser, C2, respectively. The r.f. primary is by-passed to ground by means of the .1 mfd. condenser, C4. The two coupling condensers, C, shown in the AER and R.F. coils, are built in to the coil cans and, for high selectivity conditions, should be screwed to the full-out position.

The grid condenser, C5, has a capacity of .0001mfd., whilst the grid leak, R2, has a resistance of 50,000 ohms. The cathode resistor, R3, in the cathode of the mixer tube, has a resistance of 350 ohms, and is by-passed by the .1 mfd. condenser, C6. The supply to the oscillator plate and the screening grid of V2 is obtained through the 25,000 resistor, R4, which is by-passed to ground by means of the .1 mfd. condenser, C7. The band-pass coupling condenser, C8, has a capacity of .005 mfd. The screens of V1 and V3 are tied together and are fed



An underneath picture of the receiver showing the wiring and placement of parts below the chassis. When wiring the set care should be taken to ensure that all grid and plate leads are kept as short as possible, in order to prevent any tendency towards feed-back.

from the main supply lines through the 30,000 ohm resistance, R6. They are by-passed to ground through the .1 mfd. condenser, C10.

We come now to the a.v.c. system. The a.v.c. diode of V4 is fed with r.f. voltage from the primary of IF3 through the .0001 mfd. coupling condenser, C11. A potential divider made up of two 500,000 ohm resistors is connected between the a.v.c. diode and the two volt tap on the 120 ohm resistor, R15. To this point on R15 the cathode of V4 also is returned. The junction point of the two 500,000 ohm resistors R7, R8, feeds to the grid return on IF2 through the. 25 megohm resistor, R5. The transformer side of R5 is by-passed to ground by means of the .05 mfd. condenser, C9. The diode plate side of R7 joins to the .25 megohm de-coupling resistor, R1, which, in turn, connects to the grid return of the aerial coil, and is by-passed to ground by means of the .1 mfd. condenser, C3.

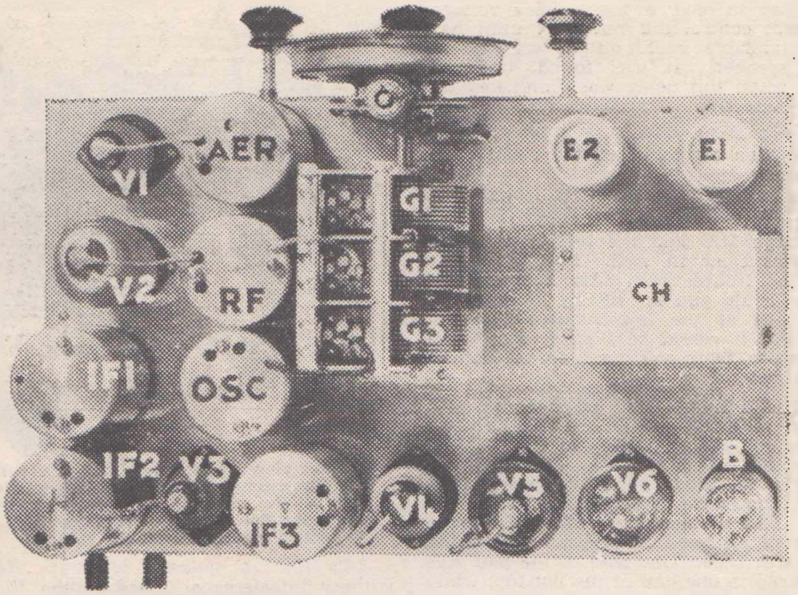
Note that the cathodes of V1 and V3 are returned to ground. This is done because the two volts developed across portion of R15 provide the bias for these tubes. Incidentally, although not shown in the diagram, the metal coating and suppressor grid connections are taken to ground. A point which should be watched is the connection of R15. This goes from the negative side of the line to ground. Be sure not to connect it in series with the valve filament or a current of 200 m.a. will flow through it in addition to the set drain.

The cathode of V4 is by-passed to ground by means of the 25 mfd. electrolytic condenser, C14. The volume control and diode load resistor, VC, is a 500,000 ohm. potentiometer. The return from the secondary of IF2 is by-passed to ground with the .0001 mfd. condenser, C13. The audio signal is fed from the diode load resistor through the .02 mfd. condenser, C12. The .1 megohm resistor, R9, is used as a grid stopper to block r.f. currents from entering the audio circuits. The bias for the audio section of V4 is obtained from the negative side of R15 through the resistors, R10 and R11. R10 is a 2 megohm resistor, whilst R11 is a .1 megohm one.

The by-pass condenser, C15, has a capacity of .1 mfd. The 100,000 ohm plate resistor for V4 is connected to the full supply voltage. The coupling condenser, C16, has a capacity of .02 mfd., whilst the grid resistor, R13, is a .5 megohm one. The bias resistor, R14, is a 400 ohm wire wound one, whilst the by-pass condenser, C17, has a capacity of 25 mfd. Screen voltage for V5 is obtained from the maximum supply through the 20,000 ohm resistor, R16, which is by-passed by means of the .1 mfd. condenser, C18. The tone control system consists of .04 mfd. condenser, C19, connected in series with a 20,000 ohm variable resistor across the primary of the audio transformer.

The loud speaker field has a resistance of 7500 ohms, and is connected between the positive side of the rectifier and chassis. The filter choke, CH, should have a d.c. resistance of not more than 300 ohms and should have an inductance of at least 20 henries. The electrolytic condensers, E1 and E2, are standard 8 mfd. 500 volt types. The condenser, C20, is a .01 mfd. mica type and is used as an r.f. by-pass on the rectifier.

A point to which special attention should be given is the wiring of the valve filaments. All, and the barretter and dial light, are wired in series, but the order shown on the circuit diagram should be followed. If desired, two dial lights can be used in place of the single one shown.



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

The only other component to come up for consideration is the line filter. This is an essential if the set is to be kept reasonably quiet, as much of the noise originates from the lines themselves. This filter was a special Airmaster type and is contained in a can similar to that used for ordinary tuning coils. The line filter should be mounted under the chassis and the power leads brought to it through shielded cable, the shielding of which is grounded. The idea of this is to prevent aerial pick-up direct from the power lines before they reach the filter.

The illustrations of the original set show very clearly the arrangement of the various components, so we shall touch only on constructional points. The a.v.c. condenser and resistor, C3, R1, are mounted directly inside the aerial coil can. IF2 similarly carries the a.v.c. condenser, C9, and the resistor, R5. Inside IF3 are mounted the coupling condenser, C11, and the two a.v.c. resistors, R7 and R8. The a.v.c. lines to V1 and V3 should be run from the can of IF3 in braided wire. Braid also should cover the leads from VC to IF3 and C12.

Another point worthy of special comment is the gang condenser. It is desirable, if easy arrangement of the waveband coverage be sought, that the gang condenser be of the Stromberg Carlson F type, having a minimum capacity of 9 mmfd. and a maximum capacity of 420 mmfd. This model condenser can be obtained fitted with trimmers.

Remember, when handling this receiver that, in certain circumstances, the chassis can be at a potential of 200 or 230 volts above ground. Never touch the ground terminal with the power on the set and, if it is essential to work on the set with the power on, be sure to remove the ground wire and to stand on some insulating material.

The alignment procedure to be followed to obtain the maximum selectivity conditions is, according to standard practice, in that all i.f. stages should be peaked to the operating frequency, 462.5 k.c., and the aerial and r.f. coils aligned after the coupling condensers, C, have been opened right out. Under these conditions the receiver will have a sensitivity around 14 microvolts throughout its tuning range.

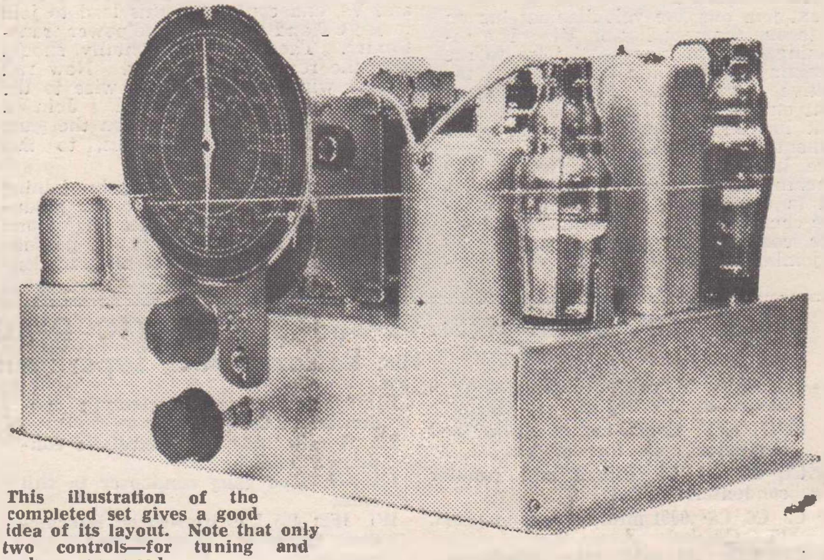
For medium selectivity alignment (band width around 6 k.c.) it will be necessary to obtain two ¼ watt resistors, each having a resistance of 250,000 ohms. Before starting the alignment remove the cans from IF1 and IF2 and solder one resistor across the trimmer condenser on the secondary of IF1 and the other across the primary of IF2. These resistors are very tiny and will lie in the grooves of the bakelite moulding of the i.f. transformer. Keep the lead lengths of the resistors to a minimum. Replace the cans and align the i.f. stage to a peak frequency—462.5 k.c. Next, remove the cans and unsolder the two resistors. Replace the cans and proceed with the r.f. alignment which should be carried out with the coupling condensers, C, in AER and RF left at their factory setting. The receiver's sensitivity under this condition of alignment will be in the vicinity of 2 microvolts.

However, if you are looking for real selectivity don't be too worried about the set's tone. Even in the high selectivity condition the reproduction sounds quite good, although it is far from high-fidelity.

Finally, we may say that, as a result of several weeks careful checking of the original, we can recommend this universal receiver to anyone who is looking for a sensitive and selective set. Used under the conditions we have set out, irrespective of whether high or medium selectivity is desired, it has proved an outstanding performer, and one which should appeal to the professional, as well as the amateur set-builder.

The Reflexed A.C. Super Four

The construction of a highly efficient four valve A.C. super-heterodyne is dealt with in this article.



This illustration of the completed set gives a good idea of its layout. Note that only two controls—for tuning and volume are used.

WHEN the A.W. Valve Co.'s engineers endowed the 6B7 type valve with super control characteristics they developed a valve which found widespread use in all types of receiver circuits. Designed for use as an r.f. amplifier, and diode detector, or diode detector and audio amplifier, the super control characteristics of the 6B7s, as the new valve was serialled, made it possible for automatic volume control to be applied to the pentode section of the tube in both its radio and audio frequency applications.

Another advantage of the 6B7s is that it can be employed very satisfactorily as a reflexed tube in which the functions of radio frequency and audio frequency amplification are combined with those of detection and automatic volume control.

THERE are still many old-time set-constructors to whom the word "reflex" is anathema. Their memories of early reflex circuits are too poignant to permit them to contemplate the modern version.

Our experience of modern reflex circuits, however, has been such that we have no hesitation in recommending their use to even the novice.

A glance at the schematic circuit diagram of the receiver will show that standard 6.3 volt series tubes are employed in the mixer, reflexed, and audio stages. The rectifier is a standard type 80.

The aerial and oscillator inductances are of the air-cored variety, whilst iron-cored 465 k.c. i.f. transformers are used.

Pains have been taken in the filter circuits to see that hum is reduced to a minimum. For this reason the second electrolytic condenser, E2, has a capacity of 16 mfd. and is rated for a working voltage of 350.

Now let us see how the reflexed stage works. First a radio frequency signal is received from the plate of the 6A7, transferred by induction from the primary to the secondary of IF1, and impressed upon the grid of the 6B7s. Here it undergoes the usual process of amplification. Note that the 500,000 ohm resistor, R7, acts as a radio frequency choke coil and prevents the flow of r.f. currents to earth, and thus the completion of the grid circuit of the 6B7s.

On the other hand, the .0001 mfd. condenser allows these currents to flow to earth.

Having been amplified, the r.f. signal appears in the plate winding of IF2 in an amplified form. The radio frequency choke, RFC, prevents the r.f. currents from flowing into the audio section of the receiver, the by-pass condenser, C12, assisting this choke in its discrimination against r.f.

Induction now is responsible for the transfer of the r.f. impulses to the secondary of IF2, and their subsequent rectification by the detection diode of the 6B7s. The resultant audio voltage is developed across the diode load made up of the resistors, R11 and VC. The values of these components are so selected that only four-fifths of the available rectified voltage is available as an audio signal.

This is done in order to prevent overload of the 6B7s.

The audio signal is selected by the arm of VC, and passed through the high capacity condenser, C7, and the secondary of IF1, where it is again amplified.

Note that the .0001 mfd. by-pass condenser, C6, has practically no by-pass effect at audio frequencies whilst the resistor, R7, offers a similar bar to the leakage of these frequencies to earth.

On being amplified, the audio voltages pass through the low resistance primary winding of IF2, and through RFC to the grid coupling condenser, C13. Thence they travel to the grid of the output valve, V3, to be handled in the usual manner.

Again it should be noted that the .00025 mfd. condenser, C12, has no by-pass effect at audio frequencies. The automatic volume control system functions in the usual manner in which an increase of voltage obtained from the a.v.c. diode due to an increase in signal strength at the aerial is responsible for an increased rectified voltage which, being negative in potential, is fed to the grid of the mixer tube, V1, where its negative effect causes a reduction in sensitivity, and thus a lowered output signal in the audio stage.

Now for the practical details of the receiver's construction. The chassis measurements are 12 inches in length, 8 inches in width, and 2¾ inches in depth. A glance at the top chassis view of the receiver will familiarise the intending constructor with the components lay-out.

A study of the underneath view of the completed set will reveal that all components but the padding condenser, PD, RFC, and the grid coupling condenser, C13, are wired directly into circuit. PD is secured to the underpart of the chassis in a position corresponding to the rear of the gang condenser. A hole must be drilled to permit access to its adjustment screw.

C13 is mounted to the rear wall of the chassis just above the socket for V3. RFC is bolted to the floor of the chassis between the sockets for V2 and V3. It also is necessary to make up a small bakelite anchor strip provided with two solder lugs. This strip is supported from the chassis by means of a machine screw and spacer washer and is mounted in front of RFC.

The socket for V4 is mounted so that the filament lugs face the loud speaker socket. The latter is so mounted that its filament lugs are vertical and face the rectifier end of the chassis. The socket for the 42 is so mounted that its filament lugs face the rear of the chassis, whilst the socket for the 6B7s is mounted so that its filament lugs are in a similar position. The filament lugs of the 6A7 socket face the end of the chassis.

When these preliminaries have been attended to, and the components have been mounted above and below the chassis, the wiring may be started. Do this by joining a lead from one of the 6.3

volt lugs on PT to one filament lug on the sockets for V1, V2 and V3. Join the remaining filament lug on each of these sockets to the remaining 6.3 volt lug on PT.

The filament leads to these valves should be twisted.

Next join one five-volt filament lug on PT to one filament lug on V4. The remaining filament lug on V4 joins to the remaining filament lug on PT and to the positive lug on E1. From this same point on V4 join a lead to the top filament lug on the l.s. socket. The other filament lug on the l.s. socket joins to the plate lug on the same socket, to the screening grid lug on the socket for V3, and to the positive lug on the electrolytic condenser, E2. When this has been done, complete the power supply wiring by joining one lug of the 385 volt winding to the plate lug on V4 socket and the remaining lug on this 385 volt winding to the grid lug on the V4 socket.

Now run the earth busbars by soldering a bare tinned wire to one holding bolt of each of the sockets for V2, V3 and V4, and continuing this lead to join to the CT and E lugs on the power transformer. These lugs, incidentally, should face the rear of the chassis. Now run a bare wire from the earth wire to the No. 5 lug on the aerial coil. Join a wire from the wiper plates on the gang condenser, through the chassis, to this last earth lead.

Carry on with the wiring by joining the Green lead from IF1 to the modulator plate lug on the socket for V1 and the green lead from IF2 to the pentode plate of V2. Solder the .5 mfd. condenser, C16, from the positive lug on E2 to the earth busbar.

Solder one lead of R2, one lead of R3, and one lead of C4 to the cathode lug on the socket for V1. The remaining leads on R3 and C4 join to the earth busbar. The remaining lead on R2 joins to the oscillator grid lug on the socket for V1, from whence a lead joins to one lug of C3 which is mounted on one of the holding bolts for the oscillator coil.

The other lug on C3 carries a lead which joins to the No. 2 lug on the oscillator coil from whence a lead travels to the fixed plate lug on the G2 section of the gang condenser. This lead should be attached to the underside of the condenser before the latter is mounted. From the top G1 fixed plate lug on the gang condenser run a lead which terminates in the grid clip for V1.

LIST OF COMPONENTS and SCHEMATIC DIAGRAM needed to Build the Reflexed A.C. Super Four

CHASSIS: Measuring 12 inches by 8 inches by 2¾ inches.

COIL KIT: Consisting of Aerial and Oscillator coils for 465 k.c.

C1, C2, C4, C5, C10: .1 mfd. tubular condensers. (T.C.C.)

C3, C6, C8: .0001 mfd. mica condensers. (T.C.C.)

C7, C13: .02 mfd. mica condensers. (T.C.C.)

C9, C14: 25 mfd. 35-volt electrolytic condensers. (T.C.C.)

C11, C12: .00025 mfd. mica condensers. (T.C.C.)

C15: .02 mfd. tubular condenser. (T.C.C.)

C16: .5 mfd. tubular condenser. (T.C.C.)

D.S. Dynamic speaker 2500 ohms to suit 42. (Rola.)

DIAL: To suit gang condenser.

E1: 8 mfd. 500-volt electrolytic condenser. (T.C.C.)

E2: 16 mfd. 350-volt electrolytic condenser. (T.C.C.)

G1, G2: Two gang condenser to suit coils.

IF1, IF2: 465 k.c. iron-cored intermediate frequency transformers. (Airmaster.)

PT: Power transformer 385-0-385 at 60 milliamperes, 1-5 volt two-ampere, 1-6.3 volt two-ampere.

RFC: Radio frequency choke.

R1, R10, R11: 250,000 ohm 1 watt resistors. (I.R.C.)

R2: 50,000 ohm 1 watt resistor. (I.R.C.)

R3: 300 ohm wire-wound resistor to carry 25 milliamperes.

R4: 20,000 ohm 1 watt resistor. (I.R.C.)

R5, R15: 10,000 ohm 1 watt resistor. (I.R.C.)

R6: 15,000 ohm 1 watt resistor. (I.R.C.)

R7, R13: .5 Megohm 1 watt resistor. (I.R.C.)

R8: 1 megohm 1 watt resistor. (I.R.C.)

R9: 2000 ohm wire-wound resistor to carry 25 milliamperes.

R12: 100,000 ohm 1 watt resistor. (I.R.C.)

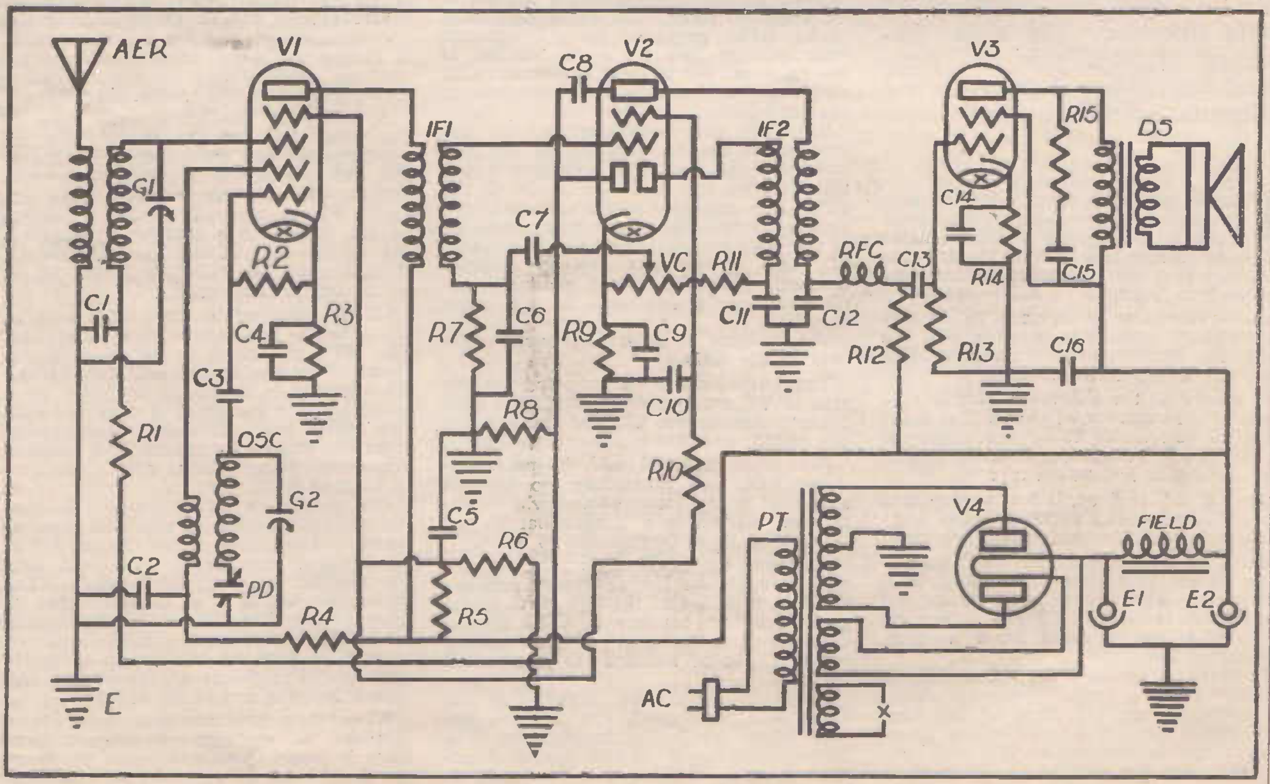
R14: 400 ohm wire-wound resistor to carry 50 milliamperes.

SOCKETS: Two small 7-pin, 1 6-pin and 2 4-pin.

VALVES: 1 each 6A7, 6B7s, 42 and 80. (Ken-Rad, Philips, Radiotron, Raytheon.)

VC: 500,000 ohm potentiometer. (Ferranti, I.R.C.)

SUNDRIES: Wiring flex, nuts and bolts, two valve shields, two knobs, four terminals, a 465 k.c. padder condenser, some tinned copper wire and 4ft. 6in. of shielded wire.



Join the No. 4 lug on the oscillator coil to the oscillator plate lug on the socket for V1. The No. 2 lug on the oscillator coil joins to the fixed plate lug on the padder condenser, PD, the moving plate lug of which is wired to the earth busbar.

Join one lead of the 20,000 ohm resistor R4, and one lead of the .1 mfd. condenser, C2, to the No. 5 lug on the oscillator coil. The other lead on R4 joins to one lug on the mounting strip. The remaining lead on C2 is wired to the earth busbar.

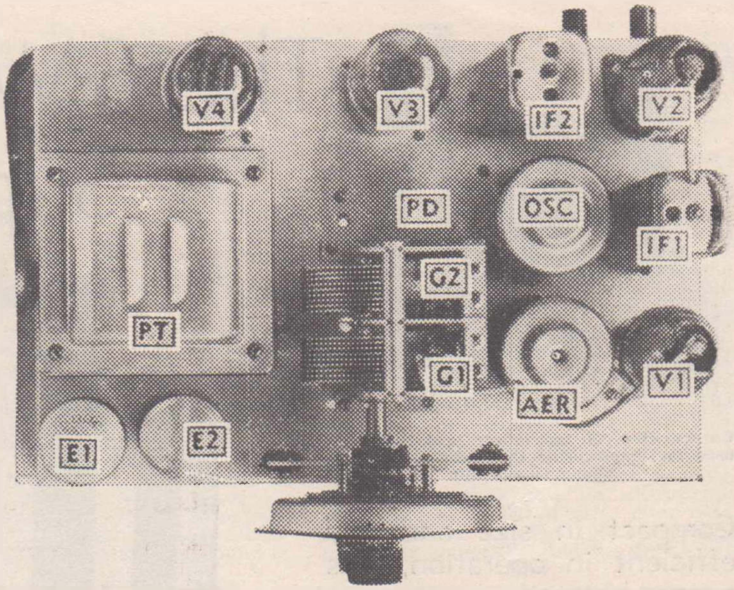
To the No. 2 lug on the aerial coil join one lead of the .1 mfd. condenser, C1, and take the other lead on this condenser to the earth busbar. Join the red lead from IF1 to the lug on the mounting strip to which R4 already has been soldered.

To this same point on the mounting strip join one lead of the 10,000 ohm resistor, R5, and one lead of the 250,000 ohm resistor, R12. From the strip run a lead which joins to that d.s. socket lug which carries the screen grid connection for V3. The remaining lead on R5 joins to one lead on R6 and to one lead on R10.

The remaining lead on R6 is soldered to the earth busbar, whilst the vacant lead on R10 joins, with one lead of the .1 mfd. condenser, C10, to the screening grid lug on the socket for V2.

The vacant lead on C10 is soldered to the earth busbar.

Run a lead from the junction point of R5, R6 and R10 to the screening grid lug on the socket for V1. To this lug on the V1 socket solder one lead of the .1 mfd. condenser, C5. The remaining lead on C5 is soldered to the earth busbar.



This key-lettered top-chassis illustration should be studied in conjunction with the circuit diagram, the parts list, and the wiring descriptions.

Solder one lead of the .0001 mfd. condenser, C8, to the a.v.c. diode plate lug on the socket for V2 and solder the other lead on this condenser to the pentode plate lug on the V2 socket. Attach a grid clip to the green lead from the top of IF1 and terminate this lead at the grid of V2.

The black lead from IF1 solders to one lead of the .0001 mfd. condenser, C6, to which also is attached one lead of the .5 megohm resistor, R7. The other lead on R7 joins to the earth busbar as does the remaining lead of the condenser, C6. To the diode lug on V2 to which was wired C8, solder one lead of the 1 megohm resistor, R8, and earth the other lead on this resistor. To the same point on the V2 socket to which R8 was soldered, join one lead of the .25 megohm resistor, R1. To the remaining lead on R1 solder a length of braided wire which terminates at the No. 2 lug on the aerial coil. Solder one lead of the 2000 ohm resistor, R9, and one lead of the 25 mfd. condenser, C9, to the cathode lug on the socket for V2. Earth the remaining leads on these two components.

Run a lead from the cathode lug on V2 to one of the outside lugs on the volume control, VC. To the centre lug on VC solder one lug of the .02 mfd. condenser, C7, and to the other lug on C7 solder a braided lead which terminates at the junction of C6 and R7.

To the remaining outside lug on VC solder another braided lead which terminates at one lead of the .25 megohm resistor, R11, which is mounted near the anchor strip.

All these braided wires should be earthed to the earth busbar.

The other lead of R11 solders to one lead of the .00025 mfd. condenser, C11 and to the Black lead from IF2. The remaining lead on C11 joints to the earth busbar. Wire the White lead from IF2 to the detection diode plate lug on the 6B7's socket. Join the Red lead from IF2 to one lug of the radio frequency choke, RFC, to which one lead of the .00025 mfd. condenser, C12, should already have been soldered. Earth the remaining lead on C12.

Join to the other lug on RFC the vacant lead on R12 and run a lead across to one lug of the .02 mfd. condenser, which already has been mounted on the rear of the chassis.

The other lug on this condenser, C13, joins to the control grid lug on the socket for V3 and carries also one lead of the .5 megohm resistor, R13. The other lead on R13 is earthed. Next solder one lead of the 400 ohm resistor, R14 and one lead of the 25 mfd. condenser, C14, to the cathode lug on the socket for V3.

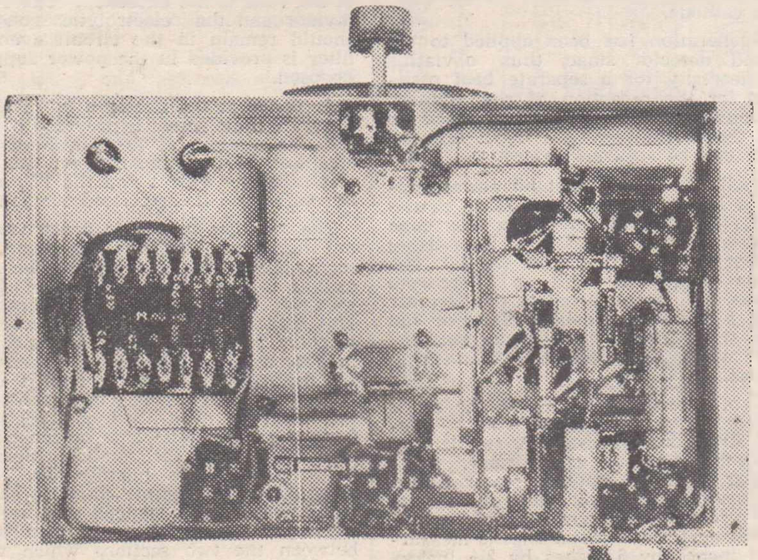
Earth the remaining leads on these two components.

Join the vacant lug on the l.s. socket to the plate lug on the socket for V3 and to this point solder one lead of the 10,000 ohm resistor, R15.

The other lead on R15 solders to one lead on the condenser, C15. The remaining lead on C15 solders to the screening grid lug on the socket for V3.

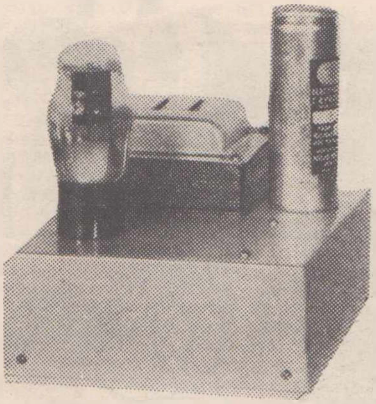
The attachment of the a.c. supply wires to the suitable lugs on the primary of PT will complete the wiring of the receiver and all is ready for the receiver to be tested.

The receiver has a sensitivity around 100 microvolts, a figure which, although not high, is sufficient to provide excellent reception of local stations and good reception of the more powerful interstate broadcasters. The selectivity of the set is excellent whilst its tonal quality is really fine.

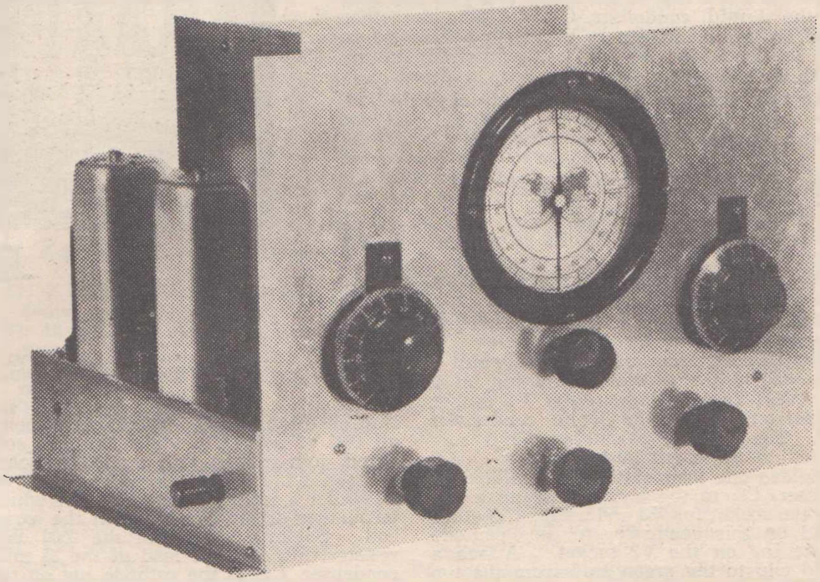


This underneath view of the receiver illustrates that a pleasing arrangement of the components can easily be obtained if care is taken in wiring the receiver.

The S.W. Headphone Super Four



Corner view of the power pack which is used for empowering the short-wave headphone super four.



The front view of the finished model showing the placement of the controls on the panel. They are (from left to right): (Upper), the trimmer condenser for G1; (lower), the first detector regeneration control; (upper), the main tuning control; (lower), the volume control; (upper), the trimmer condenser for G2; and (lower), the second detector regeneration control.

Compact in size and very efficient in operation, this super-heterodyne receiver represents the latest development in short-wave set design. Plug-in type coils coils are used in this receiver.

THE majority of short-wave listeners at the present time use dual-wave super-heterodyne receivers for the reception of overseas stations on both the commercial broadcasting and amateur bands.

A much better way over the difficulty is to build a separate short-wave super-heterodyne for use solely for headphone work and one which has a high signal-to-noise ratio due to the use of correctly proportioned coils and tuning condensers.

The receiver described here is designed solely for headphone operation over the short-wave band from 9 to 85 metres.

REFERENCE to the schematic diagram shows that the receiver consists of a first detector stage which employs the 6L7 valve, and that regeneration has been obtained by returning the cathode of this valve through portion of the grid winding in this stage. The regeneration control is a potentiometer which varies the screen voltage of the 6L7.

Smooth regeneration is obtained on each band by correctly tapping the grid coil at specified points.

A separate oscillator valve is employed, and this operates on the popular electron-coupled system. and is directly coupled to the injector grid of the 6L7 mixer valve.

A single I.F. stage has been employed, a 6K7 valve being used in this position. The intermediate frequency is 465 k.c., and both I.F. transformers are of the air-core type. A 6N7 valve is used in the second detector and audio frequency output stage. This valve consists of two triode sections with a common cathode.

Regeneration has been applied to the second detector stage, thus obviating the necessity for a separate beat oscillator for the reception of code signals. An audio gain control is provided so that the desired strength for headphone work can be adjusted to suit the user.

It will be noticed that no power supply is incorporated on the same chassis as the receiver proper. This was done because of the risk of A.C. hum being present in the output from the set. The power supply is built on a separate chassis, and is connected to the receiver with a three-wire cable. Two of the three wires in this cable are of shielded wire, which carry the A.C. filament to the set.

All of the heater wiring in the set is carried out with shielded wire to prevent stray hum pick-up. A standard 60 milliampere power transformer, an 80 rectifier, a 60 milliampere power choke, and a single 500 volt electrolytic condenser comprise the power supply, which is built on a small metal chassis measuring 8 inches by 6 inches by 2½ inches. The output of this unit is dropped by a fixed resistor to a maximum value of 200 volts. A voltage divider and another electrolytic condenser are mounted on the receiver chassis and the plate voltage for the 6N7 and the screen voltage for the 6K7 are tapped from the divider and suitably by-passed.

If desired the receiver may be operated from an existing power supply if care is taken to see that the maximum of 200 volts is not exceeded. The voltage divider and the electrolytic condenser should remain in the circuit even if a filter is provided in the power supply to be used.

A glance at the photographs of the set show that one shield is provided between the two sections of the ganged trimmer condenser and another between the mixer and oscillator valves and the I.F. amplifier valve and its associated components.

The receiver proper is constructed on an aluminium chassis measuring 12½ inches by 8½ inches by 2½ inches. This chassis is fitted with a panel of similar material to the chassis and measuring 12½ inches by 9½ inches and with two shields measuring 4½ inches by 6½ inches and 7½ inches by 6½ inches respectively. The larger shield is bolted in place 4¾ inches from the front panel and with its right-hand end 2⅜ inches from the right-hand side of the chassis. The position of the smaller shield can be seen from the photographs. It is essential that a flexible coupling be provided between the ganged trimmer condensers, G1 and G2, to prevent torque between the two sections which would result in instability on the higher frequencies.

The tuning condensers used in the receiver are isolantite insulated midget condensers. The two larger condensers, T1 and T2, are of 100 mfd. capacity whilst the ganged units have a capacity of 20 mmfds. each.

Particular attention must be paid to the earthing of the rotor plates of all of the tuning condenser. Small coiled strips of brass must be soldered to each of the rotor shafts of the condensers, T1 and T2. These strips are then soldered to the fixed plate lugs of the condensers. In the case of the ganged units the eyelets of the flexible coupling are soldered together, and earthed with a piece of metal braid to the main earth braid of the set. The wiring of this earth braid is detailed in the wiring description of the set.

The coils for the set are wound on 4 pin plug-in formers, having an outside diameter of 1¼ inches. All coils are wound with 22-gauge double silk-covered wire. The 10-metre coils, which tune from 9 to 15 metres, consist of 3¾ turns of wire spaced to cover 1 inch. In the case of the aerial coil a tap is taken at ¼ turn from the earth end, whilst the oscillator coil is tapped at 1½ turns from the earth end. The wiring of all coils to their base pins is identical. The earth end of the coil goes to the filament pin opposite to the plate pin. The grid or top of the winding connects to the other filament pin, and the tap on the coil joins to the plate pin of the former.

The 20-metre coils each consist of 6 turns of wire spaced to cover 1 inch. The aerial coil is tapped at a ¼ turn from the earth end, whilst the oscillator coil is tapped at 1½ turns from the earth end. The coverage of the 20-metre set of coils is from 13.5 to 25 metres.

The 40-metre aerial coil consists of 14 turns of wire wound to cover 1½ inches, with a tap at ½ turn from the earth end. The oscillator coil for this band consists of 13 turns of wire wound to cover 1¼ inches with a tap at 4 turns.

The 40 metre coils cover from 24 to 42 metres.

The 80 metres aerial coil consists of 38 turns of wire wound to cover 1¾ inches. A tap is taken at ¾ turn from the earth end. The 80 metre oscillator coil consists of 32 turns of wire wound to cover 1¾ inches and is tapped at 10 turns. This coil covers from about 65 to 85 metres.

After the coils have been completed the assembly of the receiver should be begun.

The key-lettered to chassis shows clearly the arrangement of the chief components.

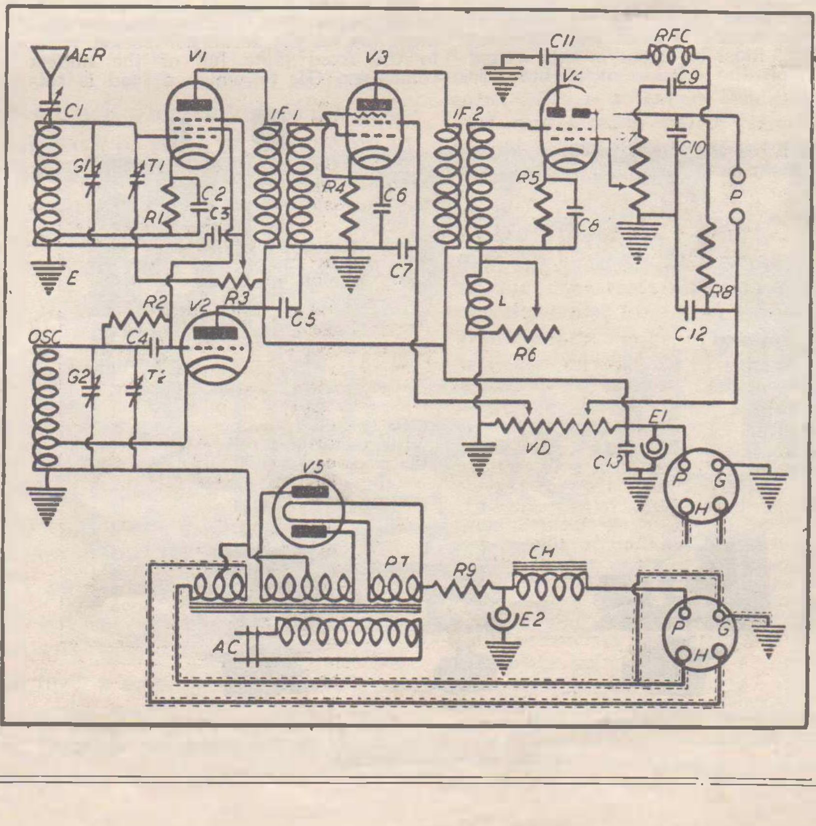
On the rear wall of the chassis, directly below the electrolytic condenser, E2, is the power input socket.

Three terminals are mounted on the rear wall of the chassis at the opposite end to the power input socket. Two of these terminals must be insulated from the metal chassis, but the other need not. The two insulated terminals will become the phone terminals. The one which is not insulated is the earth terminal. The aerial terminal is mounted on the left-hand wall of the chassis. This also must be insulated from the chassis. The voltage divider, VD, may be bolted in place under the chassis near the electrolytic condenser, E2. The .01 mfd. mica condenser, C2, is bolted in place between the mixer socket, V1, and the aerial coil

THE LIST OF PARTS AND SCHEMATIC CIRCUIT DIAGRAM

Needed to Build the S. W. Headphone Super Four

Chassis: Measuring 12½ inches by 8½ inches by 2½ inches complete with shields (see text).
Coils: See text.
C1: 25 mmfd. M.E.C. trimmer condenser.
C2, C5: .01 mfd. mica condensers. (T.C.C.)
C3, C6, C7: .1 mfd. mica condensers. (T.C.C.)
C4: .0001 mfd. mica condenser. (T.C.C.)
C8: 25 mfd. 35 volt electrolytic condenser. (T.C.C.).
C9: .01 mfd. tubular condenser. (T.C.C.)
C10, C11: .002 mfd. tubular condensers. (T.C.C.)
C12, C13: .5 mfd. tubular condensers. (T.C.C.)
Dial: To suit gang condensers.
E1, E2: 8 mfd. 500 volt electrolytic condensers. (T.C.C.)
G1, G2: 20 mmfd. isolantite insulated midget condensers.
IF1, IF2: 465 k.c. intermediate frequency transformers.
L: See text.
PT: Power transformer, 385-0-385 aside at 60 milliamperes, one 5 volt 2 ampere, 1 6.3 volt 2 ampere.
R.F.C.: Radio frequency choke.
R1, R5: 500 ohm 1 watt resistor. (I.R.C.)
R2: 50,000 ohm ½ watt resistor. (I.R.C.)
R3: 50,000 ohm wire-wound potentiometer to carry 10 milliamperes. (Ferranti.)
R4: 450 ohm wire-wound resistor to carry 10 milliamperes.
R6: 2500 ohm wire-wound potentiometer. (Ferranti.)
R7: 25,000 ohm carbon type potentiometer. (Ferranti.)
R8: 10,000 ohm 1 watt resistor. (I.R.C.)
R9: 2500 ohm wire-wound resistor to carry 100 milliamperes. (I.R.C.)
Sockets: Two 4-pin isolantite sockets, 1 isolantite octal socket, 3 octal sockets, and a 4-pin socket.
T1, T2: 100 mmfd. isolantite midget condensers.
Valves: One each 6L7, 6C5, 6K7, 6N7 and 80. (Ken-Rad, Philips, Radiotron, Raytheon.)
Sundries: Wiring flex, nuts and bolts, solder lugs, some tinned wire, 8 4-pin 1¼ inch diameter coil formers, a 4 oz. reel of 22 gauge D.S.C. wire, a small quantity of 30 gauge enamel-covered wire, 4 terminals, 4 knobs, 2 small bakelite dials, 3 yards of shielded wire and one flexible coupling.



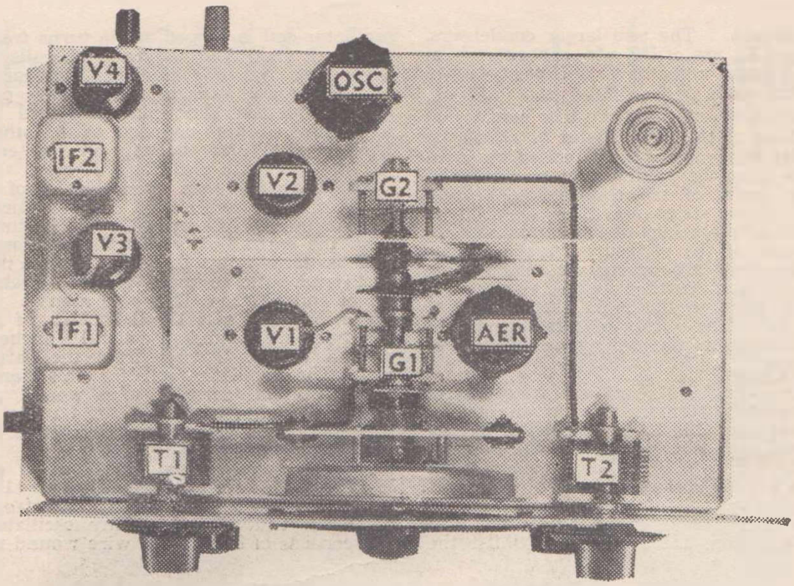
socket. A solder lug secured to a piece of insulating material must be bolted in place between the sockets for V3 and V4. This provides for the mounting of R5 and C8.

The only other components to be bolted directly to the chassis are the radio frequency choke, RFC, and the feedback coil, L. This coil is made by winding 50 turns of 30 gauge enamel covered wire on a 1 inch diameter former. This coil should be fitted with a bracket and bolted to the front panel close to the second detector regeneration control, R6. RFC is not bolted in place until the wiring is partly completed.

The first stage in the wiring of the receiver is to provide an efficient earth network for the earth returns of the various parts. A quantity of metal braid is required for this purpose. This may be obtained by removing the outside metal braid from some shielded wire and squeezing this flat in a vice. One end of this braid should be soldered to the filament lug, which is opposite the plate lug of the aerial coil socket. It is then bent so that it runs midway down the chassis till a point is reached opposite to the filament lug, which is opposite the plate lug of the oscillator coil socket. The braid is then soldered to this point. Holes should be drilled in the chassis through which to take the leads to both the fixed and moving plate contacts of the midget condensers.

Similar braid earth leads solder to the moving plate lugs of the midget condensers, T1 and T2. The lead from T1 solders to the earth braid in the centre of the chassis and the one from T2 solders to the filament lug of the aerial coil socket to which the other earth braid was soldered. Solder lugs should be placed under the holding bolts of sockets and all other components. These should be joined up with stretched tinned copper wire and joined with similar wire to the earth terminal. The braid earth network should be securely soldered to the tinned wire.

As mentioned previously, the whole of the heater wiring is done with shielded wire. Care must be taken in this wiring to see that the outside metal braid is securely soldered to the earth network and that it does not come into contact with the inside yellow lead.



Looking down on top of the chassis gives the builder an excellent idea of the layout required. All parts are keyed to correspond to the written description of the receiver.

Solder a metal braided lead to one of the filament lugs of the power input socket. Solder the other end of this lead to the number 2 lug of the socket for V2. With similar braided leads join the number 2 lugs of the sockets V1, V3, and V4, to the corresponding lug on the socket for V2. The number 7 lugs of the sockets V1, V2, V3 and V4 join together and wire to the remaining filament lug of the power input socket. All of this wiring is done in shielded wire.

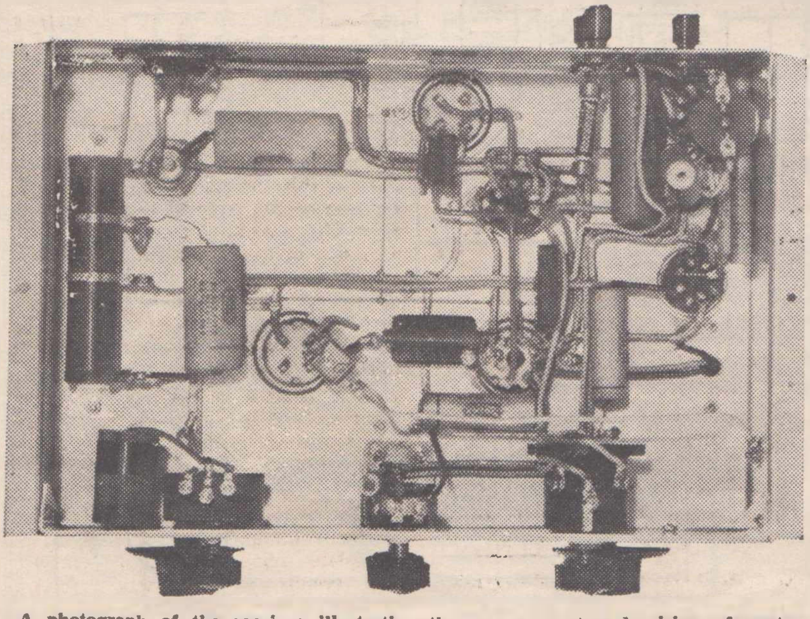
The number 1 lugs of each socket join to the earth wire. The unconnected filament lug on the aerial coil socket wires to the fixed plate lug of the midget condenser, G1, to which a lead is soldered which terminates in the grid clip for the mixer valve, V1. The fixed plate lug of the trimmer condenser, C1, solders to the filament lug of the aerial coil socket which joins to the midget condenser, G1. The plate lug of the aerial coil socket solders to one lug of the condenser, C2, and one lead of the resistor, R1. The remaining leads of these two components join together and solder to the number 8 lug of the socket for V1.

From the fixed plate lug of the midget condenser to which the grid lead for V1 was soldered take a stiff wire lead to the fixed plate lug of the trimmer condenser, T1. The Green lead of IF1 solders to the number 3 lug of the socket for VI. The Black lead of IF1 solders to earth wire. The Red lead of IF1 joins to the number 3 lug of the socket for V2, as does the Red lead of IF2. The .01 mfd. condenser, C5, solders from the number 3 lug of V2 to the earth wire. To the number 4 lug of the socket for V1 solder a lead from the arm contact of R3 and one lead of the .1 mfd. tubular condenser, C3. The remaining lead of C3 joins to the earth wire.

The arm contact of R3 must be insulated from the metal chassis with suitable insulating washers. One of the outside lugs of R3 joins to the earth wire whilst the other connects to the number 3 lug of the socket for V2. The plate lug of the Oscillator coil socket joins to the number 8 lug of the socket for V2, and the unconnected filament lug of the oscillator coil socket connects to the fixed plate lug of the midget condenser, G2. One lug of the .0001 mfd. condenser, C4, and one lead of the resistor, R2, solder to the filament lug of the oscillator coil socket which joins to G2. The remaining leads of these two components join together and connect to the number 5 lug of the socket for V2. Join the number 5 lug of the socket for V1 to the number 5 lug of the socket for V2.

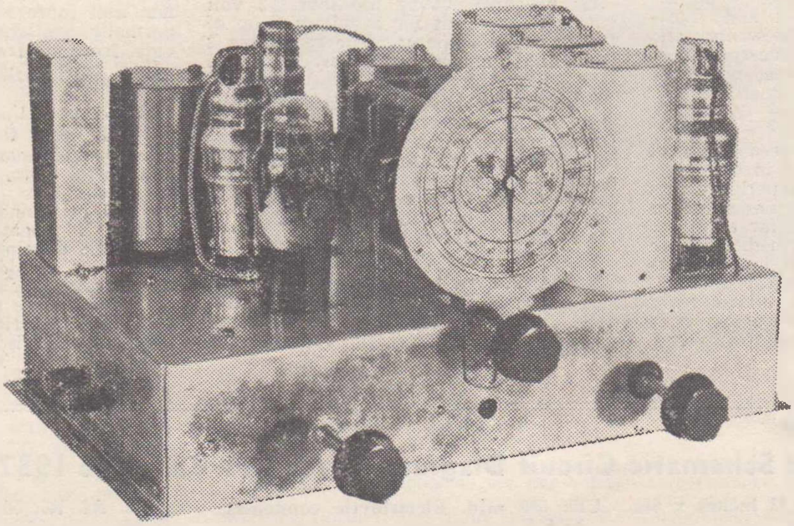
Solder together one lead of the resistor R4 and one lead of the condenser C6 and join them to the number 8 and number 5 lugs of the socket for V3. The

(Continued on Page 71)



A photograph of the receiver illustrating the arrangement and wiring of parts below the chassis. This illustration should be closely studied before the wiring of the set is commenced.

The 1937 Vibrator Five



Attractive in appearance this dual-wave receiver is capable of giving remarkable results.

The controls are (from left to right), the Volume Control, the Main Tuning Control and the Wave Band Switch.

Employing all the modern refinements of a first-class receiver, this five-valve dual-wave super-heterodyne represents the latest development in set design. An additional feature of this set is the revised version of the Inverse Feed-back system used in the audio frequency amplifier.

THE radio set-user who is remote from sources of alternating current supply has much for which to thank radio engineers during the past year. Besides providing him with ultra-efficient valves, which combine fine performance with remarkable economy of consumption, design engineers have developed new circuits for the countryman—circuits which improve selectivity, sensitivity, and tonal quality.

With the aid of vibrator power units they have made it possible for the country listener to obtain from his battery set a tonal quality equivalent to that of the best a.c. sets, and have increased the economical audio power output of such sets from some 300 milliwatts to around three-quarters of a watt.

The latest technical development applied to battery-type receivers is Inverse Feedback — a development which is probably the most important forward radio step during the past twelve months. With the aid of Inverse Feedback which involves the feeding back of some of the energy in the output circuit to the input circuit of the last stage audio tube, it is possible to obtain a freedom from distortion which previously was obtainable only with a carefully designed push-pull amplifier.

The difficulty with previous Inverse Feedback schemes adopted in battery receivers was that they reduced the available amplification of the audio driver tube from 60 to 16, a loss of nearly 75 per cent. This, in turn, reduced the receiver's overall sensitivity because it was necessary to feed a greatly increased signal into the first audio tube in order to get the required power output from the pentode.

REVISED circuiting of the Inverse Feedback system has been developed in the laboratories of the A.W. Valve Co., to whom we are indebted for the form shown in this latest vibrator model. The new Inverse Feedback arrangement is much less power wasting than the earlier one and permits a really high efficiency to be obtained from the receiver.

The arrangement of this new vibrator circuit is such that all modern improvements are contained in it. The receiver built to this circuit design is a dual-wave one tuning from 18 to 50 and from 200 to 500 metres. It has been fitted with an efficient delayed automatic volume control system to minimise fading, and with an effective form of Inverse Feedback to provide practically perfect tone quality and freedom from distortion.

Due to the use of additional bias on the output tube it is possible for the latter to be driven to the full 750 milliwatt output without running into grid current.

Finally, as it is powered from a vibrator, the receiver is fed with a maximum plate voltage of 150 a potential, which results in extremely efficient operation of each of its five valves.

The basis of the r.f. side of the receiver is the new Radiokes dual-wave coils, which are listed under the serial

D.I.C. Fitted with the new Sirufer cross-type iron-dust cores, the broadcast sections of these coil units are probably the most efficient it is possible to obtain in Australia today. The short-wave coils follow standard design, being wound on high frequency formers, and spaced to ensure an extended wave-range coverage.

A feature of these Radiokes coil units is that each coil-can is fitted with the trimmers for the broadcast and short-wave coils. This simplifies wiring and avoids restriction of the wave-range due to wiring capacities introduced when the trimmers are mounted externally.

The i.f. transformers are Airmaster high-gain litz-wound types.

It is possible for iron-cored types of i.f. transformers to be used in this position, but it has been our experience that the iron-cored type of i.f. does not offer any greater advantages, as far as either selectivity or gain is concerned, than are obtained with a well-designed litz-wound air-cored transformer.

The valve set-up is a conventional one for this type of receiver and consists of the Radiotron 2 volt series 1C4, 1C6, 1K6 and 1D4. This series of valves is particularly useful in a vibrator receiver, where the filaments must be connected in series — parallel in order to obtain successful operation from the six volt battery which is used with the vibrator power unit. The 1C4, 1C6 and 1K6 all are of the .12 ampere filament type, whilst the 1D4 operates with a filament current of .24 amperes.

By properly wiring the four .12 volt valves we account for a voltage drop of 4 volts at .24 amperes. The remaining 2 volts at .24 amperes is absorbed by the 1D4.

Note particularly the method of series and parallel connection of the five valves. Do not depart from it because upon the relationship of these valves in the filament circuit depends the bias and a.v.c. delay voltages applied to the grids of the various tubes and the a.v.c. diode of the second detector.

The r.f. valve, V1, and the i.f. valve, V3, are 1C4 radio frequency pentodes. The mixer tube, V2, is a 1C6. The 1K6 tube, V4, combines the functions of diode detection automatic volume control at first stage audio amplifier tube. The output tube is a 1D4.

An examination of the grid return resistor, R11, connected between the control grid of the 1D4 and earth will reveal that a three volt bias battery has been connected in series with this resistor and earth. The introduction of a battery in a vibrator set may seem unusual, but it is made necessary by the fact that more bias than the four volts normally available is necessary to provide freedom from overload when the output tube is operated at its maximum power.

The construction of the vibrator unit itself, in which the vibrating reed in the primary and secondary circuits is a common metal strip, precludes any attempt to obtain bias by the conventional method of connecting a series resistor in the "B" negative line. No potential would be developed across this resistor because it would be short-circuited in the vibrator itself. Consequently, it is necessary to use two 1½ volt torch cells connected in series and mounted underneath the chassis by means of an anchor

List of Parts and Schematic Circuit Diagram Needed to Build the 1937 Vibrator Five

CHASSIS: Measuring 13 inches x 8½ inches x 2¾ inches.

COIL KIT: Consisting of Aerial, R.F. and Oscillator coils for 465 k.c. (Type D.I.C. Radiokes).

"C" BATTERY: Two 1½ volt Ever-Ready torch cells.

C1, C2, C3, C5, C10, C16: .1 mfd. tubular condensers (T.C.C.).

C4, C7, C9, C11, C12: .0001 mfd. mica condensers (T.C.C.).

C6: .05 mfd. tubular condenser (T.C.C.).

C8, C14: .02 mfd. mica condensers (T.C.C.).

C13: .5 mfd. tubular condenser (T.C.C.).

C15: 500 mfd. Electrolytic condenser (T.C.C.).

CH: 25 hy. ¼ ohm filter choke (Lewbury).

G1, G2, G3: Three gang Stromberg Carlson Type G variable condenser.

IF1, IF2: 465 k.c. Iron-cored I.F. transformers. (Airmaster).

L.S.: Permanent Magnet loud-speaker, matched to 10,000 ohm output.

P.D.: 465 k.c. broadcast padder and .004 mfd. fixed condenser for S.W. padder.

RFC1, RFC2: Radio Frequency Chokes.

R1, R10: .25 megohm resistors (I.R.C.).

R2, R3, R4, R5: 50,000 ohm resistors (I.R.C.).

R6, R7: .5 megohm resistors (I.R.C.).

R8, R9, R11: 1 megohm resistors (I.R.C.).

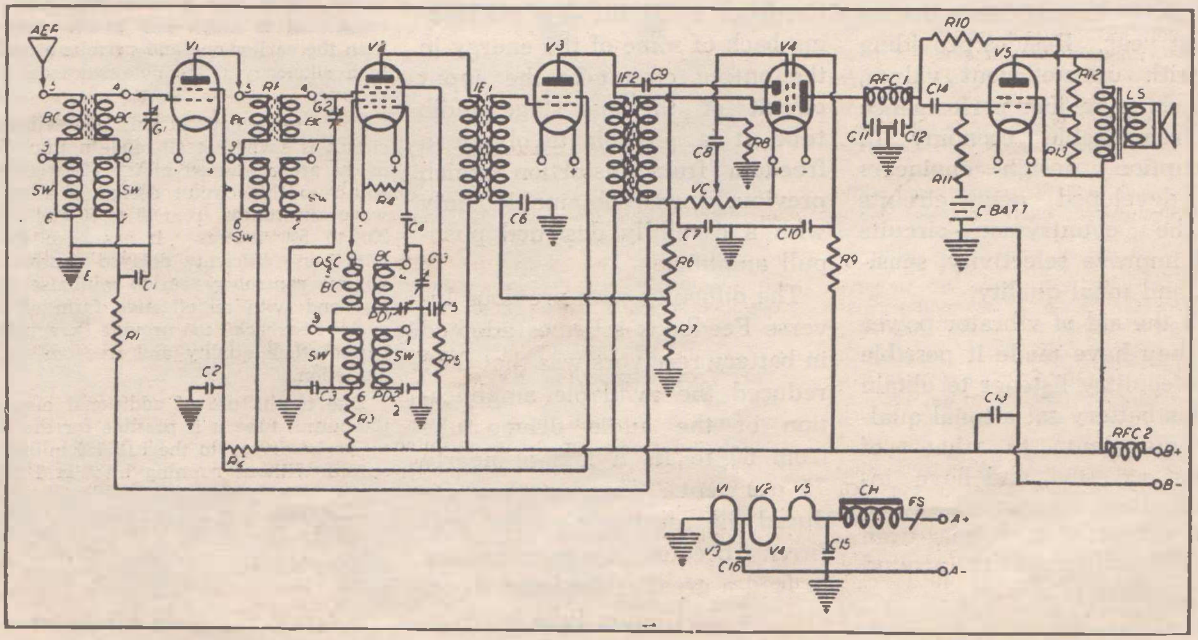
R12: .1 megohm resistor (I.R.C.).

R13: 11,000 ohm. resistor (I.R.C.).

VALVES: Two 1C4, one 1C6, one 1K6, one 1D4 with sockets (Ken-Rad, Philips, Radiotron, Raytheon).

VC: .5 megohm volume control with switch (I.R.C.).

SUNDRIES: Four valve shields, one vibrator power input socket, one Van Ruyten vibrator unit, one six-volt accumulator, dial and knobs, wiring flex, shielded wire, nuts, bolts, solder lugs, and four terminals.



strip. The service life of these cells should be at least twelve months for no current is drawn from them.

A point which will be noticed if the circuit is carefully examined is that care has been taken to filter all r.f. from the circuit and to eliminate the entrance of vibrator "hash." The result is that the full advantages of the tonal quality of the Inverse Feedback system are obtained and that, despite the set's high sensitivity, the inherent noise level is extremely low.

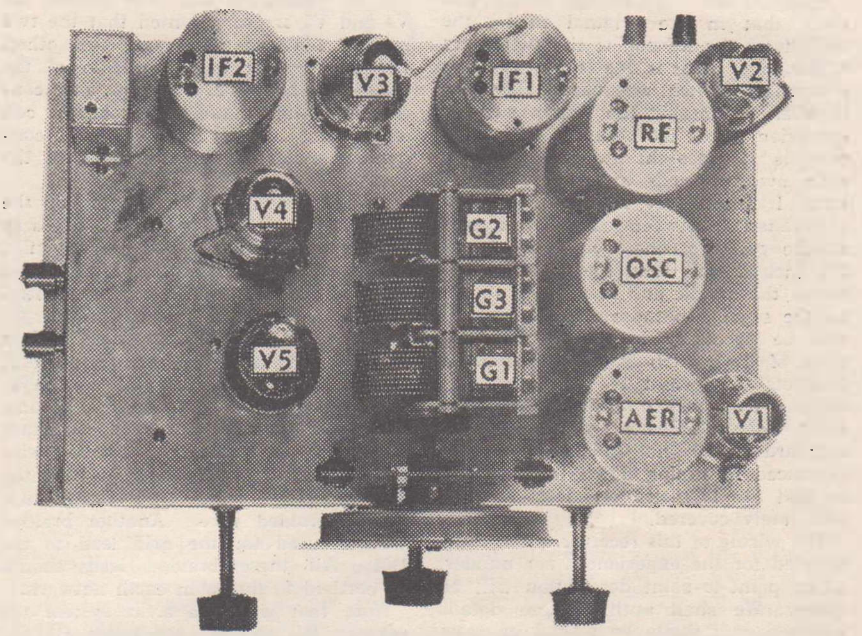
Filtration in the audio circuit is effected by the fully by-passed radio frequency choke, RFC1, connected between the plate of V4 and the grid of V5. In the main "B" plus line another radio frequency choke, RFC2, is connected to eliminate vibrator "hash." This choke is by-passed on the set side with a .5 mfd. condenser, C13, which ensures an effective return to chassis of all stray r.f. currents. In the filament circuit another by-pass condenser, C16, is connected across the filaments of the r.f. and i.f. tube. This, with the conventional filament choke, CH, and 500 mfd. electrolytic condenser, C15, clears all hash and feedbacks from these circuits.

Voltaging of the various tubes is effected in a way which combines efficiency of operation with economy. The 1C4 r.f. and i.f. tubes and the 1D4 output tube have their plates fed with the full 150 volts. The same potential is applied to the pentode plate of the mixer tube, V2. The screening grids, the r.f. and i.f. tubes are fed from the main plate supply through the 50,000 ohm dropping resistor, R2, and receive an effective voltage of approximately 70.

The screen grids are by-passed by the .1 mfd. condenser, C2. The 1C6 is being operated under economy conditions which, besides saving plate current, also result in more efficient operation. To this end the oscillator plate is fed from the main supply line through a single 50,000 ohm. resistor, R3, while a similar value resistor R5 ensures that the screen grid will receive about 70 volts from the main supply line. These resistors are by-passed to earth by condensers C3 and C5 respectively. Each of these has a capacity of .1 mfd.

The plate feed to the pentode plate of the 1K6 is tied up with the Inverse Feedback system, so we first will analyse the method used to obtain feedback. Resistors R12 and R13, which have values of 100,000 and 11,000 ohms respectively, are connected in series across the output transformer. From the midpoint of these two resistors the plate supply is taken off through a 250,000 ohm resistor, R10, to the pentode plate of the 1K6. The proportion of signal voltage feed back to the grid of the output tube is determined by the relationship existing between R12 and R13, this voltage feeding through R10 and C14 to the grid of the 1D4.

Note that the screening grid of the 1K6 has been operated at a lower potential than normal, the main supply voltage being dropped through the 1 megohm resistor, R9, which is by-passed by the .1 mfd. condenser, C10.



This plan view of the receiver illustrates the arrangement of parts on top of the chassis. All components are key-lettered to correspond to the written description.

The a.v.c. system follows standard practice in that the r.f. voltage is derived from the primary of IF2, and is fed through the .0001 mfd. condenser, C9, to the a.v.c. diode. The rectified voltage is bled off by means of a potentiometer made up of two half megohm resistors, R6 and R7, and connected between the a.v.c. diode and ground. Now, as the filament of the 1K6 is operating at a point two volts above ground, and the diode return through R6 and R7 is at ground potential, it follows that a delay of two volts is applied to the a.v.c. system, which thus does not affect the sensitivity of the receiver to weak signals.

Now glance at the illustrations of the original receiver whilst we discuss the question of its lay-out. Built up on an aluminium chassis measuring 13 inches in length, 8½ inches in width, and 2¾ inches in depth, the set is attractively laid out, and is arranged in a manner conductive to short wiring leads. Looking from the front of the receiver, we find that the r.f. valve, V1, is mounted in the front right-hand corner. The mixer tube, V2, is in the rear right-hand corner. Between these two tubes and the gang condenser are to be found the three dual-wave coil units. The aerial coil, AER, is nearest to the front of the set, the oscillator coil, OSC, is in the middle, and the r.f. coil, RF, is at the rear. Alongside this latter coil at the rear of the chassis is to be found the first i.f. transformer, IF1. To the left of IF1 is the i.f. amplifier tube, V3, while next to V3 is the second i.f. transformer, IF2. The 500 mfd. electrolytic condenser can be seen at the rear left-hand corner of the chassis.

To the left of the gang condenser, which has been mounted centrally on the chassis, are the second detector and output valves, V3 and V4. V4 is nearest to the front of the chassis. Only three controls are fitted to the receiver. From left to right these are the combined volume control and filament switch, the main tuning control, and the three gang wave changing switch.

On the rear of the chassis are to be found the aerial and earth terminals, the four pin socket for the vibrator unit, and the rubber grommeted outlet for the "A" battery cables. On the left-hand end of the chassis are the loud speaker terminals.

An inspection of the underneath of the chassis shows that the filter choke, CH, has been bolted to the floor of the chassis in the left-hand front corner. The two 1½ volt Ever-Ready torch cells are connected in series, slipped inside their carton, and mounted on solder lugs attached to a piece of bakelite which has been bolted to the rear wall of the chassis just above the socket for V3. The r.f. choke, RFC one, is fastened to one of the holding bolts of the socket for V4.

A small piece of bakelite fitted with a solder eyelet is bolted to one of the rear holding bolts of the gang condenser, being kept clear of the chassis floor by means of a small spacing washer. The only other component to be mounted directly to the chassis is the broadcast padder condenser. This is placed in line with and midway between the sockets for V1 and 2, a hole being drilled in the top of the chassis to provide access to the padder adjusting screw.

Study of the wave change switch will show that in the original model the leads from the RF coil to the switch are rather long. This is due to the fact that a standard switch was used. However, if when purchasing the switch suitable extension pieces are obtained, it will be possible to place the switch gangs directly over the coils to which they belong. If this is done, it is suggested that the distance between the front and middle gangs of the switch should be 2½ inches, and that the distance between the middle and rear gangs should be the same. In these circumstances it will be necessary to support the rear plate of the switch by means of metal brackets to prevent it wobbling and causing frequency variations on the short waves. However, even with the standard switch no difficulty was experienced in tuning down to 18 metres so that the 19 metre broadcast band is adequately covered.

The wiring of this receiver is not complicated for the experienced set builder, so no point-to-point description will be given. We shall outline those details which cannot easily be picked up from a study of the underneath view of the chassis. First note that in the circuit diagram the aerial, r.f., and oscillator coils have their connections numbered to agree with the numbered code on the bases of the coils themselves.

The sockets are so arranged that the filament lugs of the V1 socket face the near end of the chassis, whilst the V2 socket is so disposed that its filament pins are parallel with the rear of the chassis. The same arrangement is used for the socket for V3. The sockets for V4 and V5 are so mounted that the two sets of filament pins face each other, i.e., are nearest to the middle of the chassis. The a.v.c. resistors and condensers all are mounted outside the coil cans, being soldered into position at convenient points around the floor of the chassis.

Metal braided wire is used to join the aerial terminal to the switch, to carry the a.v.c. line from R1 to the r.f. tube, and to carry the black lead from IF2 to the outside lug on the volume control resistor, VC.

A braided lead also is used to join the "A" plus lug on the vibrator socket to the filter choke, CH, and thence to one of the switch lugs on the volume control-switch unit, VC. From the other switch lug on this unit a braided wire goes out through the chassis to form the "A" plus lead. The "A" — lead is a similar braided wire. Another braided wire is used for the grid lead to the 1K6. All these braided leads should be earthed to the main earth network.

Note that with the a.v.c. system the resistor, R1, and the condenser, C1, are joined into circuit at the point where the two .5 megohm resistors, R6 and R7, have been mounted. The main thing to bear in mind when wiring the receiver is to keep all leads as short as possible, and to provide an efficient earth network by means of tinned copper wire which is soldered to lugs placed under the holding bolts of the various components.

When the wiring of the set has been completed, the first job is to check it carefully to see that no mistakes have been made. This done, plug the valves into their respective sockets, and attach the grid clips. Now clamp the loud speaker leads under the output terminals. Note that under this condition of Inverse Feedback a loud speaker possessing a load resistance of 10,000 ohms is necessary. Normal operation of the 1D4 calls for the use of a 15,000 ohm load resistance, so that it will be necessary to obtain a new input transformer if the higher resistance speaker is on hand.

Attach the aerial and earth leads, plug in the vibrator unit, and join the battery leads to the correct terminals on the "A" battery. The latter should be a heavy duty type, specially designed for vibrator work, in order that reasonable service may be obtained from each re-charge.

With the volume control set well back, tune in a station on the low end of the dial. Adjust the oscillator trimmer until this station falls at its correct point if a frequency or wave-length calibrated dial is being used. Next adjust the RF and then the AER trimmers on the coil cans for loudest signal. Tune up to the top end of the dial, and, after bringing in a station, adjust the broadcast padder condenser for loudest volume. This completes the broadcast alignment.

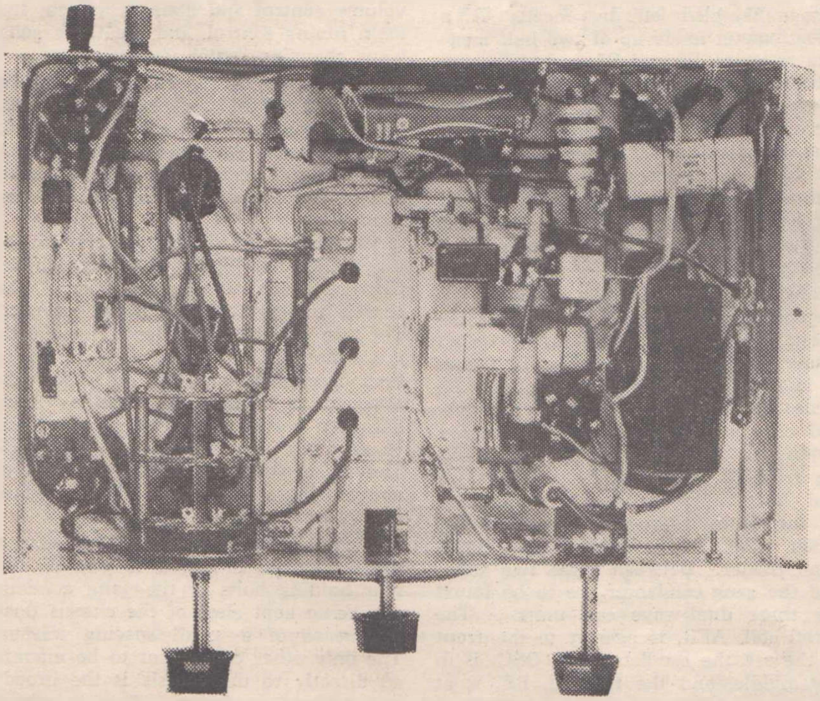
For short-wave alignment it is desirable to select a station which is as free as possible from fading. A Morse station will do if a broadcast one cannot be heard. Tune down to the bottom end of the dial, and carry out the adjustment of the trimmers on the short-wave coils in exactly the same order as for the broadcast coils. No adjustment will be possible to the short wave padding condenser because this is a .004 mfd. fixed condenser.

If these adjustments have been carefully carried out, the set should be functioning well, but a further improvement will usually be made by peaking the i.f. trimmers. Tune in a station in the middle of the broadcast band, reduce the volume so that small changes in intensity will be readily noticed, and adjust the trimmer on the secondary of IF2 for loudest volume. Repeat this adjustment with the trimmer on the primary of IF2, and on the secondary of IF1. Do not adjust the trimmer on the primary of IF1.

When properly aligned, the receiver will be found to have an exceptionally high sensitivity. On the broadcast band this ranges from 1.1 microvolts at 1500 k.c. to 8 microvolts at 545 k.c. On the short-waves the sensitivity is from 5 microvolts at 19 metres to 15 microvolts at 50 metres.

Other figures on the set's performance may be of interest. Under no signal conditions the current drain from the "A" battery is 1.08 amperes. This rises with signal until at maximum output the drain is 1.2 ampere. The total plate current drain ranges from 17 m.a. at no signal, to 21 m.a. at full output.

Whether judged from the viewpoints of tone, sensitivity, or selectivity, the receiver will be found to be a first rate performer, and one which will bring a new conception of battery receiver capabilities to its builder.



Another view of the receiver showing the placement and wiring of parts below the chassis. Care should be taken to ensure that all grid and plate leads are kept as short as possible in order to prevent tendency towards r.f. feed-back. This plan photograph of the receiver illustrates the arrangement of parts on top of the chassis. All components are key-lettered to correspond to the written description of the receiver.

General Purpose Amplifier

This photograph shows the complete assembly with a crystal type microphone standing alongside the amplifier.

This high-gain audio amplifier, capable of delivering 9 watts undistorted power, is applicable to all modern requirements.

WITH an audio output of nine watts, and employing only four valves, this amplifier is probably the most highly-developed one in the Southern Hemisphere. Possessing a gain of approximately 100 db. the amplifier will deliver full output from a crystal microphone and provision is made for full mixing facilities for one microphone and two pick-ups.

Alternatively, one pick-up and a radio tuner, or two tuners can be used. The mixing system enables the operator to mix three channels simultaneously so that change-overs between records can be made without interruption, or music can be used for a background to voice.

When it is considered that the total plate power taken by this amplifier is about 20 watts and a good 9 watts of audio power is available, it is seen that the unit is remarkably economical. A pair of AL3 valves are responsible for the high-gain as well as for the plate economy.

SINCE the output of a crystal microphone is about —65db. it is necessary to use a high-gain pre-amplifier to raise the microphone output to a value suitable for driving the output stage. A single type 79 valve takes care of this, as this dual-type valve is arranged so that its sections are in cascade. The first section of this valve is used as the microphone amplifier, and the second section employed to amplify the output of the three mixers. A type 80 rectifier completes the valve complement.

A chassis of the specified size should be employed, and the various parts laid out in exact accordance with the photographs. The gain is so high, in relation to the high output, that trouble from hum pick-up and feed-back will be experienced unless this layout is followed exactly. The audio transformer must be placed so that it can be turned in any direction, a single ½-inch hole in the chassis sufficing for all the transformer leads. It may be found with some amplifiers that the transformer must be parallel with the end of the chassis, in others at the angle indicated in the photographs. This angle can only be determined by trial, so leave plenty of space for its rotation.

The centre mixer (volume control) is mounted 5½ inches from the A.F. transformer end of the chassis, and the spacing between the shafts of the other two faders is 4½ inches. Each of these shafts is 2¼ inches from the centre fader shaft.

The small piece of aluminium mentioned in the sundries is folded over for a quarter of an inch along one long side. A line is then marked one and a quarter inches in from one end and the fold up to this line is removed. The piece of aluminium is then bent at right angles along this line. This means that the finished piece has a quarter-inch fold along the long side, but the short side, at right angles to the long side, is without a fold. It does not matter which way the fold is made. A small hole should be drilled near each end of that fold so that the shield, as this piece of aluminium becomes, can be bolted to the chassis.

This shield is shown by the letters, SH, in the photograph showing the bottom view. A small piece must be cut out of the short section of the shield so that it will fit around the fader, VC3. When in place, the shield mounts with the short side in line with the shaft of VC3 and touching the front wall of the chassis and the long side lying parallel with the front wall.

The socket for V1 is mounted behind VC1 and a quarter of an inch away from the end of SH. The faders must be of the type having a metal shield over them, otherwise the shield SH must be extended to cover them completely, in which case the socket for V1 would have to be shifted. As this may cause trouble it is best to use the correct type of control.

Several of the resistors and condensers are mounted on a resistor strip, this being attached to the end wall as illustrated.

Mount all sockets so that the filament lugs are to the rear of the chassis, and take care to insulate E1 from the chassis. The position of the terminals can be gleaned from the photographs, those marked "M" being for connections to the microphone. The terminal, E, of this group is for connection to the shielding on the microphone cable. If desired, this terminal can be mounted between the two M terminals. Another earth terminal is mounted on the rear wall of this chassis, and is used for the actual connection of the chassis to earth.

Solder-lugs are placed under the nuts holding down the sockets, and a grommet fitted in the end-wall next to the power transformer.

A piece of heavy bare busbar connects together the earth terminal on the back wall, the solder-lug next the power transformer on the rectifier socket, the corresponding lug on the two AL3 sockets, and the solder-lug on the V1 socket nearest the AL3 sockets, and the microphone E terminal.

Using shielded wire for each lead, connect the filament lugs on V1 to the 6.3-volt lugs on the power transformer. These wires need not be twisted, and are run along the busbar, being anchored to it in several places by a little solder. These leads are shown as Bus in the photograph of the wiring. The shielding should be taken as close to the lugs as possible without risking an earth.

Next, using twisted wiring flex for this purpose, connect the filament lugs on the AL3 sockets to the 4-volt winding on PT.

A single-twisted pair connects the filament lugs on V3 to the transformer, and another twisted pair connects the filament lugs of V2 to the filament lugs of V3. The filament lugs of the rectifier, V4, are connected with a twisted pair to the 5-volt winding on PT. All of these leads are laid in the form of a cable running right along the back wall of the chassis and pushed down against the chassis itself.

The next step in the wiring is to connect the plate lugs of the rectifier socket to the HT lugs on the transformer. The HT centre-tap is wired to one end of resistor, R15, the free end of which connects to the busbar. The centre-tap of the 4-volt filament winding goes to the bus-bar.

The centre-tap of the 5-volt winding

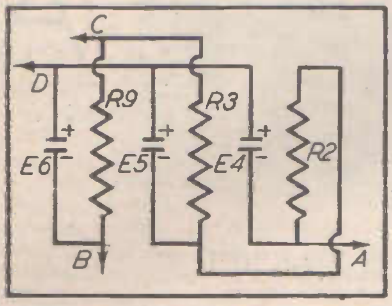
is connected to the positive of electrolytic E1 and to one of the heater lugs on the speaker socket. The other heater lug is joined to the grid lug on this socket and to the positive of electrolytic, E2. The negative of E1 is wired back to the centre-tap of the HT on the transformer.

The transformer astatic shield should be connected either to the HT centre-tap or to the chassis. In some cases it may be connected internally to the HT centre-tap. The cathode lug on the speaker socket is next connected to the plate-lug on V2 and the plate-lug of V3 taken to the plate lug on the speaker socket. The screengrid lug of V2 is wired to the same lug on V3, thence to the grid-lug on the speaker socket.

Connect together the cathodes of V2 and V3, and to one of these join one end of resistor R12, the other end of which goes to the bus-bar. To the plate of V2 connect condenser, C4, and to the free end of this condenser wire one end of R13. Repeat this with V3, using C5 and R14. Now join together the free ends of R13 and R14, and wire these to the screen-grid lug on V3. The centre-tap of the audio transformer, AFT, is connected to the bus-bar and one of the Blue leads to the grid lug of V2. The other Blue lead goes to the grid of V3. A piece of shielding is removed from some of the shielded wire and is slipped over the Red lead from AFT. This shielding is bonded to the bus-bar in several places, and the Red lead connected to plate No. 2 of V1.

All of these leads should be left long so that the transformer can be rotated later. The cathode of V1 is joined to the main bus-bar with a short piece of bus-bar, which also connects to a solder lug mounted just behind the C terminal of the PU group.

With the shield, SH, removed, connect the mixers by joining together the left-hand lug on each control (looking



The resistor and condenser strip referred to in the text.

at the controls from the rear and with the lugs uppermost, except in the case of VC3, which is turned around so that the right-hand lug will be inside SH). Using shielded wire, connect the C terminal of the PU trio to the left-hand lug of VC3. The right-hand PU terminal connects to the right-hand lug of VC3, while the other PU terminal goes to the similar lug on VC2.

All of these wires must be shielded. The three resistors, R6, R7, and R8, are mounted inside the shield by having one end of each joined together and attached to a piece of shielded wire which terminates at the No. 2 grid of V1. The end of the braid is soldered to the cathode lug on V1 as it passes it. The free end of R6 goes to the centre lug on VC1, that of R7 to the similar lug of VC2, and the free end of R8 to the centre lug on VC3.

In each case the shielding on these leads should go as close to the lug or terminal as possible, and all shielding should be bonded together and soldered to the solder lug which is wired to the cathode of V1. by the small bus-bar.

These wires should be bonded in one or two other places to keep the assembly rigid. The coupling condenser, C1, is attached directly to the No. 1 plate of V1, and the right-hand lug of VC1. The shield, SH, can then be replaced, taking care to see that it does not disturb any of the wiring or cause a short to earth.

The condensers C2 and C3 are placed as shown, with the ends nearest the right-hand end joined together and connected to the busbar. One end of resistor, R11, is soldered to the grid lug on the speaker socket, DS. The other end of this resistor connects to one end of resistor R10, to one end of resistor R5, and to the positive of E3. The free end of R10 goes to the free end of C3, and to this junction is wired the remaining lead from the transformer,

List of Parts and Schematic Circuit Diagram Required to Build the General Purpose Amplifier

AFT—Audio frequency transformer. Primary to match one section of a type 79 valve. Push pull secondary. (Airmaster Ferranti.)

Chassis—12 x 8½ x 2½ aluminium with ½-inch fold at each end.

C1, C4, C5—0.01 mfd. mica condensers. (T.C.C.)

C2, C3, C6, C7—0.5 mfd. 400-volt working tubular condensers. (T.C.C.)

E1, E2—8 mfd. 600 volt electrolytic condensers. (T.C.C.)

E3—8 mfd. 500 volt electrolytic condenser. (T.C.C.)

E4, E5, E6—25 mfd. 35 volt electrolytic condensers. (T.C.C.)

PT—Power transformer. HT secondary, 385 volts per side at 100 ma. Filaments. One 5 volt at 2 amps; one 4 volt at 4 amps; one 6.3 volts at 2 amps.

R1—1 megohm, 1 watt resistor. (I.R.C.)

R2, R3, R9—0.5 megohm, 1 watt resistors. (I.R.C.)

R6, R7, R8—0.5 megohm, ½ watt resistors. (I.R.C.)

R4, R10, R11, R13, R14—10,000 ohm, 1 watt resistors. (I.R.C.)

R5—50,000 ohm, 1 watt resistor. (I.R.C.)

R12—75 ohms wire-wound resistor. 80 m. a.

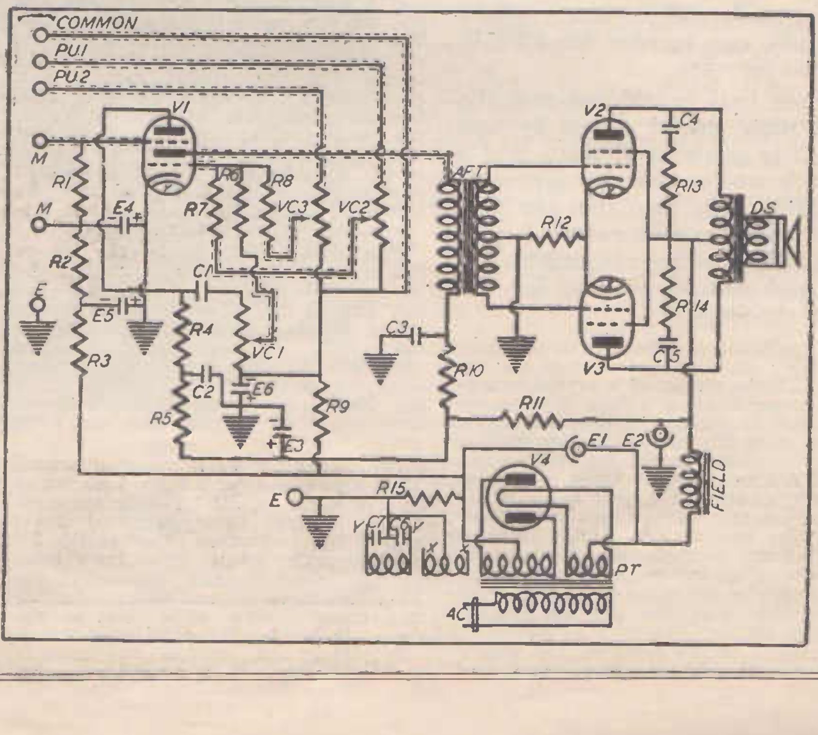
R15—30 ohms wire-wound resistor. 100 m. a.

Speaker—Primary of transformer to match two AL3 valves in push-pull. Field resistance 1300 ohms (Rola).

Valves—One type 79, two AL3, one type 80. (Philips.)

VC1, VC2, VC3—0-500,000 ohm volume controls. (Ferranti, I.R.C.)

Sundries—One 5 pin valve socket for speaker, one 6 pin socket, one 4 pin socket and two Philips "P" type sockets; 7 terminals; one grid clip; one valve shield; one piece aluminium 4¾ ins. long by 2¾ ins.; wiring flex; shielded wire; nuts and bolts; solder lugs and busbar; one piece aluminium 13 ins. by 8½ ins.

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AFT. The other end of R5 and the free end of C2 are linked together, and to this connection is also taken one end of R4, the other end of which connects to the No. 1 plate of V1.

The resistor strip is wired as shown in the illustration, this being a top view. To the points marked "A" and "B" on this strip connect several inches of shielded wire. To "C" and "D" join some of the usual wiring flex. The strip can then be mounted in place with R2 nearest the front chassis wall. Several long bolts with spacers should be used so that the strip will be about half an inch out from the end wall.

Connect the point "B" to the left-hand lug of VC1, the point "A" to the microphone terminal nearest VC1, the point "C" to the HT centre-tap on the power transformer (taking the lead along the bus-bar), and the point "D" to the busbar by the shortest path. A solder-lug should be placed under the nut used to secure the left-hand front corner of the chassis, and the braid on the lead from "B" should be soldered to it. To the remaining M terminal solder a piece of shielded wire, and pass this through a hole in the chassis.

Place the 79 in its socket and put on the valve shield. Place the grid cap on the valve, and cut off the shielded wire so that there will just be sufficient to connect to this clip. When the clip is soldered on and the shield cap placed in position, the shielding on the wire must pass the shielding, but must not touch the grid of the valve or the grid clip.

Resistor R1 is wired across the two microphone terminals. The shielding on the grid lead should be connected to the microphone E terminal.

It will be noticed that no direct earth connection is made to the filament circuit of V1, but condensers C6 and C7 are connected from each side of the 6.3 volt lugs on PT to the chassis. In some cases it may be better to use a direct earth, but we found that any direct earth introduced hum, as did an adjustable centre-tapped filament resistor.

To conclude the wiring of the amplifier connect a power-cord to the appropriate primary lugs on the power transformer.

When the wiring has been checked and found in order, the valves and speaker should be attached and the amplifier switched on. The following voltages will be obtained if everything is in order:

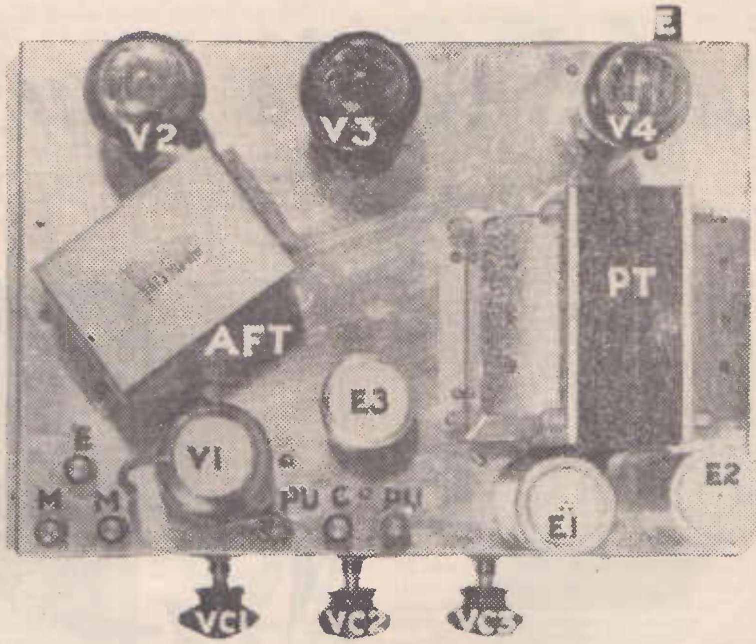
Positive of E1 to chassis, 360 volts.
Positive of E2 to chassis, 260 volts.
No. 1 plate of 79 valve to chassis, 100 volts.
No. 2 plate of 79 valve to chassis, 110 volts.
Cathode of AL3 valves to chassis, 6 volts.
HT centre tap to chassis, 2 volts.
Plate current of either AL3, 36 m.a.
Screen current of either AL3, 4 m.a.

If the amplifier is to be used for public address work it should be placed in a metal container to reduce the possibility of hum being induced into the AF transformer and the grid circuit of the first section of the 79 valve.

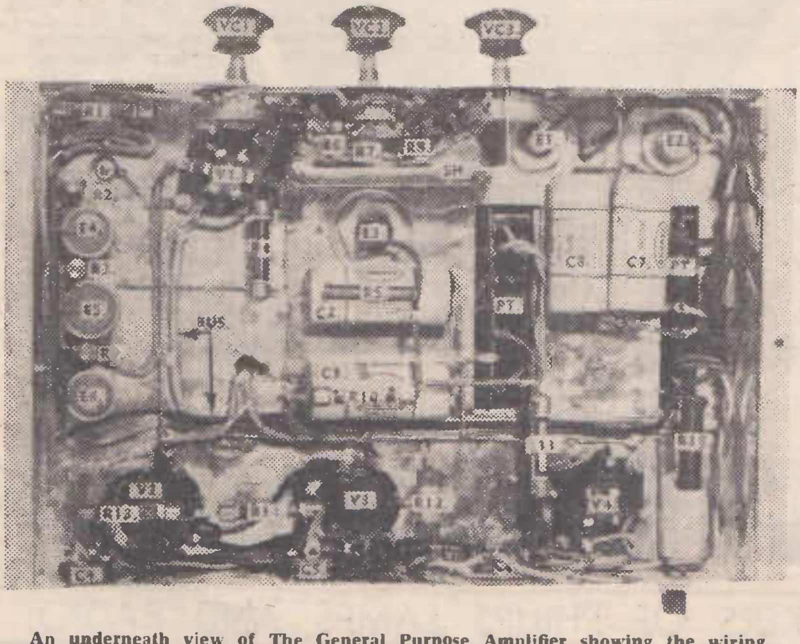
The microphone cable must be shielded and the shield connected to the microphone earth terminal. On no account must the shielding be used as one of the microphone leads. An 0-1 m.a. D.C. milliammeter can be connected between the centre-tap of the audio transformer and chassis. If this meter gives any reading other than zero it is a definite indication that the output valves are being overloaded since grid current is being drawn.

Since two pick-ups can be used simultaneously, the common PU terminal is used for the common connection between them. Irrespective of the type of gramo. motor used it must be earthed either to a separate earth or to the earth terminal on the chassis. The leads from the pick-up must be shielded and the shielding earthed. The pick-up head, if of metal, must also be earthed. Any pieces of metal around the motor, such as speed indicators, must be bonded to the motor frame. On no account can the pick-up lead shielding be used as a pick-up return.

With the microphone and one or two pick-ups in circuit it will be found that the fading system enables any level from any of these signal sources to be used singly or in any combination of the three.



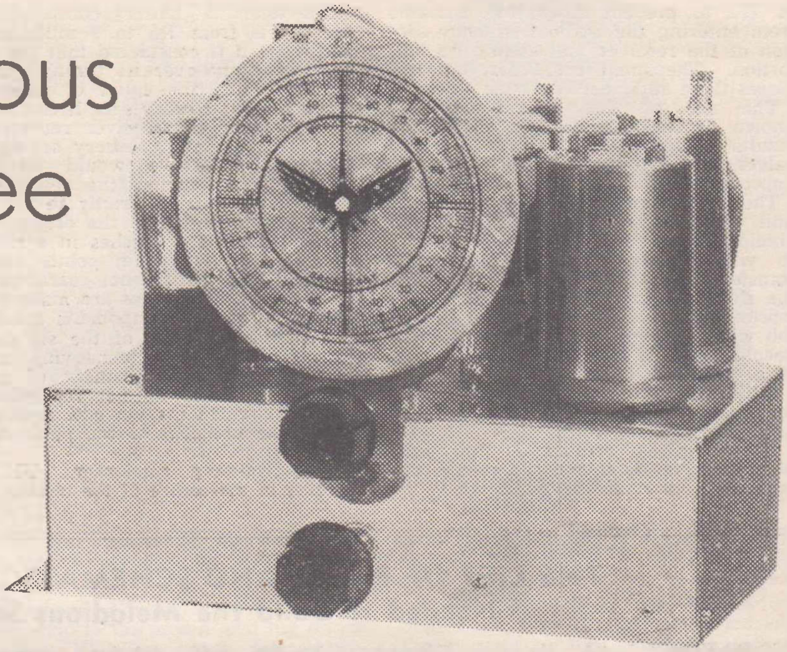
This plan photograph illustrates the layout of parts on top of the chassis. All components are keyed to correspond with the written description of the receiver.



An underneath view of The General Purpose Amplifier showing the wiring and placement of parts below the chassis.

The Melodious Super Three

Compact, efficient in operation, and inexpensive to build, this amazing receiver is capable of results equivalent to those of a five valve receiver.



The front view of the Melodious Super Three. The two controls are for tuning and volume.

IN the Melodious series of battery receivers The Listener In has endeavored to meet the requirements of a large proportion of country listeners. The success of its efforts has been manifested by the number of receivers, several hundreds, which have been built up by experimenters and have given excellent results.

Now we come with something really revolutionary in battery super-hets. — The Melodious Super Three. In this amazing little receiver it has been found possible, for the first time in Australia, to make a three valve super-heterodyne which definitely will provide distant reception and which is neither complex in construction nor expensive in component costs.

The heart of the new receiver, a worthy addition to the fine range of "Melodious" models, is the new Australian 1K6 valve developed specially for local conditions by the Amalgamated Wireless Valve Co.

The application of this valve in a reflexed circuit has made it possible for a three valve superheterodyne receiver embodying all the performance characteristics of much larger sets to be developed.

The new receiver is a midget in size but a giant in performance. Its battery appetite is in keeping with the receiver's size and has been reduced to the extraordinarily low figure of 7½ milliamperes.

Best of all the new receiver incorporates very few component parts, is not difficult to construct, and does not require coaxing to make it work properly.

The Listener In Technical Staff considers the Melodious Super Three to be its most outstanding effort in set design this year.

THIS highly efficient receiver consists of mixer stage, employing the popular 1C6 pentagrid convertor valve operated under special economy no-bias conditions.

Throughout the design of the set every effort has been made to reduce the "B" battery consumption to the absolute minimum. The economy conditions under which the 1C6 is operated assist greatly in this regard.

Under these new conditions the total drain of the mixer stage is 3.5 milliamperes, a very low value.

The mixer stage is followed by a type 1K6 Duo-diode pentode, performing the functions of intermediate frequency amplifier, diode second detector, and first stage audio frequency amplifier.

The manner in which these functions are carried out is most interesting. The I.F. signal is fed to the grid of the pentode section of the 1K6 via the high gain air-core battery type I.F. transformer. This signal is amplified in the usual way, fed to the second high gain I.F transformer, then rectified by the diode section of the valve.

So far the operation of the valve is perfectly straight-forward. We have the audio frequency voltage developed across the diode load resistor, which in this case is the volume control, VC.

On reference to the schematic diagram, it will be noticed that the grid return of the first I.F. transformer is taken through a 1-megohm resistor to the correct bias for the 1K6 grid. The audio voltage developed across VC is fed to the low potential side of this winding through the filter resistor, R5, and the coupling condenser, C4. In this way the audio signal is fed to the grid of the 1K6, and amplified at audio frequency.

Thus we find that across the primary winding of the second I.F. transformer we have the radio frequency voltage developed by the pentode section of the 1K6 as an intermediate frequency amplifier and, in addition, the audio voltage produced by this same section as an audio frequency amplifier.

The next thing is to feed this audio frequency voltage to the grid of the 1D4 output pentode output valve. This is done by connecting the "B" positive return of the I.F. primary to the coupling condenser, C7, which is connected to grid of the 1D4.

Plate voltage is applied to the plate of the 1K6 in the usual way through the resistor, R6.

Running through the operation of this portion of the circuit we find that the R.F. voltage developed across the primary of IF2 induces a similar voltage in the secondary of this transformer, and this R.F. voltage is rectified by the diodes and appears across the volume control, VC, as an audio voltage.

The audio frequency output of the pentode section of the 1K6 appears across the plate feed resistor, R6, and is applied to the grid of the pentode output valve, where it is amplified in the usual way and fed to the loudspeaker.

The radio frequency choke, RFC, is connected between the plate feed resistor, R6, and the "B" positive return of IF2 to prevent stray R.F. currents from entering the audio frequency section of the receiver and setting up distortion. The small condenser, C6, bypasses these stray R.F. currents to earth.

The use of this system, which is known as reflexing, allows five-valve results to be obtained with only three valves, and with consequently greatly improved "B" battery economy.

The aerial tuning coil is an iron-cored unit which allows maximum gain to be obtained from this section of the set. It will be noticed that air-core I.F. transformers are employed in place of the iron-core units of later design. The reason for this is that when this little job was contemplated it was decided to keep the cost of the parts as low as possible.

Still further to reduce the cost of the set small half-watt resistors have been used wherever possible.

The completed receiver is the result of exhaustive tests, and the results obtainable from it are amazing.

The total "B" battery consumption of the set is from 7½ to 8 milliamperes, and when it is considered that the average sensitivity over its tuning range is 50 microvolts, the equal of many five and six valve battery sets, it can readily be seen that the receiver represents a real achievement in battery set design.

At this stage we would stress to would-be constructors the absolute necessity for adhering strictly to the components and layout of the original set.

There are many catches in a receiver of this type if certain points are not watched, and we will not guarantee first class results if changes are made to the layout or to the components specified.

The chassis layout of the set can be seen from the accompanying photographs, but for the benefit of novice constructors who do not recognise the various components we will briefly describe the positions of the parts on the chassis.

The two-gang condenser, G1, G2, mounts in the centre of the chassis, with the aerial and oscillator coils bolted in place to the right of it. The oscillator coil is nearer the front of the chassis, and the aerial coil between it and the mixer valve socket V1, which mounts in the rear right-hand corner of the chassis

The first intermediate frequency transformer, IF1, is mounted directly behind the gang condenser, and the 1K6 socket, V2, bolts in place in the rear left-hand corner of the chassis.

The 1D4 socket, V3, occupies a position in the front left-hand corner of the chassis, and the second intermediate frequency transformer is between this socket and the socket V2.

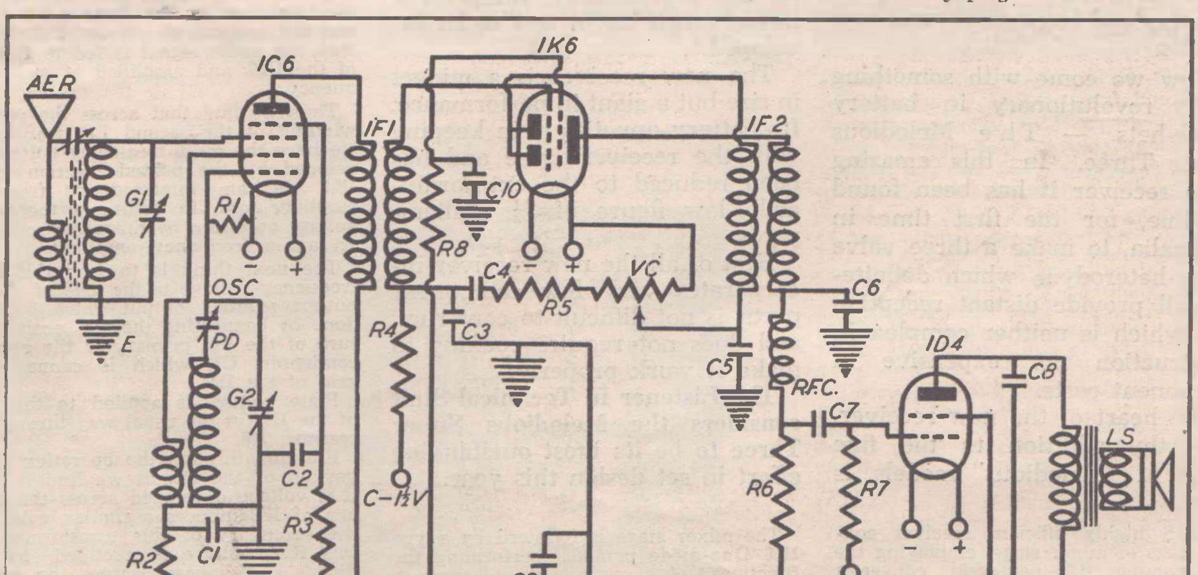
The volume control, VC, is mounted on the front edge of the chassis directly below the gang condenser.

The positions of the aerial and earth terminals, the speaker terminals, and the battery input socket, can be seen from the rear view photographs of the set.

Below the chassis, the only component

THE LIST OF PARTS AND SCHEMATIC CIRCUIT DIAGRAM
Needed to Build the Melodious Super Three

BATTERIES: "A" Battery. (Masse.) 3 45 volt "B" batteries. (Diamond, Ever-Ready.) 9 v. "C" battery.
CHASSIS: Measuring 9 inches by 7½ inches by 2¾ inches.
COIL KIT: Consisting of iron core aerial and oscillator coil with built-in padder condenser. (Airmaster.)
C1, C2, C10: .1 mfd. tubular condensers. (T.C.C.)
C3, C6: .0001 mfd. mica condensers. (T.C.C.)
C4, C7: .02 mfd. tubular condensers. (T.C.C.)
C5: .00025 mfd. mica condensers. (T.C.C.)
C.8: .006 mfd. tubular condenser. (T.C.C.)
C9: .5 mfd. tubular shielded type. (Ducon.)
Dial: Radiokes type D.
G1, G2: Two gang condenser. (Saxon.)
IF1, IF2: Air core battery IF.'s (Airmaster.)
L.S.: Permagnetic speaker to suit 1D4. (Rola.)
R1: 50,000 ohm ½ watt resistor. (I.R.C.)
R2: 50,000 ohm 1 watt resistor. (I.R.C.)
R3: 60,000 ohm 1 watt resistor. (I.R.C.)
R4: 1 megohm ½ watt resistor. (I.R.C.)
R5: 100,000 ohm ½ watt. (I.R.C.)
R6: 100,000 ohm 1 watt resistor. (I.R.C.)
R7, R8: 500,000 ohm ½ watt resistor. (I.R.C.)
RFC: Radio frequency choke. (Radiokes 3-21.)
VC: 500,000 ohm Potentiometer with switch. (Ferranti, I.R.C.)
SOCKETS: 2 6-pin, 2 5-pin, 1 4-pin.
SUNDRIES: Hook-up wire, nuts, bolts, one valve shield, grid clips, shielded wire, knobs and terminals, and battery plug.



which bolts directly to the chassis is the radio frequency choke RFC. This component occupies a position between the sockets for V2 and V3.

A small insulating strip with a solder lug attached should be bolted in position near the socket for V1. This lug, which connects to "B" positive maximum, is used to support the resistors R2 and R3. A similar insulating strip bolts in place near the volume control VC, and the lug on this strip supports the coupling condenser, C4.

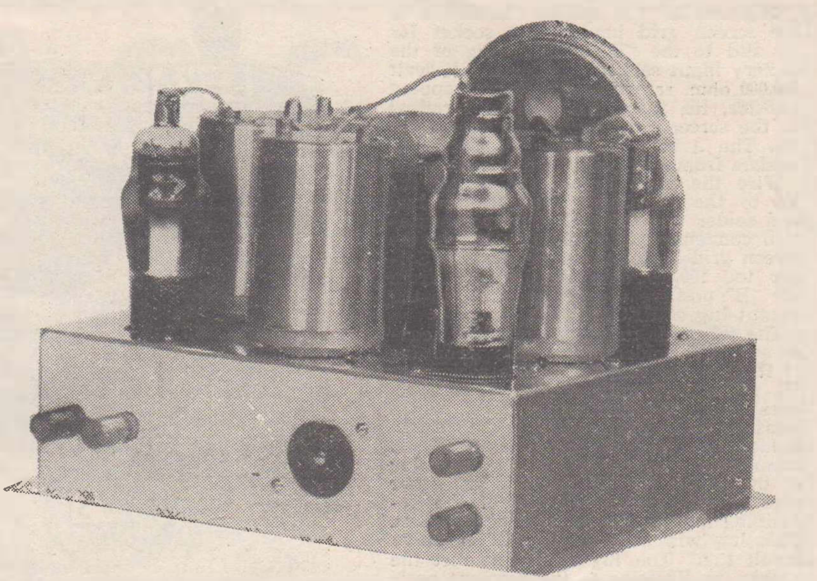
When the assembly of the parts has been completed, the wiring may be commenced. Wire in place the earth bus-bars, to which all earth connections are soldered. These bus-bars are of tinned copper wire soldered to lugs conveniently placed under the holding bolts of sockets, coils, I.F. transformers and the gang condenser.

These earth bus-bars should then be joined to the earth terminal with tinned wire.

Solder the negative filament lugs of the sockets for V1, V2 and V3 to the earth wire. Join the positive filament lugs of these sockets together, and connect them to one contact of the filament switch, SW. The remaining contact of SW connects to one of the filament lugs of the battery input socket. This lug becomes the "A" battery positive lug. Solder the Black lead of the oscillator coil to the earth wire. Connect the Red and Yellow leads of this coil to the oscillator plate, and oscillator grid lugs respectively of the socket for V1.

Join the insulated lug on the strip mounted near the socket for V1 to one of the remaining lugs on the battery input socket. This lug will become the "B" positive lug of this socket.

Solder the 60,000 ohm screen grid dropping resistor, R3, in place from the lug on the strip to the screen grid lug on the socket for V1. The .1 mfd. bypass condenser, C2, solders from this point to the earth wire. Solder one lead of the one watt 50,000 ohm oscillator plate resistor, R2, to the "B" positive lug on the insulating strip, and connect the .1 mfd. bypass condenser, C1, from the remaining lead of R2 to earth. The White lead of the oscillator coil solders to the junction of R2 and C1.



This rear view of the receiver illustrates the mounting positions of the aerial and earth terminals, the battery input socket, and the loud-speaker terminals.

Solder the .5 mfd. R.F. bypass condenser, C9, from the "B" positive lug on the insulating strip to earth. Solder the Black and the White leads from the aerial coil to the earth wire, and connect the Braided aerial lead of this coil to the aerial terminal.

Remove the cans from the aerial and oscillator coils. Solder a lead to the lug on the oscillator coil, to which the Yellow lead connects. Take this new lead out through a hole drilled in the oscillator coil can.

This lead solders to the fixed plate lug of the G2 section of the gang condenser.

Bring out through the holes in the top of the aerial coil can the two Yellow leads of this coil. One of these will connect to the fixed plate lug of the G1 section of the gang condenser. The other terminates in the grid clip for the 1C6.

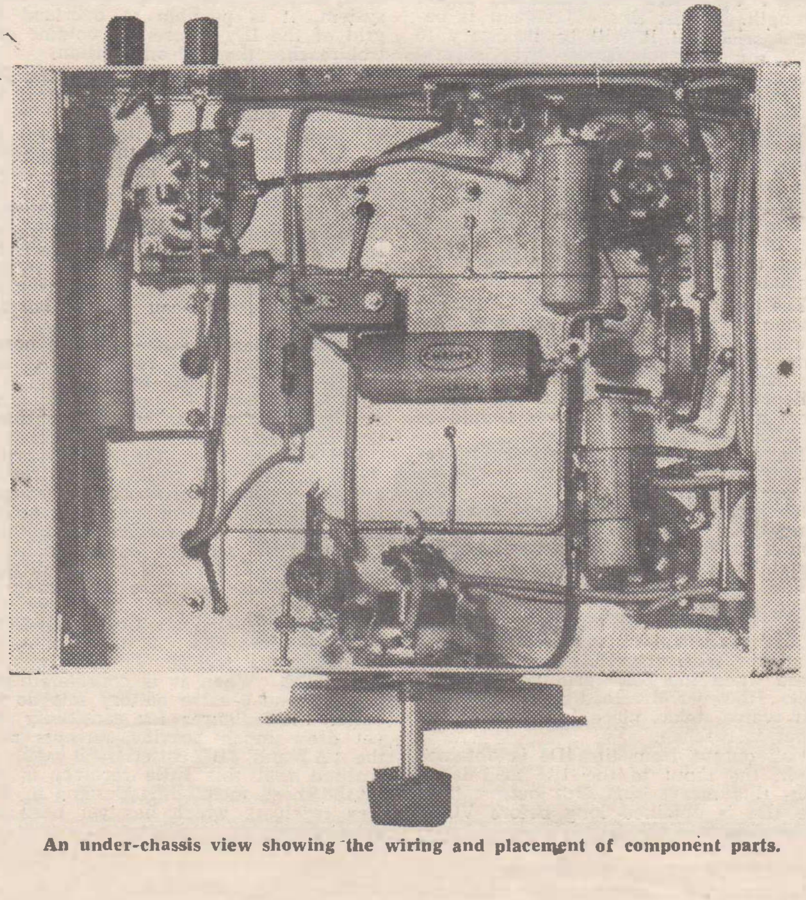
The Blue lead of IF1 solders to the plate lug of the socket for V1, whilst the White lead of IF1 joins to the "B" positive lug on the battery input socket.

Remove the can from IF1 and unsolder the black lead of this unit from its contact. Replace this Black lead with one of shielded wire long enough to reach across to the volume control, VC. Solder one lead of the ½ watt 1 megohm resistor, R4, to the lug from which the Black lead was removed. To the remaining side of this resistor solder a lead which connects to one of the remaining lugs on the battery input socket. This lug will become the "C" negative 1.5 volt lug. The .0001 mfd. by-pass condenser, C3, also solders to earth from the lug of IF1 to which the Black lead was attached.

The can may now be replaced on IF1.

Join together the diode plate lugs of the socket for V2 and to them solder the Yellow lead of IF2. The Blue lead of IF2 joins to the plate lug of the socket for V2, whilst the White lead from the same component joins to one side of the Radio frequency choke, RFC.

Remove the can from IF2 and replace the Black lead on this component with one of braided wire sufficiently long to join to the centre contact of VC. The outside metal braid of all braided wire leads must be securely soldered to earth.



An under-chassis view showing the wiring and placement of component parts.

Join one of the speaker terminals to the screen grid lug on the socket for V3 and to the "B" positive lug of the battery input socket. Solder the ½ watt 500,000 ohm. screen grid voltage dropping resistor, R8, from this speaker terminal to the screen grid lug of the socket for V2. The .1 mfd. bypass condenser, C10, solders from this point to the earth wire.

Wire the plate lug of the socket for V3 to the remaining speaker terminal and solder the .006 mfd. tone compensation condenser, C8, from this lug to the screen grid lug of the same socket. Solder the 100,000 ohm resistor, R6, from the "B" positive speaker terminal to the vacant lug of RFC.

The .02 mfd. tubular coupling condenser, C7, solders from this same lug of RFC to the grid lug of the socket for V3. The .0001 mfd. condenser, C6, solders from the contact of RFC which joins to the white lead of IF2, to earth. Solder one lead of the ½ watt 500,000 ohmr grid resistor, R7, to the grid lug of the socket for V3 and join the other side of this resistor to one of the remaining lugs on the battery input socket. This lug will become the "C" negative 6-volt lug. The lug of VC nearest the socket for V3 joins to the filament positive lug of the socket for V2.

The ½ watt 100,000 ohm filter resistor, R5, solders between the other outside lug of the volume control, VC, and the insulated lug mounted near VC on the front edge of the chassis. One lead of the .02 mfd. coupling condenser, C4, also solders to this lug, while the remaining lead of C4 joins to the braided lead from IF1. Solder one lug of the .00025 mfd. by-pass condenser, C5, to earth and join the remaining contact of this condenser to the arm or centre lug of VC.

The remaining lug of the battery input socket joins to earth. The Yellow lead coming out through the can housing, IF1, terminates in the grid clip for the 1K6.

This completes the wiring of the receiver, and all connections should be thoroughly checked before any attempt is made to connect the batteries.

The wiring having been found correct, the battery cable should be connected to the five-pin plug which plugs in to the battery input socket, and the battery leads tagged to agree with the written description.

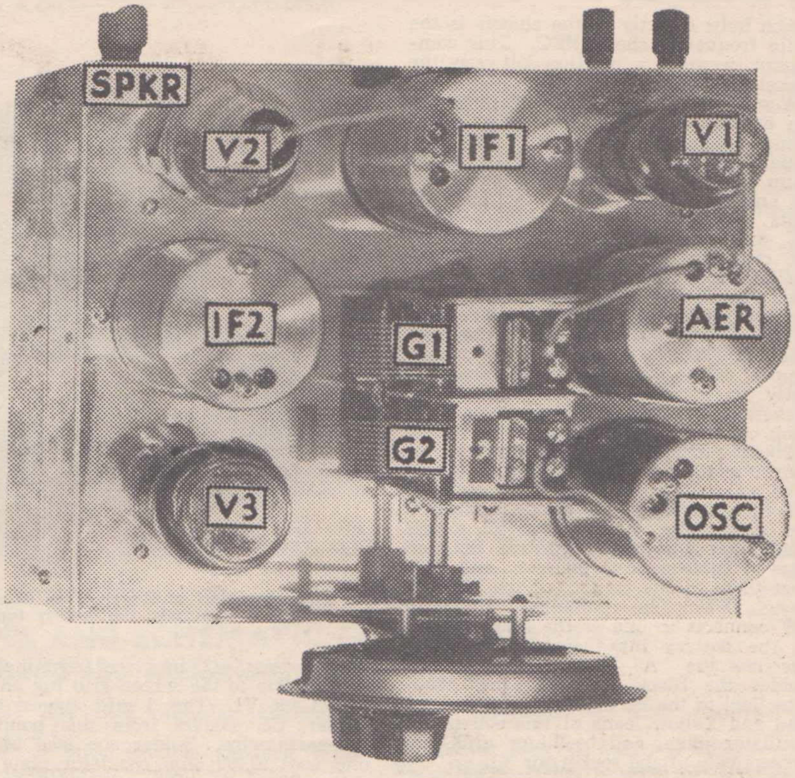
This done, the valves may be placed in their correct sockets, the aerial, earth and speaker leads attached, and the batteries connected. Before proceeding further, adjust the trimmer on the G2 section of the gang condenser to minimum capacity, i.e., with the plate full open, and do likewise with the trimmer on the G1 section of the gang condenser.

A hole should be drilled in the top of the can housing the aerial coil to correspond with the trimmer adjustment screw inside the aerial coil. Everything is now ready for the alignment of the set, but, before we proceed with the instructions for same, we would advise constructors to have their receiver aligned by an expert with the aid of a signal generator and output meter.

It is impossible to obtain maximum results from this or any other superheterodyne type of receiver if the alignment of the tuned circuits is carried out by ear.

Having given this warning, we can proceed with the alignment of the set. Switch the set on and tune in a station on the higher frequency end of the dial, i.e., with the condenser plates near the full-out position.

Now, with an insulated screwdriver, adjust the trimmer on top of the aerial coil for maximum signal strength.



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

This done, tune a station towards the other end of the scale and adjust the padder condenser for maximum signal strength. Whilst this adjustment is being carried out it will be necessary to rock the gang condenser over several degrees as the adjustment of the padder condenser affects the tuning of the receiver.

With this adjustment completed return once more to the initial station and try a slight readjustment of the trimmer on the aerial coil. The set should now be in a fairly sensitive condition, but in almost every case the sensitivity can be still further improved by adjustment to the trimmers of the two intermediate frequency transformers.

The procedure is as follows: — Tune a station in the centre of the band and, starting with the trimmer on the secondary of IF2, adjust the trimmers of IF2 for maximum results.

Repeat this procedure with the trimmers of IF1 and the receiver should be in its most sensitive condition.

There are one or two catches in reflexing the 1K6, which it may be as well to mention at this stage.

It is well known that there is a tendency on the part of the amplifier section of the reflexed valve to rectify under certain operating conditions.

The amplifier section of the reflexed valve will begin to rectify if the peak grid voltage becomes too great, resulting in distortion and in some cases motorboating. With the 1K6 overload takes place when the peak grid voltage is .5 volt. However, overload of the 1D4 output valve takes place long before this input is reached.

Full output from the 1D4 is obtained when the input to the 1K6 grid is .04 volt; this means that full output from the 1D4 is obtained long before VC is at maximum.

Speaking in non-technical language, it will be found that, when tuned to a fairly strong signal on an average aerial system, it is possible to overload the grid of the 1D4 before the volume control reaches the full-on position.

This is caused by the fact that full output is obtained from the 1D4 before the maximum audio signal voltage is fed to the grid of the 1K6. With judicious use of the volume control this overloading can be prevented and exceptional results obtained from the receiver.

This is the only point on which it is possible to fault the set. When the receiver's amazing sensitivity, selectivity, low initial cost, and, above all, its exceptionally low upkeep, are considered, this little point can easily be disregarded.

The batteries necessary for the operation of the set are a two-volt "A" battery, 135 volts of "B" battery, and a 6-volt "C" battery. Its operating economy can be seen from the current consumption of the "A" and "B" batteries.

The drainage from the "A" battery is .48 of an ampere, while the extremely low "B" battery consumption of 7.5 milliamperes to 8 milliamperes is a particular feature of the receiver. The sensitivity of the receiver leaves nothing to be desired. The figures on the original model may interest those technically inclined.

At 1500 k.c. the sensitivity was found to be 50 microvolts. At 1000 k.c. it was 60 microvolts and at 600 k.c. was 70 microvolts. When it is considered that many 5 and 6-valve battery sets do not better these figures for sensitivity and yet draw much heavier currents from the "A" and "B" batteries it will be realised that this little receiver is one of the most outstanding designs in battery receivers which has yet been developed.

THE FIDELITY I.F. SUPER 5

Combining remarkable sensitivity with purity of tone, this modern superheterodyne receiver gives amazing results, Inverse feed-back has been used in the audio frequency side of this set.

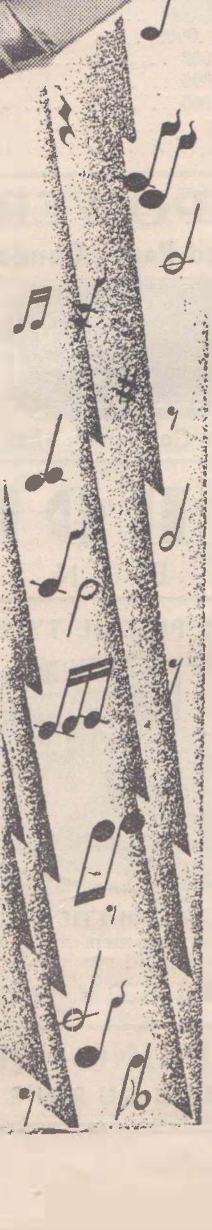
WITH the steady improvement in the frequency responses of the various local broadcasters and the increasing tendency to employ recordings which cover a wide frequency range, the question of high fidelity receivers has become more and more important.

Today we may say with truth that the high fidelity receiver has moved out of the laboratory and has become a necessity to the average listener whose musical ear will not be satisfied with the reproduction obtainable from ordinary receivers.

In the past we have dealt with a number of high fidelity receivers. Most of these, however, have suffered from the drawback that a large number of valves was required. This, and the fact that the associate components were expensive, placed the construction of high fidelity sets beyond the reach of the average experimenter.

It is generally accepted that the frequency range of a high fidelity receiver should lie between 30 and 7500 cycles.

The construction of a high fidelity receiver is not altogether easy if costs are to be kept low. However, with the development of Inverse Feedback, it has become possible to design a low cost audio amplifier capable of handling large power outputs with a minimum of distortion. The radio frequency side of the high fidelity receiver still requires considerable adjustment if a perfectly flat response is to be obtained, but this subject will be dealt with more fully at a later date.



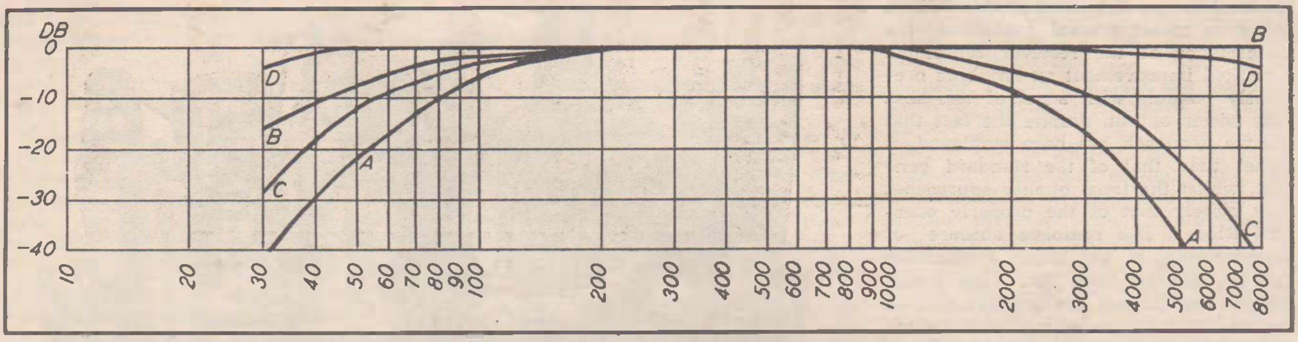
At the moment, through the cooperation of the A. W. Valve Co., we are able to present a five valve circuit which is capable of extraordinarily fine results.

IF the circuit of this interesting receiver is studied, it will be seen that a 6A7 is used as a conventional mixer tube, while a 6B7's diode-pentode is employed as combined i.f. amplifier and diode detector. A 6C6 pentode driver audio tube is resistance-coupled to a type 42 pentode, which is operated under Inverse Feedback conditions to limit harmonic distortion. The rectifier is a conventional type 80.

The receiver has been designed along severely practical lines, and, although particularly suited to the home constructor's needs, is really a commercial design, in which all but the essentials have been eliminated. It has been engineered from start to finish with the object of eliminating distortion. The combination of separate diode detection—in so far as the audio system is concerned—and the employment of the 6C6—Inverse Feedback 42 combination is responsible for an exceptionally fine response from the audio amplifier.

Measured at the primary of the output transformer, a frequency check showed that the amplifier was flat within 2 decibels from 100 to 8000 cycles. A fall-off was found to exist between 100 and 30 cycles, the response being 16 Db. down at the latter frequency. These figures, particularly those dealing with the low frequency side of the amplifier's response, can be bettered if the output is fed into a resistive load and measured across it.

Particular attention has been given in the design of the r.f. portion of the receiver to the diode load resistor, and to the automatic



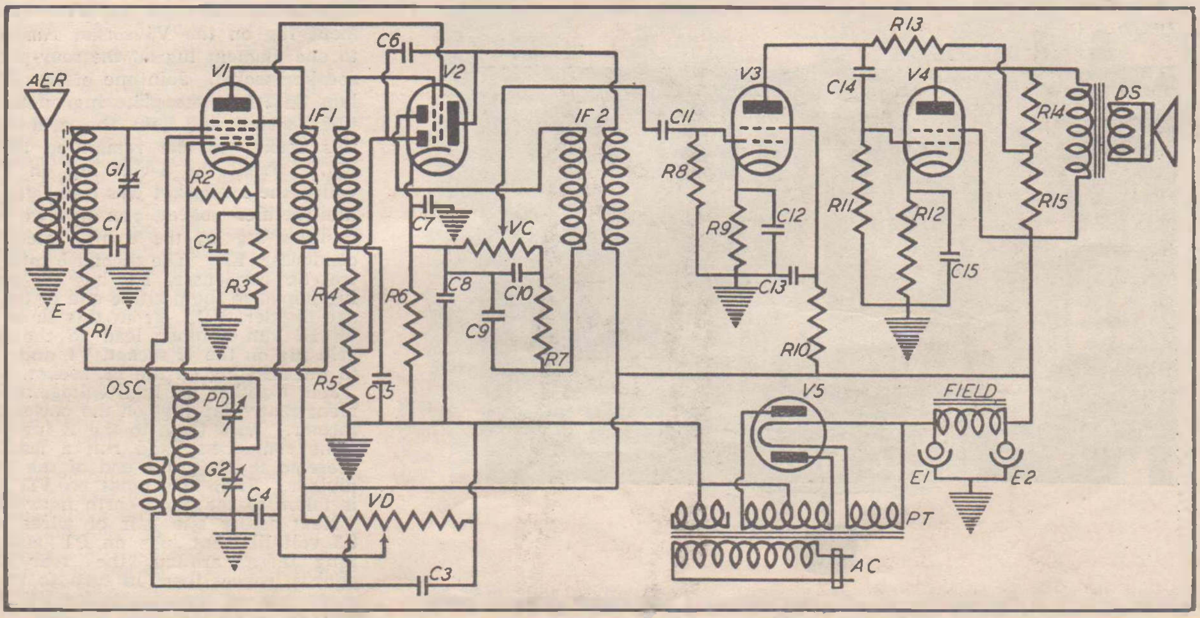
SOME ILLUMINATING MEASUREMENTS.—These curves of theperformance of the Fidelity I.F. Super 5 show how the overall performance is affected by the design of the i.f. amplifier. Curve B shows the amplifier response and curve A the overall response when measured at the primary of the speaker transformer. Curve C (overall) and curve D (amplifier) result when the output is fed to a purely resistive load.

volume control system. The diode load has been so subdivided that the diode is operating upon a desirable point of its characteristic in order that distortion shall not be present at low signal outputs. The delayed automatic volume control system also has been proportioned to reduce distortion to a minimum.

The result is that the overall fidelity of the receiver is governed chiefly by the frequency band which the i.f. amplifier will pass. If this amplifier is of the high selectivity type such as is normally used it will be found that the higher frequencies will be attenuated considerably. Over-coupled i.f. units, which produce a wide band-pass in the

THE LIST OF PARTS AND SCHEMATIC CIRCUIT DIAGRAM NEEDED TO BUILD THE FIDELITY I.F. SUPER FIVE

AER, OSC: Aerial and 465 k.c. Oscillator coils. Iron-Cored (Airmaster).
CHASSIS: Aluminium, measuring 13½ inches by 8 inches by 2¾ inches.
C1, C5: .05 mfd. Tubular Condensers (T.C.C.).
C2, C3, C7, C13: .1 mfd. Tubular Condensers (T.C.C.).
C4: .5 mfd. Tubular Condensers (T.C.C.).
C4: .5 mfd. Tubular Condensers (T.C.C.).
C6, C9, C10: .0001 mfd. Mica Condensers (T.C.C.).
C8, C12, C15: 25 mfd. 25 volt Electrolytic Condensers (T.C.C.).
C11, C14: .02 mfd. Mica Condensers (T.C.C.).
DS: 2000 dhm field type Dynamic Speaker, matched to 7000 ohm load (Rola).
E1, E2: 8 mfd. 500 volt Electrolytic Condensers (T.C.C.).
G1, G2: Two Gang Condenser, to suit coil kit.
IF1, IF2: High Gain Air-cored i.f. Transformers, 465 k.c. (Airmaster).
PD: Pudding Condenser built into OSC coil.
PT: Power Transformer:—385-0-385 v. at 60 m.a., 6.3 v. at 2 a., and 5v. at 2 a.
R1, R7, R14: .1 megohm 1 watt Resistors (I.R.C.).
R2: 50,000 ohm ½ watt Resistor (I.R.C.).
R3: 300 ohm 25 m.a. w.w. resistor (I.R.C.).
R4, R5, R8, R11: 1 Megohm ½ watt resistors (I.R.C.).
R6: 250 ohm 25 m.a. w.w. resistor.
R9: 2000 ohm 25 m.a. w.w. resistor.
R10: 1.5 megohm 1 watt resistor (I.R.C.).
R12: 400 ohm 100 m.a. w.w. resistor
R13: 250,000 ohm 1 watt resistor (I.R.C.).
R15: 11,000 ohm 1 watt resistor (I.R.C.).
VALVES: One each types 6A7, 6B7's, 6C6, 42, and 80, with sockets to suit. Shields also required for 6A7, 6B7s, and 6C6 (I.R.C.).
VC: 500,000 ohm potentiometer (Ken-Rad, Philips, Radiotron, Raytheon).
SUNDRIES: One 4 pin speaker socket, dial, wire, hook-up, and braided wire, machine screws and nuts, two terminals, three grid clips, and two knobs.



i.f. amplifier, will overcome this failing, but even under normal conditions the performance of the receiver represents a marked improvement on anything previously possible with a set of this size.

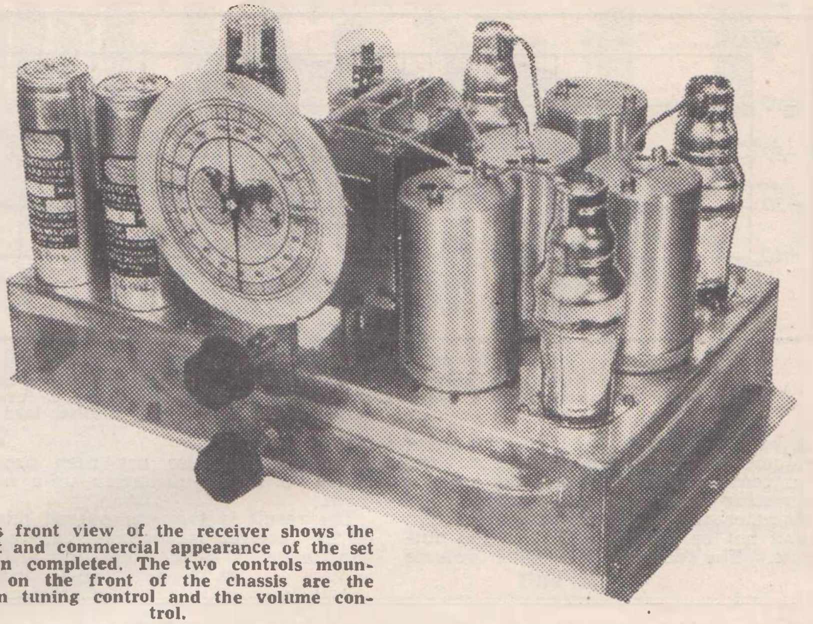
Its power output, despite the fact that Inverse Feedback has been employed, is higher than that of the standard pentode, whilst the tonal quality approaches very closely that of the properly operated triode. The complete absence of over-emphasis of the higher frequencies and the freedom from that "raggedness" which characterises the reproduction of the ordinary pentode makes the receiver an eye-opener to those who previously believed nothing good could come from pentodes.

The employment of the high-gain 6C6 pentode audio amplifier has maintained the power sensitivity of the complete audio system practically at the same level as that existing when a diode-triode or diode-pentode is fed directly to a normally connected output pentode.

The result is that the set's r.f. sensitivity is extremely high providing that good coils and i.f. transformers are used. In the original model little difficulty was encountered in obtaining a sensitivity ranging from 5 microvolts at 1500 k.c. to 15 microvolts at 550 k.c.

Thus, in addition to being a high quality performer on local stations, the receiver is a real Interstate getter. The original design incorporated a magic eye tuning device, but with a view to economy this was eliminated in the present version. However, its use is desirable if the receiver is to be fitted with variable selectivity i.f. units because in the broad setting of these units it will be difficult to hit the centre of the carrier when tuning by ear.

The key-lettered plan photograph of the completed receiver shows clearly the layout of the components on top of the chassis. Note that the arrangement is compact and provides for short wiring leads. This is desirable if reasonably efficient i.f. units are to be used, for it is probable that i.f. instability will be present if long leads are used. Braiding of the r.f. carrying leads will damp the tuned circuits, and thus reduce the gain. On the other hand, the presence of regeneration in the i.f. system will sharpen the tuning and still further reduce the high frequency response in addition to introducing distortion. The moral is to stick to the present layout, and to keep r.f.-carrying leads as short as possible.



This front view of the receiver shows the neat and commercial appearance of the set when completed. The two controls mounted on the front of the chassis are the main tuning control and the volume control.

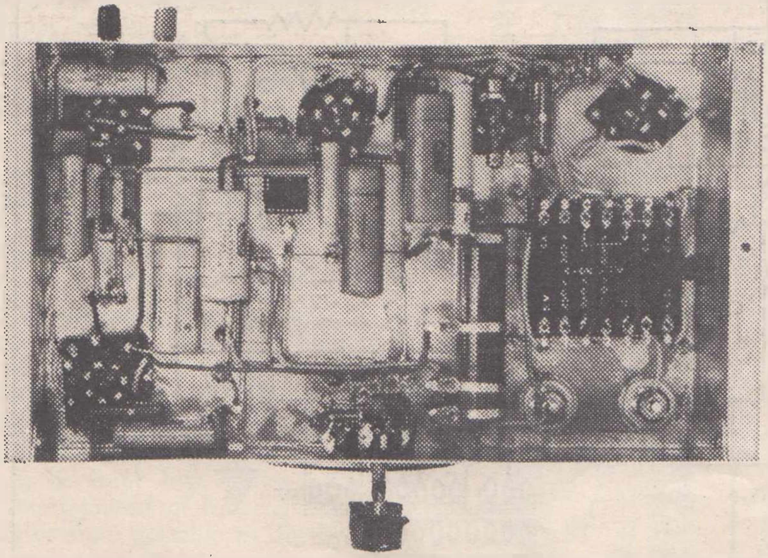
The actual constructional details of the receiver will now be covered. The original set was built up on an aluminium chassis measuring 13½ inches in length, 8 inches in width, and 2½ inches in depth. The layout of the components mounted on the top of the chassis can be clearly seen from the key-lettered view of the finished set. Underneath the chassis only the voltage divider, VD, and the two mica coupling condensers, S11 and C14, have been directly mounted.

All other components are wired into circuit by means of their connecting leads. C14 is mounted to the floor of the chassis by means of a bolt passed through the latter at a point midway between the sockets for V3 and V4. One of the socket holding bolts for V3 serves as the support for C11 and for a small bakelite strip carrying a single solder lug. Both C11 and C14 are kept clear of the chassis by means of spacing washers.

Start the wiring of the receiver by running a pair of leads from the five volt filament lugs on PT to the filament lugs on the socket for V5. From one filament lug on the V5 socket run a lead to one filament lug on the four-pin loud speaker socket. Join one of the 385 volt lugs on PT to the plate lug on the rectifier socket and join the grid lug on this socket to the remaining 385 volt lug. From the 5-volt lug on PT, to which the l.s. socket was connected from the rectifier socket, run a lead to the positive lug on the 8 mfd. electrolytic condenser, E1. The second 8 mfd. electrolytic condenser, E2, has its positive lug joined to the positive end of the voltage divider, VD. From this same point on E2 run another lead to the screen grid lug on the 42 socket, V4, and thence to the grid lug on the l.s. socket.

Join together the high voltage and filament centre-tap lugs on the power transformer. Wire them to the E lug on the same component, and run a lead from there to the negative end of the voltage divider. From this point on VD a lead is taken to the main earth network.

Next solder one pair of wires to the 6.3 volt filament lugs on PT, and, running these around the rear of the chassis, conect them in turn to the filament lugs on the sockets for V4, V3, V2 and V1. To the same 6.3 volt lugs on



Another picture of the receiver showing the placement and wiring of parts below the chassis.

PT wire another pair of leads and take them around by E1 and E2, and up through a hole in the chassis to solder to the dial lights. Solder the plate lug on the socket for V4 to the plate lug on the l.s. socket.

To the plate lug on V4 solder one lead of the .1 megohm resistor, R14, and to the screen grid lug on the same socket solder one lead of the 11,000 ohm resistor, R15. Join the remaining leads of these two resistors to one lead of the .25 megohm resistor, R13. The other lead on R13 solders to one lug of the .02 mfd. condenser, C14, which also carries a lead joining to the pentode plate lug on the socket for V3. The remaining lug on C14 joins to the control grid lug on the socket for V4, and carries one lead of the 1 megohm resistor, R11. The other lead on R11 is wired to the earth network. To the cathode lug on the socket for V4 solder the positive lug of the 25 mfd. electrolytic condenser, C15, and one lead of the 400 ohm. bias resistor, R12. The remaining leads on these two components are soldered to the negative lug on VD.

Join together the grid lug and the vacant filament lug on the l.s. socket and from this point run a lead which terminates in the anchor strip mounted on the bolt which secures C11 to the chassis. This is the main "B" plus anchor point. Solder one lead of the 1.5 megohm resistor, R10, and one lead of the .1 mfd. condenser. C13, to the screening grid lug on the socket for V3. The remaining lead on C13 joins to the earth network, whilst the remaining lead on R10 terminates at the "B" anchor strip lug. To this same anchor strip lug solder the plate lead from IF2 and the plate lead from IF1.

Although not shown in the diagram, a desirable refinement is the connection of a .5 mfd. condenser across the main "B" supply line. If this component is included it may be connected between the main "B" plus anchor lug and earth. One lug of the .02 mfd. condenser, C11, should be joined to the grid clip for V3 by means of a braided lead which passes up through the chassis. A similar braided lead joins the other lug on C11 to centre lug on the volume control potentiometer, VC. Both these braided leads must be earthed to the main earth network.

Join together the cathode and suppressor grid lug on the socket for V3, and to them solder one lead of the 2000 ohm bias resistor, R9, and the positive lead of the 25 mfd. electrolytic condenser, C12. The remaining leads on these two components join to the main earth network. To the lug on C11 which is carrying the grid lead for V3 solder one lead of the 1 megohm resistor, R8. The other lead on R8 joins to the earth network. Join together one lug of each of the .0001 mfd. condensers, C9 and C10. Solder the remaining lug of C10 to one outside lug of VC, and join the remaining outside lug of VC to the common point of C9 and C10.

To the VC side of C10 solder one lead of the .1 megohm resistor, R7, and join the other lead of this resistor to the remaining lug on C9. From this same point on C9 run a braided lead across the chassis to go up into IF2, where it joins to the earth end of the secondary winding. Another braided lead is run from the junction point of C9 and C10 to the cathode lug on the socket for V2.

To this same lug on V2 solder the positive lead of the 25 mfd. electrolytic condenser, C8, one lead of the .1 mfd. condenser, C7, and one lead of the 250 ohm. resistor, R6. The remaining leads on all three components are wired to the earth network. The remaining secondary lead on IF2 is joined to the rectifier diode plate lug on the socket for V2.

Remove the can from IF2 and solder one lug of the .0001 mfd. condenser, C6, to the plate lug on IF2. To the other lug on C6 solder a lead which comes down through the bottom of the transformer can to terminate at the a.v.c. diode plate lug on the socket for V2. Replace the can on IF2.

Join the plate lead from IF2 to the pentode plate lug on V2 socket. To the A.V.C. diode plate lug on the socket for V2 solder one lead of each of the 1 megohm resistors, R4 and R5. The remaining lead of R5 joins to the earth network.

Remove the can from IF1 and to the earth lug of the secondary winding solder one lead of the .05 mfd. condenser, C5. The other lead on this condenser is soldered to the metal supporting bracket for the IF coils. To the junction of the IF1 secondary and C5 solder a piece of braided wire bringing it down through the bottom of the coil can to terminate at the vacant lead of the 1 megohm resistor, R4. Replace the can on IF1. The grid lead from IF1 should be provided with a clip to terminate at the control grid of V2.

Remove the can from the AER coil and to the earth end of the secondary solder one lead of the .05 mfd. condenser, C1, and one lead of the .1 megohm resistor, R1. Earth the remaining lead on C1 to the coil mounting bracket. To the other end of R1 solder a piece of braided wire which is passed down through the coil can to terminate at the end of R4 to which the lead from IF1 already has been soldered. Replace the can on the AER coil.

Join the plate lead from IF1 to the pentode plate lug on the socket for V1. The screening grid lug on the socket for V1 is joined to the screening grid lug on the socket for V2. To the screen grid lug on V1 also attach one lead of the .5 mfd. condenser, C4, and a lead which terminates at the 100 volt tap on the voltage divider, VD. Earth the remaining lead on C4. Join the plate lead from the oscillator coil, OSC, to the oscillator plate lug on V1. The oscillator "B" ÷ lead is taken to 200 volt tap on VD and to one lead of the .1 mfd. condenser, C3. The other lead on C3 joins to the earth network. Join the grid lead from the under side of the oscillator coil to the oscillator grid of V1, to which also must be soldered one lead of the 50,000 ohm resistor, R2. Solder the remaining lead on R2, and one lead each of the 300 ohm resistor, R3, and the .1 mfd. condenser, C2, to the cathode lug on the socket for V1. Earth the remaining leads on R3 and C2. Join the aerial terminal to the aerial lug on AER with metal braided wire and earth the earth lead from the AER coil.

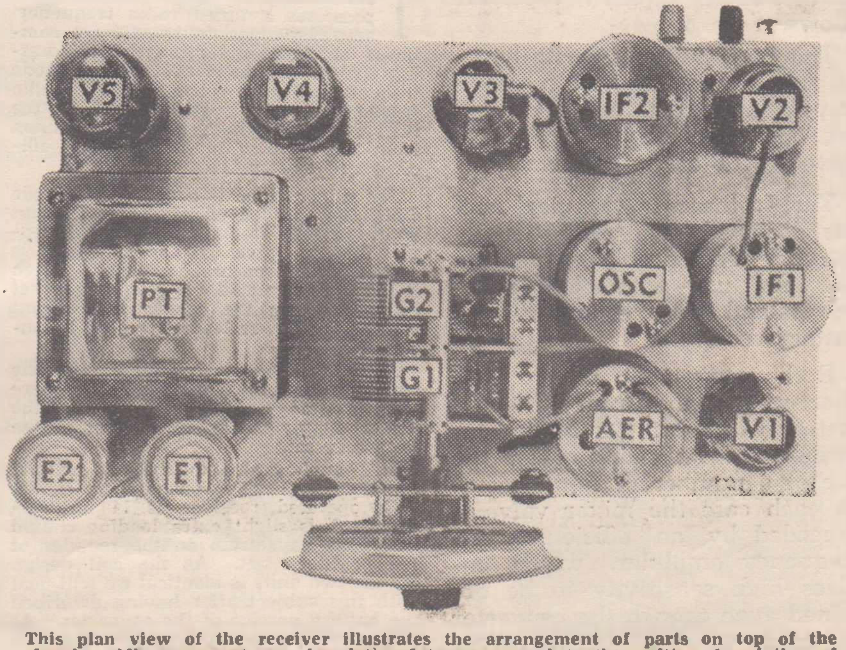
Solder one of the Yellow leads from AER to the fixed plate lug on the G1 section of the gang condenser and fit the other Yellow lead from the AER coil with a grid clip which terminates at the control grid of V1. The Yellow lead from the top of the OSC coil is soldered to the fixed plate lug of the G2 section of the gang.

All that is necessary to complete the wiring of the receiver is to attach the a.c. power leads to the correct lugs on PT.

When this has been done check over the wiring to make sure no mistakes have been made, plug in the valves and loud speaker, attach the aerial and earth, and connect the set to the power mains.

Alignment is carried out in a normal manner using the system so often described. If the set has been built to specification and has been carefully aligned it will be found to give outstanding results.

We believe that the Fidelity I.F. Super 5 will go a long way towards solving the problems of those who are looking for a high fidelity receiver which presents no constructional difficulties and which can be built at a reasonable cost.



This plan view of the receiver illustrates the arrangement of parts on top of the chassis. All components are key-lettered to correspond to the written description of the receiver.

THE GLOBE GIRDLER TWO

This extremely sensitive short-wave converter is capable of tuning from 16 to 50 metres. Both the A.C. and Battery versions of this specially designed converter are fully described in the following article.

THE large number of dual and all-wave receivers which radio dealers have disposed of during the past two or three years proves beyond all doubt the popularity of this type of receiver with the majority of radio listeners.

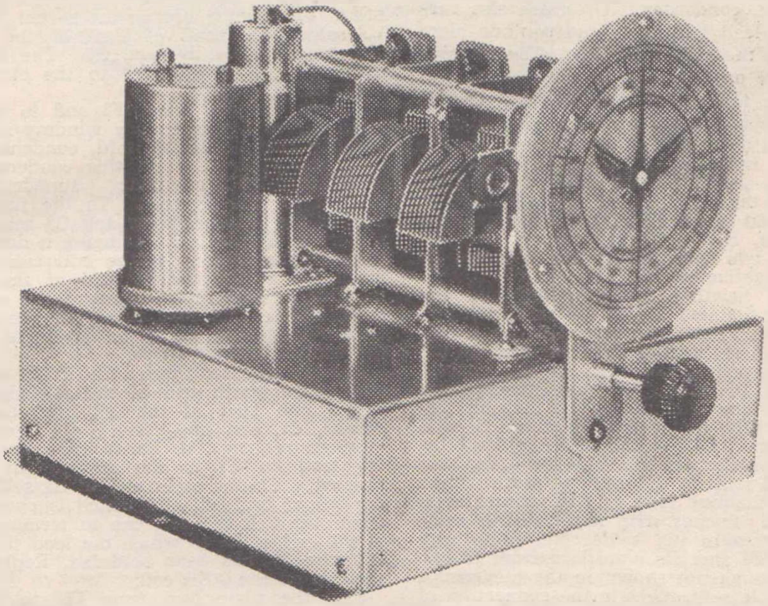
In fact, it may be said that the development of the dual-wave and all-wave receiver has done more to sustain the interest of the radio public than any other receiver design feature in recent years.

A large number of listeners possess broadcast receivers of more ancient vintage than these dual and all-wave sets and are debarred from the reception of overseas stations, which the use of the more modern receivers allows.

This need not necessarily be so, as, by the addition of a short-wave converter to the broadcast set, these stations may be received with ease.

The Listener In technical staff has designed two exceptionally sensitive and simple converters, one for use with electric receivers and the other for use with battery receivers.

Both converters cover the short-wave band from 16 to 50 metres without the necessity for complicated switching or for the use of a number of tuning coils. In each case the mixer valve is preceded by an efficient radio frequency amplifier, which enables high sensitivity to be obtained even though the converter is used with a comparatively insensitive set.



The front view of the completed short-wave converter. The special high gain intermediate frequency transformer is seen mounted at the rear left-hand corner of the chassis.

THE electric version of the converter possesses a tuned radio frequency amplifier stage followed by a combined oscillator-mixer stage incorporating one of the latest continental octode frequency changer valves. An EF5 radio frequency pentode is employed in the R.F. stage and high gain is obtained from this stage with the aid of an efficient coil system.

The mixer valve is a type EK2 octode which has proved exceptionally efficient on the higher frequencies. Power supply for the valves in the converter is obtained from the broadcast set to which it is to be connected. A plug and socket is provided on the chassis of the unit to take the power leads from the broadcast set.

As the total heater consumption of the converter is only .4 of an ampere, there need be no hesitation in taking the heater supply voltage from that of the broadcast set.

This applies also to the "B" supply for the unit. The consumption of the A.C. operated receiver is 14 milliamperes. This slight extra loading should not place any strain on the rectifier of the broadcast set. As the coil design for the two units is identical we will deal with this subject after having described the battery version of the converter. As in the case of the A.C. version the battery unit is equipped with an efficient R.F. stage.

The valve employed in this stage is a type 1C4 R.F. pentode, which operates with maximum efficiency at zero bias. The mixer valve in the battery version is the well-known 1C6, which results in high gain in this section of the converter.

As the 1C6 requires a minimum bias of three volts it has been necessary to connect a .1 mfd. condenser from the earth return of the 1C6 grid coil to earth and connect the bottom of the coil to "C" negative 3 volts.

The .1 mfd. condenser slightly reduces the maximum capacity of the G2 section of the gang condenser. This, in turn, necessitates a change in the padding capacity for the tuned circuit of the oscillator stage.

Whereas, in the A.C. version, this capacity is .004 mfd., in the battery unit it is raised to .007mfd., to obtain correct tracking. So much for the actual converters. Next we come to the coil design. Special attention has been paid to the coil design to enable maximum gain to be obtained from the units.

The secondaries of the coils are space-wound, as this method of winding is the most efficient on the higher frequencies.

The primary of the oscillator coil is reverse wound, with fine wire, over the lower turns of the oscillator grid or secondary coil. The primaries of the aerial and R.F. coils are wound with 34 gauge double silk-covered wire at the high, or grid, ends of their respec-

tive coils. Were these primaries to be placed at the earth end of the secondary windings, the gain from them would be much lower than is the case when they are wound in the manner described.

Being wound with heavy gauge wire, the coupling is fairly tight and exceptionally high gain is obtained.

So much for the theoretical side of the converters. The first step in the construction of either one of the units is to obtain a suitable chassis and to drill it to take the other components. We will deal first with the A.C. version of the converter and follow its constructional details with that of the battery version.

The layout and assembly of the two units is identical, so the assembly details will not be repeated for the battery version.

The three-gang condenser, G1, G2, G3, occupies a central position on top of the chassis, with the R.F. valve socket bolted in place to the right of it and in line with the front section of the gang condenser. The socket for V2 is mounted directly behind the gang condenser, whilst the special coupling transformer, IFT, bolts in place in the rear left-hand corner of the assembly.

Mounted on the rear edge of the chassis are the aerial and earth terminals and the power supply socket.

The two terminals situated close to the power input socket are the output terminals of the converter. One of these is for high impedance primaries in the broadcast set and the other for primaries of the low impedance type.

Below the chassis the padder condenser, PD, and the coils and coil shields are mounted. These coil shields measure 2 inches by 2¼ inches, and for ease in mounting are bent at right angles for a distance of ⅜ of an inch.

One shield is mounted 2¾ inches from the front edge of the chassis and the remaining shield is spaced 1⅝ inches from the first one. With the aid of small aluminium brackets the aerial and R.F. coils are mounted on end, whilst the oscillator coil is mounted horizontally between the two coil shields. A glance at the under chassis photograph of the unit will clear up any doubt in the mind of the constructor regarding the placement of the components situated below the chassis.

So much for the assembly of the converter. We come next to its wiring.

Wire the heater lugs of the socket for V1 to the heater lugs of the socket for

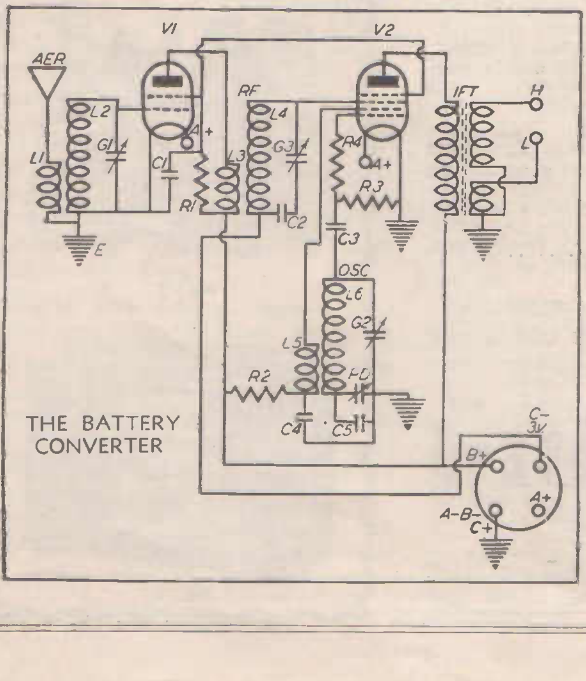
SCHEMATIC DIAGRAMS and PARTS LIST for "THE GLOBE GIRDLER TWO"

A.C. CONVERTER.

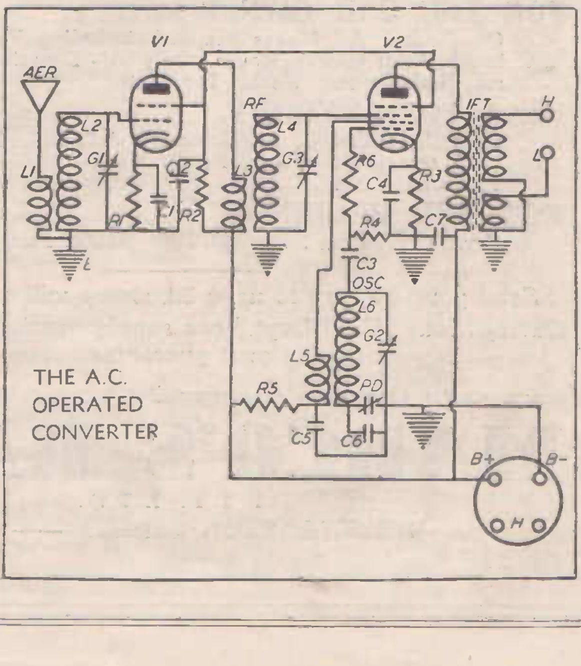
CHASSIS—Measuring 8 inches by 8 inches, 2½ inches.
COILS—See text.
C1, C2, C4, C5, C7—.1 mfd. tubular condenser. (T.C.C.)
C3—.0001 mfd. mica condenser. (T.C.C.)
C6—.004 mfd. mica condenser. (T.C.C.)
DIAL—Aeroplane type dial to suit gang condenser.
G1, G2, G3—Three gang condenser.
IFT—Special convertor type intermediate frequency transformer (Airmaster.)
PD—7 plate isolantite padder condenser.
R1—300 ohm 25 milliampere wire wound resistor.
R2—30,000 ohm 1 watt resistor (I.R.C.)
R3—500 ohm 25 milliampere wire wound resistor.
R4—50,000 ohm 1 watt resistor. (I.R.C.)
R5—20,000 ohm 1 watt resistor (I.R.C.)
R6—250 ohm 1 watt carbon resistor (I.R.C.)
SOCKETS—Two type P and one 4 pin.
VALVES—One each EF5 and EK2 (Philips.)
SUNDRIES—Wiring flex, nuts and bolts, four insulated terminals, a four pin speaker plug, three 2½in. lengths of ¾in. diameter bakelite former, two small aluminium shields (see text), a reel of 22 gauge enamel wire, small quantities of tinned wire and 34 gauge silk-covered wire, and two lengths of spaghetti sleeving.

BATTERY CONVERTER.

CHASSIS—Measuring 8 inches by 8 inches, 2½ inches.
COILS—See text.
C1, C2, C4—.1 mfd. tubular condensers. (T.C.C.)
C3—.0001 mfd. mica condenser. (T.C.C.)
C5—.007 mfd. mica condenser. (T.C.C.)
DIAL—Aeroplane type dial to suit gang condenser.
G1, G2, G3—Three gang condenser.
IFT—Special convertor type intermediate frequency transformer (Airmaster.)
PD—7-plate isolantite padder condenser.
R1—30,000 ohm 1 watt resistor. (I.R.C.)
R2—20,000 ohm 1 watt resistor (I.R.C.)
R3—50,000 ohm 1 watt resistor (I.R.C.)
R4—250 ohm 1 watt carbon resistor. (I.R.C.)
SOCKETS—Two 4-pin and 1 5-pin.
VALVES—One each 1C4 and 1C6. (Ken-Rad, Philips, Radiotron, Raytheon).
SUNDRIES—Wiring flex, nuts and bolts, two valve shields, four insulated terminals, a four-pin speaker plug, three 2¼in. lengths of ¾in. diameter bakelite former, two small aluminium shields (see text), a reel of 22 gauge enamel wire and small quantities of tinned wire and 26 and 34 gauge silk covered wire.



THE BATTERY CONVERTER



THE A.C. OPERATED CONVERTER

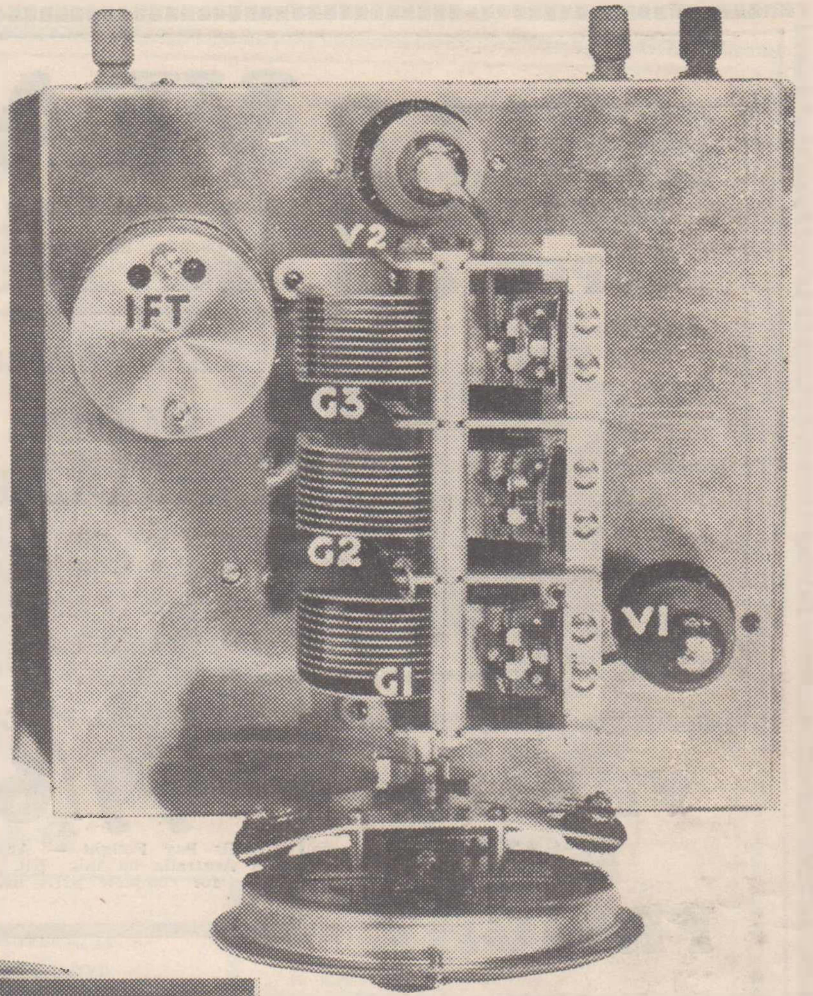
V2 and connect them to the filament lugs of the power input socket. All of this wiring must be carried out by means of twisted leads. Solder lugs should be placed under the bolts holding the coil shields, and these should be connected together with tinned wire and joined to the earth terminal.

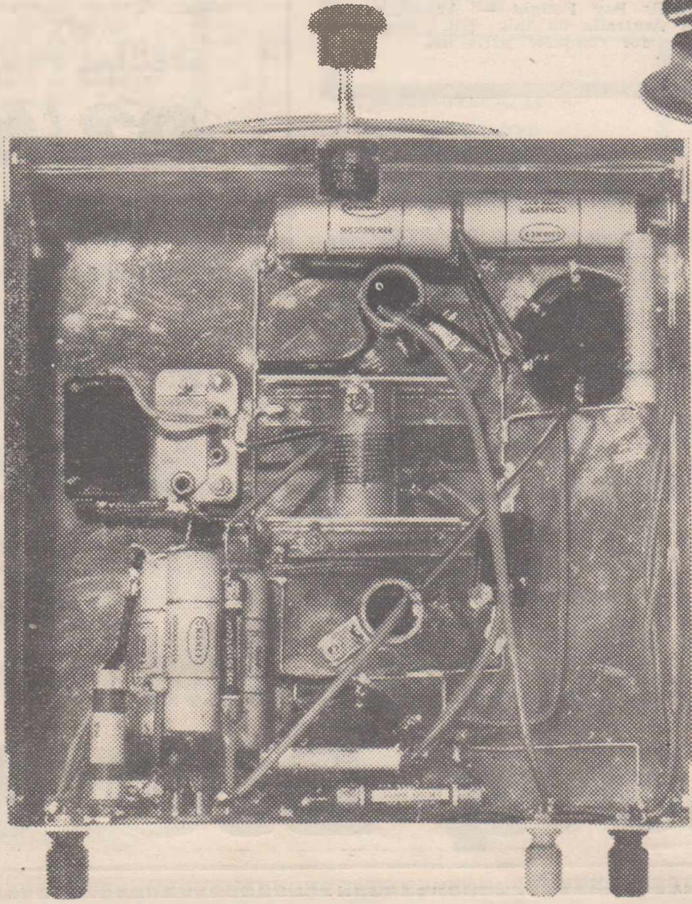
Similar lugs must be placed under these bolts on top of the chassis and the wiper contacts on the moving plates of the gang condenser joined to them with tinned wire. This wiring is most important and on no account should it be omitted.

Solder together the cathode and suppressor grid lugs of the socket for V1, and to them connect one lug each of the 300 ohm resistor, R1, and the .1 mfd. condenser, C1. Solder the remaining contacts of R1 and C1 to earth. The metal coating lug of the socket for V1 also joins to earth. Solder one leg of the .1 mfd. condenser, C2, to the screen grid lug on the socket for V1 and join this lug to the screen grid lug on the socket for V2. Earth the other lug on C2.

The 30,000 ohm resistor, R2, solders between the "B" plus lug on the power input socket and the screen grid lug of the socket for V2.

Bolt the .0001 mfd. oscillator grid condenser, C3 in place near the shield between the R.F. and oscillator coils, and solder the resistor R6 from one lug of this condenser to the oscillator grid lug of the socket for V2. Solder the 50,000 ohm oscillator grid lead, R4, from the junction of R6 and C3 to the cathode lug of V2.





The plan photograph above shows the layout of the components mounted on top of the chassis and has been key lettered to agree with the written text. The photograph below shows the layout and wiring of the A.C. version of the convertor.

To this lug solder one leg each of the 500 ohm resistor, R3, and the .1 mfd. condenser, C4. Join the remaining lugs of these components to earth. The metal coating lug of the socket for V2 also joins to earth. Solder the Blue lead from IFT to the plate lug of the socket for V2 and join the Black lead of IFT to earth.

The White lead of IFT connects to the "B" lug of the power input socket whilst the Red and Yellow leads connect to the high and low impedance output terminals respectively.

The coil wiring remains to be done. Commence this by connecting the start of the secondary winding, L2, to the fixed plates of the G1 section of the gang condenser. Leads should be soldered to the fixed plates of the gang condenser before it is bolted in place.

The finish, or earth end, of the winding, L2, joins to the earth wire as does the finish of the aerial primary winding, L1. The start of the winding L1 joins to the aerial terminal.

BEATABLE VALUES

able values and a choice from an unequalled
alls — expert buyers, experienced salesmen,
rices . . . the lowest consistent with quality
w despatch makes dealing with Vealls a

ONY
YLESS 4

orts from all over Australia prove the sym-
ny Batteryless 4 to be the best and biggest
e ever offered. Results equal to any 5 Valve
ctric receiver yet only one six volt accum. is
quired for its operation. No "B" Batts. re-
quired. Everything necessary to build the com-
plete chassis with Valves and Rola Speaker, only
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Solder a lead from the fixed plates of the G2 section of the gang condenser to the start of the secondary or grid winding of the oscillator coil, L6, and wire the finish of this coil to the fixed plates of the padder condenser, PD. The moving plates of the padder condenser, PD, join to the earth wire and the condenser, C6, connects across the two lugs of the padder condenser.

The start of the oscillator feed-back coil, L5, connects to the oscillator plate lug of the socket for V2. The end of the winding L5 joins to one side of the 20,000 ohm resistor, R5. The condenser, C5, joins from this point to the earth wire.

The remaining lug of the resistor, R5, joins to the "B" plus lug of the power input socket, from which point the .1 mfd. condenser, C7, joins to the earth wire.

The unconnected lug of the oscillator grid condenser, C3, joins to the start of the winding L6.

Wire the lead from the fixed plates of the G3 section of the gang condenser to the start of the winding L4. The end of this winding joins to the earth wire.

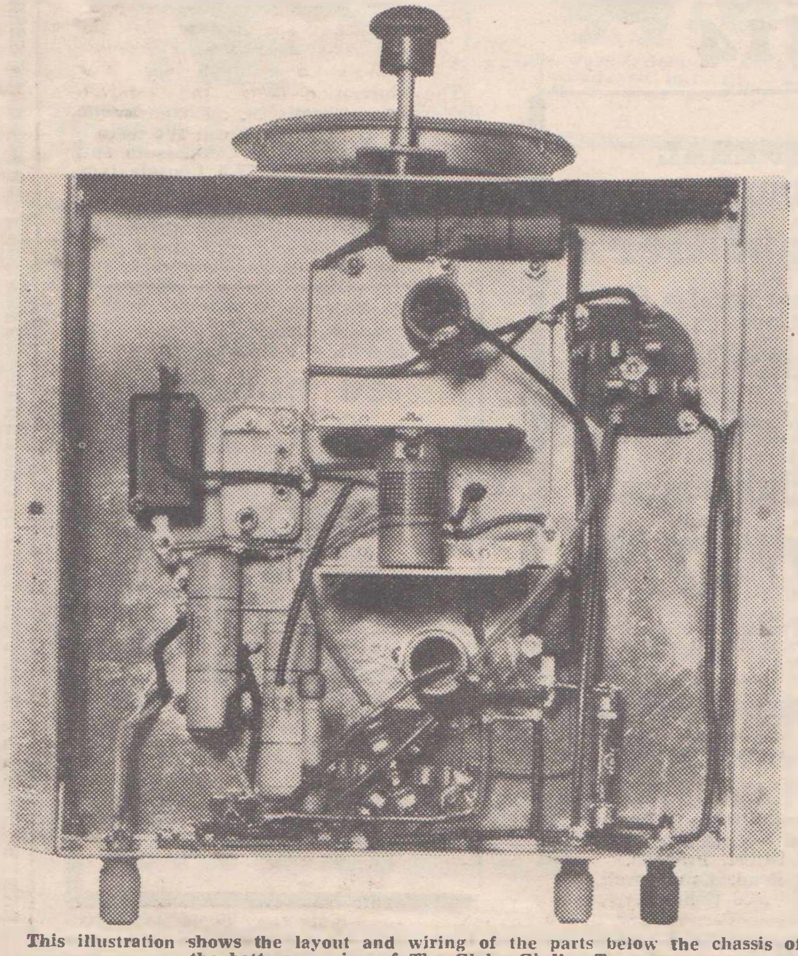
Solder the start of the plate winding, L3 to the plate lug of the socket for V1 and connect the remaining lead of L3 to the "B" plus lug of the power input socket. Join the unconnected lug of the power input socket to the earth wire. The wiring is completed by soldering leads to the fixed plate lugs of the G1 and G3 sections of the gang condenser and soldering to them the grid clips for the valves V1 and V2.

Wiring the Battery Version

Solder lugs should be placed under the holding bolts for the coil shields both above and below the chassis. The lugs below the chassis should be joined together with tinned wire and connected to the earth terminal with similar wire. The lugs above the chassis should be connected with tinned wire to the moving plate wipers of the gang condenser. Solder the negative filament lugs of the sockets for V1 and V2 to earth. Connect together the positive filament lugs of these sockets and join them to the "A" positive lug of the battery input socket. The "A" negative of this socket joins to earth.

Solder one leg of the .1 mfd. condenser, C1, to the screen grid lug of the socket for V1 and join this lug to the screen grid lug of the socket for V2. Solder the remaining leg of the condenser C1 to earth and solder the 30,000 ohm resistor, R1, from the "B" positive lug of the battery input socket to the screen grid lug of the socket for V2.

Bolt the .0001 mfd. oscillator grid condenser, C3, in place close to the shield between the R.F. and oscillator coils and solder the resistor, R4, from one lug of this condenser to the oscillator grid lug of the socket for V2. Solder the 50,000 ohm oscillator grid leak, R3, from the junction of R4 and C3 to earth.



This illustration shows the layout and wiring of the parts below the chassis of the battery version of The Globe Girdler Two.

Solder the Blue lead from IFT to the plate lug of the socket for V2 and solder the Black lead of IFT to the earth wire. The White lead of IFT connects to the "B" positive lug of the battery input socket whilst the Red and Yellow leads of IFT join to the high and low impedance output terminals respectively.

Leads should be attached to the fixed plate lugs of the three sections of the gang condenser before it is bolted in place and passed through suitable holes drilled in the floor of the chassis.

The lead from the G1 section of the gang condenser solders to the start of the aerial coil secondary winding, L2, whilst the finish of the winding L2 joins to earth. The start of the aerial primary winding, L1, joins to the aerial terminal. The finish of this winding joins to earth. The start of the oscillator secondary coil, L6, connects to the fixed plate lug of the G2 section of the gang condenser whilst the finish of the winding joins to the fixed plate lug on the padder condenser, PD.

The moving plate lug of the padder, PD, joins to the earth wire. The .007 mfd. condenser, C5, connects directly across the two lugs of the padder condenser.

The vacant lug on the oscillator grid condenser, C3, solders to the junction of the fixed plates of the G2 section of the gang condenser and the coil L6.

The start of the oscillator plate feed-back coil, L5, joins to the oscillator plate lug of the socket for V2, whilst the finish of the winding solders to one leg of the resistor, R2.

The .1 mfd. condenser, C4, solders from this point to earth and the remaining leg of R2 joins to the "B" + lug of the battery input socket. The lead from the fixed plate lug of the G3 section of the gang condenser joins to the start of the R.F. coil secondary winding, L4, the finish of which solders to the "C" — lug on the battery input socket. The .1 mfd. condenser, C2, joins from this point to the earth wire.

The start of the R.F. plate winding, L3, solders to the plate lug of the socket for V1, whilst the finish of the winding L3 connects to the "B" + lug of the battery input socket.

The wiring is completed by soldering leads to the fixed plate lugs of the G1 and G3 sections of the gang condenser and connecting to them the grid clips for the valves V1 and V2 respectively.

The wiring of the converter having been completed and checked, the valves may be inserted in their correct sockets and the initial tests carried out.

Before proceeding with the testing of the converter, a word as to the connection of the units to broadcast receivers may not come amiss.

The A.C. version of the converter in its present form can be used with any broadcast receiver employing 6.3 volt series valves. It may also be used on a batteryless receiver by connecting the heater lugs of the power input socket across the accumulator terminals and connecting the "B" + and "B" — leads to their correct positions on the vibrator supply unit.

In connecting the converter to an A.C. receiver the heater lugs of the power input socket connect to the 6.3 volt winding of the broadcast set and the "B" + lug of the converter power socket to the "B" + of the broadcast set. The "B" —

lug of the converter power socket joins to the earth terminal of the broadcast set.

The correct output terminal of the converter is joined to the aerial terminal of the broadcast, depending on whether the broadcast set has a high or a low impedance primary winding aerial coil. The aerial lead-in wire is then joined to the converter's aerial terminal.

We come now to the connections for the battery version.

This unit is designed for use with battery receivers using two volt series valves either of the American or Continental type.

In the case of the battery unit it is a good idea to have a four-pin speaker plug at both ends of the cable. One of these plugs into the battery input socket on the rear edge of the chassis and the other one plugs into a four-pin socket mounted on the broadcast receiver chassis and suitably wired into circuit.

Thus the converter may be connected or disconnected at a moment's notice.

If desired, this system may also be applied to the A.C. version.

The "A" + lug of the battery input socket joins to the "A" + lug of the broadcast set and the "A" — lug of the battery input socket joins to the "A" — lug of the broadcast set.

The "B" + lug of the battery input socket joins to the "B" + lug of the broadcast set whilst the "C" — 3 volt lug of the battery input socket joins to the "C" — 3 volt lug of the broadcast set.

If by any chance the broadcast set does not employ a "C" battery a separate bias battery may be used.

The positive lug of the "C" battery should connect to the earth wire of the converter, and the "C" lug of the battery should be joined to the 3 volt lug on the battery socket.

This completes the battery connections to the converter. It is now only necessary to connect the correct output terminal on the converter to the aerial terminal of the broadcast set depending on whether it has a low or a high impedance type aerial coupling.

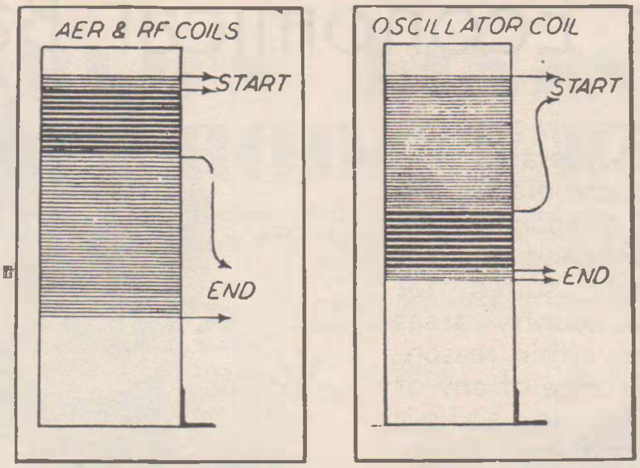
If it is not known which particular type of coupling is employed, it will be necessary to experiment with these connections to ascertain which gives the better results.

With the connection of the aerial and earth wires to the converter and the placing of the valves in their correct sockets the unit should be in operating condition.

The coils are wound on ¾ inch diameter bakelite formers. The secondaries are wound with 22 gauge enamel wire and the primaries either with 26 double silk covered wire or with 34 gauge double silk covered wire. The aerial and R.F. coils are wound on 2¼ inch lengths of former, whilst the oscillator coils are wound on 1 5-8 inch lengths of former.

The aerial and R.F. coil secondaries, L2 and L4, are wound with the 22 gauge enamel wire and consist of 11 turns of wire spaced the diameter of the wire. The best manner in which to wind these coils is to cut off two lengths of wire sufficient to wind 11 turns on the former and to wind them on side by side leaving sufficient wire at the ends of the winding to make connections.

The start and finish of the winding may be held in place by drilling two small holes in the former and threading the wire through them. With the two sets of windings in place one is removed leaving the other one spaced by the diameter of the wire.



These diagrams depict the windings and their correct connections on the aerial, R.F. and oscillator coils. These coils and connections are adaptable for either the battery or A.C. versions of the converter.

This winding is then "doped" with liquid celluloid or clear duco lacquer to hold it in place.

The oscillator secondary winding, L6, is wound in a similar manner except that it consists of only 10½ turns. In the case of the secondary windings on the aerial and R.F. coils these are wound as near the top of the former as possible, the start of the winding being the end nearer the top.

The oscillator secondary winding is wound in the centre of the former, the grid, or start, of the coil being toward the rear of the chassis.

The aerial winding, L1, and the R.F. plate winding, L3, each consist of four turns of the 26 gauge silk covered wire wound in the space between the turns of the secondary winding.

These windings are wound in the same direction as the secondary windings and are wound at the grid end of these windings.

The start of the aerial and R.F. plate windings may be threaded through the same holes which were drilled for the start of the secondary windings.

The primary of the oscillator coil, L5, is wound with 34-gauge silk covered wire, and consists of six turns wound in the reverse direction to the secondary winding, L6.

It is interwound over the last few turns of the L6 winding. As it is in the reverse direction the fine wire for L5 crosses over the heavier gauge secondary winding at each turn.

In the case of the oscillator primary the start of the winding is nearer the grid or start of the secondary winding.

In every case sufficient wire should be left at the start and finish of the windings to enable connections to be made.

This completes the winding of the coils and the remainder of the construction may be proceeded with.

The initial adjustments of the two units are identical and are as follows:— First, tune the broadcast receiver to a spot on the dial, just above 3AR, where no other station is being received. Switch on the converter and adjust the trimmer on IFT until there is a loud rushing noise such as is heard when the broadcast set is tuned off a station with the volume control full on. This shows that IFT is tuned to the frequency of the broadcast set, and as the dial of the converter is rotated it should be possible to receive a station. When a station is received try re-adjusting the trimmer on IFT for best results.

Having once tuned IFT take a note of the broadcast set's dial reading, as whenever the converter is used the broadcast set must be tuned to the same dial setting.

The actual setting of the trimmers will vary with individual sets, but those of the original model will serve as a guide in beginning the adjustments.

Screw the padder condenser hard up and then release it a half turn. Next unscrew the trimmer on the oscillator section of the gang condenser (G2) until it is at minimum capacity. This is essential to the operation of the converter. The other two trimmers should then be adjusted for maximum signals.

In the case of the original converters, these trimmers were about 1½ turns from the full-in position.

It must be understood that all adjustments to the trimmers on the gang condenser are carried out with the converter tuned to a high frequency station, i.e., with the condenser plates in the full-out position. On the other hand, padder adjustments are made at the other end of the dial scale with the condenser plates near the full-in position.

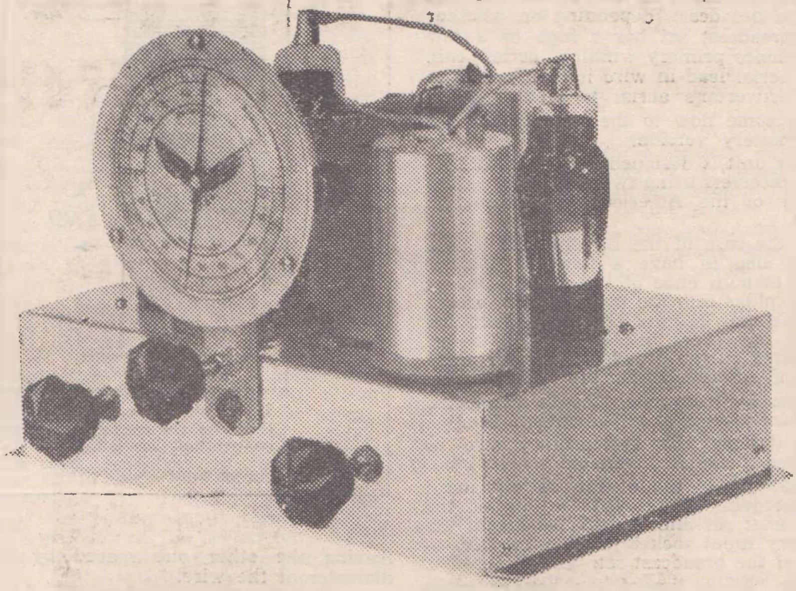
Having set the trimmers on a high frequency station, another station at the low frequency end of the dial should be tuned in and the padder condenser adjusted for maximum results.

This completes the alignment of the unit and it should now be in a sensitive condition.

With the converter attached to a tuned radio frequency set having a sensitivity not higher than 70 microvolts per metre, full speaker results were achieved from many overseas stations.

An Economical Battery Three

An extremely sensitive battery - operated receiver incorporating the latest component refinements and which is admirably suited for use in country areas situated within reasonable distance of any of the broadcasting stations.



A front view of the completed assembly showing the arrangement of the operating controls. They are (from left to right) the combined volume control and battery switch, the main tuning control and the reaction condenser.

THIS simple battery operated three-valver has been designed for the man who does not wish to build a super-het, yet requires a sensitive and economical set.

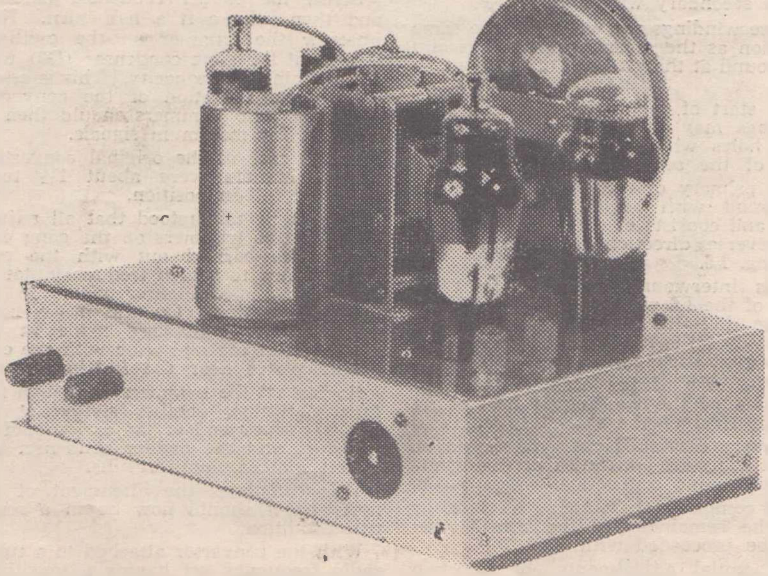
THE receiver consists of a stage of radio frequency amplification followed by a regenerative screen grid detector operating on the grid leak principle.

This, in turn, is followed by a pentode output valve, the bias for which is obtained from a resistor connected in the "B" negative lead. The set is equipped with the American series of valves. The R.F. and detector stage valves are type 1C4's whilst the output valve is a type 1D4 pentode.

Due to their greatly increased efficiency over the air core type of coil, iron core tuning units are employed. The use of these coils results in higher gain together with improved selectivity.

High-impedance type couplings are used in both the aerial and R.F. plate circuits, and this assists greatly in improving the sensitivity of the receiver on the lower frequencies.

The 1C4 is designed to operate as an R.F. amplifier with zero bias, and this simplifies the design of the set considerably, as well as doing away with the necessity for tapping the bias resistor R5.



On the rear side of the chassis can be seen the battery input socket and the aerial and earth terminals.

The volume of the receiver is controlled in the grid circuit of the pentode output valve, and the volume control has fitted to it the filament switch. It is only necessary to turn the volume control to minimum to switch off the set entirely.

Series-feed resistors have been provided for the screens of the R.F. and detector valves, and this does away with annoying taps on the "B" battery.

It will be noticed that an R.F. filter has been fitted in the plate circuit of the detector valve. This is necessary to prevent stray R.F. entering the audio circuit and setting up distortion.

All of the parts for the receiver should be exactly as specified if the results obtained from the original receiver are to be duplicated. Particularly does this apply to the gang condenser and tuning coils. These components are the heart of the set and, if any economising is to be done; on no account do it with these parts.

The first step in the construction of the receiver is to mount the various components on the metal chassis. The gang condenser, G1, G2, occupies a central position on the top of the chassis, with the aerial coil mounted to the right of it. The coils should be bolted in place as close to the gang condenser as is possible, so that the leads to the condenser are kept short. If this is not done, difficulty will be experienced in tuning the higher frequency stations.

The R.F. valve socket is mounted to the right of the gang condenser. The exact position of this socket can be seen from the plan photograph of the receiver.

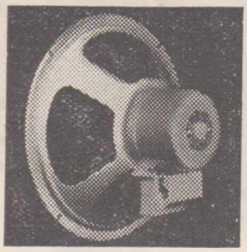
The R.F. coil is bolted to the chassis at the rear of the gang condenser, whilst the detector valve socket, V2, is mounted in the rear left-hand corner of the assembly.

THE WORLD'S FINEST SOUND REPRODUCERS!

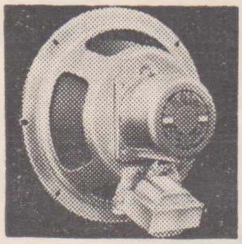
A radio receiver can be no better than its speaker; it is a fact that today's finest radios are Rola-equipped. Rola speakers represent the newest developments in sound reproducers, and signally contribute to the success of modern receiving and amplifying installations. There is a Rola unit for every type of radio or sound apparatus, and each Rola speaker is especially designed and built to perform in accordance with those phenomenally high standards which have ever been the prerogative of Rola products.

Rola

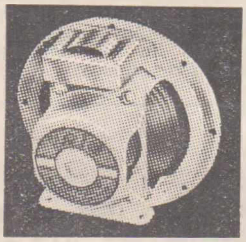
To Specify The Name . . . . Synonymous with Quality Is To Ensure The Best Speaker



The Rola K-12 shown above is deluxe 12in. unit giving faithful reproduction over a wide range of power inputs. Excellent results will be obtained with either single tube or push-pull output 62/-.

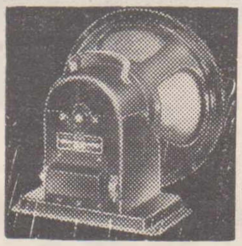


Due to a large magnet of new ALNI steel, the 8in. Rola 8-20 permanent magnet speaker shown above has remarkable sensitivity; incorporates patented Rola dustproof assembly and transformer is sealed against moisture and battery fumes. 42/6.

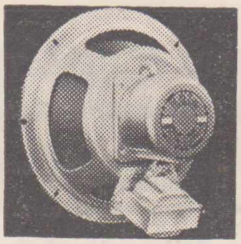


Above is the smallest speaker in the Rola range — the F-4, at 24/-. This is a 5 in. model, designed for midget receivers. Has remarkable sensitivity and power handling capacity. Available also in Permanent Magnet Model, 5-6. 29/6.

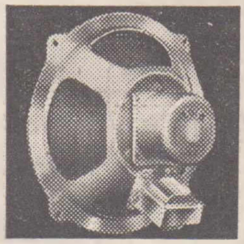
The Rola G-12 below, is a new 12 in. speaker with great power-handling capacity, affording accurate reproduction of all frequencies between 50 and 7,500 cycles, and will give exceptional service in all types of apparatus. £10.

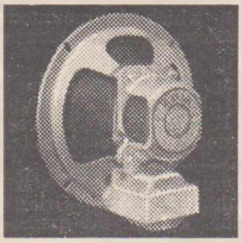


Below, the Rola K-8 is an 8in. high-efficiency product favored for all types of console receivers, as monitor in sound-film installations, and for hotel and school equipment. 27/6 internal spider; 28/6 external spider; 30/- dustproof.

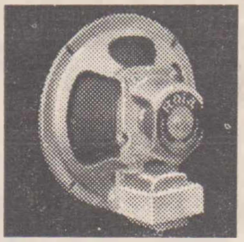


Making use of a new magnet alloy the new Rola 10-in. model 10-21 permanent magnet speaker shown below takes every advantage of the remarkably high flux obtainable from its new magnet. Capable of handling large power inputs. 50/-.

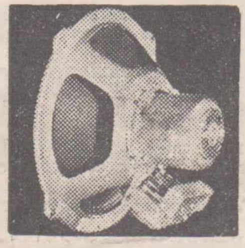




The new 6¾in. Rola DP-5-B shown above, incorporates the new patented Rola dustproof and acoustic filter assembly. Rola DP-5-B meets the exacting requirements of car radio and mantel set construction. 26/-.



A 6¾ in. permanent magnet speaker, the Rola Model 6-6 is shown above. Well suited for mantel and car radios, this unit has effective protection by patented Rola dustproof assembly and moisture sealed transformer. 29/6.



A carefully designed 10 in. unit, the Rola K-7 shown above has an improved diaphragm assembly which, with the exceptionally high flux available at the air gap, provides a greatly extended frequency range. 40/-.

Guaranteed products of **ROLA CO.** *(Australia) Pty. Ltd.*

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Adjacent to this socket, the two speaker terminals are mounted. The position of these and the pentode output socket, V3, can also be seen from the plan photograph of the set.

Mounted on the front side of the chassis are the reaction condenser, M, and the volume control potentiometer, R3.

The reaction condenser, M., is to the right of the main tuning control, and the volume control to the left of this control.

The rear side of the chassis carries the battery input socket and the aerial and earth terminals. The battery input socket bolts in place near the detector socket, V2, whilst the aerial and earth terminals occupy a position near the R.F. valve socket, V1.

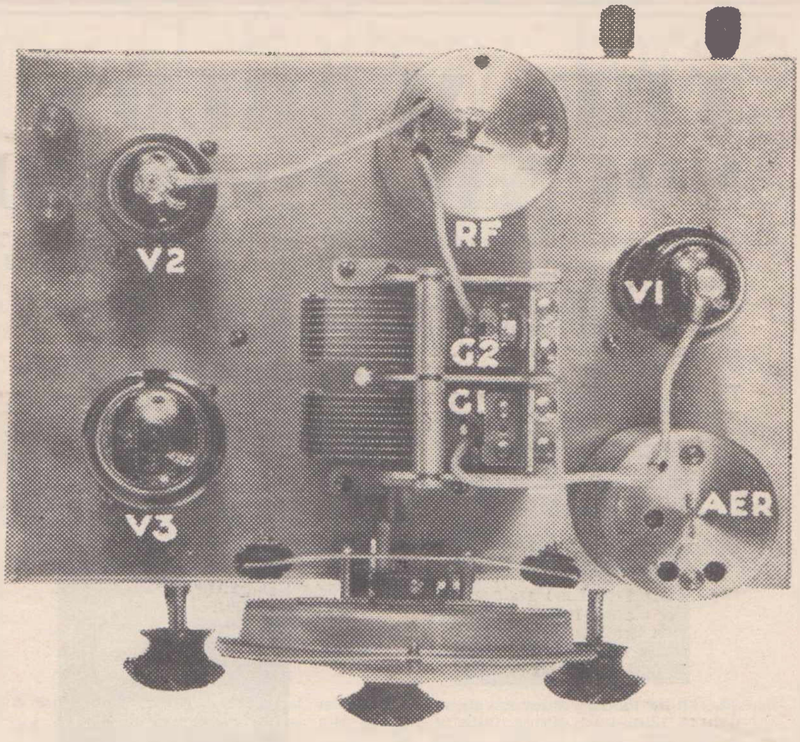
The only other component bolted directly to the chassis is the coupling condenser, C4, which is mounted between the detector and pentode valve sockets.

The mounting of the parts completed, the wiring of the receiver should be commenced. It may be as well, at this juncture, to detail the connections to the sockets used in the set.

A standard numbering system is now employed with this valve series, and this makes the job of the home-constructor much more simple.

In the case of the four-pin sockets, looking at the under-chassis view of them with the filament lugs away from you, the number one or filament positive lug is the one to the right, proceeding in a clockwise direction; number two is the plate lug; number three the screen grid lug; and number four the filament negative lug.

Again with the filament lugs of the five-pin socket away from you, the one on the right is the filament positive; number two the plate lug; number three the grid lug; number four the screen grid lug; and number five the filament negative lug.

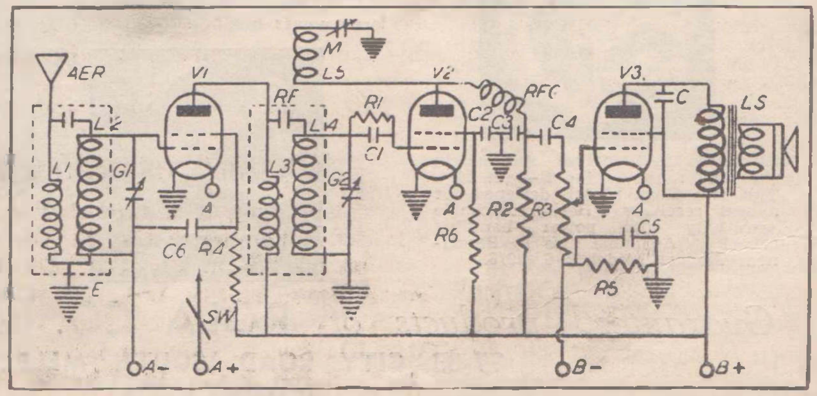


This plan view of the receiver depicts the arrangement of parts on top of the chassis. All components are keyed to correspond with the written description of the set.

THE LIST OF PARTS AND SCHEMATIC CIRCUIT DIAGRAM

Needed to Build the Economical Battery Three

Chassis measuring 9 inches by 7½ inches by 2½ inches.
Coil kit, consisting of iron cored Aerial and R.F. with reaction. (Airmaster.)
C: .005 mfd. mica condenser. (T.C.C.)
C1: .00025 mfd. mica condenser. (T.C.C.)
C2, C6: .1 mfd. tubular condensers. (T.C.C.)
C3: .0001 mfd. mica condenser. (T.C.C.)
C4: .02 mfd. mica condenser. (T.C.C.)
C5: 25 mfd. .35 volt electrolytic condenser. (T.C.C.)
DS. Permagnetic speaker to suit 1D4. (Rola.)
Dial. Broadcast type dial to suit gang condenser.
G1, G2: 2 gang condenser, type G.17 mmfd. to 385 mmfd. (Stromberg-Carlson.)
M: 23 plate midget condenser.
R1: 2 megohm grid leak. (I.R.C.)
R2: 250,000 ohm carbon or metallised resistor. (I.R.C.)
R3: 500,000 ohm potentiometer with switch. (Ferranti or I.R.C.)
R4: 150,000 ohm carbon or metallised resistor. (I.R.C.)
R5: 500 ohm wire wound resistor, to carry 19 milliamperes.
R6: 500,000 ohm carbon or metallised resistor. (I.R.C.)
RFC.: Radio frequency choke.
Sockets: 1 5-pin, 3 4-pin.
Valves: 2 type 1C4's and a 1D4. (Ken-Rad, Philips, Radiotron, Raytheon.)
Sundries: Hook up wire, a 4-pin battery plug, grid clips, a small quantity of tinned wire for earths, 3 knobs, nuts and bolts, and aerial, earth and speaker terminals.
Batteries required: 2 volt accumulator for the "A" battery. (Masse.) 135 volts for "B" battery. (Diamond, Ever Ready.)



The battery socket connections are the same as the other four-pin sockets.

Commence the wiring by connecting together the filament negative lugs of each of the valve sockets with tinned copper wire. This tinned wire should be soldered also to solder lugs placed under the holding bolts of the gang condenser and valve sockets. This earthed wire should then be connected to the earth terminal. A tinned wire soldered to the wipers on the moving plates of the gang condenser must also be soldered to this earthed wire. This earthed system is most important and should not be omitted.

Continue the wiring by connecting together the filament positive lugs of each of the three valve sockets and wiring them to one contact of the switch on the volume control, R3.

The remaining contact of this switch connects to the filament positive lug of the battery socket. The filament negative lug of the battery socket joins to the earth wire.

Solder the metal-braided lead of the aerial coil to the aerial terminal and carefully solder to the earth wire the outside metal braid. The black and the white lead of the aerial coil solder to the earth wire, whilst the yellow leads of the same coil are taken through the top of the can. One of these yellow leads connects to the fixed plate lug of the G1 section of the gang condenser, whilst the other solders to the grid clip which makes contact to the grid pip of the R.F. valve, V1.

The blue lead of the R.F. coil solders to the number two or plate lug of the R.F. valve socket, V1, whilst the green lead from the R.F. coil solders to the number two contact of the battery socket.

The red lead from the R.F. coil solders to the number two or plate lug of the detector valve socket, V2, whilst the white lead from the same coil connects to the fixed plates of the midget reaction condenser, M.

The moving plates of this condenser join to the earth wire.

The black lead from the R.F. coil joins to the earth wire.

The grid leak, R1, and the grid condenser, C1, solder directly to the lug of the R.F. coil to which the yellow leads are connected. One of these yellow leads is left connected to the lug, whilst the other is removed and connected to the remaining side of the grid leak and condenser combination, R1-C1.

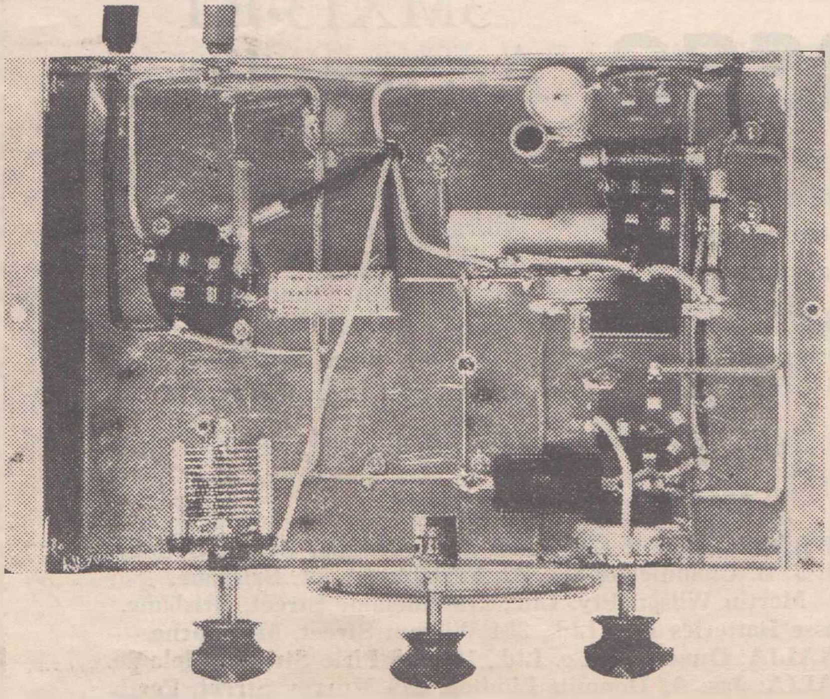
Both these yellow leads are taken through the top of the can, the one connecting to the original coil lug joining to the fixed plates of the G2 section of the gang condenser, whilst the other is connected to the grid pip of the detector valve, V2.

This completes the coil wiring. It should be checked before continuing with the rest of the wiring.

Solder one lug each of the condenser, C6, and the resistor, R4, to the number three or screen grid lug of the R.F. valve socket, V1; the remaining lug of the condenser C6 solders to the earth wire; while the unconnected lug of R4 joins to the number two lug of the battery socket.

Solder the number two lug of the detector valve socket, V2, to one side of RFC and connect the other side of RFC to one lug of the coupling condenser, C4. The .0001 mfd. by pass condenser, C3, solders from this point to earth.

The unconnected side of the coupling condenser, C4, solders to one of the outside contacts of the volume control potentiometer, R3; the centre contact of R3 joins to the number three or grid lug of the pentode output valve socket, V3.



This illustration shows the placement and wiring of parts below the chassis. When wiring the receiver it is essential that all plate and grid leads be kept as short as possible.

The remaining outside lug of the volume control connects to the number four lug of the battery socket, from which point the resistor, R5, and the condenser, C5, join to earth. The red or positive side of C5 connects to the number four lug of the battery socket.

The resistor, R6, solders from one of the speaker terminals to the number three lug of the detector valve socket, V2, and the condenser, C2, connects from this point to the earth wire.

The resistor, R2, solders between the speaker terminal to which R6 was connected, and the junction of RFC and C4. The number four or screen grid lug of the pentode valve socket, V3, connects to the speaker terminal to which the resistors, R2 and R6, were connected, and this, in turn, is wired to the number two contact of the battery socket.

The number two or plate lug of the pentode valve socket, V3, connects to the remaining speaker terminal and the condenser, C, is soldered across the two speaker terminals.

This completes the wiring of the receiver and every connection should be checked over to see that it is correct.

The battery plug and cable should now be prepared.

To the contact of the battery plug which makes contact to the number one lug of the battery socket, solder a red lead. This will become the "A" battery positive lead. A black lead should be connected to the lug of the battery socket which makes contact with the number four contact of the battery socket. This should be labelled "A battery negative."

A yellow lead should be soldered to the lug of the battery plug which makes contact to the number two lug of the battery socket, and this will become the "B battery positive 135 volt" lead. To the remaining pin of the battery plug solder a blue lead which will become the "B battery negative" lead.

The battery plug may then be plugged into the battery socket and the valves inserted in their correct sockets. The aerial, earth and speaker leads should then be connected.

This done, the receiver is ready for its initial test. Switch on the set by turning the volume control towards maximum and tune in a station at the high frequency end of the band, say, 3XY.

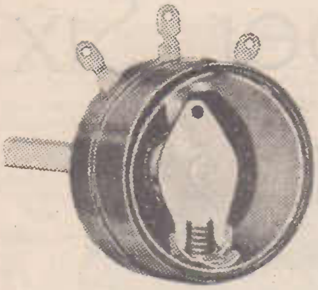
Before any other attempt at alignment is made, it is necessary to remove the trimmer on the G1 section of the gang condenser. This is done by unscrewing the adjustment screw and removing the bolt which holds the trimmer plate in position.

The trimming of the aerial coil is carried out entirely on the small condenser housed inside the can of this coil. If no hole is provided for this adjustment, one should be drilled to allow an insulated screwdriver to be inserted.

This trimmer, and the one on the G2 section of the gang condenser, should be adjusted for maximum signal strength on the high frequency station. While adjustment on the trimmers is being carried out, the volume control should be reduced until the alignment is being done on a comparatively weak signal.

Now tune the set to a station at the low frequency end of the band, say, 3AR, and check the adjustment of the trimmers. Perfect alignment is denoted when the adjustment at the high frequency end of the band holds for the low frequency end also.

The receiver is very economical in battery consumption. the "A" battery current drain being .48 of an ampere and the "B" battery drain 9 milliamperes at 135 volts "B" battery.



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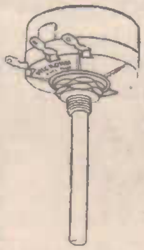

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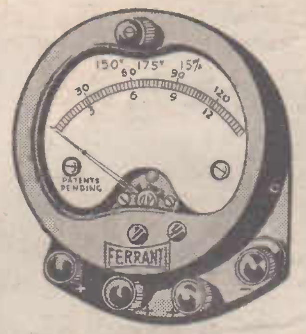

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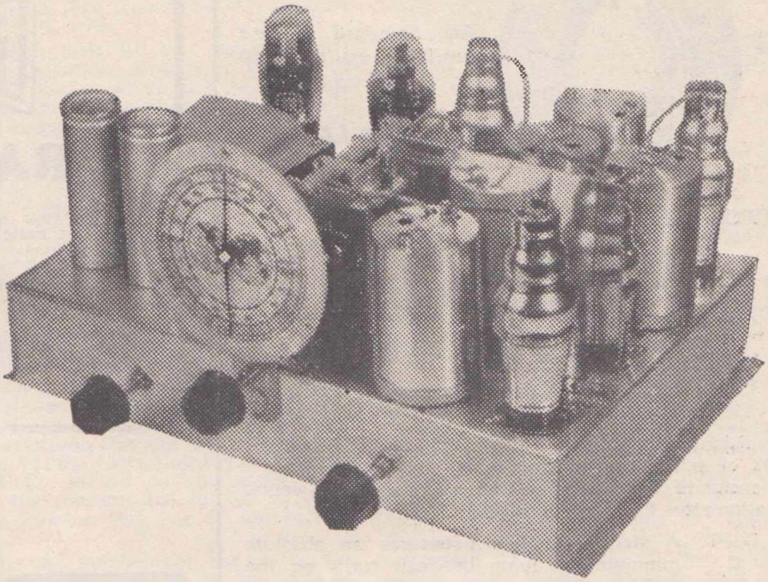


The front view of the completed chassis showing the positions of the three controls mounted on the front of the chassis. They are (from left to right) the Tone Control, the Main Tuning Control and the Volume Control.

VARIOUS forms of automatic volume control systems have been in use in modern receivers for some considerable time. Of late, these systems have become fairly efficient, particularly in receivers having three and more controlled stages.

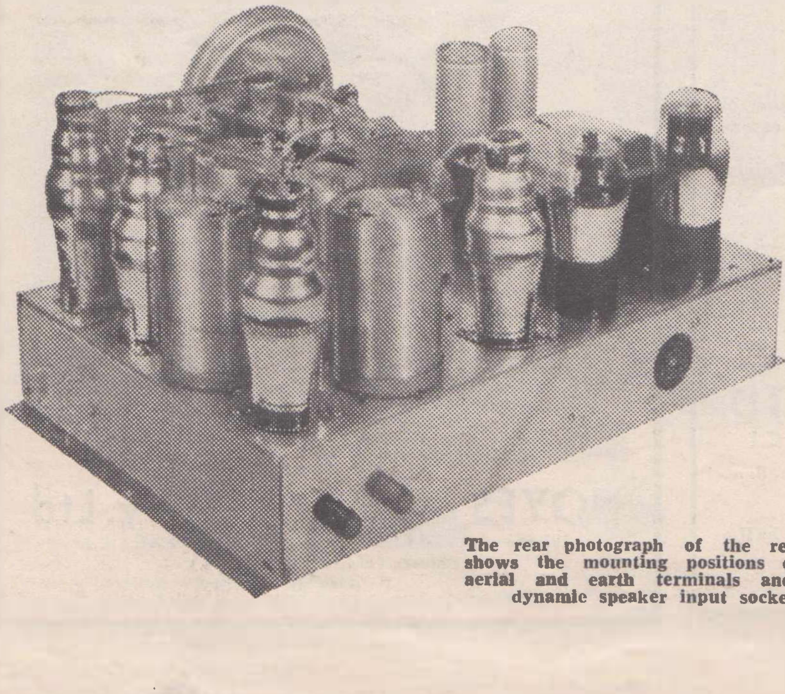
With the average set employing only two controlled stages, it has been most difficult to obtain efficient automatic volume control action to overcome the troublesome effects of fading on the weaker stations.

With the development of the super control 6B7s by the Amalgamated Wireless Valve Company Ltd., however, it was found possible by using a system of audio A.V.C. on the 6B7s grid, to provide a very efficient overall A.V.C. characteristic.

As an example of the efficiency of the system, the following figures are quoted:—With no A.V.C. applied to the 6B7s there is a rise of over 12 d.b., i.e., six audible steps, between input signals of 100 micro-volts and 1 volt.

With half the available A.V.C. voltage fed to the 6B7s, the rise over the same range of input signals is approximately 1 d.b., or one audible step. From these figures, the amazing efficiency of the system may be seen, as compared with sets not possessing the audio A.V.C. system.

The receiver described is fitted with this system, and this, together with its high degree of selectivity and sensitivity and good tonal response, makes it one of the outstanding receivers of the year.



The rear photograph of the receiver shows the mounting positions of the aerial and earth terminals and the dynamic speaker input socket.

AS may be seen from the circuit diagram, the receiver consists of a stage of radio frequency amplification, followed by a mixer stage which in turn is followed by a single intermediate frequency amplifier stage operating on the popular I.F. frequency of 175 k.c.

Rectification is carried out in the normal manner by the diode section of the 6B7's second detector and first stage audio frequency amplifier valve, and A.V.C. voltage is applied to the control grid of this valve by returning the grid resistor to the mid-point of the A.V.C. voltage dividing resistors R10 and R11.

The audio amplifier is perfectly standard and employs a type 42 pentode in the output stage. Tone control is provided by wiring the potentiometer, R20, and the condenser, C17, across the output of the 42.

The receiver is constructed on an aluminium chassis, the dimensions of which are given in the parts list.

The assembly of the parts completed, a start may be made on the wiring by soldering the two ends of a twister pair to the heater lugs of the socket for V1. The filament lugs on all sockets should face outwards to the edge of the chassis, and all the heater wiring must be tucked down in the corners of the chassis to prevent stray hum pick-up.

The twisted pair should be soldered in turn to the heater lugs of the socket for V2, and the corresponding lugs for the sockets for V3, V4 and V5; the remaining ends of this wire are soldered to the 6.3 volt winding on PT.

Twisted pairs join the heater lugs of the socket for V6 to the 5 volt winding on PT, and the plate lugs of the same socket to the outers of the high voltage secondary winding.

A quantity of tinned wire should then be straightened by holding one end in a vice and giving the other end a quick pull with a pair of pliers. This tinned wire is to be used to provide an earthed network around the chassis to which components may be soldered. Solder lugs should be placed under the holding bolts of the sockets, gang condenser and coils, and the tinned wire soldered to these lugs and connected to the earth terminal. To this earth wire is joined the centre-tap of the 6.3 volt filament winding and the centre-tap of the high voltage secondary winding.

The E lug on PT also joins to the earth wire. Join together the cathode and suppressor grid lugs of the socket for V1 and V3. Solder one lead of the resistor, R2, and one lead of the condenser, C2, to the cathode lug of the socket for V1. The remaining leads of these components join to the earth wire. Join together the screen grid lugs of the sockets for V1, V2 and V3. Solder the 25,000 ohm resistor, R7, from the screen grid lug of the socket for V1 to the earth wire. Replace the Blue lead of the R.F. coil with one of shielded wire sufficiently long to connect to the plate lug of the socket for V1.

The outside metal braid of all shielded wires must be securely soldered to the earth wire. Solder one lead of the resistor, R4, and one lead of the condenser, C4, to the cathode lug of the socket for V2. The remaining leads of these components join to the earth wire.

Solder one lug of the .0001 mfd. condenser, C3, to the oscillator grid lug of the socket for V2 and connect the 50,000 ohm resistor, R3, from this same lug to the cathode lug of the V2 socket. The Yellow lead from the oscillator coil joins to the remaining lug of the condenser, C3. The Black lead of the oscillator coil joins to the earth wire, as does the White lead from the Aerial coil. The metal braided lead from the aerial coil joins to the aerial terminal and the Black lead of the same coil should be disconnected from its lug and replaced with a lead of shielded wire long enough to reach to the diode lugs of the socket for V4. A .1 mfd. tubular condenser, C1, solders from the lug of the aerial coil, from which the Black lead was disconnected to the earth frame of the coil.

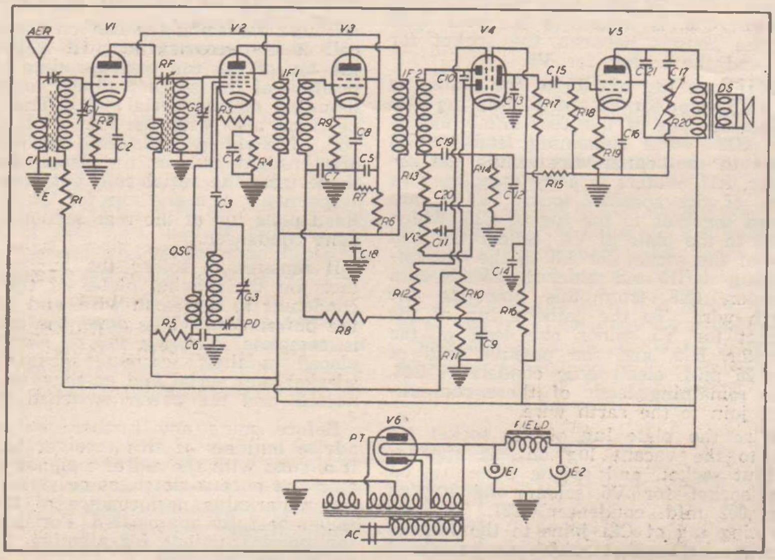
The Red lead of the oscillator coil solders to the oscillator plate lug of the socket for V2. The insulated lug, which consists of a solder lug fixed to a piece of insulating material, should then be bolted in place near the socket for V3. Another similar lug bolts in place close to the socket for V4.

Connect the positive lug of the electrolytic condenser, E1, to one side of the 5-volt winding on PT and wire this lug in turn to one of the filament pins of the speaker output socket. The positive lug of the other electrolytic condenser, E2, joins to the remaining filament lug on the speaker output socket, which is connected to one of the smaller pins on the same socket.

From this point a wire is taken to the insulated lug near the socket for V3. This lug becomes the "B" positive lug. Solder one lead of the 20,000 ohm resistor, R5, to this "B" positive lug, and solder the .1 mfd. tubular condenser, C6 from the remaining lead of R5 to the earth wire.

The White lead from the oscillator coil solders to the junction of R5 and C6. One lead of the 15,000 ohm 2 watt resistor, R6, solders to the "B" positive lug and the other lead of R6 solders to

The List of Parts and Schematic Diagram Needed to Build the Full A.V.C. Super Six



Chassis: Measuring 13½ inches by 9 inches by 2½ inches.

Coil Kit: Consisting of Iron Core Aerial, R.F. and Oscillator Coils for 175 K.C. (Airmaster).

C1, C2, C4, C5, C6, C8, C9, C14: .1 mfd. tubular condensers. (T.C.C.)

C3, C10, C20: .0001 mfd. mica condensers. (T.C.C.)

C7, C17: 05 mfd. tubular condensers. (T.C.C.)

C11, C15: .02 mfd. mica condensers. (T.C.C.)

C12, C16: 25 mfd. 35 volt electrolytic condensers. (T.C.C.)

C13, C19: .0002 mfd. mica condensers. (T.C.C.)

C18: .5 mfd. tubular condenser. (T.C.C.)

C21: .002 mfd. mica condenser. (T.C.C.)

Dial: To suit gang condenser.

E1, E2: 8 mfd. 500-volt electrolytic condensers. (T.C.C.)

G1, G2, G3: Three-gang type G condenser. (Stromberg Carlson.)

IFT1, IFT2: 175 K.C. air core intermediate frequency transformers. — (Airmaster.)

PT: Power transformer, 385-0-385 volts 100 milliamperes, 1-5 volt, 2 ampere, 1-6.3 volt, 3 ampere.

R1, R8, R18: 250,000 ohm ½ watt resistors. (I.R.C.)

R2, R9: 300 ohm wire-wound resistor to carry 25 milliamperes.

R3: 50,000 ohm ½ watt resistor. (I.R.C.)

R4: 300 ohm wire-wound resistor to carry 25 milliamperes.

R5: 20,000 ohm 1 watt resistor. (I.R.C.)

R6: 15,000 ohm 2 watt resistor. (I.R.C.)

R7: 25,000 ohm 1 watt resistors. (I.R.C.)

R10, R11: 500,000 ohm ½ watt resistors. (I.R.C.)

R12: 1 megohm ½ watt resistor. (I.R.C.)

R13: 100,000 ohm ½ watt resistor. (I.R.C.)

R14: 2500 ohm 1 watt resistor. (I.R.C.)

R15, R17: 250,000 ohm 1 watt resistors. (I.R.C.)

R16: 1 megohm 1 watt resistor. (I.R.C.)

R19: 400 ohm 100 milliampere wire-wound resistor.

R20: 20,000 potentiometer. (Ferranti.)

Sockets: 2 small 7-pin, 3 6-pin, 2 4-pin.

VC: 500,000 potentiometer. (I.R.C., Ferranti.)

Valves: 2 6D6, 1 6A7, 1 6B7s, 1 42 and an 80. (Ken-Rad, Philips, Radiotron, Raytheon.)

Sundries: Wiring flex, power flex, nuts and bolts, solder lugs, tinned wire, shielded wire, 4 valve shields, 3 knobs, 2 supporting strips, 2 terminals, and 4 grid clips.

Speaker: Dynamic speaker 1500 ohm field to suit 42. (Rola.)

the screen grid lug of the socket for V3. The .1 mfd. tubular condenser, C5, solders from this point to the earth wire.

The blue lead of IFT1 solders to the plate lug of the socket for V2, while the white leads of IFT1 and IFT2 join to the "B" positive lug. The .5 mfd. tubular condenser, C18, solders from this point to the earth wire. The black lead of IFT1 solders to one lead of the .05 mfd. tubular condenser, C7, the remaining lead of which solders to the earth wire.

Solder one lead of the resistor, R9, and one lead of the condenser, C8, to the cathode lug of the socket for V3, and earth the remaining leads of these two components.

The blue lead of IFT2 solders to the plate lug of the socket for V3, and the yellow lead of IFT2 joins to one of the diode lugs on the socket for V4. Remove the can from IFT2 and solder one lug of the .0001 mfd. mica condenser, C10, to the lug to which the yellow lead is attached. A lead should be soldered to the remaining lug on C10, and this should connect to the remaining diode lug on the socket for V4. The black lead of IFT2 is replaced with one of shielded wire long enough to reach to the volume control, VC. Solder one lug of the .0002 mfd. condenser, C19, to the cathode of V4. The other lug of C19 solders to one of the outside lugs of the volume control, VC, to which also is soldered one lead of the 100,000 ohm resistor, R13.

To the remaining lead of R13 is soldered the braided lead from IFT2. The .0001 mfd. mica condenser, C20, solders from this point to the cathode of V4. The other outside lug of VC wires to the cathode lug of the socket for V4, to which is soldered one lead of the 2500 ohm resistor, R14, and the positive lead of the 25 mfd. electrolytic condenser, C12. The remaining leads of these two components join to the earth wire.

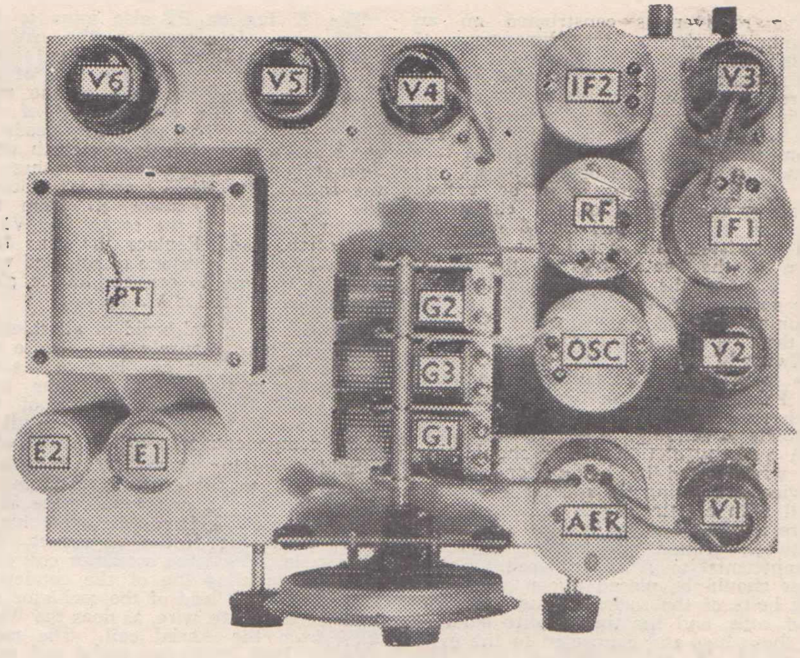
Solder one lug of the .02 mfd. mica coupling condenser, C11, to the centre contact of VC. To the remaining lug of C11 solder a shielded wire which connects to the insulated lug near the socket for V4. Solder together one lead of each of the 500.000 ohm resistors, R10 and R11. The remaining lead of R10 solders to the diode plate lug of the socket for V4, to which the lead from C10 is connected. The remaining lead of R11 joins to the earth wire.

Solder the 1 megohm resistor, R12, from the junction of R10 and R11 to the insulated lug to which the shielded lead from VC is connected, and to this point also solder a shielded lead which is passed through a hole in the chassis to terminate in the grid clip for V4.

Solder one lead of the 250,000 ohm resistor, R1, to the diode plate lug to which R10 is soldered, and to the remaining lead of R1 solder the braided lead from the aerial coil. The 250.000 ohm resistor, R8, solders to the junction of R10 and R11, and a shielded lead connects the unconnected lead of R8 to the junction of the black lead from IFT1 and the .05 mfd. tubular condenser, C7.

The .1 mfd. tubular condenser, C9, solders from the junction of R10 and R11 to the earth wire. To the screen grid lug of the socket, V4, solder one lead of the resistor, R15, and one lead of the .1 mfd. tubular condenser, C14, and solder the remaining leads of these components to the earth wire.

The 1 megohm resistor, R16, solders from the screen grid lug of the socket



This plan view of the receiver illustrates the arrangements of parts on top of the chassis. All parts are keyed to correspond to the written description of the receiver.

for V5 to the screen grid lug of the socket for V4. The screen grid lug of V5 joins to the filament lug of the speaker socket which was joined to one of the smaller contacts of the same socket. The .02 mfd. mica coupling condenser, C15, is bolted to the rear wall of the chassis between the socket for V4 and the socket for V5.

Wire one lug of C15 to the plate lug of the socket for V4 and to this lug also solder one lug of the .0002 mfd. condenser, C13. The remaining lead of C13 joins to the earth wire, while the resistor, R17, solders in place from the two lugs of the speaker socket which are wired together to the lug of C15, which joins to the plate of V4. Solder the grid lug of the socket for V5 to the remaining lug of C15 and solder the 250,000 ohm resistor, R18, from this point to the earth wire. To the cathode lug of the socket for V5 solder one lead of the resistor, R19, and the positive lead of the 25 mfd. electrolytic condenser, C16. The remaining leads of these components join to the earth wire.

Wire the plate lug of the socket for V5 to the vacant lug on the speaker output socket, and to the plate lug on the socket for V5 solder one lug of the .002 mfd. condenser, C21. The remaining lug of C21 joins to the lugs of the speaker socket which are soldered together. Solder one lead of the .05 mfd. tubular condenser, C17, to one of the outside lugs on the tone control, R20, and wire the centre contact of this control to the plate lug of the socket for V5.

This completes the wiring of the set below the chassis; it now remains to wire the grid leads of the coils to their correct positions on top of the chassis. A yellow lead must be soldered to the lug of the oscillator coil to which the yellow lead which is wired to the condenser, C3, is connected. This new yellow lead is taken out through the top of the can and soldered to the fixed plate lug of the centre section of the gang condenser.

The two yellow leads from the aerial coil are taken out through the holes in the can. One of these leads terminates in the grid clip for V1, whilst the other solders to the fixed plate lug of the front section of the gang condenser.

Before replacing the can on the aerial coil it is necessary to drill a hole in the top of the can corresponding to the position of the small trimmer condenser mounted on the aerial coil. This must be done also with the can of the R.F. coil. The yellow leads from the R.F. coil are brought out in the same way as those from the aerial coil, but terminate respectively in a grid clip for V2 and the fixed plate lug of the rear section of the gang condenser.

It remains to solder the wiping contacts on the moving plates of the gang condenser to the earth wire, and to affix the power cord. This done, the receiver is complete, and the valves should be placed in their correct sockets, the speaker and aerial and earth wires connected, and the power switched on.

Before going any further, we would advise builders of this receiver to have it aligned with the aid of a signal generator and output meter, as only then will the remarkable performance of the receiver be fully appreciated. For this reason no instructions for aligning the set by ear will be given.

The efficiency of the A.V.C. system has already been discussed, and it remains only to give some idea of the sensitivity of the receiver. The absolute sensitivity of the receiver was found to be 2 microvolts at 1500 k.c. and 5 microvolts at 600 k.c.

Tested on a mediocre aerial and earth system, the set was found capable of tuning the majority of Australian stations at excellent strength, and on several occasions New Zealand and foreign stations have been received at fair speaker volume.

The receiver is an outstanding design and should find favor with those desirous of building a really modern set.

The Trap-Tuned Crystal Set

Here is a Simple, yet Selective, Receiver, which can be built cheaply, yet will provide good Headphone Reception.

THE selectivity is of a high order, and sufficient volume will be obtained to operate several pairs of headphones when near a broadcasting station. When used in country areas with a good aerial, it will oring in the city stations; even with a poor aerial some of the stronger stations will be heard.

The heart of this receiver is the coil, and care should be taken in its construction if the loudest signals are to be obtained. The circuit shows that the tuned coil is inductively-coupled to the remainder of the set, and acts like a wave-trap.

For the coil, obtain a piece of cardboard or bakelite tubing, three inches in diameter and four inches long. Half an inch from one end of this former make a small hole in it, and thread through one end of a reel of No. 18 d.c.c. wire. Now carefully wind on 45 turns of this wire, taking care that it is tightly wound without overlapping and without any kinks in it.

If you can get someone to help you, the easiest way is to get him to hold the reel of wire and let out a little at a time as you wind it on the former.

You will find that the 45 turns will take almost three inches of space, and on completing the last turn, make another hole in the former, and thread through the wire. (Cut off about a foot more of the wire than is required to wind the coil, and thread this through.) These ends are to be used for connections.

The next step is to cut a piece of heavy brown paper, so that you have a strip two inches wide and thirty inches long. This is to be wound over the centre of the 45-turn winding, L2, and will make about three layers. A few small dabs of glue can be used to hold the ends of the paper in place.

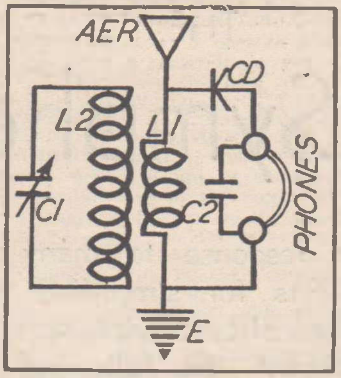
The second winding, L1, can then be put into place. This consists of 15 turns of the same wire wound on the layers of paper. Lay a strip of adhesive tape, sticky side up, along the paper, and wind the aerial coil, that is, L1, over this. The first turn of L1 is started half an inch in from the end of the paper layer, and the whole winding will take almost one inch. Thus, there will be half an inch of paper at each end of the winding.

As soon as the fifteen turns have been put in place, the ends of the adhesive tape can be brought over, and stuck down, thus keeping the wires in place. As with the previous coil, leave a foot or so of wire at each end for connections.

This coil must be wound very tightly, otherwise it will be inclined to slip off the paper layer. If desired, the completed coil can be given a coat of thin shellac, made by mixing dry shellac with methylated spirits. Do not use too much shellac on the coil.

LIST OF PARTS

- 1 variable condenser, .0005 mfd., with dial.
- 1 semi-fixed crystal detector.
- 1 fixed condenser, .00025 mfd. (T.C.C.)
- 4 terminals.
- 1 piece three-inch former, four inches long.
- 1 piece panel, 6 in. x 6 in.
- 1 baseboard, 6 in. x 6 in.
- 1 reel of No. 18 D.C.C. wire (½ lb.).



Circuit diagram of the trap-tuned crystal receiver.

Mounting the parts is simple, as the variable condenser of .0005 mfd. capacity is mounted on a piece of 6 x 6 bakelite, or ebonte. This panel can be either ⅛ or ¼ of an inch thick.

Mount the condenser so that the dial will be in the centre of the panel. A block of wood, six inches square by one inch thick, is used as a base, the front panel being attached to it by three screws. Mount the coil on the baseboard, so that it lies behind the condenser, with the connecting wires uppermost. The semi-fixed crystal detector and the phone condenser are mounted on the base, as shown in the diagram.

Place the aerial and earth terminals on the left-hand side of the dial, and the headphone terminals on the other side.

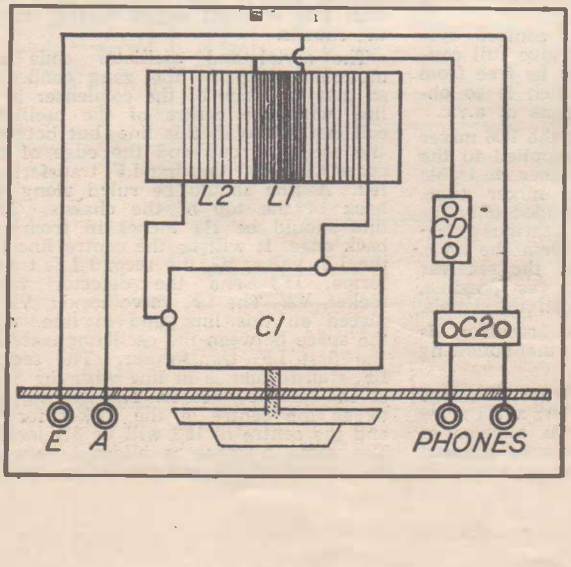
Connect the start of the tuned winding, L2, to the stationary plates of the variable condenser, and the other end to the moving plates. The condenser will be provided with the necessary terminals for these connections. Use the shortest leads you can, cutting off any wire not needed.

Now connect together the aerial terminal and one terminal of the detector, and to this wire connect the start of the aerial coil, L1. The remaining terminal of the detector is connected to one terminal of the phone condenser and one of the headphone terminals.

This done, connect together the earth terminal, the remaining phone condenser terminal, and the second headphone terminal. To this wire also connect the remaining lead from the aerial coil, L1.

This completes the wiring of the set, which is ready for testing. Connect the aerial and earth to the correct terminal, and a pair of high resistance headphones to the phone terminals.

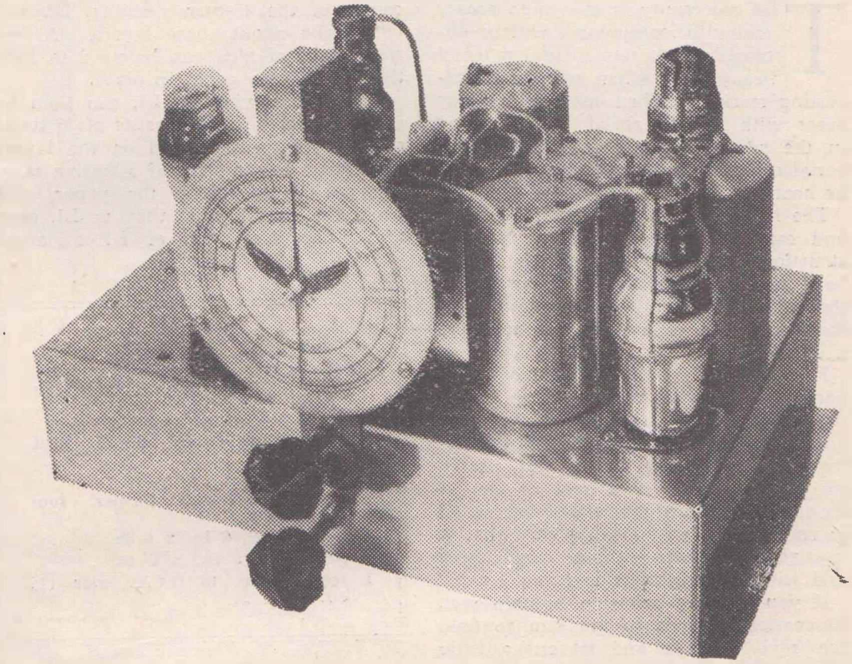
Slowly turn the dial until a signal is heard, and then adjust the detector for loudest signals. The set is then ready for regular use. To protect it from injury, it may be mounted in a small wooden box.



Diagrammatic plan of the crystal set showing the layout and wiring of the receiver.

THE Symphony Vibrator Four

In response to many requests for simplified versions of batteryless sets, we present the following article. This four valve superheterodyne receiver is capable of giving outstanding results.



A front view of the Symphony Vibrator Four showing the mounting positions of the controls. They are (upper) the main tuning control and (lower) the volume and battery switch control.

THE batteryless receiver continues to attract considerable attention from those country listeners who are seeking the ultimate in radio reception yet reside outside the areas supplied by A.C. power.

The first models of batteryless receivers were rather complicated in design and consequently were costly to construct.

The present model, called the "Symphony Batteryless Four" because of its excellent tonal qualities, has been simplified considerably. Its four valves, operating in a soundly designed superheterodyne circuit, provide high sensitivity, excellent selectivity, a comparatively large power output.

The current drain of the receiver, operating under no signal conditions, is 1.2 amperes for the "A" battery and 21 milliamperes for the vibrator plate supply. Under signal conditions, when the efficient automatic volume control with which the set is fitted comes into operation, the current drains are reduced. Even under the rated figures, a service life of from four to five weeks with each charge of the "A" battery can be expected.

The sensitivity of the receiver is extremely high for a set of this type in which maximum performance has been sacrificed to ease of construction. It is from 20 to 40 microvolts throughout the tuning range.

A STUDY of the schematic circuit diagram will show that the receiver employs a fairly standard super-heterodyne circuit in which the four valves have their filaments wired in a series parallel arrangement in order to obtain the necessary voltage distribution from the 6-volt battery used with the vibrator unit.

The mixer tube is a 1C6, whilst the I.F. amplifier tube is a 1C4 operating at 462.5 k.c. The second detector is a 1K6 penthode, which operates as diode detector, automatic volume control tube, and first audio amplifier. The output tube is a 1D4 pentode.

The automatic volume control system has been designed to give full control of the receiver and to be free from the side-band "swish" which is so objectionable with many forms of a.v.c.

Full control is applied to the 1C6 mixer tube, and half control is applied to the i.f. stage. It is not altogether desirable to attempt to control the mixer tube, but as this receiver is intended only for broadcast operation, no serious frequency shifts will result from the a.v.c. action. At the same time the receiver will be protected, as far as possible, from r.f. overload due to strong signals.

The construction of the receiver is quite straightforward, as the following details will show:—

The chassis is made from 18-gauge aluminium and measures 12¼ x 7¼ x 2½ inches. A half-inch flap is allowed at each end so that the set can be screwed to a baseboard in a cabinet.

In laying out the chassis the gang condenser is mounted so that its shaft lies along the exact centre of the chassis. The condenser is placed back from the front so that the dial mounting plate will fit flush against the front wall of the chassis. It will be necessary to cut out a small piece of the front of the chassis to allow the dial mechanism to fit. If this is not done the gang condenser must be mounted on spacing washers. The volume control is mounted directly below the dial. If the fitting of these components is correct the dial and the volume control shaft will be in a vertical line at right angles to the top of the chassis.

The aerial and oscillator coils are mounted alongside the gang condenser so that the back of the condenser is in line with the centre of the oscillator coil can. Also in this line, but between the oscillator coil and the edge of the chassis is fitted the first I.F. transformer, IF1. A line should be ruled along the back of the top of the chassis. This line should be 1¼ inches in from the back edge. It will be the centre line for the I.F. valve, V2, the second I.F. transformer, IF2, and the detector valve socket, V3. The I.F. valve socket, V2, is placed on this line, and in line with the space between the oscillator coil and the first I.F. transformer. The second I.F. transformer is in line with the back of the gang condenser. The spacing between the centre of the socket for V2 and the centre of IF2 will be 3½ inches. The same distance is allowed between the centres of IF2 and the V3 socket.

The V1 socket is mounted in line with the centre of IF1 and the centre of the aerial coil can.

The socket for the output valve, V4, and the electrolytic condenser, C9, are mounted in line with the centres of IF1, the oscillator coil, and the end of the gang condenser. The centre of the V4 socket is 1½ inches in from the edge of the chassis. The speaker terminals are mounted in the corner of the chassis, as shown in the illustrations. The aerial and earth terminals, the power socket, and the battery lead grommet, are mounted along the back wall of the chassis. In mounting the sockets, see that the filament lugs of the V1 socket are the lugs nearest the end wall of the chassis. The filament lugs of the V2 and the V3 sockets are the lugs nearest the back wall of the chassis. The filament lugs of the output valve socket, V4, are those closest to the end of the chassis. This means that the sockets for V1 and V4 face in opposite directions.

The filament choke, FC, is placed near the output valve socket in the position shown in the photograph. The resistor R10 is mounted on the end wall of the chassis over the V2 socket.

Obtain a small piece of insulating material and mount a solder lug on it. The insulating strip is then mounted on the underneath side of the chassis, just behind the gang condenser. The hole for the mounting bolt is drilled a quarter of an inch back from the back of the gang condenser, and a quarter of an inch from the oscillator coil can.

In assembling the components, place a spring washer under each nut, so that the nuts will not work loose with vibration. Also place a solder lug under the nuts.

The ends of all the solder lugs should be lifted up from the chassis, and an earth network formed by soldering lengths of heavy gauge bare bus-bar from one solder lug to the next. Now solder a length of bus-bar to the wiping contacts of the gang condenser and connect the free end of this bus-bar to the earth network. The bus-bar will pass through a hole drilled in the chassis at the most convenient point. The wiping contacts on the gang condenser are the ones that bear against the moving plate

THE LIST OF PARTS AND SCHEMATIC CIRCUIT DIAGRAM

Needed to Build the Symphony Vibrator Four

CHASSIS: Measuring 12¼ inches by 7¼ inches by 2¼ inches.

COIL KIT: Consisting of iron-core aerial and oscillator coil with built in padder condenser (Airmaster).

C1, C2, C3, C14: .1 mfd. tubular condensers. (T.C.C.)

C4: .05 mfd. tubular condenser. (T.C.C.)

C5, C11, C13: .0001 mfd. mica condensers. (T.C.C.)

C6, C7: .02 mfd. tubular condensers. (T.C.C.)

C8: .006 mfd. tubular condenser. (T.C.C.)

C9: 500 mfd. 12 volt electrolytic condenser. (T.C.C.)

C10: .5 mfd. tubular condenser. (T.C.C.)

C12: .5 mfd. shielded tubular condenser. (T.C.C.)

DIAL: Radiokes type D.

F.C.: Special low resistance choke (Van Ruyten).

G1, G2: Type G two-gang condenser.

IF1, IF2: Air core battery, IF's (Airmaster).

R1: 250,000 ohm ½ watt resistor. (I.R.C.)

R2: 50,000 ohm ½ watt resistor. (I.R.C.)

R3: 20,000 ohm 1 watt resistor. (I.R.C.)

R4: 30,000 ohm 1 watt resistor. (I.R.C.)

R5, R6: 500,000 ohm ½ watt resistors. (I.R.C.)

R7: 1 megohm resistor. (I.R.C.)

R8: 250,000 ohm 1 watt resistor. (I.R.C.)

R9: 500,000 ohm ½ watt resistor. (I.R.C.)

R10: 16 ohm 300 milliampere wire wonnd resistor.

R11: 1 megohm 1 watt resistor. (I.R.C.)

R12: 100,000 ohm ½ watt resistor. (I.R.C.)

SOCKETS: 2 4-pin, 2 6-pin, 1 5-pin.

VC: 500,000 ohm potentiometer with switch. (Ferranti, I.R.C.)

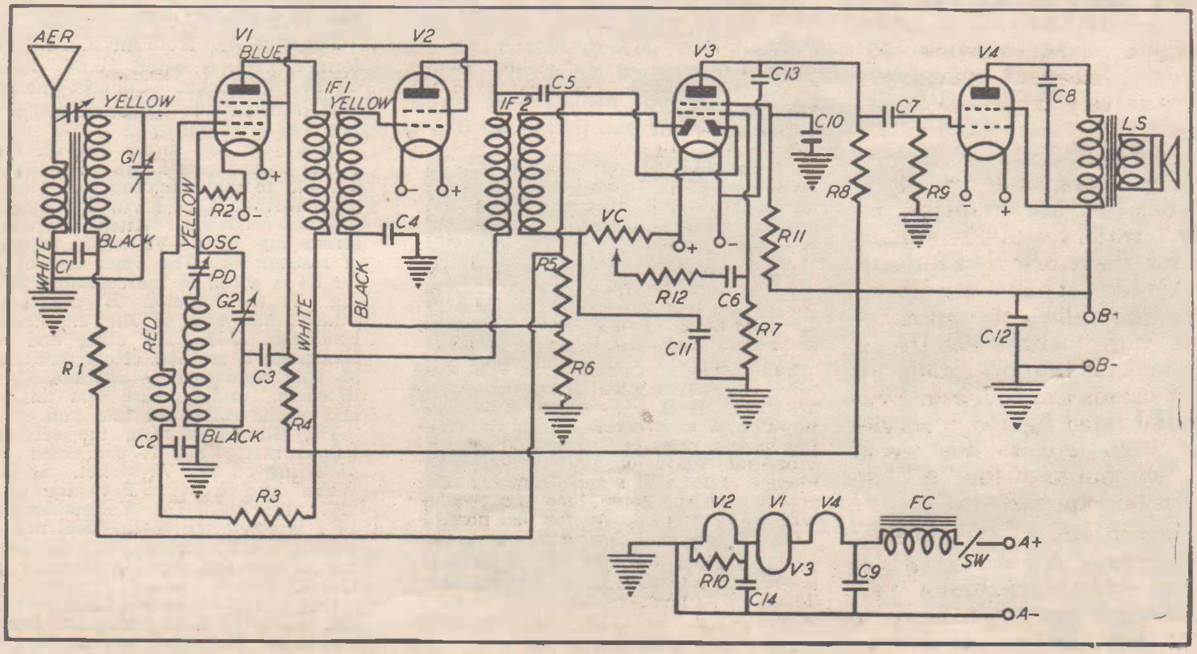
Sundries: Wiring flex, nnts and bolts, grid clips, shields, shielded wire knobs and terminals.

BATTERY: 6-volt accumulator. (Masse.)

VALVES: 1C6, 1C4, 1K6, 1D4.

SPEAKER: Permanent Magnet type to suit 1D4. (Rola.)

VIBRATOR: (Van Ruyten).



assembly. Do not earth the lugs on the bottom of the condenser, as they will not function if this is done. The filament circuits must be wired in the correct manner, or the set will be a failure. The various biasses are obtained by the voltage drop across the filament circuit of the set, and if the valves are incorrectly wired, the bias will be incorrect. For this reason, too, the specified valves must be employed.

The negative filament lug on the V2 socket is connected to the chassis and to one lug on the resistor, R10. The other lug on the resistor, R10, is connected to the positive filament lug on the V2 socket.

The negative filament lug on the V1 socket is connected to the negative filament lug on the V3 socket.

The positive filament lug on the V1 socket is wired to the positive filament lug on the V3 socket.

Connect the negative filament lug on the V1 socket to the positive filament lug on the V2 socket. Wire the positive filament lug on the V3 socket to the negative filament lug on the V4 socket. The positive filament lug on the V4 socket is connected to one lug on the filament choke, FC. The free end of the filament choke, FC, connects to one of the switch lugs on the battery switch SW.

Connect the positive of the electrolytic condenser, C9, to the positive filament lug on the V4 socket.. The negative of the electrolytic condenser, C9, is connected to the chassis. Connect one lug of the .1 mfd. condenser C14, to the positive filament of the V2 socket. The other end of the condenser, C14, is earthed.

All of this wiring is done with ordinary wiring flex, and is run around the channel formed by the top, sides and back walls of the chassis. Now connect the earth terminal of the set to the chassis.

Remove the coil can from the aerial coil. Unsolder the Shielded lead and connect a longer Shielded lead in its place. The other end of this lead is connected to the aerial terminal of the set. Earth the White lead from the aerial coil. Remove the Black aerial coil lead and solder one lead of condenser C1 to the lug from which you removed the Black lead. This is the low potential end of the secondary coil.

The Red lead from the oscillator coil is wired to the oscillator plate lug on the V1 socket. There will be two Yellow leads attached to the oscillator coil. One of these leads will come out through the top of the coil can, and the other lead will pass through the chassis. Connect the latter Yellow lead to the oscillator grid lug on the V1 socket. Connect one lead of the resistor, R2, to the oscillator grid lug on the V1 socket. The other end of the resistor, R2, is wired to the negative filament lug on the V1 socket. Make these leads as direct and short as possible. The Black lead from the oscillator coil is earthed.

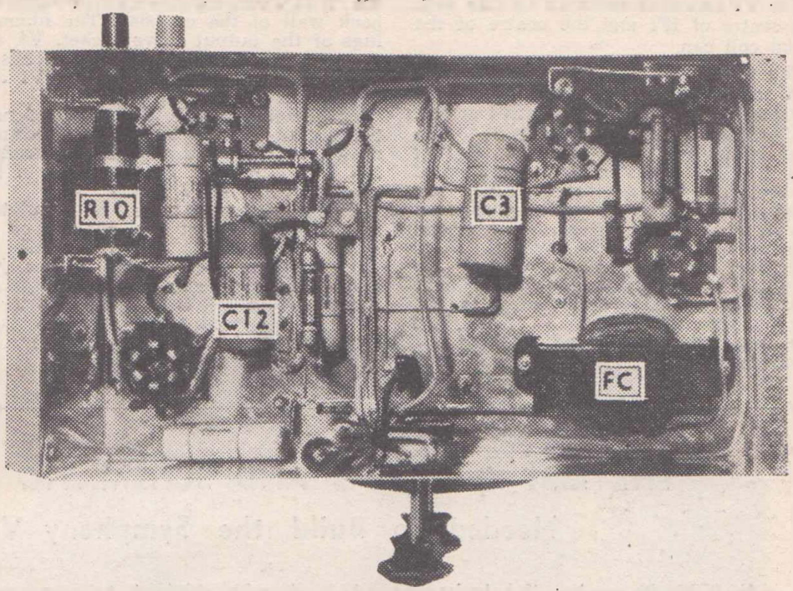
Connect one end of resistor R3 to the insulated solder lug that was mentioned in the assembly instructions. This lug should be spaced about half an inch off the chassis, and becomes the "B" plus lug. To the other end of resistor R3 connect the White lead from the oscillator coil and one end of condenser C2. Earth the other end of condenser C2.

The Blue lead from the first I.F. transformer, I.F.1, is wired to the plate lug on the V1 socket. Connect the White lead from I.F.1 to the common "B" plus lug.

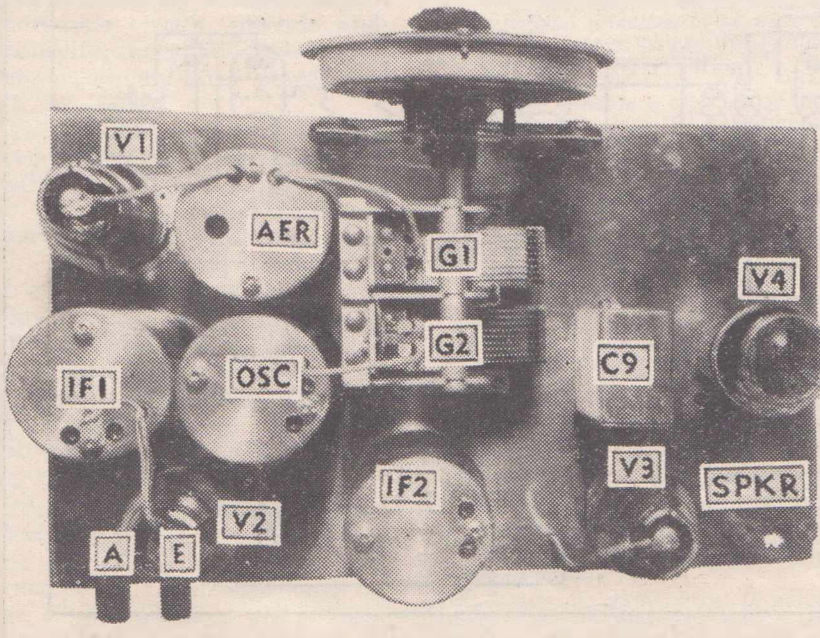
Now join the screen lug on the V1 socket to the screen lug on the V2 socket and to the latter lug attach one end of condenser C3. Earth the other end of this condenser. Then connect the screen lug on the V2 socket to one end of resistor R4. The other end of resistor R4 is wired to the common "B" plus lug. To the common "B" plus lug also attach one end of the non-inductive condenser, C.12. The other end of the condenser is earthed. Note that one end of this condenser is marked "connect to earth." and be sure that this is the end of the condenser that you earth.

The Blue lead from the second I.F. transformer, I.F.2, is connected to the plate lug on the V2 socket. Solder the White lead from I.F.2 to the common "B" plus lug. The Yellow lead from I.F.2 is connected to the detection diode lug on the V3 socket. This is the diode lug nearest the negative filament lug on the V3 socket.

One end of condenser C5 is soldered to the lug in I.F.2, to which the Blue lead connects. The other end of C5 has one end of resistor R5, one end of resistor R1, and a piece of flex soldered to it. The other end of the piece of flex is



Another photograph of the receiver illustrating the placement and wiring of parts below the chassis..



A keyed plan view of the receiver showing the arrangement of the component parts on top of the chassis.

wired to the second diode lug on the V3 socket.

To the free end of resistor R5 attach one end of resistor R6 and earth the other end of R6 to the metal framework of the I.F. transformer. Condenser C5 and resistors R1, R5 and R6 are all housed within the coil can of I.F.2. When placing the can back into position, make sure that none of the added components will touch the can. A length of shielded wire is attached to the free end of resistor R1, the metal braiding being earthed to the metal frame of the I.F.2 structure.

The other end of the braided lead is connected to the low potential end of the aerial secondary coil, in the aerial coil assembly. Earth the end of the metal braiding.

A lead is then attached to the junction of resistors R5 and R6 and connected to the lug in the first I.F. transformer, I.F.1, to which the Black lead is wired. Remove the black lead. To the lug just mentioned also wire one end of the .05 mfd. condenser, C4. Earth the free end of condenser C4.

Remove the Black lead of the second I.F. transformer, I.F.2, and connect a length of shielded wire to the lug from which you removed the Black lead. The other end of this shielded lead is wired to one of the outer lugs on the volume control. To this lug on VC attach one end of the RF by-pass condenser, C11. The other end of C11 is earthed. The remaining outer lug on the volume control, V.C, is connected to the positive filament lug on the V3 socket.

A resistor of 100,000 ohms, R12, has one end wired to the centre lug on the volume control. The other end of this resistor is soldered to one end of the tubular condenser, C6. The other end of condenser C6 has one end of resistor R7 soldered to it. Earth the free end of resistor R7. A length of shielded wire is attached to the junction of condenser C6 and resistor R7. This wire passes through a hole in the chassis near the V3 socket and terminates in a grid clip for attachment to the grid of V3.

Attach one end of condenser C10 to the screen lug on the V3 socket. Earth the other end of the condenser. To the screen lug on V3 also attach one end of resistor R11. The other end of this resistor is wired to the plate lug on the power socket. Connect the plate lug on the power socket to the screen lug on the V4 socket. A lead is then taken from the common "B" plus plug to the screen lug on the V4 socket. One lug of condenser C13 is soldered to the plate lug on V3. Connect the other lug of condenser C13 to the negative filament lug on the V3 socket.

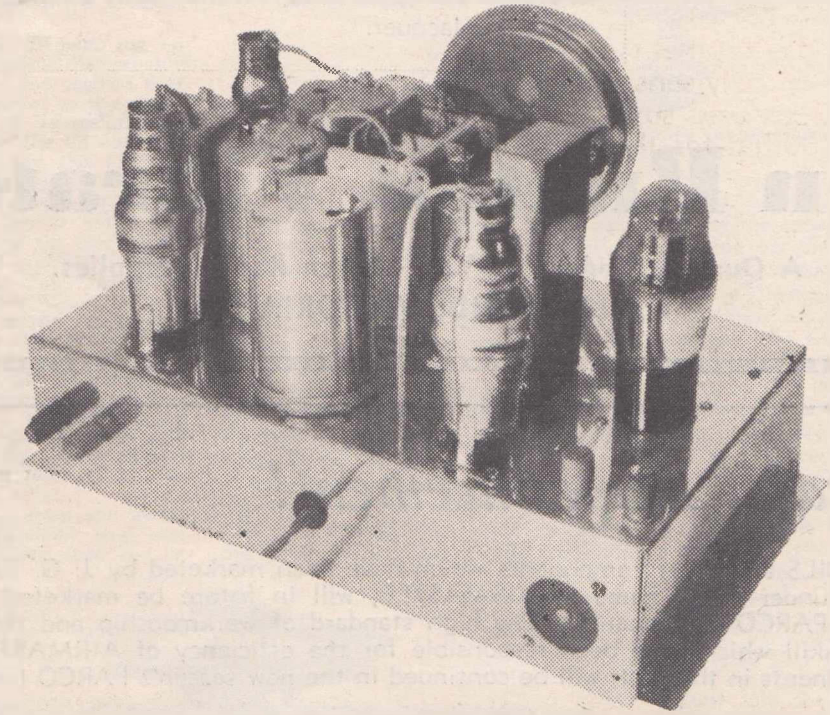
A further lead is taken from the screen lug on V4. This lead terminates at one of the speaker terminals.

Connect one end of resistor R8 and one end of condenser C7 to the plate lug on the V3 socket. The free end of R8 is wired to the screen lug on V4.

The free end of condenser C7 should be attached to the grid lug on the V4 socket. Earth one end of resistor R9 and connect the other end to the grid lug on V4. The plate lug of the V4 socket is wired to the free speaker terminal.

One side of condenser C8 is soldered to the plate lug on V4 and the other end of condenser C8 is taken to the screen lug on the output valve socket V4.

The filament lug next to the plate lug on the power socket is wired to the switch lug to which the choke, FC, connects. Join the other filament lug on the power socket to the cathode lug on the same socket and earth the junction.



At the rear of the set can be seen the aerial and the earth terminals, the vibrator power input socket, and the two "A" battery leads arranged along the rear side of the chassis.

A long length of shielded wire is attached to the free lug on the battery switch. This wire should be passed through the grommet in the back of the chassis and should be marked "A" plus for identification. Another long piece of shielded wire has one end earthed to the chassis. This wire is also passed through the grommet and should be marked "A" minus.

Turn the chassis the right way up, and connect one of the Yellow leads from the aerial coil can to the stator lug on the G1 section of the gang condenser. A grid lead is soldered to the other Yellow lead from the aerial coil can. The single Yellow lead from the oscillator coil can is attached to the stator lug on the G2 section of the gang condenser. A piece of metal braiding should be slipped off a piece of shielded wire. This piece of shielding is slipped over the Yellow lead that comes out of the top of the first I.F. transformer, IF1. Earth the shielding, and connect a grid clip to the end of the Yellow wire.

This completes the wiring of the set. The wiring should be thoroughly checked over before the set is tested.

The metal braiding on the braided wires should be attached to the earth network at a number of points to make it secure.

If all the wiring is correct, the valves and power plug may be plugged in. The speaker should be connected and the "A" minus battery wire connected to the negative of the "A" battery. The positive of the "A" battery carries the "A" plus battery wire.

The alignment of the set should be carried out with a signal generator and output meter, if maximum sensitivity is desired.

For the assistance of those who cannot have their sets aligned on a generator, we will describe the method used to align with the aid of broadcasting stations.

The I.F. transformers should be adjusted to 462.5 k.c. when they leave the factory, and the wiring process should not throw the calibration out very much.

Tune the set to a high frequency station, such as 3XY. Remove the trimmer from the G1 section of the gang condenser, and adjust the oscillator trimmer, G2, until the station comes in at the correct position on the dial. Now adjust the trimmer in the top of the aerial coil until best results are obtained. It may be necessary to drill a hole in the top of the aerial coil so that the screw will be accessible.

After these adjustments, turn the dial to a station such as 3AR, and adjust the padder for maximum results. The gang condenser should be slowly rocked across the signal as the padder is adjusted. The padder is adjusted by a screw-driver, and can be located inside the oscillator coil can. Holes are already drilled in this can.

Now re-tune the high frequency station, and slightly readjust the aerial trimmer for maximum results. The set should then be tuned to 3DB, and the I.F. transformer trimmers peaked on this station. The aerial for use with this set should be about 30 ft. high, and not more than 50 feet long. Make the aerial as high as possible, but keep the overall length of the aerial and lead in to 75 or 80 feet.

If the set is to be used near a broadcasting station, then the aerial for local reception should be a very small one, or the set will overload and distort.

The Air-Cell Battery 4

Employing "the air-cell," one of radio's latest developments for the man out-back, this extremely sensitive and selective four valve battery-operated superheterodyne receiver is admirably suited for the country listener.

THE man who is far removed from electric power facilities is very limited in his choice of a radio receiver for he must have a set that is sensitive and yet economical to operate. The initial cost of a receiver is not very high, but if the battery replacement cost is excessive, the whole proposition becomes prohibitive.

If an accumulator is employed to supply the filament current for a set then the set-owner must have a standby accumulator or must rent one while his normal accumulator is being charged, if he wants continuous reception. This cost must be added to the actual charging cost and the freight on the accumulator.

In many cases this type of filament supply is far too costly or impossible, so the set owner has recourse to dry cells. Now dry cells can be an expensive proposition, because battery valves are designed to operate from an accumulator, and the voltage from a bank of dry cells is not the same as that of the accumulator. This means that the valves must be either under powered if insufficient cells are used, or a wasteful resistance has to be used to cut down an excessive dry cell battery bank to the correct voltage.

Furthermore, the set owner has to trust that the batteries are fresh when sent to him or he will not get very long life from them. Lastly, if he orders a lot of cells so that he will reduce his freight costs he is liable to find that some of them have deteriorated by the time he wants to use them.

The newly announced Eveready Air Cell overcomes the weaknesses of both the accumulator and the dry cell.

THE Air Cell looks like an accumulator, but it is of radically different internal construction. The Air Cell comes sealed, and it will remain fresh indefinitely as long as the seals are not broken. To put the Air Cell into operation it is necessary only to fill it with water. It will immediately rise to full voltage, and will have a life of approximately 1200 hours of actual service at its maximum discharge rate. When it is completely discharged the Air Cell is discarded, as it cannot be recharged. The only care to be taken with it is to see that the level of the water is correct, an inspection once a month being ample.

The actual service life of the Air Cell is 600 ampere hours, which means that with the set to be described it will be possible to obtain almost a year's service from one Air Cell with a set in use three hours a day. It must be borne in mind that an Air Cell cannot be used with any battery set without alterations to the set.

The maximum current that can be taken from the Air Cell is 0.65 ampere, and its operating voltage varies between 2.53 volts and 2.25 volts, the latter figure being obtained at the end of the cell's life. Thus, if an ordinary battery set using two volt valves is used with an Air Cell, the valves will receive an excessive voltage, and their life will be shortened. Any receiver that is to be used with an Air Cell must have a small fixed resistance inserted in series with one of the "A" battery leads, so that the voltage at the filaments of the valves will be within reason.

If the precaution is taken of placing the correct value of resistor in series with one battery lead and the total filament drain of the receiver does not exceed 650 m.a., then an Air Cell can be used with any two-volt battery-operated receiver in place of the usual "A" battery. It must be borne in mind that the resistance of the battery leads and circuit wiring must be taken into account when calculating the value of resistance to be used.

"B" battery consumption is another important factor, as "B" batteries are expensive. If the total "B" battery consumption can be kept to less than 15 milliamperes, the set owner will be assured of long service from his batteries.

The set to be described has been designed to operate from an Air Cell and to have a very low "B" battery drain. Furthermore, it is sensitive and selective, and will bring in distant stations without interference from closer stations.

The set is a four-valve superheterodyne using a 1C6 as mixer, a 1C4 as I.F. amplifier, a 1K6 as combined diode detector, A.V.C. and pentode audio amplifier, and a 1D4 as pentode output valve. The valves are operated under economy conditions, with the result that the total "B" Battery drain is 12 milliamperes. The output valve is operated in an overbiassed condition in order to drop its plate current, and although this results in the drop of only a few milliamperes, it is a saving which helps to give longer "B" battery life.

A pre-selector circuit using iron-cored coils is employed while the intermediate trequency amplifier uses high gain battery type air cored transformers operating at 175 k.c.

In constructing this set be careful to follow the instructions exactly. Approximately 25 per cent. of the letters answered in the Trouble Corner show that the instructions have not been followed, and as a result the set builder finds that his set will not operate properly. Radio set building has long passed the stage when it was possible to substitute different lay-outs, resistors, condensers and valves. With high gain valves and coils it is imperative that lay-outs be followed exactly.

The gang condenser is mounted so that its shaft lies along the centre of the chassis. The condenser must be of the type having the trimmers at the top when the back of the condenser is to the right of the shaft. Then the coils can be mounted close to the condenser in order to keep the leads short. If the condenser is mounted so that the plates open between the condenser and the coils the leads will be so long that the set will oscillate.

The aerial coil is mounted near the front of the chassis and within half an inch of the gang condenser. Immediately behind it is the oscillator coil, and in line with both coils is the pre-selector coil. The two I.F. transformers and the valve sockets for V1 and V2 are mounted so that their centres are in line with each other and about one and a quarter inches in from the back of the chassis. The distance between the centres of these two valves and the I.F. transformers is 2¼ inches.

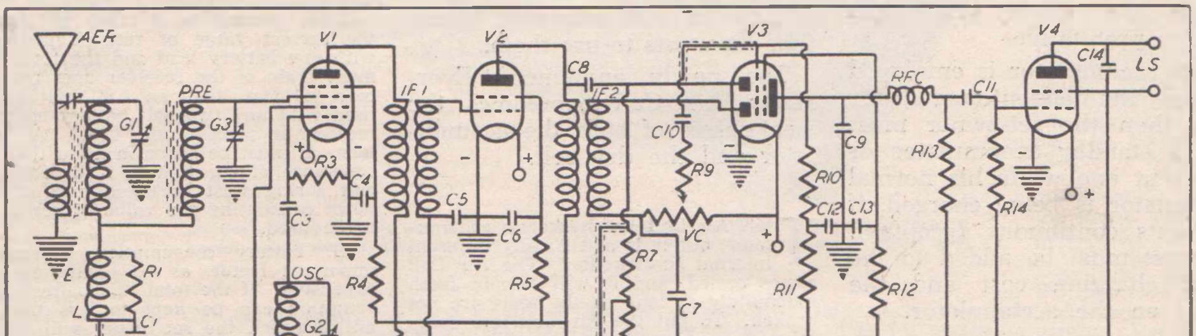
On the rear of the chassis are mounted the aerial and earth terminals and the battery socket. The two speaker terminals are fitted to the side walls of the chassis near the output valve.

The combined volume control and battery switch is placed underneath the dial, while the small coupling coil, L, is mounted underneath the chassis between the aerial and pre-selector coils. The radio frequency choke, RFC, is mounted under the chassis and alongside the plate lug on the V3 socket. Other components to be mounted directly to the chassis are the .005 mfd. condenser, C14, the .01 mfd. coupling condenser,

THE LIST OF PARTS AND SCHEMATIC CIRCUIT DIAGRAM

Needed to build The Air-Cell Battery Four

CHASSIS: 12in. x 8½in. x 3in., made from gauge 18 aluminium.
COILS: Aerial, pre-selector, and oscillator for 175 k.c. (Airmaster iron-core type).
C1, C2, C4, C6, C13: .1 mfd. tubular condensers (T.C.C.).
C3, C7, C8, C9: .0001 mfd. mica condensers (T.C.C.).
C5: .05 mfd. tubular condenser (T.C. C.)
C10, C11: .02 mfd. mica condensers (T.C.C.).
C12, C15: .5 mfd. tubular condensers
C14: .005 mfd. tnbular condenser (T.C.C.).
E1: 25 mfd. 35-volt electrolytic condenser (T.C.C.).
G1, G2, G3: Three-gang Stromberg Carlson type G condenser.
IF1, IF2: 175 k.c. air core I.F. transformers (Airmaster).
L: Coupling coil (part of coil kit).
R1: 25,000-ohm 1-watt resistor. (I.R.C.)
R2, R3, R4: 50,000-ohm 1-watt resistors (I.R.C.).
R5: 75,000-ohm 1-watt resistor (I.R.C.).
R6, R11: 250,000-ohm ½-watt resistors (I.R.C.).
R7, R8: .5-meg. ½-watt resistors (I.R.C.).
R9: .1-meg 1-watt resistor (I.R.C.).
R10, R14: 1-megohm 1-watt resistor (I.R.C.).
R12: .5 megohm 1-watt resistor (I.R.C.).
R13: .25-meg. 1-watt resistor (I.R.C.).
R15: 500-ohm 25 m.a. wire-wound resistor tappcd at 125 ohms.
R16: 0.7-ohm wire-wound resistor to carry 1 amp.
RFC: Radio frequency choke.
VC: 500,000-ohm volume control, with battery switch (I.R.C.).
Valves: V1, 1C6; V2, 1C4; V3, 1K6; V4, 1D4, and sockets. ... ... V4, 1D4, and sockets (Ken-Rad. Philips, Radiotron, Raytheon).
Sundries: 1 dial, 1 4-pin plug and socket, 3 grid clips, 4 terminals, 3 valve shields, nuts and bolts, solder lugs, wiring flex, shielded wire, 1 "Air-cell" "A" battery, 3.45-volt H.D. "B" batteries (Diamond, Ever Ready), 1 permagnetic speaker to match 1D4 valve (Rola).



C10, and the automatic bias resistor, R15.

Condenser C14 is bolted to the bottom of the chassis in the space between the front wall and the V4 socket. Condenser C10 is mounted on the back of the front wall near the volume control, while resistor R15 is bolted to the chassis bottom about one inch from the centre line of the chassis and the V3 and V4 sockets. If resistor R16 has mounting lugs it can be mounted on the back wall of the chassis near the battery socket.

Mount the sockets for V1 and V2 so that the filament lugs will be nearest the back wall. The other two valve sockets are placed so that the filament lugs are nearest to the end wall. The filament lugs on the sockets are those lugs which correspond to the two large holes in the socket. The battery socket will correspond to the V2 socket for markings.

In bolting down the various components place a solder lug underneath each nut.

Join all the solder lugs together with pieces of tinned 16 gauge bus-bar. The bus-bar should be straightened before wiring it into position. Connect this earth network to the set's earth terminal. Also connect the wiping contacts on the gang condenser to earth. If this is not done the set may oscillate.

Any reference in the wiring to the earthing of a component means that the component is connected to the earth network. Connect the negative filament lug on each valve socket to earth. Join the negative filament lug on the battery socket to one side of resistor R16. The other lug on this resistor is earthed.

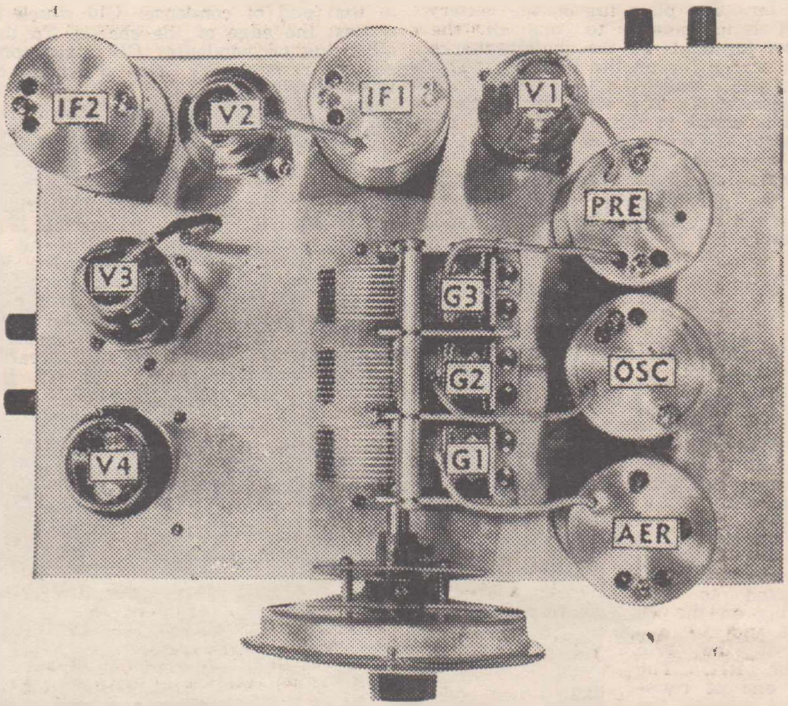
Connect together the positive filament lugs on each of the valve sockets. The positive filament lug on socket V1 is then wired to one of the lugs on the battery switch. The other battery switch lug is connected to the positive filament lug on the battery socket.

Next remove the shielded wire from the aerial coil and substitute a longer one. Connect the free end of this wire to the aerial terminal of the set, earthing the braid in several places. The other wire from the aerial coil must be earthed.

Connect the Yellow lead from the grid end of the secondary of the aerial coil assembly to the stator lug on the G1 section of the gang condenser. The other end of the secondary coil is connected to the nearest lug on the coupling coil, L. While the coil can is off the aerial coil, drill a quarter inch hole in the top of the can over the adjusting screw of the small trimmer condenser which is built into the coil assembly. The lead to the G1 section of the variable condenser is taken out through the top of the coil can.

The Yellow lead from the pre-selector coil is taken through the top of the coil can to the stator lug on the G3 section of the gang condenser. Another lead is taken from the grid end of the pre-selector coil, out through the top of the can and terminated in a grid clip for attachment to the grid of VI.

The other end of the pre-selector coil is wired to the lug on the coupling coil to which the grid return of the secondary coil has already been wired. Then wire one end of resistor R1 to one lug on the coupling coil, L, and wire the other lug on this coil to the free end of resistor R1. To this lug also connect one end of the by-pass condenser, C1. Earth the free end of condenser C1.



This plan view of the receiver illustrates the arrangement of parts on top of the chassis. All components are key-lettered to correspond to the written description of the set.

Connect one end of resistor R3 to the oscillator grid lug on the V1 socket. Earth the free end of R3. To the oscillator grid lug on the V1 socket also attach one lug of the grid condenser, C3. The other lug on condenser C3 is wired to the grid end of the oscillator coil (Yellow lead). The padder condenser PD, is built into the oscillator coil and is already wired into circuit.

The plate end of the oscillator plate coil is connected to the oscillator plate lug on the V1 socket. Next connect the stator of the G2 section of the gang condenser to the grid end of the oscillator grid coil by taking the lead through the top of the coil can.

Connect the plate end of the primary of IF1 (Blue lead) to the plate lug on the V1 socket. The other end of the primary of IF1 is connected to the plate lug on the battery socket. One end of resistor R4 and one end of condenser C4 are joined to the screen grid lug on the V1 socket. Earth the free end of condenser C4.

The free end of resistor R4 is connected to one end of resistor R2, and the junction is wired to the plate lug on the batery socket, this being the "B" plus battery lug. One end of condenser C2 is earthed, and the other end connected to the free end of resistor R2. This junction is then wired to the "B" plus lead from the oscillator plate coil (White lead). This group of condensers and resistors can be seen in the photograph between the V1 socket and the chassis wall.

The grid end of the secondary of IF1 is wired to a grid clip, so that it can be connected to the grid of V2. The low potential end of the secondary of IF1 is wired to a Black lead. This lead is connected under the chassis to condenser C5 at a point where the Black lead emerges through the chassis. Earth the free end of condenser C5.

Remove the can from the second I.F. transformer, IF2, and solder one lug on condenser C8 to the lug on the trimmer condenser, which corresponds to the plate end of the primary winding of the transformer. A Blue lead will have been wired to this point by the coil maker. To the other end of condenser C8 attach one end of resistor R7, one end of resistor R6, and a length of Green wire. To the free end of resistor R7 attach one end of resistor R8, and earth the free end of resistor R8 to the framework of the coil assembly.

Attach a length of Red wire to the junction of R7 and R8. Note that resistors R6, R7 and R8 are all of the ½ watt type.

The Green lead is connected to the positive diode lug on the V3 socket. The Red lead goes to the junction of condenser C5, and the Black lead from IF1. The high potential end of the secondary of IF2 is wired to the negative diode lug on the V3 socket. A length of shielded wire is connected to the free end of resistor R6. This shielded wire is taken along the back of the chassis, and then up to the coupling coil, L, where it is connected to the junction of L and condenser, CI. Earth the braiding in several places.

Remove the Black lead from the low potential end of the secondary of IF2, and substitute a length of shielded wire. This wire is taken along the back of the chassis and then along the centre of the chassis to the volume control. It is connected to the right-hand volume control lug, looking at the volume control from the back. The "B" plus end of the plate coil of IF1 has a White lead coming from it. This lead is wired to the plate lug on the battery socket. The remaining outer lug on the volume control is wired to the positive filament lug on the V3 socket.

At this point it is advisable to start the wiring of the last stage valve, and work backwards, as the assembly will be easier. The plate lug on the battery socket is connected to one of the speaker terminals on the chassis, thence to the screen lug on the V4 socket. This lug is also connected to one lug on the condenser, C14. The other speaker terminal is wired to the plate lug on V4, thence to the free lug on condenser C14. Now wire one lug of the RF choke to the plate lug on the V3 socket.

To the plate lug on the V3 socket also attach one lug of the condenser C9. The other lug on this condenser is soldered directly to the negative filament lug on the V3 socket.

To do this the lugs on condenser C9 are bent so that the condenser fits right across the socket.

To the free end of the RF choke, RFC, attach one end of the plate resistor, R13, and one lug of the coupling condenser, C11. The free end of resistor R13 is wired to the speaker terminal which connects to the screen lug on the V4 socket. The remaining lug on condenser C11 is connected to the grid lug on the V4 socket and to one end of the grid resistor, R14. The other end of resistor R14 goes to the end of resistor R15 nearest the volume control. Also attach a wire to this end of resistor R15 and wire it to the grid lug on the battery socket. Now connect the negative of the electrolytic condenser, E1, to the same point on R15. Earth the positive of E1 and the other end of R15.

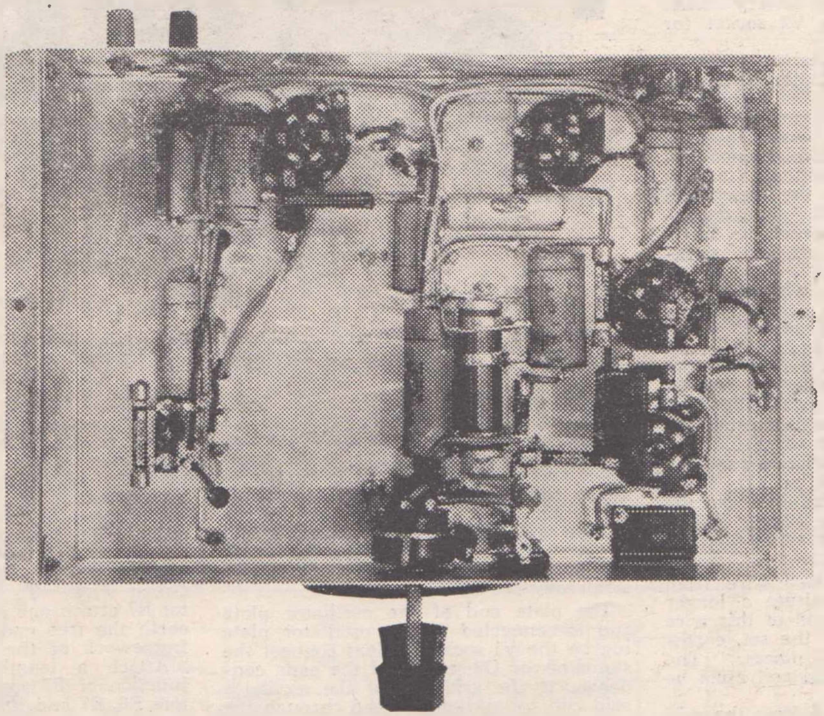
Connect one side of condenser C6 to the screen lug on the V2 socket and earth the free end of the condenser. One end of condenser C13 is then attached to the screen lug on the V3 socket and the free end of the condenser earthed. One end of resistor R5 is attached to the screen lug or socket V2 and the other end of the resistor wired to the screen lug on the V4 socket. One end of resistor R12 is soldered to the screen lug on the V3 socket and the other end of resister R12 goes to the screen lug on the V4 socket.

In practice resistor R11 passes under resistor R13, the plate coupling resistor, and between the RF choke and the wall of the chassis. Resistor R5 is placed parallel with resistor R12, but is located on the opposite side of the RF choke.

One lug on condenser C7 is wired to the volume control lug to which the shielded wire connects. The other lug on condenser C7 is earthed to one of the bolts which secures condenser C10 to the front chassis wall.

The volume control is mounted with the lugs towards the bottom of the chassis. One end of resistor R9 is wired to the centre lug on the volume control and the free end of this resistor is taken to that end of condenser C10 which is nearest the edge of the chassis. To the other lug on condenser C10 attach one end of resistor R10 and a length of shielded wire.

Take the shielded wire down the centre of the chassis, alongside the wires to the volume control, the battery switch, and resistor R15. It is taken to within about three inches of the back wall of the chassis, then bent at right angles until it meets the V3 socket. A hole is drilled in the chassis about a quarter of an inch away from the V3 socket, and the shielded wire is passed through this hole. Solder a grid clip to the end of the braided wire for connection to the grid of the V3 valve. Solder the shielding on the wire to earth in several places.



Another photograph of the receiver showing the placement and wiring of parts below the chassis. This illustration should be closely studied before the construction of the set is commenced.

The free end of resistor R10 is attached to one end of resistor R11 and one end of condenser C12. Earth the free end of condenser C12 and connect the free end of resistor R11 to the tap on resistor R15.

To complete the wiring, solder one end of condenser C15 to the plate lug on the battery socket. Earth the other end of condenser C15.

Most of the wiring is passed around the back wall of the chassis, the end wall with the speaker terminals, and along the line of solder lugs under the coil holding nuts. Some of it also passes down the centre of the chassis as described.

The battery cable is made up of four leads attached to a four-pin plug. A Red lead connects to the positive filament pin, a Black lead to the negative filament pin, a Green wire to the plate pin, and a Brown lead to the grid pin.

The Red lead is "A" battery postive, the Black lead is "A" battery negative, the Green lead is "B" battery positive, and the Brown lead is "B" battery negative. The Red and Black leads must be five feet in length and must be standard 10-strand Beldon hook-up wire. If other wire is used or different lengths are employed, the valves will not receive the correct filament voltage.

In this set we have calculated the filament resistance values so that the valves will be operating with 2 volts on the filament with the air cell in a half-exhausted condition. When the air cell is nearing the end of its life the voltage at the valve filaments will be a little under 2 volts, but this is not detrimental to them.

A pilot light must not be used with the set or the current drain on the air cell will be too great. Three 45-volt "B" batteries are required for the HT supply. These batteries are connected in series.

When the set has been completed and the wiring checked, the batteries, valves, and speaker should be connected. Attach a good earth to the earth terminal and use a good aerial wired to the aerial terminal.

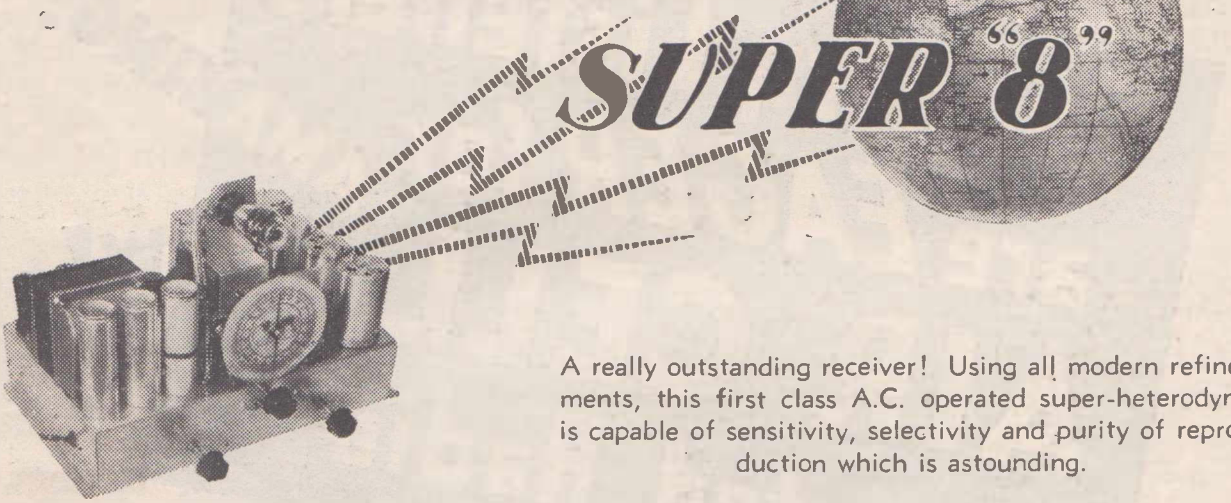
With the set switched on, the junction of resistors R15 and R11 should show 1.5 volts negative with respect to the chassis. The junction of R15 and R14 should show six volts negative with respect to chassis. If these values are not obtained with a "B" battery drain of 12 m.a., the clips on the resistor R15 should be altered to give the indicated voltage. In ordering resistor R15 it would be advisable to specify a resistor of 500 ohms with the clip in position. If this is not done, you may receive a resistor in which the shorting effect of the clip has not been allowed for, and as a result the total resistance is less than 500 ohms.

The IF transformers should be aligned to 175 k.c., as has been described on many occasions. Then the RF portion of the set is aligned. Tune to a station low down on the dial. Remove the trimmer from the G1 section of the gang condenser. The oscillator trimmer on G2 is adjusted to set the station at the desired point on the dial, and then the trimmer on G3 and the trimmer in the aerial coil can be adjusted for maximum volume.

Then tune in a station near the top of the dial and adjust the padder in the usual manner.

It will be found that, although the set is very selective, the tone is quite good, The aerial should be as high as possible, and the flat top about 50ft. long. If the many little wiring precautions described are followed, the set-builder will have a very sensitive receiver that will not squeal through unwanted regeneration. He will also find that the set is very light on batteries, and is a worth-while proposition for any country listener.

GLOBE GIRDLER "SUPER 8"



A really outstanding receiver! Using all modern refinements, this first class A.C. operated super-heterodyne is capable of sensitivity, selectivity and purity of reproduction which is astounding.

HERE is a receiver into the design of which we have put an extraordinary amount of effort in the endeavor to develop a set which would combine sensitivity with real tonal quality. So successful have our endeavors been that we claim the set represents the very best obtainable with existing equipment and could only be bettered with the use of more valves and with a re-designed i.f. amplifier system.

This is no fairy story. Careful measurements have proved the set to be excellent from the viewpoint of tonal quality. The combination of the A.W.A. Inverse-feedback system and a really distortionless diode second detector has reduced harmonic distortion to a negligible proportion. The power output under normal operating conditions reaches a maximum of some four watts, a figure which can only be exceeded with similar distortion-free characteristics by a pair of 45's in push-pull.

Employing a triple wave system the set tunes from 9 to 75 metres and from 200 to 550 metres. Change-over from one band to another is effected by means of a conventional switch system. Despite the wide frequency range covered on the short-waves the receiver's sensitivity is really high and exceeds that of most conventional dual or all-wave sets.

This is due to the care taken in the design of the tuning system as well as to the selection of valves used in the receiver.

The latter are of the metal type and include the 6L7 injector-mixer tube. A separate oscillator provides more stable operation on the short-waves and enhances the set's sensitivity by permitting a higher conversion gain from the 6L7 than would be possible were a 6A7 mixer tube used to replace it and 6C5. The 6C5 separate oscillator is working under modified electron-coupling conditions, a fact which results in extreme stability and extensive wage range coverage.

WE do not claim that this receiver is an easy one to build. The construction and wiring into circuit of the short-wave coils is a task which well may daunt the novice. However, for the experienced constructor the job will not present any real difficulty and he will have the reward of knowing that he has built an ultra-modern set whose performance cannot be duplicated by any other type of commercial or home-built set of similar dimensions.

Apart from the employment of the separate oscillator and the 6L7 mixer tube the r.f. section of the receiver has no particularly outstanding features. The coil design, however, is responsible for most of the short-wave efficiency.

It is in the audio section of the set that greatest care has been taken. An examination of the second detector and audio circuits will reveal apparently complex circuiting, but a short explanation of the whys and wherefores of the various components will speedily prove the simplicity of this section of the set.

First let us explain that sensitivity has been sacrificed to fidelity in the second-detector-audio stages of the set. By changing the values of a few components and by revising the circuit slightly it would be possible to increase the gain tenfold. On the other hand, this increase in gain would be attended by a corresponding drop in tonal quality. As the receiver is we claim that the reproduction is well nigh perfect as far as the audio channel is concerned.

The sacrifice of sensitivity has been made mainly in the second detector stage. It will be noticed that a 6H6 double diode tube has been used. The idea of this is to confine the function of detection to an entirely isolated tube and thus to prevent the r.f. component of detection from entering the audio circuit, as it would if a diode-triode or diode-pentode were used. This tube also possesses the advantage that it simplifies the a.v.c. system and readily enables delay voltages to be applied to it without complicating other parts of the circuit.

The loss characteristic is due to the use of an extremely low load resistor. The normal diode load resistor has a value of 500,000 ohms. Under these conditions the diode, contrary to the belief held by most radio technicians, is not linear and is incapable of handling deeply modulated signals without distortion. Furthermore, the shunting effect of the grid resistor in the audio circuit unbalances the detection characteristic by varying the diode load resistance. That is a rather broad way of discussing the matter, but in effect is what happens.

By reducing the value of the diode load resistor and keeping that of the audio grid resistor high, the parallel resistance of the two is not materially changed. However, less voltage is developed by a given current flowing through 1000 ohms than is developed through 10,000 ohms. Consequently the available detection voltage, and thus the voltage fed to the audio circuit, is lowered when a low value diode load resistor is used.

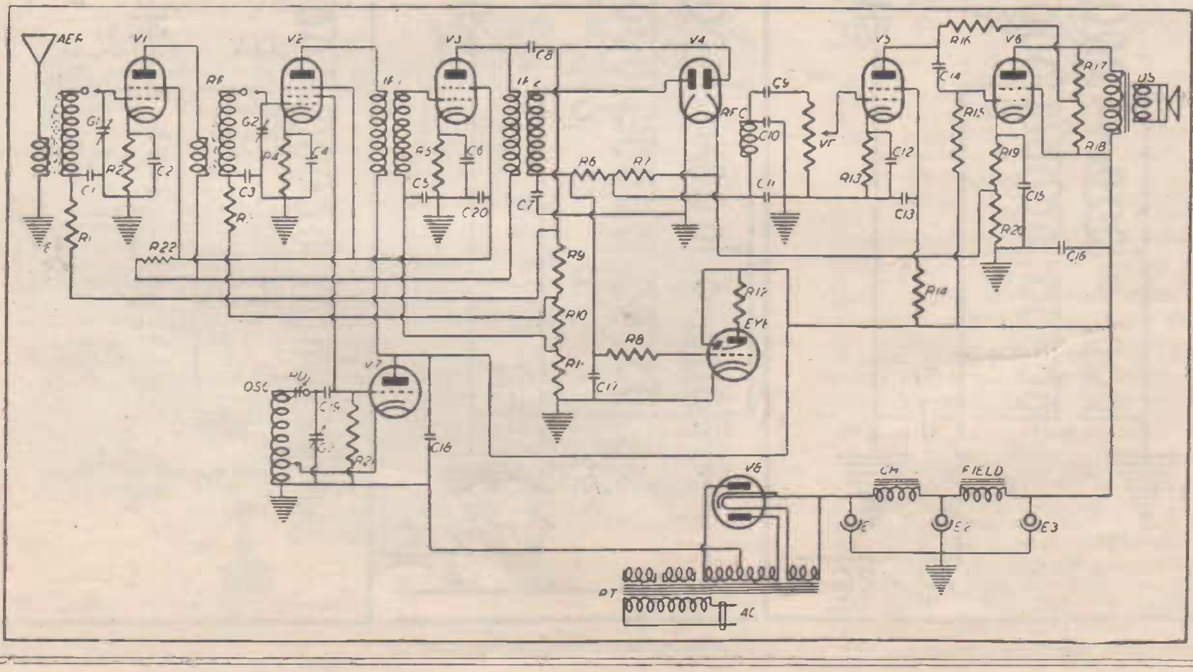
With the idea of still further improving the detection characteristic by ensuring that the diode shall work on a favorable point on its operating curve, the load resistor has been split and only a portion of the rectified voltage is fed to the audio amplifier.

In the present case the proportion is 5-6th. Naturally, the output of a diode, although preceded by sensitive i.f. and r.f. amplifiers, is insufficient to drive the average pentode even on the powerful signals of local stations. Consequently it is necessary to include a high-gain driver audio stage between the diode and the output tube. Because Inverse-Feedback, with its resultant power wastage, is used it is essential that the audio driver shall have exceptionally high gain. This is achieved by employing a 6J7, the metal tube replica of the 57 and the 6C6.

The output tube is a 6F6, glass type 42. The 6J7 is operated under normal voltaging conditions, as is the 6F6. It will be

The List of Parts and Schematic Circuit Diagram Needed to build THE GLOBE GIRDLER SUPER "8"

CHASSIS: Measuring 14 inches by 9½ inches by 3 inches.
COIL KIT: Consisting of Iron-core Aerial, R.F., and Oscillator coils for 465 K.C. (Airmaster).
Short-wave Coils: See Text.
C1, C2, C4, C6, C13: .1 mfd. tubular condensers. (T.C.C.)
C3: .05 mfd. tubular condenser. (T.C.C.)
C5: .02 mfd. tubular condenser. (T.C.C.)
C7, C8, C11, C19: .0001 mfd. mica condensers. (T.C.C.)
C9, C14, C17: .02 mfd. mica condensers (T.C.C.)
C10: .00005 mfd. mica condenser. (T.C.C.)
C12, C15: 25 mfd. 35 volt electrolytic condensers. (T.C.C.)
C16, C20: .5 mfd. tubular condensers. (T.C.C.)
C18: .01 mfd. mica condenser. (T.C.C.)
CH: Special low resistance filter choke (Lewbury).
DIAL: To suit gang condenser.
DS: Dynamic speaker 2500 ohm field to suit 6F6 (Rola).
E1, E2, E3: 8 mfd. 500 volt electrolytic condensers. (T.C.C.)
G1, G2, G3: Three gang type F condenser without trimmers (Stromberg Carlson).
IF1, IF2: 465 K.C. air core intermediate frequency transformers (Airmaster).
PADDERS: See Text.
PT: Power transformer, 385-0-375, 5 volt 3 ampere, 6.3 volt 3 ampere, 6.3 volt 3 ampere.
R1, R3: 250,000 ohm ½ watt resistors. (I.R.C.)
R2, R4, R5: 350 ohm 25 milliampere wire-wound resistors.
R6: 10,000 ohm ½ watt resistor (I.R.C.)
R7, R21: 50,000 ohm ½ watt resistors. (I.R.C.)
R8: 2 Megohm 1 watt resistor. (I.R.C.)
R9: .5 Megohm ½ watt resistor. (I.R.C.)
R10: 300,000 ohm one watt resistor. (I.R.C.)
R11: 200,000 ohm 1 watt resistor. (I.R.C.)
R12, R15: 1 megohm 1 watt resistors. (I.R.C.)
R13: 2000 ohm 25 milliampere wire-wound resistor.
R14: 1.5 megohm 1 watt resistor. (I.R.C.)
R16: 250,000 ohm 1 watt resistor. (I.R.C.)
R17: 100,000 ohm 1 watt resistor. (I.R.C.)
R18: 11,000 ohm 1 watt resistor. (I.R.C.)
R19: 350 ohm 100 milliampere wire-wound resistor.
R20: 50 ohm 100 milliampere wire-wound resistor.
SOCKETS: 8 Octal sockets, 1-6 pin socket, 1-4 pin socket (Tasma).
VALVES: 2-6K7, 1-6L7, 1-6H6, 1-6J7, 1-6F6, 1-6C5, 1-5Z4, and a 6E5 magic Eye. (Kenrad, Philips, Radiotron, Raytheon.)
VC: 500,000 ohm potentiometer. (Ferranti.)
SW: Three gang 5 contact wave change switch. (Yaxley.)
SUNDRIES: Wiring flex, nuts and bolts, magic eye mounting bracket, shielded wire, solder lugs, a small quantity of tinned wire, 4 metal valve grid clips, 3 knobs, 3 insulated terminals, a 6 inch length of good quality ¾ inch diameter former, a reel of 22 gauge tinned copper wire, a reel of 26 D.S.C. wire, a small quantity of 34 gauge D.S.C. wire, aluminium shields, 8 M.E.C. type trimmer condensers, a rubber grommett, and a length of power flex.



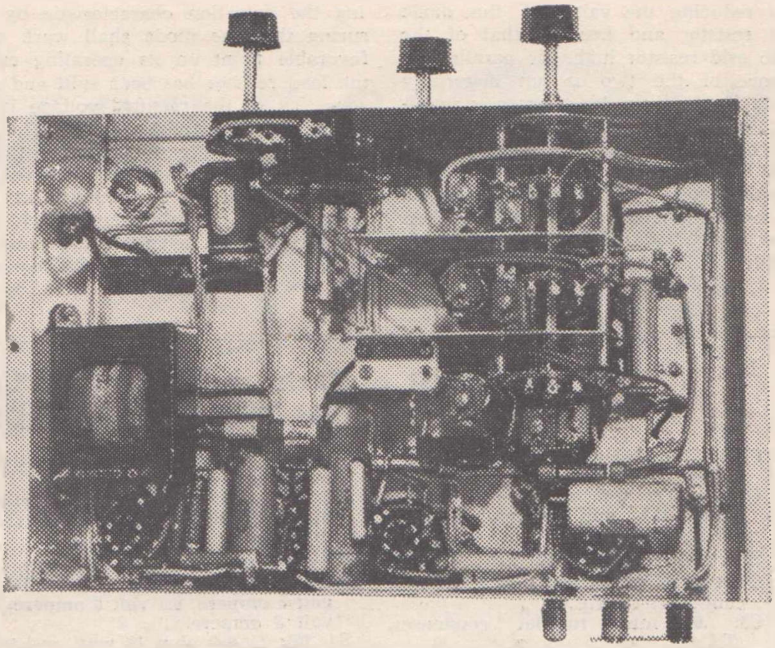
noticed, however, that extreme care, as evidenced by the inclusion of a doubly by-passed radio frequency choke, has been taken to ensure that no r.f. shall enter the audio system.

In order still further to increase the potential developed across the detection diode, the diode load resistor has been returned to positive point on the bias resistor for the 6F6. This has the effect of applying a potential of nearly two volts to the detection diode. This, with the incoming signal, means that there will be something like 12 volts developed across the diode load resistor under normal local signal conditions. The result is that detection or demodulation is linear and the tonal quality is considerably improved.

Since we developed this method of detection the A.W. Valve Co. has produced an almost identical circuit which it claims is to all intents distortionless.

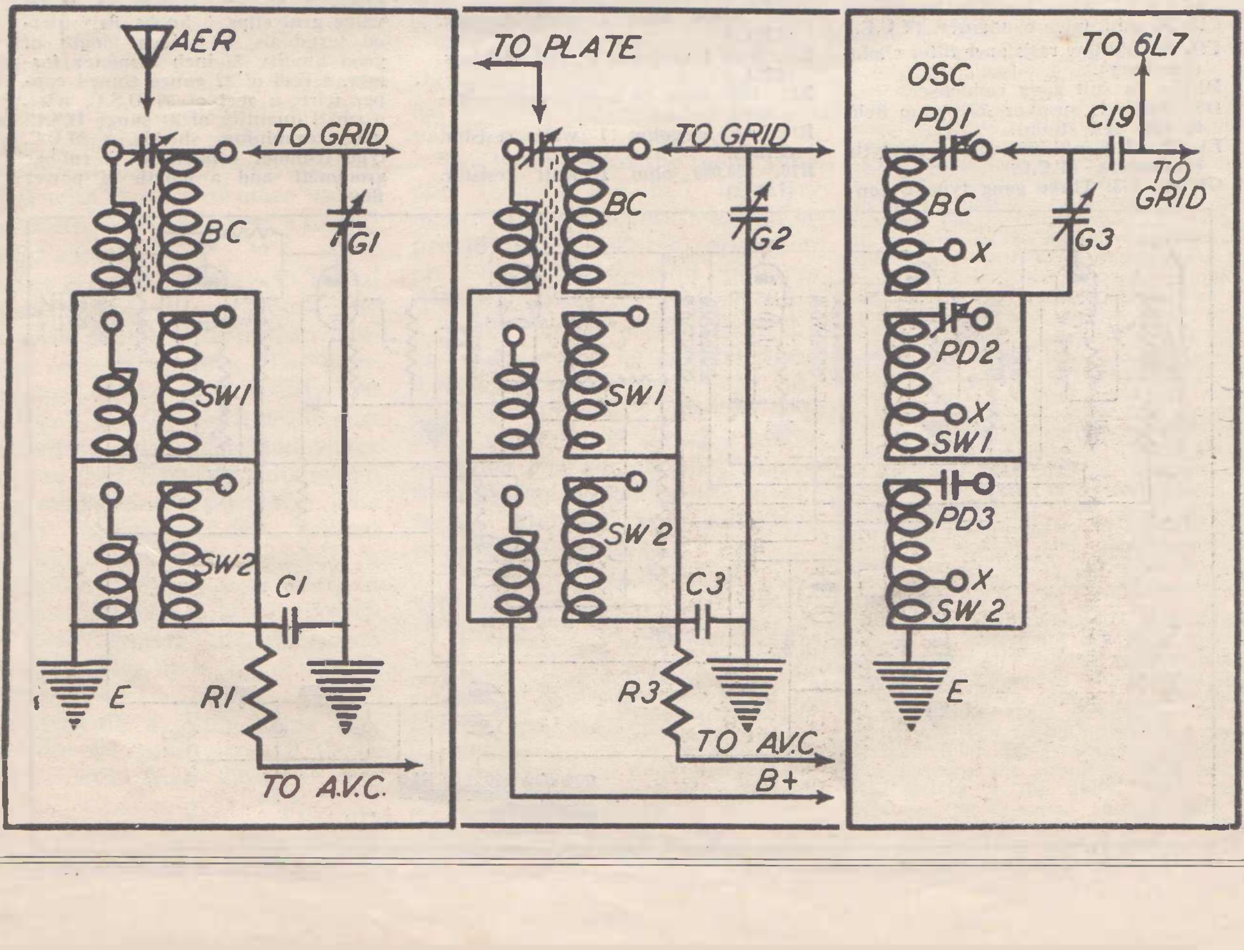
Bearing this in mind, we believe that the overall distortion of the detector-audio system used in the present receiver is less than 4 per cent. as compared with the normal 30 per cent. distortion encountered even in allegedly high quality pentode output sets.

Our curves show that, fed into a resistive load, the audio side of the receiver is flat within 1 d.b. from 50 to above 10,000 cycles. The comparatively poor performance under actual reception conditions is due to the selectivity of

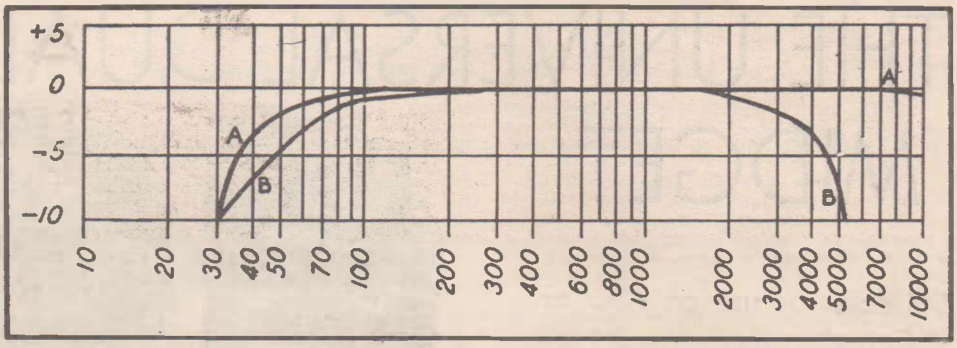


Another photograph of The Globe Girdler Super "8." This illustration shows the wiring and placement of parts below the chassis.

Circuit Diagrams of the Coils and Multi-Switch Wiring Connections



Two interesting curves which will give the reader an idea of the remarkable tonal quality which can be obtained from this receiver. Curve B is the overall response of the receiver, whilst Curve A is that of the audio frequency section of the circuit. Both readings were taken with the output of the receiver fed into a resistive load.



the r.f. and i.f. amplifiers, and points out the necessity for band widening.

However, many people who profess to be good judges of tone quality may consider that the "highs" predominate in this receiver. To these our answer is to employ a baffle capable of reproducing the now notes in their true perspective. Possibly an acoustic labyrinth is the most compact and economical way of overcoming this difficulty of adequate low note response.

For goodness sake, bearing in mind our statements regarding the response characteristics of the audio section of the set, don't attempt to fit a tone control.

A complete analysis of the audio system will show that one section of the twin diode 6H6 is employed as a detector, whilst the other functions as the a.v.c. rectifier tube. The diode load, comprising the 10,000 and 50.000 ohm resistors, R6 and R7, has been made abnormally low in order to reduce distortion. From the junction point of these resistors the audio signal is fed off through the r.f. choke. RFC, and the .02 mfd. coupling condenser, C9, to the grid of the driver audio tube, V5.

The detection diode of the 6H6 has its cathode returned to ground, but for reasons already mentioned the diode load resistor is returned to the a.v.c. cathode, which is operated at a point some 2 volts above ground. The latter potential is obtained by returning the second cathode of the 6H6 to a 50 volt section of the 400 ohm. bias resistor for the 6F6.

Note that the grid feed to the magic eye tube, 6E5, is carried through a decoupling network comprising the 2 megohm resistor, R8, and the .02 mfd. by-pass condenser, C17. The Inverse Feedback system used in the final audio stage is a normal one and provides about .10 per cent. feedback.

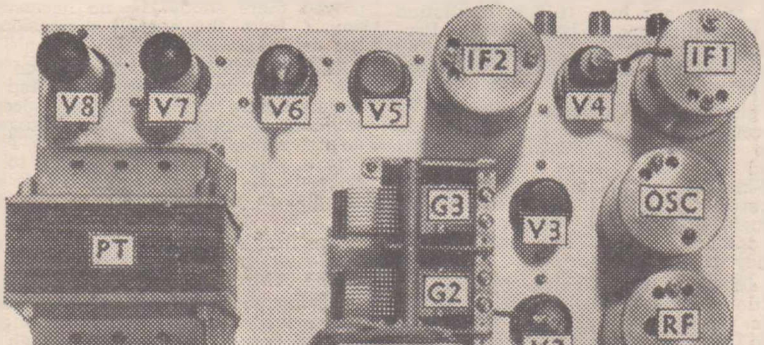
In a high quality high gain receiver it is essential that due care be taken with the a.v.c. system. The main thing to guard against is distortion due to the fact that large signal voltages are applied to valves operated in an overbiassed condition. In the present arrangement it is the 6K7 i.f. amplifier tube which has to be watched.

It is never desirable to apply a.v.c. to a standard mixer tube such as a 6A7, but with the 6L7 injector type tube no frequency drift or similar trouble is likely, even on short-waves, when a.v.c. is applied. It will be seen that control is effected on three tubes. The full a.v.c. voltage is applied to the r.f., 6K7. Half the control voltage is applied to the 6L7 and one-fifth of the a.v.c. voltage is applied to the 6K7 i.f. tube. This is done by means of the potentiometer formed by the three resistors, R9, R10 and R11. Note also that the by-pass condensers, C1, C2 and C5, have been similarly proportioned. Under this method of a.v.c. full but not over-control is obtained and the 6K7 i.f. tube is never fed with a strong signal whilst it is overbiassed.

Each of the three controlled tubes is initially biassed by means of its cathode resistor.

In the oscillator stage, it will be seen that a modified form of electron coupling has been employed. In this arrangement the necessary feedback has been obtained by returning the oscillator tube cathode to ground through a portion of the grid coil. Under these conditions it is necessary for the padder condenser to be placed in the "high" side of the circuit. Fixed padding is used on the high frequency s.w. band, but variable padders are used on the low frequency and broadcast bands.

In any high quality receiver, where the low note response is likely to be good, care is necessary in designing the power unit to see that no hum shall be present. This has been achieved in the present case by connecting an extremely low resistance filter choke between the power transformer and the speaker field which serves as the main filter choke. These two chokes and the three 8 mfd. condensers, E1, E2 and E3, ensure a practically hum-free power supply. Note, though, that CH has a d.c. resistance of only one quarter of an ohm. Larger resistance chokes will result in a voltage drop which will prevent the tubes being supplied with their correct plate potentials unless the output of the power transformer is raised sufficiently to compensate for the potential drop across the choke.



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

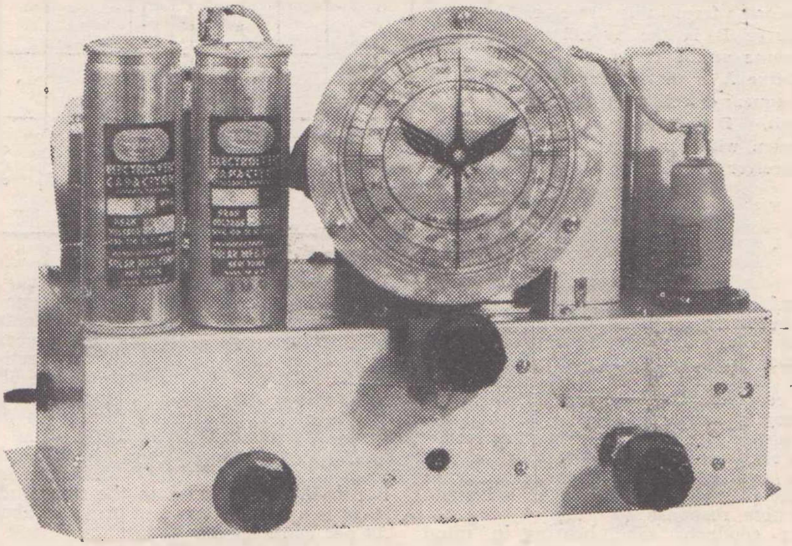
Turning to the actual construction of the receiver, we find that it is built up on a chassis measuring 14 inches in length, 9½ inches in width, and 3 inches in depth. The top and under chassis illustrations of the finished set will give intending constructors a good idea of the placement of the various components, but a few words on the coil system may not come amiss. The broadcast coils are conventional Airmaster types and are mounted in their cans on the top of the chassis.

Underneath the chassis is the three-gang Yaxley wave changing switch. The spacers between each section of this switch have been extended so that when the switch has been secured to the front of the chassis the first gang of the switch is 1¼ inches from the front, the middle gang is 3½ inches from the front, and the third gang is 5⅛ inches from the

(Continued on Page 72)

THE UNIVERSAL DUAL-WAVE MIDGET

Suitable for use on A.C. or D.C. mains, this compact six valve super-heterodyne receiver incorporates all the latest technical refinements.



A front view of the finished receiver. The controls required to operate this set are (from left to right) the volume control, the main tuning control and the band switching control.

THE tendency of modern set designs is to reduce the physical dimensions of all receivers to the absolute minimum.

We find numerous A.C. receivers produced in midget form to cover a variety of designs and uses. We find also many battery operated midget sets both for fixed and portable use.

The majority of these receivers are for use on the broadcast band, although gradually dual-wave receivers are being produced in midget form.

In the matter of midget sets the A.C.-D.C. receiver has been badly neglected.

When a set of this type was contemplated it was decided to make it a dual-wave job and to make it a real midget as far as size was concerned. How well the finished receiver complies with these specifications is evidenced by the fact that the overall dimensions of the receiver are 10¾ inches by 6 3-8 inches by 8 inches. It is a real midget in size, yet its extremely high sensitivity, averaging 5 micro-volts over both the broadcast and short-wave bands, prove it to be a giant in performance.

A FEW words of warning to those contemplating the building of the receiver may not come amiss. There are many catches in designing and building a high gain midget set of this type.

In the first place high gain is of no use if the receiver is not perfectly stable in operation. This stability is not hard to obtain providing care is taken in the layout of components to ensure short direct leads.

The use of shielding and the manner in which this shielding is carried out is another great factor in the final stability of the set. It is useless for any person who has not had a little experience in the construction of a high gain multi-valve receiver to attempt the construction of this set. He will only bring on himself trouble due to the necessity of watching each technical point as the set is being constructed.

Those who build the receiver should stick to the layout and design exactly as it is set out here if R.F. oscillation and instability are to be avoided. Particularly does this apply to the shielding of the R.F. and mixer valves both above and below the chassis.

A glance at the schematic diagram of the receiver shows that it consists of a radio frequency amplifying stage followed by a mixer stage employing the well-known Continental type of Octode convertor. This in turn is followed by a single intermediate frequency amplifier operating on an intermediate frequency of 462 k.c.

A duo-diode triode valve performs the functions of diode second detector, automatic volume control and first stage audio frequency amplifier. The output of this valve feeds into a pentode output valve capable of large outputs with negligible distortion.

The intermediate frequency transformers are of the iron-core type to allow of maximum results being obtained from the intermediate frequency amplifier stage. Full A.V.C. is applied to the R.F. valve whilst half of the A.V.C. voltage is applied to the I.F. valve.

An interesting point about the A.V.C. system is that it automatically furnishes the correct minimum bias for the R.F. and I.F. valves, thus eliminating the necessity for bias resistors for each of these stages.

It will be noticed that great care has been taken to see that no stray R.F. voltages can leak through to the audio section of the receiver. A filter consisting of a small fixed resistor is placed in the grid feed of the audio amplifying section of the second detector valve, whilst in the plate circuit of the same valve an efficient filter consisting of an R.F.C. and two small bypass condensers has been connected. These effectively prevent stray R.F. from entering the audio stages and setting up distortion.

The first step in the construction of the set is to obtain the necessary parts and to lay out the chassis. Providing the parts specified in the parts list are employed there should be no necessity to depart from the overall dimensions of the original receiver.

The general lay-out can be seen from the photographs showing the top and under-chassis views. However, certain shielding is essential and the photographs do not show this to advantage. Therefore it will be as well minutely to describe the layout and the procedure to be adopted in the assembling of the components.

The first step is to position the gang condenser and its associated tuning dial in the centre on top of the chassis.

Having positioned the gang condenser, solder leads to the fixed place lugs on each section and pass them through ¼in. holes drilled directly below the lugs. To the left of the gang condenser mount the two electrolytic condensers, lettered E1 and E2 in the plan photograph.

The socket for the rectifier valve, V6, should be bolted in place in the rear left-hand corner of the chassis, with the socket for the pentode output valve, V5, in line with it along the rear edge of the chassis. The socket for the barretter, B, mounts as closely as possible to these two sockets, but midway between them.

To the right of the gang condenser are mounted the sockets for V1 and V2, the two intermediate frequency transformers, IF1 and IF2, and the sockets for V3 and

V4. Before mounting the I.F. transformers, IF1 and IF2, slight additions and alterations must be made to these components.

Remove the can from IF1 and unsolder the Black lead from its lug. Replace this Black lead with one of shielded wire about 6in. long, taking care to see that the metal braid does not brush against the two windings. The .05 mfd. tubular condenser, C9, should be soldered from this lug to the outside metal braid of the shielded wire and the can replaced.

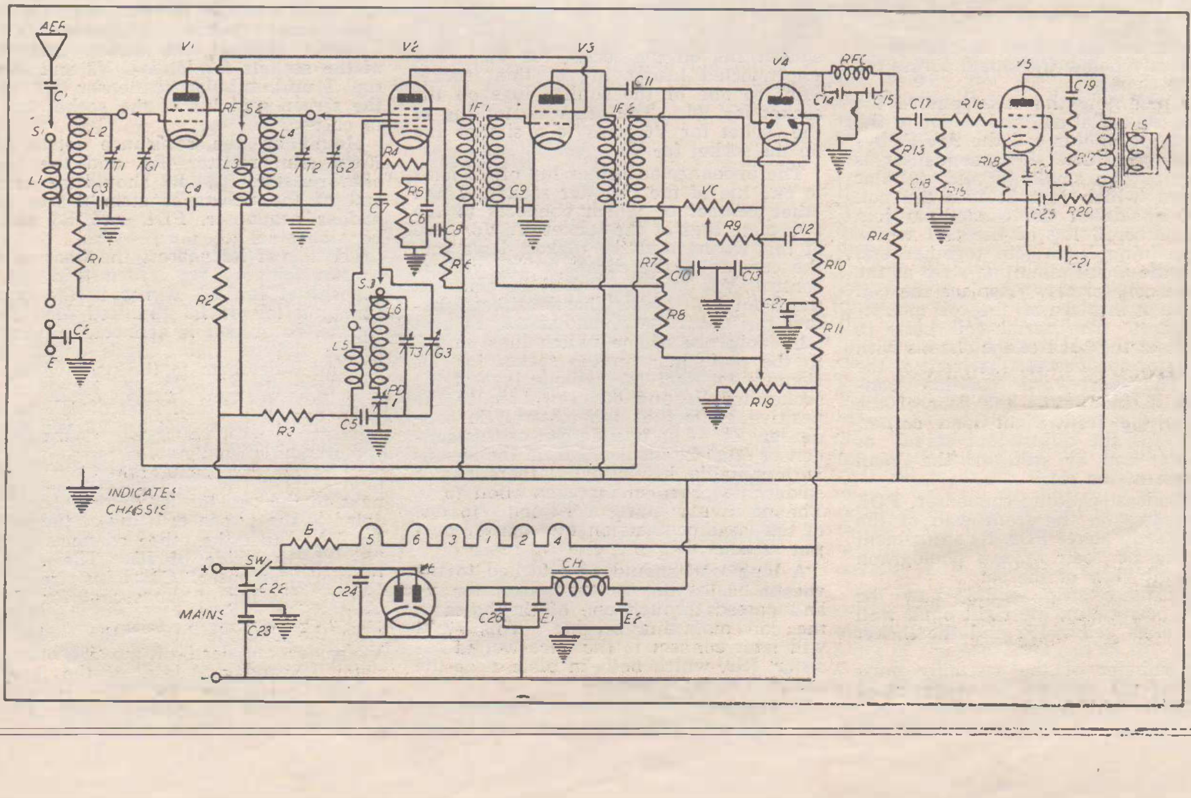
In the case of IF2 the Black lead must be replaced with one of shielded wire about 12in. in length and the .0001 mfd. mica condenser soldered to the lug to which the Green lead connects. To the vacant lug of this condenser solder a lead long enough to connect to one of the diode lugs of the socket for V4.

Shields are provided between the sockets for V1 and V2 as follows:—A shield is bolted in place against the right hand side of the gang condenser. The socket for the R.F. valve, V1, bolts in place as close to the rear wall of the chassis and as close to this shield as possible. In mounting the socket for the mixer valve, V2, leave only sufficient space between this socket and the socket for V1 for the small cross shield which may be seen from the plan photograph of the set.

In the original set this small cross shield and the shield separating V1 and V2 from V4 and IFT2 were welded together for ease in mounting. The socket for V4 bolts in place in the rear right

THE LIST OF PARTS AND SCHEMATIC CIRCUIT DIAGRAM
Required to Build the Universal Dual-Wave Midget

CHASSIS: Measuring 10¾ inches by 6⅜ inches by 3 inches, complete with dividing shields. (See text.)
COIL KIT: Consisting of type DWC aerial, R.F. and Oscillator coils (Radiokes).
C1: .0005 mfd. tubular condenser. (T.C.C.)
C2, C24: .01 mfd. tubular condenser. (T.C.C.)
C3: .1 mfd. tubular condenser (see text).
C4, C5, C6, C8, C25: .1 mfd. tubular condensers. (T.C.C.)
C7, C10, C11: .0001 mfd. mica condensers. (T.C.C.)
C9, C22, C23: .05 mfd. tubular condensers. (T.C.C.)
C12, C17: .02 mfd. mica condensers. (T.C.C.)
C13, C20, C27: 25 mfd. 35-volt electrolytic condensers. (T.C.C.)
C14, C15: .00005 mfd. mica condensers. (T.C.C.)
C18, C21: .5 mfd tubular condensers. (T.C.C.)
C19: .02 mfd. tubular condensers (T.C.C.)
C26: 8 mfd. 500 volt tubular electrolytic condenser. (T.C.C.)
CH. 30 Henry Power Choke, low resistance, to carry 80 milliamperes.
DIAL: Type D to suit gang condensers.
E1, E2: 8 mfd. 500-volt electrolytic condensers. (T.C.C.)
G1, G2, G3: Three gang TYPE F condenser with trimmers.
LS: Permagnetic Speaker to suit CL2. (Rola.)
IF1, IF2, 465 K.C. iron-core Intermediate Frequency Transformers.
PD1: 7-Plate 465 K.C. padding condenser.
PD2: As above, with .005 mfd. tubular condenser in parallel.
R.1: 250,000 ohm ½ watt resistor. (I.R.C.)
R2: 20,000 ohm 2 watt resistor. (I.R.C.)
R3: 10,000 ohm 1 watt resistor. (I.R.C.)
R4, R9, R14: 50,000 ohm ½ watt resistor. (I.R.C.)
R5: 500 ohm 10 milliampere wirewound resistor.
R6: 200,000 ohm 1 watt resistor. (I.R.C.)
R7, R8, R15: 500,000 ohm ½ watt resistors. (I.R.C.)
R10: 1 megohm ½ watt resistor. (I.R.C.)
R11, R16: 100,000 ohm ½ watt resistors. (I.R.C.)
R13: 250,000 ohm 1 watt resistor. (I.R.C.)
R17: 5000 ohm ½ watt resistor. (I.R.C.)
R18: 425 ohm 50 milliampere resistor.
R19: 150 ohm 100 milliampere wirewound resistor, with adjustable clip.
R20: 20,000 ohm ½ watt resistor. (I.R.C.)
SW: Switch on volume control.
S1, S2, S3: Three gang 5 contact switch. (Yaxley.)
Sockets: *i* type P sockets and 1 4-pin.
VC: 500,000 ohm volume control with switch. (Ferranti, I.R.C.)
VALVES: Two EF5's, one EK2, one EBC3, one CL2, one CY2 and a C1 Barretter. (Philips.)
SUNDRIES: Wiring flex, power flex, nuts and bolts, 4 insulated terminals, 2 yards shielded wire, aluminium shields. (See text.) One resistance strip, 5½ inches long and 1¾ inches wide, 5 grid clips, three knobs, some tinned copper wire and solder lugs.



hand corner of the chassis, the positions of the I.F. transformers, IF1 and IF2, can be seen from the plan photograph, which is key-lettered to agree with this description.

It will be noticed that there are four terminals mounted on the rear wall of the chassis. Two of these are connected together and earthed to the chassis through the .01 mfd condenser. C2.

The other two are connected internally to the aerial and earth lugs of the aerial coil. This is done so that a doublet type of aerial can be used with the set if desired.

When an ordinary aerial system is being used the terminal connected to the earth lug of the aerial coil is connected with a piece of bus bar to one of the earth terminals. The position of the speaker socket can be seen from the rear photograph of the set.

We come now to the mounting of the parts below the chassis. The first thing to do is to place a small shield bent at right angles around the socket for V1, thus dividing this socket from those of V2 and V4. One side of the shield will come between the sockets V1 and V2, whilst the other side will come between V1 and V4.

The coils are mounted on a metal bracket which is the same depth as the chassis and as long as the space between the front and rear walls of the chassis. The holes for the coils terminal strips are cut from this bracket. The bracket should have ⅜ inch slots cut in the corners corresponding with the corners of the chassis to allow leads to be taken through. Holes must also be drilled in the bracket to take the holding bolts of the coil cans.

Drill these holes in such a position that the number one lugs of the coils are uppermost, i.e., farthest from the floor of the chassis. Three more holes must be drilled in the bracket before it is bolted in place. These holes should correspond with the three leads from the fixed plate lugs of the gang condenser and should be above the floor level of the chassis to reduce capacity losses which would restrict the tuning range of the set on the short-wave band.

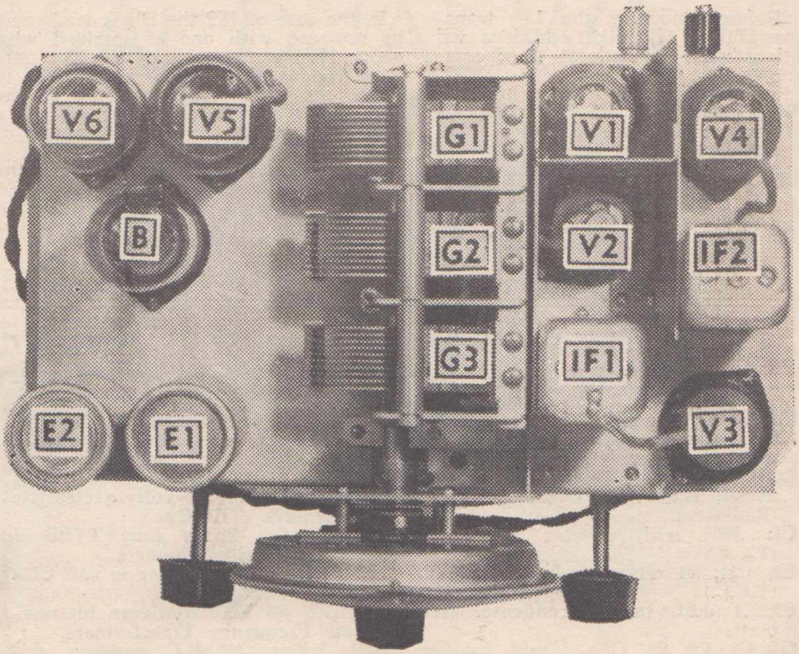
The bracket may then be bolted in place directly below the shield across the top of the chassis.

Before mounting the coils remove the can from the aerial coil and solder to the number 3 lug of this coil the A.V.C. bypass condenser, C3. This condenser is made up of two small .05 mfd. tubular condensers, which just fit into the coil can. One side of the condensers join to the number 3 lug of the coil whilst their remaining leads join together and solder to the metal mounting strip at the top of the coil former. Replace the coil and mount it in place on the coil mounting bracket. The aerial coil bolts in place nearest the back of the chassis with the oscillator coil nearest the front of the chassis. The short-wave padding condenser, PD2, mounts on the floor of the chassis in the front right-hand corner. The hole for the adjustment screw of this padder can be seen in the plan photograph of the set.

The broadcast padding condenser, PD1, bolts in place on the front wall of the chassis directly above PD2. Its adjustment screw may be seen in the photograph of the front view of the set.

The resistance strip should now be bolted in position on the right hand wall of the chassis below IF2 and the socket for V4.

The remainder of the assembly must be done as the receiver is being wired as the parts on the floor of the chassis would otherwise be inaccessible. Before



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

proceeding with the wiring description we would impress upon constructors the necessity for short direct leads and the use of shielded wire where directed.

Commence the wiring by joining up the solder lugs placed under the holding bolts of sockets and I.F. transformers, with tinned wire. To this earth wiring join the wiper contacts on the moving plates of the gang condenser.

Wire one of the heater lugs on the socket for V4 to a similar lug on the socket for V2, and join the other heater lug of this socket to one of the heater lugs of the socket for V1. The remaining heater lug of this socket connects to a similar lug on the socket for V3. The unconnected heater lug of this socket joins to one of the similar lugs on the socket for V6. The other heater lug of the socket for V6 joins to a similar lug on the socket for V5.

The unconnected heater lug of V5 joins to one lug of the Baretter socket, B, the other contact of which connects to the two plate lugs of the socket for V6. All of this wiring must be tucked down into the corners of the chassis. The volume control, VC, may be bolted in place on the front wall of the chassis directly below the electrolytic condensers, E1 and E2. Join one of the switch lugs on VC to the plate lugs on the socket for V6. Connect together the cathode lugs of the socket for V6 and connect them to the positive contact of the electrolytic condenser, E1. The outside can of this condenser must be insulated from the chassis with suitable insulating washers and a solder lug provided for connection to it. The positive contact of E2 joins to one of the large contacts on the speaker output socket.

A long lead should be attached to the vacant heater lug on the socket for V4 and passed through one of the holes in the coil mounting bracket. This lead will later connect to the wire-wound resistor, R19, which bolts in place near the speaker output socket.

A flex lead should also be attached to the lug contacting the outside can of the electrolytic condenser, E1. This lead also will join to the resistor R19. Solder the .01 mfd. tubular condenser, C24, from the cathode lugs of the socket for V6 to the plate lugs of the same socket. Solder the .05 mfd. tubular condenser, C22, from the plate lugs of the same socket to the earth wire. The .05 mfd. tubular condenser, C23, solders from the lug contacting the outside can of the electrolytic condenser, E1, to the earth wire. Solder together the metal coating, cathode, and suppressor, grid lugs of the socket for V1 and join them to the earth wire. Do likewise with the corresponding lugs on the socket for V3. Connect together the screen grid lugs of the sockets for V1 and V3 and solder the .1 mfd. tubular condenser, C4, from the screen grid lug of the socket for V1 to earth.

Mount on the resistance strip the 20,000 ohm resistor, R2, and the 10,000 ohm resistor, R3. R2 should be at the end of the resistance strip nearer the padder condenser, PD1, and R3 should be alongside it.

The leg of R2 nearest the floor of the chassis joins to the screen grid lug of the socket for V3, whilst to the corresponding leg of R3 the Red lead from the oscillator coil is connected. Join together the remaining leads on R2 and R3 and wire them to the positive lug of the electrolytic condenser, E2.

Connect the Green lead of IF1 to the plate lug of the socket for V2 and solder the Red lead of IF1 to the "B" positive side of R2 and R3. Mount the 200,000 ohm resistor, R6, on the resistance strip next to the resistor R3. One lead of R6 joins to the screen grid lug of the socket for V2, whilst the other connects to the "B" positive side of R3. The .1 mfd. tubular condenser, C8, joins from the screen grid lug of the socket for V2 to earth.

To the Cathode lug of the socket for V2 solder one lead of the 500 ohm resistor R5 and one lead of the .1 mfd. tubular condenser, C6. The remaining leads of these components join to the earth wire. Solder the 50,000 ohm oscillator grid leak, R4, from the oscillator grid lug of the socket for V2 to the cathode lug of the same socket. To the oscillator grid lug of this socket solder one side of the .0001 mfd. mica condenser, C7. Join the metal coating lug of the socket for V2 to earth. Do likewise with the corresponding lug on the socket for V4. Solder the Green lead of IF2 to the plate lug of the socket for V3 and connect the Red lead of IF2 to the "B" positive side of R3.

Solder the lead from the condenser C11, which was previously mounted in the can housing IF2, to the A.V.C. diode lug on the socket for V4. Solder in place on the resistance strip the 500,000 ohm ½ watt resistors, R7 and R8. They should be situated directly above the A.V.C. diode plate on the socket for V4. Wire one lead of R7 to the A.V.C. diode plate. Solder together the remaining lead of R7 and one lead of R8 and connect the other lead of R8 to the cathode lug of the socket for V4. A long lead should be attached to this lug and passed through the hole in the coil bracket. This lead will connect later to the resistor. R19.

Solder the electrolytic condenser, C13, from the cathode lug of V4 to the earth wire. The positive lead connects to earth. The White lead of IF2 joins to the remaining diode plate lug on the socket for V4.

Join the shielded lead which replaced the Black lead on IF2 to the outside lug of VC. The other outside lug of VC joins to the cathode lug of the socket for V4. Solder one lead of the 50.000 ohm ½ watt resistor, R9. to the centre contact of VC. To the other lead of this resistor solder a long shielded lead. This lead should be long enough to reach to the centre of the resistance strip. The .0001 mfd. mica condenser. C10, joins from the outside lug of VC which connects to the shielded lead from IF2 to earth.

Solder in place in the centre of the resistance strip the .02 mfd. mica coupling condenser, C.12. Drill a hole in the chassis close to the socket for V4 and pass through this hole a piece of shielded wire. One end of this shielded wire terminates in the grid clip for V4. whilst the other joins to one lug of the condenser C12. To the remaining lug of C12 join the shielded lead from the resistor, R9. The outside metal covering of all shielded wire leads must be joined to earth and care must be taken to see that the braid does not come in contact with live contacts on other parts.

Solder together one lead of the resistors R10 and R11 and solder the free end of R10 to the lug of C12 which joins to the shielded lead from V4. The free end of R11 joins to an insulated lug on the resistance strip close to C12, and a lead is soldered to this lug. This lead should be long enough to pass through the hole in the coil mounting bracket and will connect later to the resistor R19.

The 25 mfd. electrolytic condenser, C27, solders from the junction of R10 and R11 to the earth wire. The positive lead of C27 connects to earth. A shielded lead should be soldered to the number 3 lug of the aerial coil and connects to one side of the ½ watt 250,000 ohm resistor, R1. The other leg of R1 joins to that side of R7 which is wired to the A.V.C. diode plate.

The shielded lead from IF1 which replaced the black lead on that component solders to the junction of R7 and R8. Wire the number 3 lug of the oscillator coil to the fixed plates of the padder condenser, PD1. The number 4 lug of the oscillator coil joins to the corresponding lug of PD2. The moving plate lugs of PD1 and PD2 join to the earth wire.

Solder the number 5 lug of the aerial coil to one of the terminals on the back of the chassis. Join together two of the remaining terminals and solder the .01 mfd. tubular condenser, C2, from this point to the earth wire. The remaining terminal will become the aerial terminal.

Solder a long shielded lead to the plate lug of the socket for V4 and pass it through the hole in the coil mounting bracket nearest the back of the chassis. Bolt in place near the socket for V5 the .02 mfd. coupling condenser, C17, and the radio frequency choke, RFC. Join the shielded wire from the plate of V4 to one side of RFC.

To this same lug of RFC solder one lug of the .00005 mfd. condenser, C14, and to the other contact of RFC solder one lug of the other .00005 mfd. condenser, C15. The remaining lugs of C14 and C15 join to the earth wire. The junction RFC and C15 wires to one lug of the .02 mfd. coupling condenser, C17. Solder together one lead of the resistors R13 and R14 and solder the free end of R13 to the junction of C15 and C17. The free end of R14 joins to "B" positive. The .5 mfd. tubular condenser, C18, solders from the joint of R13 and R14 to earth.

From the vacant lug of the condenser C17 solder the 100,000 ohm resistor, R16, to the grid of the socket for V5. The 500,000 ohm ½ watt resistor, R15, solders from the junction of R16 and C17 to earth. To the cathode lug of the socket for V5 solder one leg of the 425 ohm resistor, R18, and one leg of the 25 mfd. electrolytic condenser, C20. The remaining contacts of these components join to earth.

Solder the 20,000 ½ watt resistor, R20, from the "B" positive lug of the speaker output socket to the screen grid lug of the socket for V5. The .1 mfd. tubular condenser, C25, joins from this point to the earth wire.

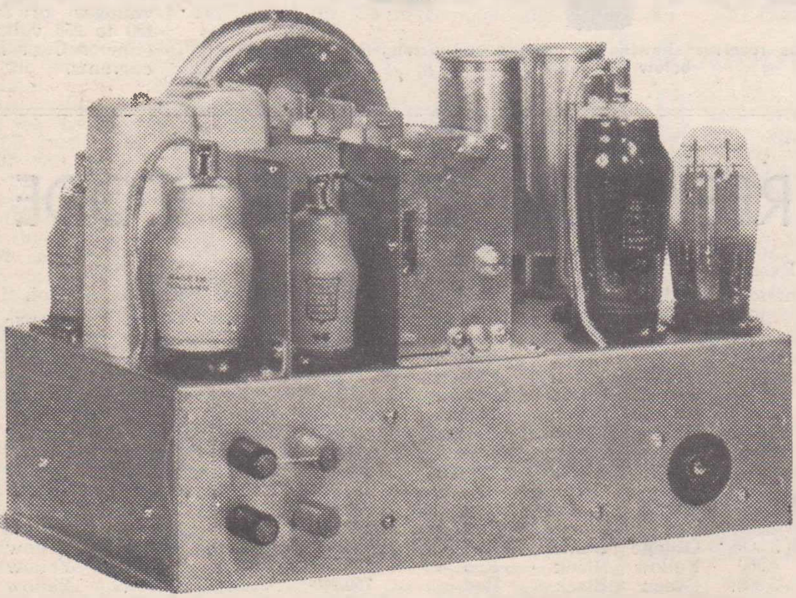
The plate lug of the socket for V5 joins to the remaining large contact of the speaker output socket. One lug of the .02 mfd. condenser, C19, solders to this point. The ½ watt 5000 ohm resistor, R17, solders from the free end of C19 to the "B" positive lug of the speaker socket. The .5 mfd. condenser, C21, solders from this point to the earth wire. The resistor R19 may then be bolted in place near the speaker output socket. One of the outside lugs of R19 joins to earth. To the other outside lug of R19 solder the leads from the heater lug of the socket for V4, the outside can of the electrolytic condenser, E1, and the resistor, R11.

The leads from the cathode of V4 and the resistor R8 join to the sliding clip on R19. Mount the power choke, CH, on the side wall of the chassis and connect one lug of the choke to the positive lug of E1. The remaining lug of the choke joins to the positive lug of E2. The 8 mfd. condenser, C26, joins from the junction of CH and E1 to the negative main lug of the resistor, R19. The positive side of C26 joins to the junction of the choke and E1.

Solder pieces of flex to the plate lug of V1 and the oscillator plate lug on the socket for V2. The wave-band switch may then be fixed in place. The spacing of the switch banks should be so arranged that the first section is close to the front of the chassis and the two following sections are directly above the sockets for V1 and V2 respectively. An aluminium shield must be placed between these two sections of the switch to prevent interaction.

With the switch bolted in place the switch arms nearest the coil mounting bracket become the grid contacts. To the arm of the oscillator section, the one nearest the front of the chassis, solder the lead from the G3 section of the gang condenser and the vacant lug of the oscillator grid condenser C7. To the other arm of this section of the switch join the lead from the oscillator plate lug of the socket for V2. It is important that all leads to these switch contacts should be kept as short and as rigid as possible if good results are to be obtained. For this reason all of the switch wiring is done with tinned copper wire covered with spaghetti sleeving.

Set the switch so that the first contact to the grid arm is farthest from the coil mounting bracket. Connect the number 1 lug of the oscillator coil to this contact and wire the next contact of this bank to the number 2 lug of the oscillator coil. Make certain that the number 1 and number 2 contacts coincide, i.e., that



This photograph of the receiver shows the aerial and earth terminals and the loud speaker input socket arranged along the rear side of the chassis.

when the grid section is on number 1 that the oscillator plate section is in a similar position.

The arm of the centre bank of the switch nearest the coil mounting bracket joins to the lead from the G2 section of the gang condenser. The number 1 contact of this section of the switch joins to the number 1 lug of the R.F. coil. The number 2 lug of the R.F. coil joins to the number 2 contact of the switch.

The remaining arm on this bank of the switch connects to the plate of the socket for V1.

The number one contact of this switch joins to the number 4 lug of the R.F. coil, and the number 6 lug of this coil wires to the second contact of the switch.

To the arm of the remaining bank of the switch nearest the coil mounting bracket connect the lead from the G1 section of the gang condenser. The number one and number two contacts of this section of the switch join to the number 1 and number 2 lugs of the aerial coil respectively.

To the remaining arm contact on this bank of the switch solder one leg of the .0005 mfd. tubular aerial condenser, C1, the remaining leg of C1 going to the aerial terminal. The number 1 contact of this switch joins to the number 4 lug of the aerial coil, and the second contact of the switch to the number 6 lug of the aerial coil.

It remains now to solder the trimmers in place from the number 1 contact of each of the grid sections of the three banks to earth. These trimmers should be so placed that they can be adjusted from below the chassis, i.e., with the chassis stood on end.

A base plate of similar material to the chassis is bolted over the bottom of the chassis and holes should be drilled in this plate to allow these trimmers to be adjusted.

The wiring is completed with the connection of the grid leads for V1 and V2 to the G1 and G2 sections of the gang condenser and the attaching of the grid clips for the remaining valves. All that now remains is to connect the power cord. This cord should be marked positive and negative, and the positive lead should be soldered to the vacant contact of the switch, S.W., on the volume control. The other lead of the power flex joins to that side of R19, which connects to C23.

Before connecting the receiver to the mains, carefully check the wiring for faults. If possible, this test should be carried out with the assistance of an ohmmeter.

Satisfied that the wiring is correct, the valves may be placed in their sockets and the aerial, earth and speaker leads connected to their correct terminals. If an ordinary aerial system is to be used, the terminal which connects to the number 5 lug of the aerial coil should be joined to one of those terminals which connects to chassis through the .01 mfd. condenser.

If a doublet system is to be employed, this connection is not made and the doublet is connected to the aerial terminals and the terminal which connects to the number 5 lug of the aerial coil.

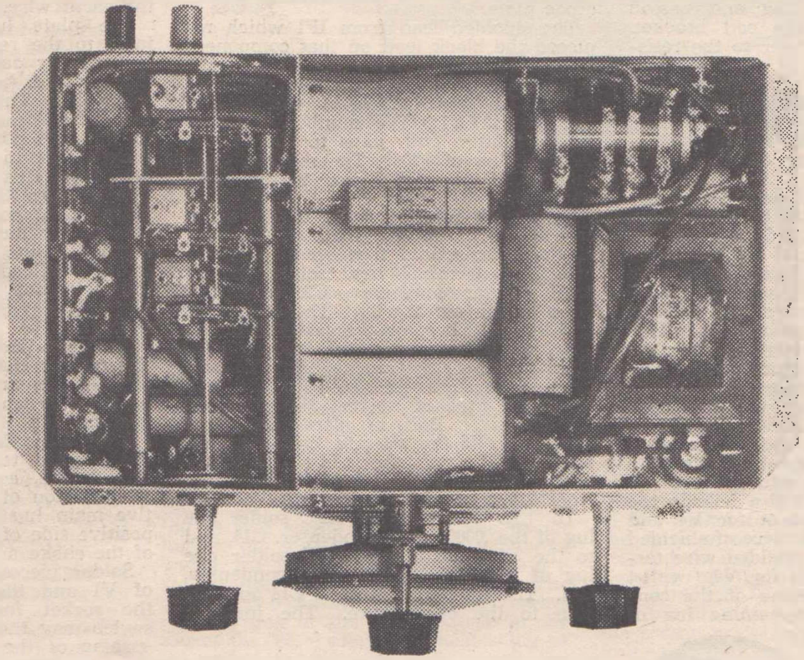
There should be no catches with the job providing the instructions are carefully followed, the original model gave no trouble at all as far as instability went and the sensitivity was all that could be desired.

On the broadcast band the sensitivity ranged from 2 microvolts at 1500 K.C. to 7 microvolts at 600 K.C. On the shortwave band the sensitivity ranged from 4 microvolts to 6 microvolts.

The tonal quality of the receiver is particularly good for a set of this type, this being mainly due to the care with which the audio circuit has been decoupled.

Tested in the city area the set was found to be one which could be relied upon to furnish excellent entertainment from the local stations, and on a very mediocre aerial system it was found possible to receive the German broadcaster on several occasions at excellent strength.

The set should prove ideal for those who travel extensively in country towns, as it will operate on voltages of from 180 to 250 volts of either A.C. or D.C. currents.



Another view of the receiver showing the wiring and arrangement of parts below the chassis.

STANDARD RESISTOR COLOR CODE

IN the RMA (American) standard coding, ten colors are assigned to the figures as shown in the following table:

Figure.	Color.	Figure.	Color.
0	Black	5	Green
1	Brown	6	Blue
2	Red	7	Violet
3	Orange	8	Grey
4	Yellow	9	White

The body of the resistor is colored to represent the first figure of the resistance value. One end of the resistor is colored to represent the second figure. A band or dot of color, representing the number of ciphers following the first two figures, is located within the body color.

Examples:—

Ohms.	Body.	End.	Dot.	Ohms.	Body.	End.	Dot.
100	Brown	Black	Brown	15,000	Brown	Green	Orange
150	Brown	Green	Brown	20,000	Red	Black	Orange
200	Red	Black	Brown	25,000	Red	Green	Orange
250	Red	Green	Brown	30,000	Orange	Black	Orange
300	Orange	Black	Brown	40,000	Yellow	Black	Orange
350	Orange	Green	Brown	50,000	Green	Black	Orange
400	Yellow	Black	Brown	60,000	Blue	Black	Orange
450	Yellow	Green	Brown	75,000	Violet	Green	Orange
500	Green	Black	Brown	100,000	Brown	Black	Yellow
750	Violet	Green	Brown	150,000	Brown	Green	Yellow
1,000	Brown	Black	Red	200,000	Red	Black	Yellow
2,000	Red	Black	Red	250,000	Red	Green	Yellow
3,000	Orange	Black	Red	300,000	Orange	Black	Yellow
4,000	Yellow	Black	Red	500,000	Green	Black	Yellow
5,000	Green	Black	Red	750,000	Violet	Green	Yellow
6,000	Blue	Black	Red	1,000,000	Brown	Black	Green
10,000	Brown	Black	Orange	2,000,000	Red	Black	Green

THE S.W. HEADPHONE SUPER FOUR

(Continued from Page 16)

remaining lead of R4 and C6 join to the earth wire. Solder a lead to the 100 volt tap on the voltage divider, VD, and solder the other end of this lead to the number 4 lug of the socket for V3. The .1 mfd. tubular condenser, C7, solders from this point to the earth wire. The Green lead on IF2 solders to the number 3 lug of the socket for V3, and the White lead on IF2 solders to the number 4 lug of the socket for V4. A shielded lead must be soldered to the number 5 lug of the socket for V4. The other end of this lead connects to the centre arm contact of the volume control, R7.

The arm contact of this component must be insulated from earth.

One of the outside contacts of R7 joins to the earth wire and to the other outside lug of R7 is soldered one lead of the .01 mfd. tubular condenser, C9. A long braided lead is attached to the remaining lead of C9 and the other end of this lead solders to one lug of RFC. The other lug of RFC joins to the number 3 lug of the socket for V4 from which point the .002 mfd. tubular condenser joins to the earth wide. The number 7 lug of the socket for V4 joins to one phone terminal, while the other phone terminal joins to the 135 volt tap on the voltage divider, V.D.

This tap is by-passed to earth with the .5 mfd. tubular condenser, C12. Solder one lead of the resistor, R8, to the phone terminal which connects to VD and join the other lead of R8 to the lug of RFC which joins to C9. To the number 8 lug of the socket for V4 solder one lead of the 25 mfd. tubular condenser, C8, and one lead of the resistor R5. The remaining leads of these two components join together and solder to the insulated lug mounted near the socket for V3.

The Black lead of IF2 also solders to this lug. The arm contact of the second detector regeneration control, R6, and one side of the coil, L, join to the earth wire. The remaining lead of L joins to one outside contact of R6. This contact on R6 connects to the insulated lug to which the negative lead of C8 is soldered. The .002 mfd. tubular condenser, C10, solders from the number 6 lug of the socket for V4 to the earth wire.

Join the number 3 lug of the socket for V2 to the positive lug of the electrolytic condenser, E1. To this lug on E1 also is soldered the outside lug of VD which is nearest the VD tap which has been wired to one phone terminal. The other outside lead of VD joins to the earth wire. The plate lug of the power imput socket joins to the positive lug of E1. The .5 mfd. condenser C13 solders from this point to the earth wire. The grid lug of the power imput socket joins to the earth wire.

The wiring of the set is completed by joining the fixed plate lug of the midget condenser, G2, to the corresponding lug of the midget condenser, T2. This wiring is carried out with tinned copper wire covered with spaghetti sleeving. It only remains to solder the grid clip for V3 to the white lead above the chassis on IF1 to complete the wiring.

The wiring of the power supply will not be detailed, but the wiring of the original is shown in the schematic diagram.

The tuning of the receiver on each band is quite simple, once the handling of the controls has been mastered.

The purpose of the trimmer condensers T1 and T2 is to set the band on which operation is desired. When this has been done the tuning is carried out by means of the ganged midgets, G1 and G2. It may be necessary slightly to reset T1 so that perfect tracking is obtained over the tuning range of G1 and G2. The dial readings of T1 and T2 will not be identical, T2 being set slightly lower in capacity than T1. The regeneration control on the first detector should operate smoothly. No difficulty was experienced in obtaining smooth regeneration on all bands with the coil tappings given. The second detector regeneration control also should be smooth in action.

Judicious use of these two controls will result in amazingly high gain being obtained from the receiver. It must be remembered, when reception of code stations is required, that the second detector must be made to oscillate in order to heterodyne the incoming signal. In some cases a much cleaner note on code signals is obtained if the main tuning controls, G1 and G2, are slightly detuned.

If any difficulty is experienced in making any of the valves oscillate the tappings on the coils should be moved nearer the grid end of the coil. In the case of the second dectector stage the turns on the coil L should be increased.

Once the controls have been mastered the receiver will be found to be an excellent one. Its sensitivity is particularly high, and its signal-to-noise ratio is good.

GLOBE GIRDLER SUPER "8"— *(Continued from Page 65)*

front. Suitable extension pillars to permit this can be purchased with the switch. Between the first and second gangs of the switch an aluminium screen 5 inches in length and 2¾ inches in depth is included. A similar shield cuts off the middle section from the end section of the switch. These shields should be provided with flanges so that they can be mounted to the chassis. Holes are drilled through the shields to permit the entry of the switch shaft and the shields are assembled with the switch in such a way that they become supports for the latter, and prevent undesirable wobble. The short wave coils are mounted in the screened compartments thus formed at the right of the switch. Only one coil former is used for each of the three coils. The high frequency winding which is laid on with 22 gauge tinned copper wire is at the top of each former. The latter are made of special high efficiency bakelite and are ⅞ of an inch in diameter and 2 inches in length.

The grid windings for the aerial, r.f. and oscillator coils for the high frequency bands are: Aerial 4 turns, r.f. 4 turns, and oscillator 3.9 turns. These windings are spaced a distance equal to twice the wire diameter. The aerial winding itself and the plate winding each consist of four turns of 32 gauge d.s.c. wire interwoven between the grid winding. The tap for the oscillator coil is taken out at a point.

The windings for the low frequency s.w. band are: Aerial 14 turns, r.f. 14 turns, and oscillator 12½ turns. These coils are close wound with 28 gauge d.s.c. wire. The cathode tap for the oscillator coil is taken out at the third turn.

The aerial and plate windings on the low frequency coils each consist of four turns of 32 gauge d.s.c. wire interwound between the four top turns of the respective grid coils. The coils are mounted either by means of small brackets or, as in our case, by bolting tight-fitting wooden blocks to the chassis and pushing the coil formers down over them.

The trimmers for the high-frequency bands are soldered to the top of the coils and fit over the formers. The trimmers for the low-frequency s.w. bands are mounted on the appropriate sections of the gang for the aerial, r.f., and oscillator coils. The two trimmers required on the broadcast coils are on the r.f. and oscillator stages. The oscillator trimmer is mounted to the appropriate lug of the back gang of the switch, whilst the r.f. trimmer is suspended by heavy wire just alongside the r.f. section of the switch. The trimmer for the aerial stage broadcast coil is the small coupling condenser to be found inside the coil can.

The broadcast padding condenser is already built into the oscillator coil can. The short-wave padders are mounted conveniently near the oscillator tube socket, the variable section for the low-frequency s.w. band being bolted to the side of the rear screen. The capacity of the short-wave trimmers must be made up by connecting fixed condensers in parallel.

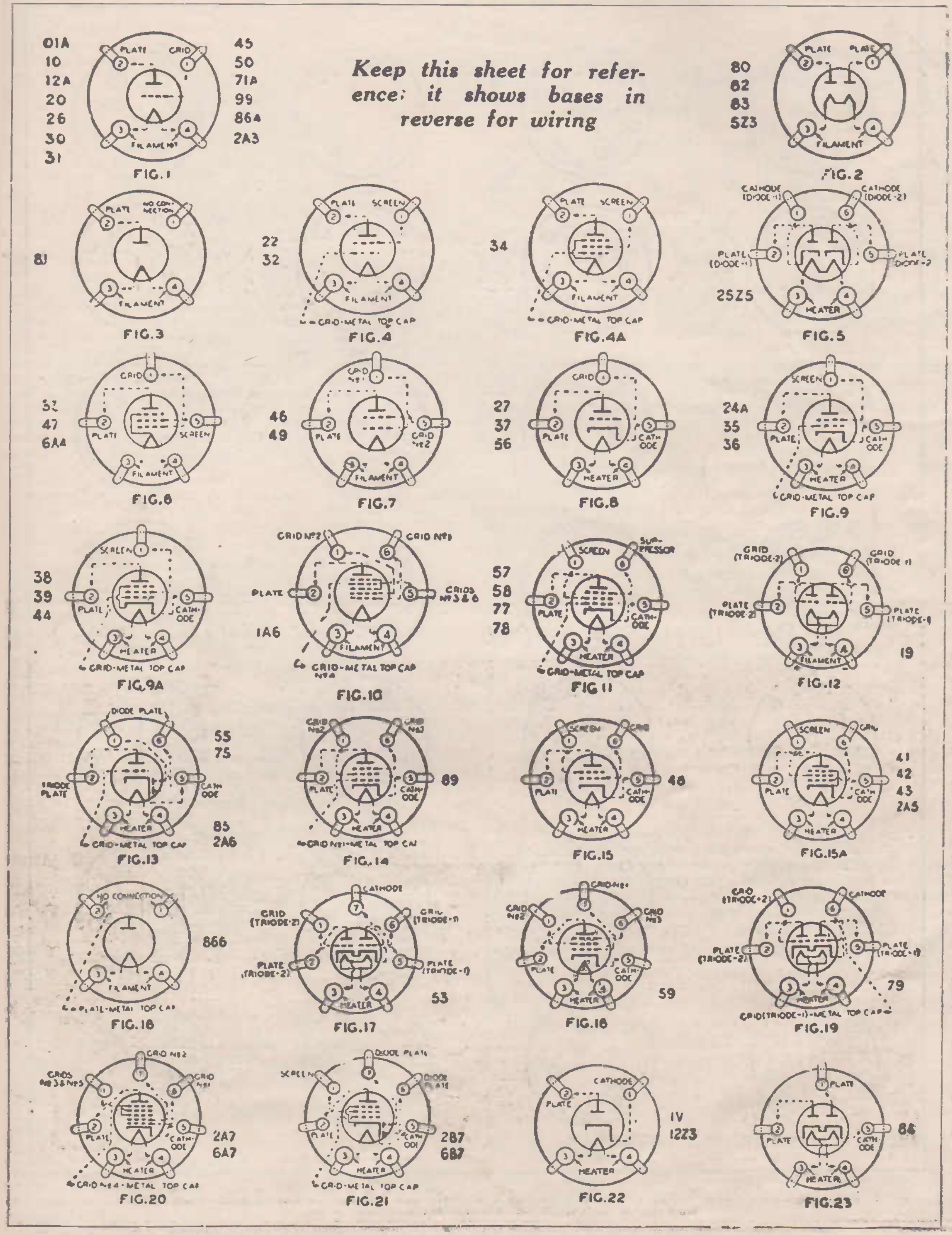
The low-frequency padder consists of a standard 465 k.c. variable padder, and a .003 mfd. condenser connected in parallel. The high-frequency trimmer consists of a capacity of .08 mfd. made up by connecting two or more condensers in parallel.

With these capacities it will be found that the short-wave tuning will track from 9 to 28 metres on the high-frequency band and from 27 to 75 metres on the low-frequency band. The broadcast sensitivity of the set is in the region of four microvolts throughout, whilst the short-wave sensitivity varies from 4 to 20 microvolts throughout the whole tuning range.

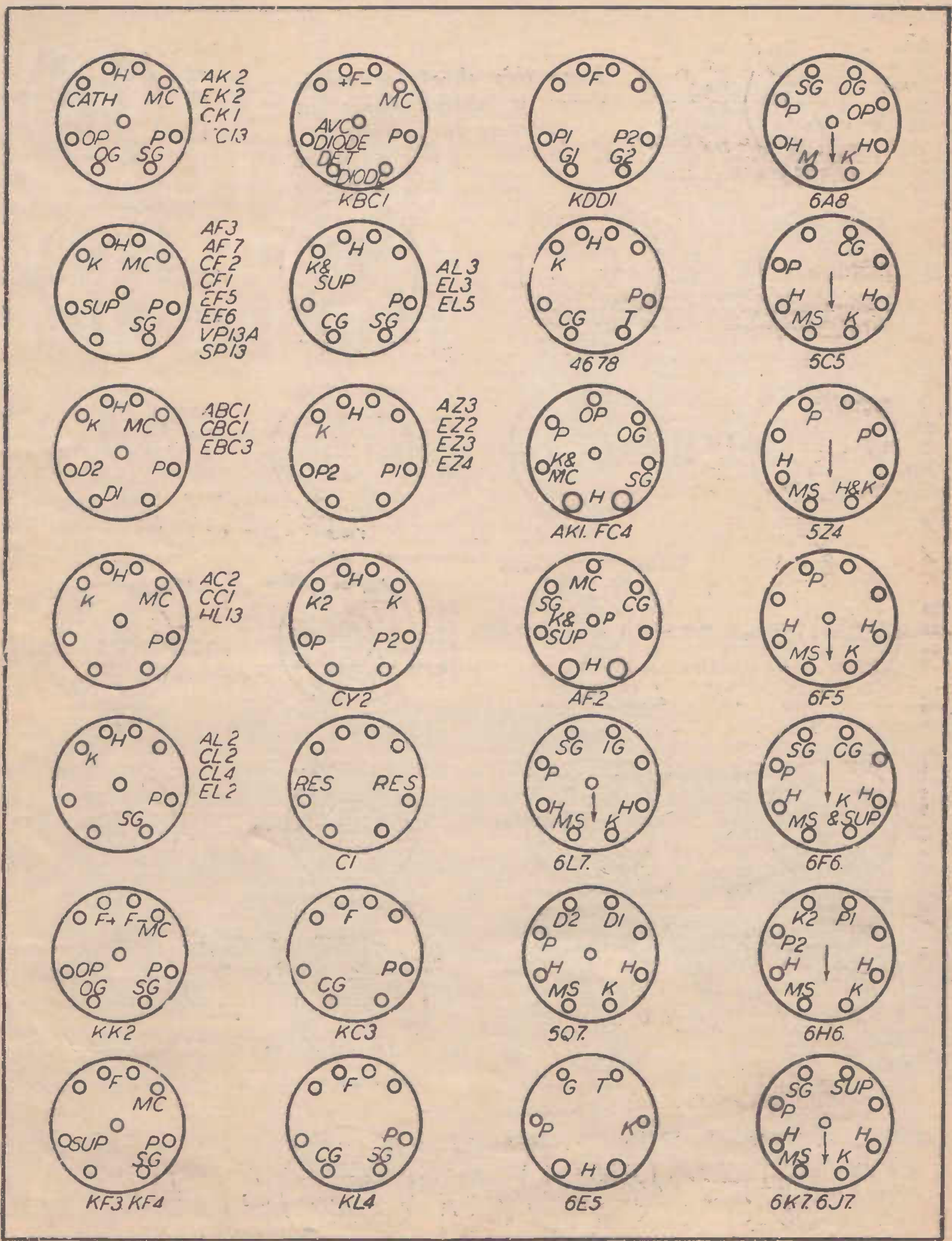
We have purposely refrained from touching upon the wiring of the receiver, because we believe its construction is no job for the amateur to undertake. However, the experienced set-builder will have no difficulty in building the set from the information we have provided, and will not require any point-to-point wiring description from which to work.

The results obtained with the original receiver having been really outstanding. Excellent tonal quality is combined with high sensitivity and large power output in a manner which will prove a revelation to most users of pentode valves.

STANDARD AMERICAN VALVE BASES



Continental Valve Bases As Viewed From Below



Note! Small unmarked circles in the centre of some socket diagrams indicate that the control grid connection is taken from the cap at the top of the valve.

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