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THE LISTENER IN HANDBOOK, No. 9

F.P.

A Practical Design Handbook for the Experimenter

CONTENTS:

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1 250,000 ohm 1 watt Resistor	0	1	0
1 Renrade 450 ohm Wire Wound Resistor	0	1	0
1 Radiokes RV1 Divider	0	3	9
1 Radiokes 23-plate Midget Condenser	0	4	9
1 Saxon No. 16 Transformer	0	18	6
1 R.C.A. 56 Valve	0	15	0
1 R.C.A. 2A5 Valve	0	17	0
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2 Carbo 1 watt Resistor 60,000		2	0
1 Carbo 1 watt Resistor 40,000		1	0
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2 TCC .01 MFD Mica Condensers	0	5	6
2 Dulytic 25 MFD Electrolytic Condensers 25 volt	0	5	0
2 Dulytic 25 MFD Electrolytic Condensers 75 volt	0	7	0
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1 Radiotron 56 Valve	0	15	0
1 Radiotron 5Z3 Valve	0	16	0
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1 Set Dual Speaker, Jensen	4	10	0
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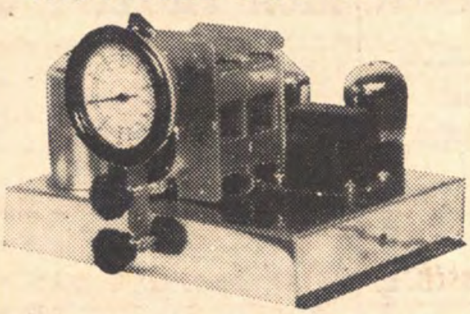

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PM14	4 Volt Screen Grid	21/
PM16	6 Volt Screen Grid	21/
H.F. PENTODES (Battery)		
SP2	2 Volt H.F. Pentode	16/6
VP2	2 Volt Variable-Mu.	17/6
MISCELLANEOUS TRIODES (Battery)		
PM1HL	2 Volt Det. and Amplifier	14/6
PM2DX	2 Volt Det. Driver	14/6
TDD2	2 Volt Duo-Diode-Triode	18/6
PM3	4 Volt G. Purpose	15/
PM4DX	4 Volt Det. Amplifier	15/
TDD4	4 Volt Duplex Diode Triode	16/6
PM5X	6 Volt G. Purpose	15/
POWER TRIODES (Battery)		
PM2A	2 Volt Small Power	15/6
PM4	4 Volt Power	15/6
PM254	4 Super Power	18/6
PM6	6 Volt Power	15/6
PM256	6 Volt Super Power	17/6
POWER PENTODES (Battery)		
PM22A	2 Volt Economy Pentode	17/6
PM24	4 Volt Pentode	21/
PM26	6 Volt Pentode	21/
PM2B	2 Volt Class B Twin Amplifier	17/6
2 VOLT BATTERY VALVES		
1C6	2 Volt Pentagrid	18/6
1A6	Pentagrid Converter	18/
19	Class "B" Twin Amplifier	17/6
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31	Power Amplifier Triode	14/6
32	R.F. Amplifier Tetrode	16/6
33	Power Amplifier Pentode	17/6
34	Super Control R.F. Pentode	17/6
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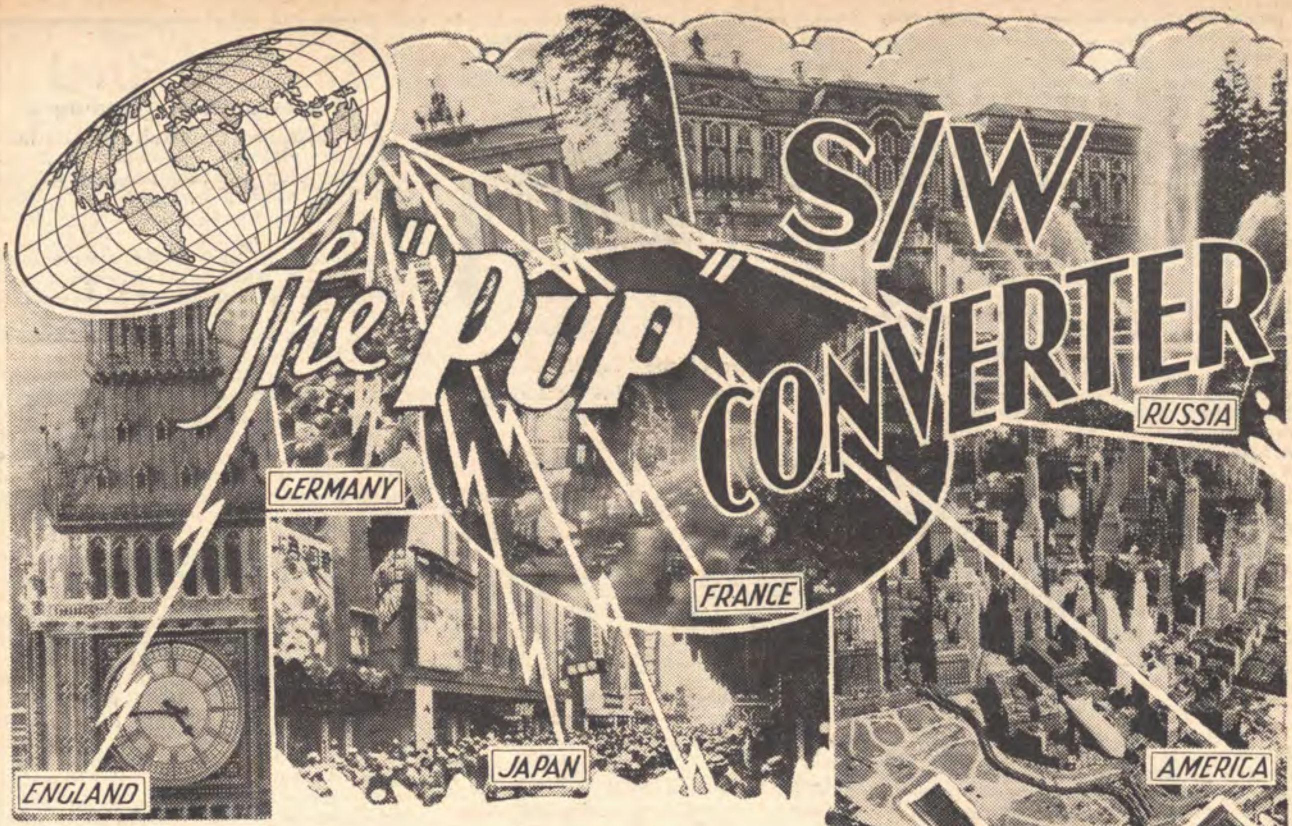


Operated on the superheterodyne principle, this tiny, single-valve unit brings in world - wide broadcasts at good strength and with easy tuning when placed before an existing electric receiver.

By "RADEX"

THERE are thousands of people who own good broadcast receivers, manufactured or home-made, super-hets or T.R.F.'s, who would like to get short-wave broadcasts occasionally, but do not wish to change over completely to an all-wave set. They realise, probably, that short-wave reception is an uncertain quantity, most easily available at odd hours of the day. In consequence, they rightly consider that means for its interception should not involve any great cash outlay.

For such we have designed "The Pup S/W Converter." It is easily built, simply operated, and quite inexpensive. It employs only one valve; it connects cleanly to any electric set and does not create an overload on the power-pack. It operates in conjunction with any broadcast receiver, provided the latter includes at least one stage of tuned radio frequency amplification, or alternatively, is any sort of super-heterodyne. Its physical size warrants the name "Pup."

The single valve of the Pup is a conventional super-heterodyne mixer and can be either a 2A7 or a 6A7.

The system of the converter is plain super-heterodyne reception, with the delivery of an intermediate frequency inside the broadcast band, i.e., anything between 1500 and 550 k.c.

The converter having transposed any incoming S/W transmission to the uniform frequency of (say) 550 k.c., its output is fed to the aerial terminal of the B/C receiver, on which the dial has been adjusted to a pre-determined and corresponding position. The latter receiver now functions as an intermediate frequency amplifier at 550 k.c., and then, if it is a super-het, re-transposes again to whatever its own I.F. happens to be. Once its dial is adjusted to the proper reading (always the same to within half a degree), the B/C set looks after itself, **but its volume control remains operative;** its rotation will continue to govern the speaker's output.

Special I.F. Transformer

The out-put of the 2A7, i.e., its intermediate frequency delivery, is made to transformer IF, as enclosed in the dotted rectangle. This, in some respects is a special unit although an old intermediate frequency transformer can be adapted to the purpose. Its primary winding, shunted and tuned by FC which is in the can, operates at around 550 k.c.; naturally the exact frequency is determined by the setting of F.C. The secondary, unlike a normal IF transformer, is pushed as close to the primary as possible without actually touching, it contains about half the number of turns of the primary, and it is NOT shunted with a condenser of any sort. One end of this secondary is earthed, the other goes to an insulated terminal that ultimately is connected to the B/C set's normal aerial terminal.

In-put power is fed by means of a 4-pin plug and corresponding socket which is wired as illustrated. For the sake of clarity it is as well to use the "P" pin as the positive B, which may be safely any value between 180 and 250 volts, although the higher value is preferable. G of the socket, via the plug, goes back to the earth terminal of the main set, so making both earth and the B negative return to power-pack.

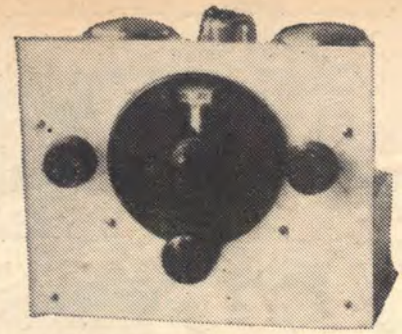
Ganged Band Spreading

As usual with short-wave receivers coils are inter-changeable for the various bands to be covered, the range of the set being from about 13 to 102 metres. For this coverage four sets of two units each are required, L1-L2 forming one unit, and L3-L4 the other. When first building it is only necessary to make up sets of coils Nos. 2 and 3; these cover almost all the S/W broadcasting channels on which there is much of interest or signals of value to Australia.

Now, broadly speaking, S/W transmissions are confined to very limited bands in the spectrum of which the most commonly used are known as 49, 31, 25 and 19 metres. Using the proper coil and a midget tuning condenser alone, such as one of 23 plates, very much less than six degrees of the dial would be more than enough to cover one of these bands. It will be obvious, firstly, that a very small movement of the dial is enough to pass right over the transmission, and secondly that if several stations are operating simultaneously on any given band they will appear to be badly crowded together. In other words, even a high ratio vernier dial does not offer a sufficiently fine movement, and the operator feels that he would like to "spread" the band over a greater proportion of the dial.

Band-spreading is offered in the Pup, and it is effected in a very simple manner. M1 and M2 are ordinary 23-plate (0.0001 mfd.) condensers; they are fitted with knobs only, and, in the photos, can be seen one on each side of the vernier dial. They act as the main tuning condensers, but they are adjusted for any given band, and then left alone.

The real tuning, so far as operation is concerned, is done with a gang of two midgets G1-G2, each section of which is only 0.000035 mfd., or 11 plates. These are simultaneously rotated by the vernier dial, and they spread the bands comparatively widely. A practical example of operation will be illustrative.



Some idea of the "Pup's" size can be obtained from this photograph.

Actual Tuning Instances

In the original model for the 25-metre band Coil Set No. 2 is used, and M1 and M2 are turned both full out (minimum capacities). The band is now covered by the rotation of the dial (operation of G1-G2) between 45 and 60 degrees. If it is desired to move up to the 31-metre band the same coils are left in circuit, but M1 and M2 are half enmeshed; rotation of the dial from about 25 to 42 degrees now covers the new band. Naturally, if M1 and M2 were enmeshed slightly less than half the band could still be covered, but the rotation of G1-G2 would be through a number of degrees correspondingly higher on the dial scale; but for the sake of accuracy and ease of return to a pre-determined adjustment, it is as well to set M1 and M2 at simply re-discovered spots, such as "all out," "half," "three-quarters," and "all in."

Notes on Coil Winding

All coils are wound on 1¼-inch diameter Marquis four-pin formers, and they plug into four-pin sockets. The order of winding and the connections to the pins are illustrated in Figs. 2 and 3.

Both coils L1 and L3 are close-wound with No. 30 d.s.c. wire. In every case there is a gap of ⅛-inch between L1 and L2, but there is no gap at all between L3 and L4. Naturally, all coils must be wound in the same direction, and the order of the connections to the pins, as illustrated, must be followed.

Tuned coils L2 and L4 are space-wound with enamel-covered wire of gauges specified in the data. This spacing varies with each combination, but is quite easily arranged. No matter how many turns are in any given coil, each coil covers exactly 1½ inches of the former's length. Thus, the fewer turns there are in a coil, the greater is the spacing.

The special intermediate frequency transformer was made by the Colonial Radio Co., although it does not involve any difficult manufacture. It is simply an ordinary 465 k.c. job, with rather fewer turns than usual on the primary and half that number on the secondary. It contains only one adjustable compression-type condenser, FC. Turning in the screw of this condenser increases the frequency (i.e., lowers the wave length) of the tuned primary. To conserve space, as shown in the photograph beneath the chassis, this trans-

PARTS LIST and CIRCUIT DIAGRAM

- **C1.—Mica condenser 0.00025 mfd. (Simplex, T.C.C., Wetless).**
- **C2, C3, C4, C5.—0.1 mfd. Tubular condensers (Concourse, Raycophone, Saxon, T.C.C., Wetless).**
- **G1, G2.—0.000035 mfd. dual gang condenser (Precedent, Raycophone, Saxon).**
- **Vernier Dial.—(Efco, Precedent, Radiokes, Raycophone).**
- **IF.—Special intermediate frequency trasformer (see text).**
- **L1, L2, L3, L4.—Coils, see text; add two 4-pin sockets and two coil cans (Colonial Radio, Paramount, Precedent, Radiokes, Saxon, Velco).**
- **M1, M2.—0.0001 mfd. Midget condensers (Paramount, Radiokes, Saxon).**
- **R1, R2.—Resistors, 25,000 ohms.**
- **R4, R5.—Resistors, 60,000 ohms. (I.R.C., Raycophone, Velco).**
- **R6.—Resistor, 40,000 ohms.**
- **R3.—Wire wound resistor, 250 ohms. (Paramount, Precedent, Radiokes, Raycophone, Saxon, Stedipower, Wendel).**
- **Valves.—One only 2A7 (or 6A7), with can, clip, and 7 pin socket (Mullard, Philips, Radiotron, Triad).**
- **Chassis.—No. 16 gauge aluminium 7½ by 5¼ by 2½ inches deep, with panel 7½ by 6 inches.**
- **Sundries.—4 pin socket and plug, two terminals, scrap ebonite and wire.**

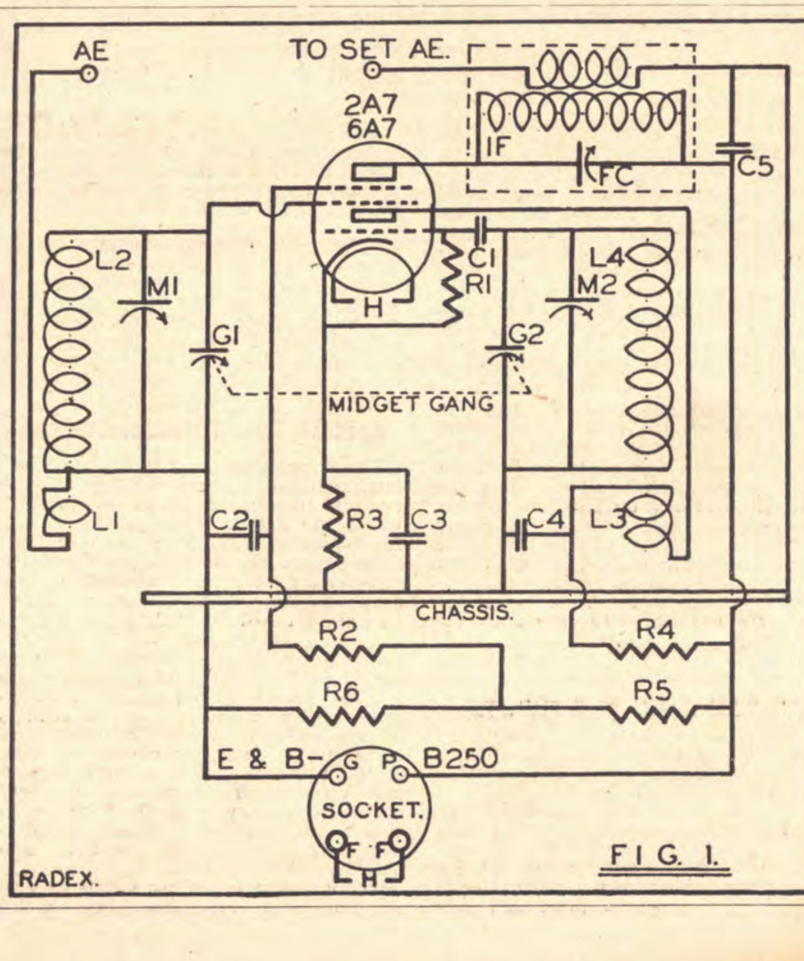


FIG. 1.

former fits underneath, and to this end its can is made only 2¼ inches in height: as the secondary is very close to the primary, this reduction in can size is quite in order.

Points in Assembly

The most difficult job in the construction of this converter is the making of the ganged condenser unit, each section of which consists of an 11-plate midget condenser. We found that midgets manufactured by Essanay lent themselves most easily to the project. Note, in the top view, that G2 section is that nearer the front.

Commence by cutting the shaft of G1 so that only ⅛-inch of its length is left clear of the threaded collar. Hold the shaft of G2 in a vice vertically, and solder the stump of G1's shaft to the boss at the end of the moving plates of G2.

Before doing this, thoroughly tin the end of the stump and the boss and sweat the two points together with a very large hot iron, or, better still, one that is electrically heated. Be careful to keep the stump concentric with the boss, and a second pair of hands to hold G1 will be very useful. Further, before starting this final soldering, see that the moving vanes of both midgets are fully enmeshed.

whole of G1 will revolve with the moving vanes of G2. Take a look at the completed set's top view, and you will see that a small bracket is made fast to the top of the chassis, and to this the lock-nut of G1 is made fast. Naturally, the hole in the face panel taking the shaft of G2 and the slot in the socket for G1 must be at equal heights above the chassis top.

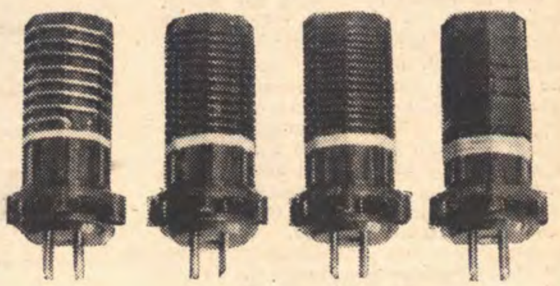
fixed vanes of G2 and M2, also ends of R4 and C4 solder direct to the nearer F clip which goes to the B end of L3.

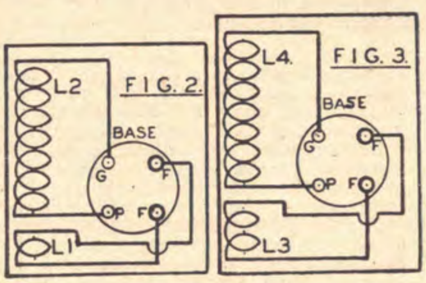
Similar action can be taken with the 7-pin socket for the 2A7, a reverse view of which is given in these pages. Thus to K can be attached ends of R1, R3 and C3. TG will take the other end of R1 and the other end of C1, C2 and

COIL DATA

Pair No.	Band (Approx.)	L1 Turns	L2 Turns	L3 Turns	L4 Turns	Wire Gauge L2 & L4
1.	13-24 M.	3	6	6	6	No. 16
2.	19.3-37 M.	3	12	7	12	No. 18
3	27-52 M.	4	19	8	15	No. 18
4.	47-102 M.	4	35	12	27	No. 24

Examples of the finished coils (one of each pair) and the data for their construction.





Wiring order of the coils to the legs of their 4-pin winding formers, viewed from the former's pin ends.

Section G2 of the gang bolts directly to the converter's aluminium face panel. It will be obvious that, unless some preventive measures are employed, the

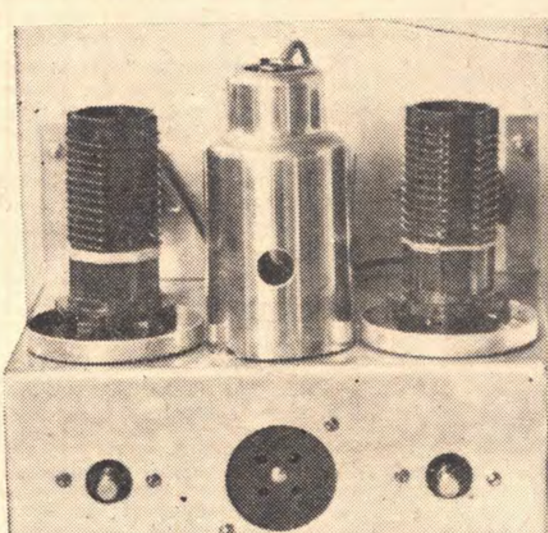
The two larger midget condensers, M1 and M2, balance the gang. At the rear centre is the seven-pin socket for the 2A7, with its heater connections toward the rear. Left and right rear respectively are the cans containing coils L1-L2 and L3-L4, but care should be taken in the way their sockets are placed relative to the positions of their holes taking the thick pins. Figs. 4 and 5 show plan views of these sockets as seen from below.

Beneath the chassis the only permanent fixture is the intermediate frequency transformer IF. This is so placed that its holding bolt comes through the chassis at the rear of the end of M2.

Wiring Hints

Do not trust to the chassis for earth returns. Take tails of bare tinned copper wire from the moving plates of all variable condensers (M1, M2, G1 and G2) through small holes drilled in the chassis. All points shown in Fig. 1 as connected to chassis should also be wired together with similar wire. All such bare leads should be joined together, and finally lead to point G on the socket for power, which is let into the back of the chassis.

Examples of direct contact wiring in Fig. 5 are:—C1 to the G clip besides a lead going off to the

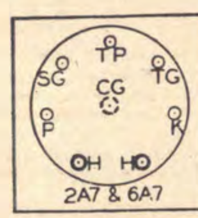


The "Pup" from the rear with Coil Pair No. 2 fitted. Connections from left are:—AE to B/C set, power in-put socket and true AE terminal.

R2 connect directly to SG. The heater leads between the power in-put socket H and the HH contacts on the 7-pin socket are little over an inch in length. The connection to the grid-pip clip for the 2A7 is taken off the fixed vanes of G1 on top of the chassis.

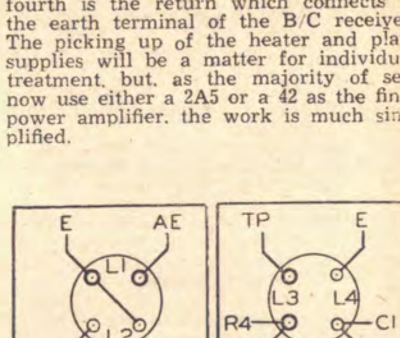
Power Supply

Of the four wires attached to a 4-pin plug that fits the rear power socket



Connections of the socket of the 2A7 (or 6A7) as seen below the chassis.

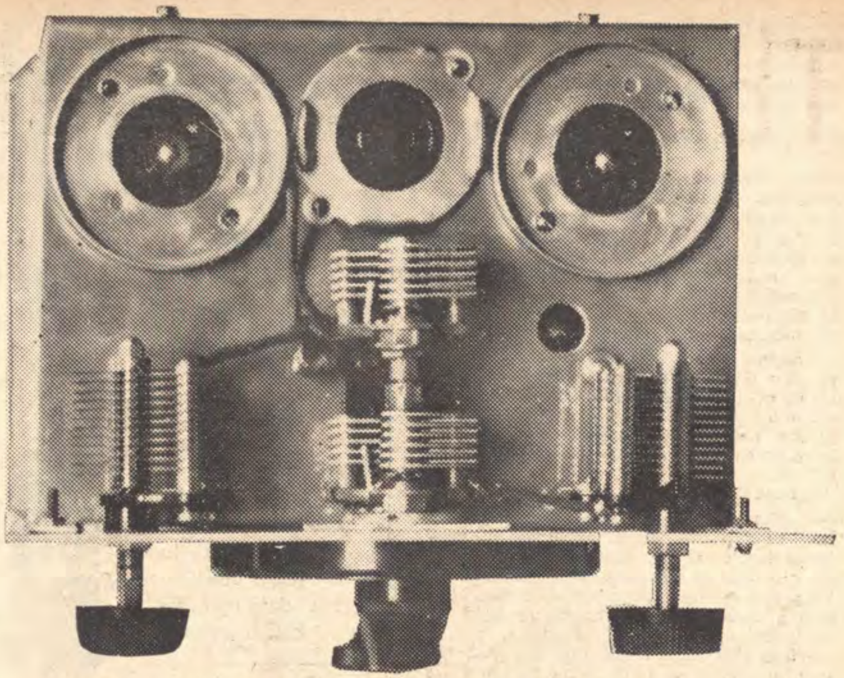
two carry heater current, one supplies B positive voltage at around 250, and the fourth is the return which connects to the earth terminal of the B/C receiver. The picking up of the heater and plate supplies will be a matter for individual treatment, but, as the majority of sets now use either a 2A5 or a 42 as the final power amplifier, the work is much simplified.



Socket wiring of the coils as from below the chassis.

In such instances, obtain a piece of celluloid, fairly thick and around 1¾ inches square. Extract the above type pentode from its socket and punch six holes in the celluloid to match the pins of the valve. Taking three of the four leads from the Pup, twist the proper heater pair's ends around the valve's two thick pins, and similarly attach the third to its screen-grid pin which gets full voltage. In making these loops be careful to leave no stray ends. Now slip the prepared celluloid on to the valve's pins and return the tube to its socket. Although the pentode has only 6 pins, as compared to the 2A7's seven, the former's S/G pin is in the same relation to the heaters as is that illustrated for the 2A7.

Where one or other of these audio pentodes is not employed in a B/C set it will be necessary to pick the heater current off one of the other valve sockets, and the plate supply can be taken from an appropriate point below the chassis. Once the supply points have been picked up, irrespective of the system used, it is unnecessary to disconnect them again from the B/C set. It will be sufficient to pull out the plug from the Pup, and, of course, change over the aerial connections when short-wave reception is completed.



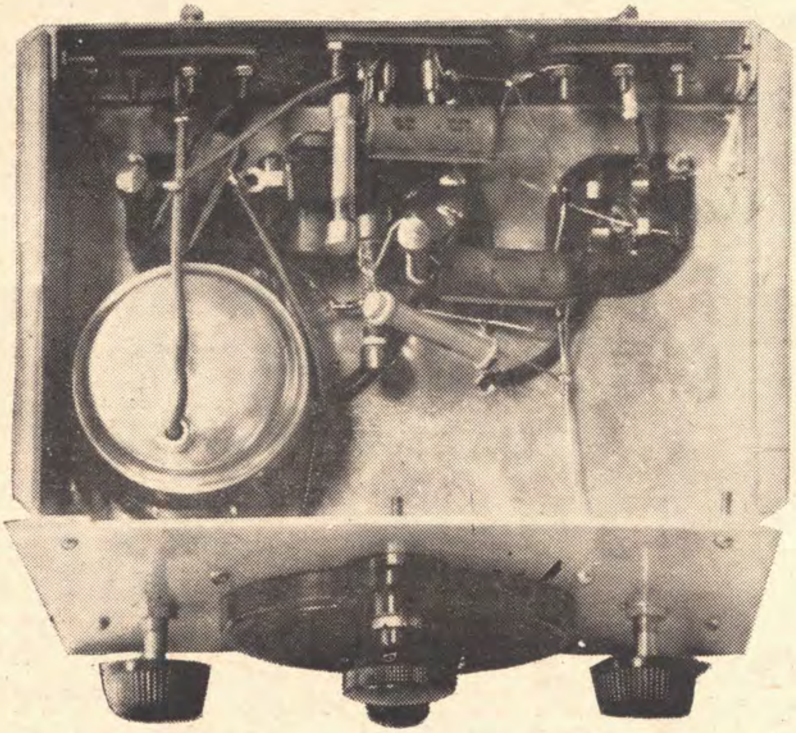
Plan view of the "Pup's" chassis with the valve and coil cans removed. The hole to the left rear of the right-hand midget (M2) is that through which FC of the I.F. coil is adjusted.

Final Line-Up

For the first line-up insert coil pair No. 2, turn out the midgets M1 and M2 completely (minima capacities), and set the dial controlling the gang to about 35. Turn the dial of the broadcast receiver to a degree or so above 2CO, and set its volume control, etc., to give the instrument the maximum of sensitivity.

Intermediate frequency transformer's primary (IF) should have been set in manufacture to 550 k.c., but it is likely that wiring will have altered this a fraction either way. Adjust FC, either up or down, but generally down, until a suppressed roar in the speaker rises to a maximum.

Now slowly rotate the Pup's dial until any sort of signal is heard, morse will do very well. If necessary, adjust M1 for a better level. Give a final touch to FC for a further increase, and then note the exact setting of the B/C receiver's dial. When using the Pup always return to that B/C dial setting before doing anything else, although, as soon as signals come in on any one day, you may find that a variation of half a degree or so either way will intensify volume. When commencing to search always make use of morse signals for this purpose; your ability or inability to read such transmissions is immaterial.



The I.F. coil fits in below the chassis. The photo shows the use of a minimum amount of wire for connections, its place being taken by resistors' pig-tails wherever possible.

Tuning Hints

Very small differences in coil winding and internal connections of this converter have comparatively large effects on the dial setting of the ganged condensers. It is, therefore, impossible to say exactly what dial readings the various short-wave bands will have on your particular recreation of the unit.

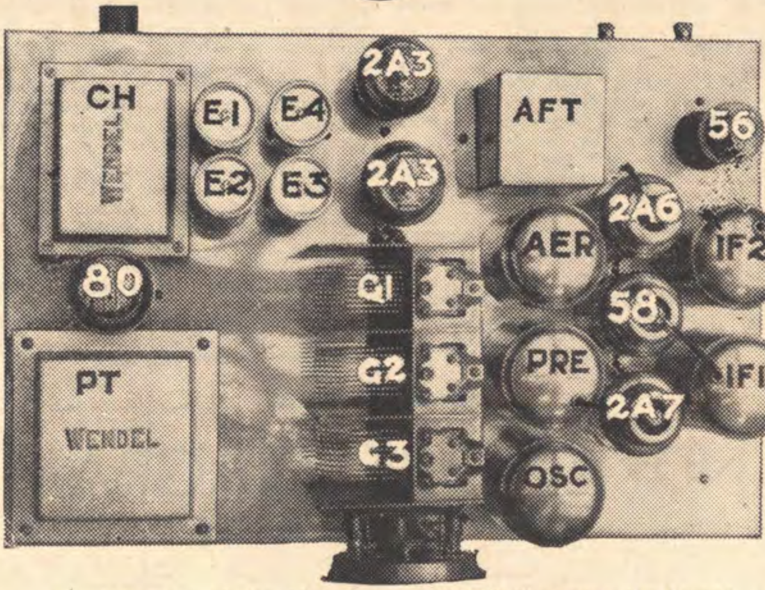
In an accompanying table it is shown that the 19-metre band can be covered probably by Pair 2, and certainly by Pair 1. Marker stations are those now coming in strongest in any particular band. Other stations in that band may be either above or below the markers.

In the 70- and 49-metre bands you will get a lot of harmonics of local stations, which are confusing at first, but are soon recognised. They come in as steady signals, while true S.W. stations evidence a peculiar background like distant waves on the seashore. One bad harmonic is from 3AR, only a fraction of a degree above RV15.

TUNING CHART

Band Metres.	Coil Pair	M2	Dial at Marker.	Marker.
70	4	⅜ in.	47	RV15
49	3	All in	55	RV59
31	2	½ in.	34	GSB
25	2	¼ in.	37	GSD
19	2	Zero	15	GSF
19	1	⅝ in.	27	GSF

The High Fidelity "6/7"



This top view of the High-Fidelity "6/7" illustrates the layout employed. All parts are tabulated to correspond with the text.

A modern Super-het. which combines a high degree of selectivity with a really large power output and an exceptional purity of tone.

By A. K. BOX

FIDELITY of tone, the faculty of re-creating in the loud speaker the original cadences of voice or music picked up by the microphone in the broadcasting studio, should be the outstanding characteristic of any radio receiver worthy of the name. Synthetic tones, arranged to suit the requirements of the individual listener, and made adjustable by electrical means, is an anathema to every self-respecting radio designer. This is as it should be, for, after all, we would not attempt to alter the tonal pitch of a Strad simply because we happened to prefer deep tones to the natural high-pitched ones of the violin.

Evidences that there is a move afoot to re-design the public's collective ear to suit the ideal radio receiver instead of fitting the radio set to the individual's ear, are not wanting. Instead of contenting themselves with artificially emphasised bass note response and a gradually falling amplification curve to the present upper frequency limit of 4500 cycles, American designers are setting out, with the aid of new type loud speakers, to extend the frequency range of new model receivers from 30 to 7500 cycles, and at the same time to keep the degree of amplification constant over the whole range.

Comprehensive Coverage

Personally we have very decided views anent this matter of fidelity. True bass note amplification is undoubtedly a desirable attribute in the high fidelity receiver. The depth and fullness of the received music is realised fully only when the low pitched instruments, such as the viols, can be heard thumping through in proper perspective. Similarly we desire a receiver in which the reproduction of the sibilants of speech give a promise of something further at the high frequency end. Without elaborate and expensive audio measuring gear it is difficult to say definitely how high a given amplifier will go, but the problem can be solved arbitrarily by designing it to have as little high note loss as possible and by the use of suitable couplings to reproduce the lower frequencies at their true value.

All this preamble simply indicates that we are riding our hobby horse—fidelity of radio reproduction—and it is intended to serve as an introduction to a technical description of a receiver we have just designed. Some months ago we described "My Own Superhet," a high quality job which apparently aroused considerable interest among the music-loving set builders. The present job follows along somewhat similar lines, but tube developments and experience with the earlier model have made it possible to get even better results here than from the former.

Steps in the Cascade

The schematic circuit diagram shows that the basic arrangement of the High Fidelity 7 is that of a 462 k.c. superhet employing a pre-selector stage in front of the mixer tube, a single i.f. amplifier stage, a diode detector operating also as an auto bias audio amplifier, a driver stage and a pair of 2A3's operating in push pull.

It will be noticed that particular attention has been paid to the power supply system, and that neither effort nor expense has been spared to ensure adequate filtration of the rectified voltage. All this is necessary in the present job for reasons which will become apparent later on. Meanwhile, let us deal with the r.f. and i.f. sections of the receiver, and then go fully into the question of the audio amplifier.

On paper, it would appear that with a 462 k.c. i.f. amplifier, there would be no need for pre-selection in the input circuit. Our experience, however, has been that in order to avoid splash of various kinds, the pre-selector is a desirable attribute to the receiver's tuning. For this reason the conventional inductively coupled pre-selector system has been included. Lest it be thought that we are defeating our own argument against the need for too much selectivity, it might be pointed out that the inherent selectivity of this system could hardly be raised to 10 k.c., even if litz-wound coils were used. With standard coils, the selectivity is probably around 20 k.c., or worse, so that we are not hurting our high note response by including it.

The mixer tube is a conventional 2A7 arranged in a more or less orthodox circuit where R2 serves simply as a voltage reducing resistor on the plate of the oscillator section of the tube. Its advantage is that the tube operates just as efficiently with the lower oscillator plate voltage, and, as the cathode current is lower, too, the tube is operating safely and is less noisy than if all elements are worked at peak. Note that our idea is for the best possible local reception, not the highest degree of r.f. and i.f. sensitivity.

De-Coupled Volume Control

The cathodes of the 2A7 mixer and the 58 i.f. amplifier tube are provided with an independent fixed bias through the resistors R3 and R4. Volume control is carried out on both tubes by means of the potentiometer VC. Naturally independent cathode by-passing by means of the .1 mfd. condensers, C3 and C4, is necessary. The screening grids of the 2A7 and the 58 are by-passed by a single .1 mfd. condenser C5 and connected to the 100 volt point on the voltage divided VD.

We come now to the diode-triode tube used as a combined second detector and first audio amplifier. This tube is the comparatively new 2A6, a high mu diode triode which apparently is a considerable advance on the older 55. The tube is more tractable in operation, has a high amplification factor which results in an apparent increase in a receiver's sensitivity, and at the same time exhibits the flatness of response which was the 55's chief claim to fame. The diode section is identical in characteristics to that of all the other American type diode triodes and diode tetrodes. In our present circuit arrangement the 2A6 is cathode biased by means of a 6000 ohm resistance R7 is connected to ground. This resistor is by-passed to ground by means of the 25 mfd. electrolytic condenser C9. Now only one point remains to be dealt with before we pass on to the audio side. It will be noticed that a 10,000 ohm fixed resistor R5 and a .1 mfd. fixed condenser C6 are included in the B plus side of the second i.f. transformer. On the face of it, this de-coupling arrangement may seem absurd when only a single i.f. stage was used, but the fact remains that it was necessary in order to eliminate code interference which was riding through the input circuits of the receiver, and being amplified by the i.f. stage. Tuning of the oscillator, mixer and aerial circuits had no effect on the interference, so it was decided finally after discovering that the interference came in even when the oscillator tube was out of its socket, that the i.f. amplifier was regenerating (not oscillating). The inclusion of the plate circuit de-coupler practically cleared up all the trouble, so that in this case its presence is well worth while.

The Push-Pull Amplifier

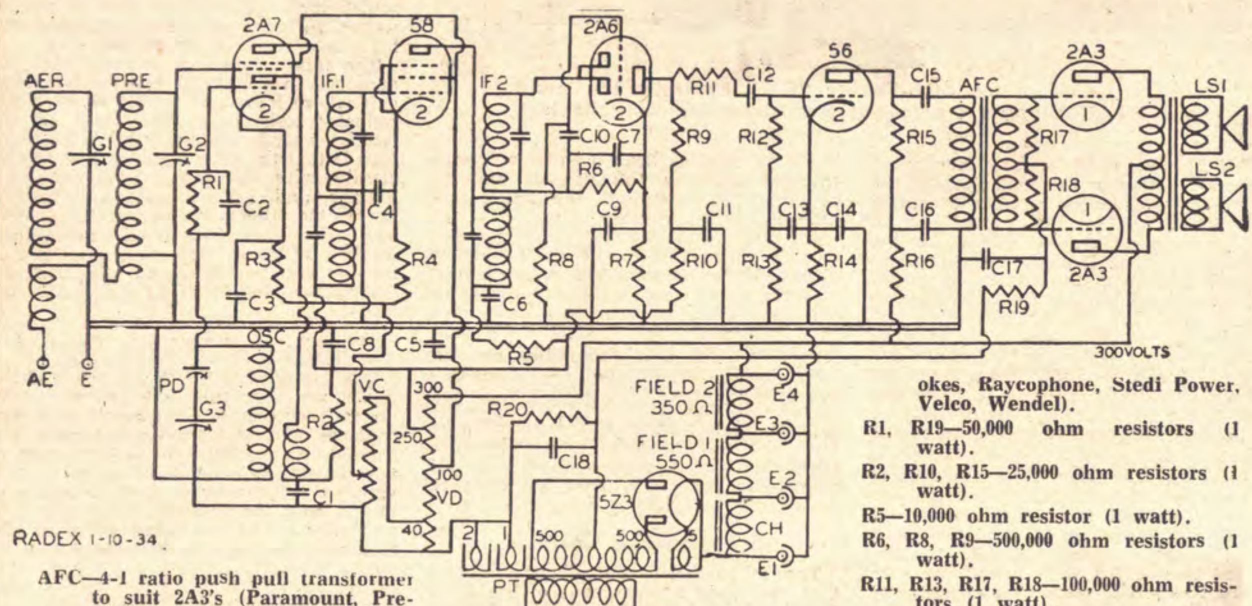
Now for the audio amplifier: The first stage of this consists of the triode section of the 2A6 in which C10 functions as the grid coupling condenser between the triode grid and the diode and the .5 meg. resistor R8 serves to establish the 1.6 volts bias, developed by R7, on the triode grid of the tube. The plate circuit is according to Hoyle, except that, in addition to the .5 meg. coupling resistor R9, a de-coupling circuit consisting of the .5 mfd. fixed condenser C11 and the 25,000 ohm. resistance R10 has been included to eliminate audio feed backs and to keep out hum. The .1 meg. resistor R 11 is employed to keep r.f. from getting into the second audio stage.

The coupling condenser C12, like that used for the grid coupling of the 2A6 is of .01 mfd. capacity. Both these condensers are of the mica dielectric type. The grid circuit of the 56 second audio stage is fully de-coupled by means of the .1 meg. resistor R13 and the .5 mfd. fixed condenser C13. This tube is given a 9-volt negative bias by means of the 2700 ohm resistor R14. The by-pass condenser across R14 is a 25 mfd. electrolytic. It may be remarked that the value of the grid resistor R12 is not high enough to obtain maximum amplification from the tube, but, in defence of the comparatively low value, we would point out that the tube can handle only a peak grid swing of nine volts, and the reduction is desirable.

The 56 is transformer coupled to the push pull output stage. In order to preserve the inductance of the primary winding of the coupling transformer, and thus maintain the low note transfer, this transformer is shunt fed. The plate voltage for the 56 is obtained from the maximum point on the voltage divider through the 15,000 ohm de-coupling resistor R16 and the 25,000 plate resistor R15. The junction between these two is by-passed to ground through a 4 mfd. condenser, this high capacity being necessary to eliminate hum.

The coupling condenser between the plate of the 56 and the audio transformer is worthy of note. Experiments with condensers ranging in capacity from .01 mfd. to 2 mfd. were carried out. The lower values reduced the low note amplification whilst the higher values introduced what apparently was a reverberatory period. The .5 mfd. value finally decided upon overcame the disadvantages of both extremes.

PARTS LIST AND CIRCUIT DIAGRAM



AFC—4-1 ratio push pull transformer to suit 2A3's (Paramount, Precedent, Radiokes, Raycophone, Saxon, Wendel).

C1, 3, 4, 5, 6—.01 mfd. tubular condensers 500 volt working.

C8, 11, 13, 15—.5 mfd. tubular condensers, 500 volt working.

C16—4 mfd. paper dielectric condenser 1500 volt test. (Concourse, Raycophone, Saxon, T.C.C. Wetless).

C2—.0001 mfd. mica condenser.

C7—.00025 mfd. mica condenser.

C10, C12—.01 mfd. mica condensers. (Simplex, T.C.C., Wetless).

C9, C14—25 mfd. 25 volt electrolytic condensers.

C17, C18—25 mfd. 75 volt electrolytic condensers. (Concourse, T.C.C.)

CH—20 henry 150 m.a. choke, 185 ohms, D.C. resistance. (Paramount, Precedent, Radiokes, Raycophone, Stedi Power, Velco, Wendel).

E1, E2, E3, E4—8 mfd. 600 volt working electrolytic condensers. (Concourse, T.C.C.)

G1, G2, G3—Three gang variable condenser. (Precedent, Raycophone, Saxon).

Kit—Aerial, Pre-selector, and oscillator coils; two 462 k.c. i.f. transformers and padding condenser. (Colonial Radio, Paramount, Precedent, Radiokes, Saxon, Velco).

LS1, LS2—Dual Dynamic Speakers, 10 in. (LS1) has 550 ohm field and inch (LS2) has 350 ohm field. Input transformer to match 5000 ohm load (P.P. 2A3's). Amplion, Precedent, Saxon.

PT—Power transformer delivering 500 volts at 150 m.a., 2.5 V. at 6 A 2.5 V. at 8 A, and 5 volts at 3 A. (Paramount, Precedent, Radiokes, Raycophone, Stedi Power, Velco, Wendel).

R1, R19—50,000 ohm resistors (1 watt).

R2, R10, R15—25,000 ohm resistors (1 watt).

R5—10,000 ohm resistor (1 watt).

R6, R8, R9—500,000 ohm resistors (1 watt).

R11, R13, R17, R18—100,000 ohm resistors (1 watt).

R12—250,000 ohm resistors (1 watt).

R16.—15,000 ohm, resistor (1 watt) (I.R.C., Raycophone, Velco).

R3, R4.—250 ohm, 10 m.a. W.W. resistors.

R7.—6000 ohm, 10 m.a. W.W. resistor.

R14.—2700 ohm 10 m.a. W.W. resistor.

R20.—500 ohm 150 m.a. W.W. resistor. (Paramount, Precedent, Radiokes, Raycophone, Saxon, Stedi Power, Wendel.)

VC—2500 ohm potentiometer (Marquis, Paramount, Precedent, Radiokes, Raycophone, Saxon).

VD.—25,000 ohm voltage divider (Paramount, Precedent, Radiokes, Raycophone, Saxon, Stedi Power, Wendel).

Chassis.—19 in. by 12 in. by 2½ in.. 16 gauge aluminium.

Valves.—2A7, 58, 2A6, 56, 5Z3 and two 2A3's (sockets and shields to suit). (Mullard, Philips, Radiotron, Triad.)

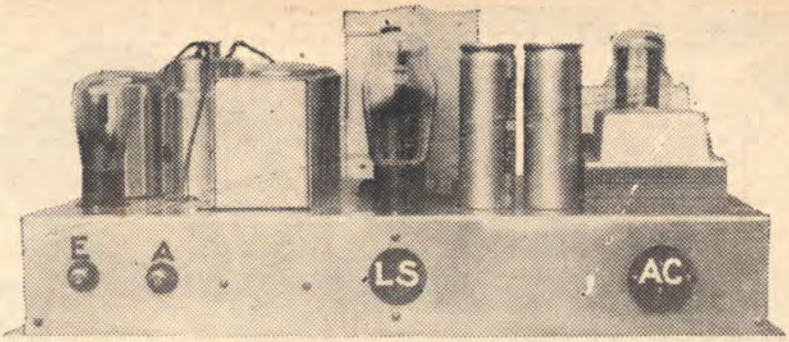
Transfer to Final Stage

The coupling transformer used with the receiver was one of the special 4/1 ratio types developed by Firth Bros. especially for use with the 2A3's. It may be remembered that this unit was suggested in the article on "My Own Super-Het." It has a sufficiently high step-up ratio to allow full excitation of the grids of the 2A3's, and its response characteristic is seemingly very flat.

The .1 megohm resistors R17 and R18 are connected across the secondary of the transformer in order, by reflection, to help the impedance match between primary and the plate of the 56.

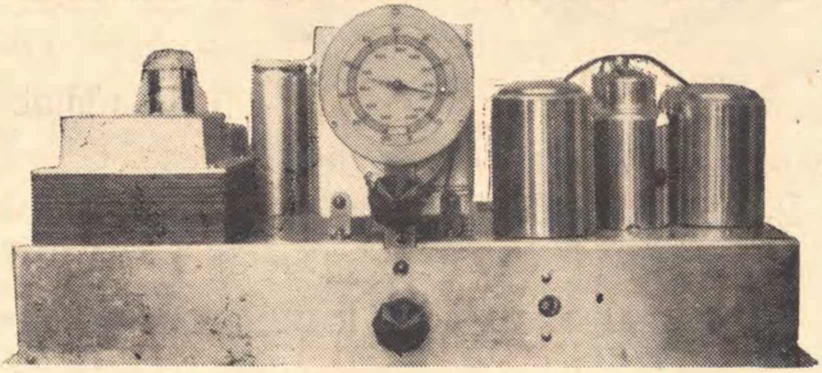
The output circuit is standard except that the loud speaker input transformer has been designed for an impedance of 5000 ohms, a figure which study of the Radiotron valve operating curves for the 2A3's reveals to be a good compromise between maximum output and minimum distortion. The most interesting point in the arrangement of the output stage is the method used to bias the 2A3's. This is officially known as "semi-fixed bias," and is obtained by connecting a resistor of suitable value between the centre tap of the high voltage winding on the power transformer and ground. The advantage of this method of bias over the more common cathode or filament bias is that as all the plate and screen current for the receiver flows through the resistor, the fluctuations in voltage drop caused by plates current swings in the 2A3's will have less effect than if only these final stage tubes derived their bias from the drop across the resistor.

Naturally, for audio purposes, it is necessary to provide a low resistance path to filament (ground in this case).



A key-lettered rear view of the finished chassis.

Accordingly we find that the 50,000 decoupling resistor R19 and the bias resistor R20 each are by-passed to ground by means of the new type 25 mfd. 75 volt electrolytic condensers C17 and C18.



A front view of the set showing at the right the adjusting port for the padder consenser.

Demands of Power Pack

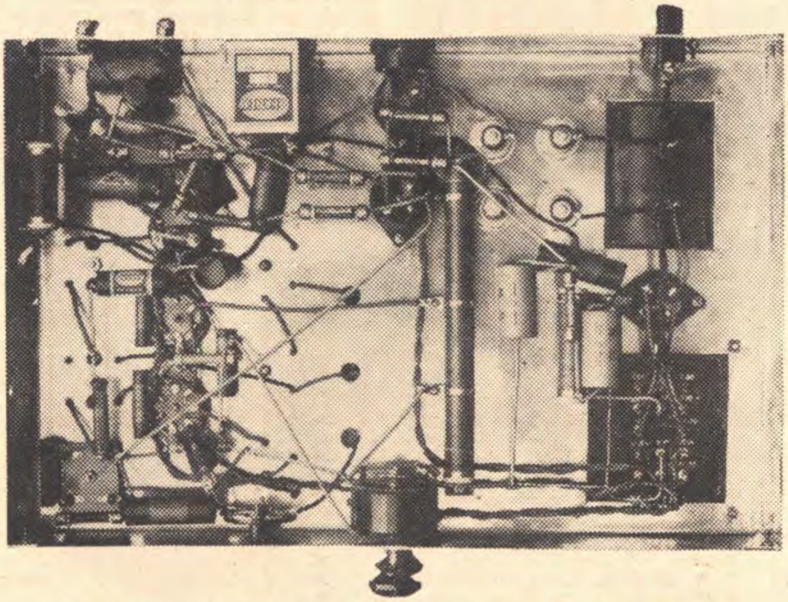
One of the main difficulties encountered by the set-builder who requires a power transformer is to obtain one that will deliver its rated output voltage under load. We have had several sad experiences in this respect, and in the case of the present receiver, which called for a transformer delivering 500 volts at 125 ma., we found it necessary to enlist the aid of the Wendel Electric Co., who built up an oversized unit. This one does not "drop its bundle," with the result that through the filter system, consisting of a choke and two loud speaker fields, we are still able to obtain 300 volts to ground. Two 2.5 volt filament windings, one at 8 amperes and the other at 6 amperes, are provided as well as the 5 volt 3 ampere winding for the 5Z3 rectifier.

As can be seen from the schematic circuit diagram, the filter system consists of three units. The first is a specially built 20 henry choke which has the low direct current resistance of 185 ohms and is capable of carrying 150 m.a. The four electrolytic condensers, E1, 2, 3 and 4 are 8 mfd. units rated at 600 volts d.c. working. The choke is required because the excellent low note response of the receiver makes it imperative that every fraction of hum be eliminated from the power supply if the receiver is to have a quiet background. In practice the results are so good that the receiver, when tuned off a station, is almost as quiet as a battery-operated set.

Differential Reproducers

As was the case in the earlier receiver already mentioned, dual loud speakers are used. Since the other set was developed, the Rola Co. has manufactured a 10-inch speaker, so naturally one of our duals was of this type. Now the larger speaker requires greater excitation than the 8-inch models, so the field windings had to be altered to suit. With a field resistance of 550 ohms it was possible to obtain an excitation of more than 8½ for the 10-inch speaker and of nearly 5½ watts for the little one. These figures, although they could be increased with advantage, provide an excellent excitation for the power output we expect to get from the 2A3's.

The results from the receiver are best left to the imagination and experience of the individual constructor. There are some things which defy description, and, to our mind, the fidelity of the present model falls into this class. A power output of something over 10 watts, coupled with a fidelity of tone, which with a good station and good records, leaves one gasping, provides the ultimate in radio reception.



The underneath photograph shows the arrangement and wiring of the parts below the chassis.

The MOTOR CAR RADIO "5"

A Set Designed for Automobile Use, Empowered Solely from a Car Battery, and Built Entirely from Standardised Components that are Obtainable from Any Radio Dealer.

By J. LEN BAIN and P. R. DUNSTONE

WHILE the basic circuit of an automobile set does not vary much from that of an all-electric super heterodyne employing a corresponding number of valves, there are several important factors over which care has to be taken, or regarding which forethought must be exercised, in the auto design. Such major features include:

Essentials of Design

The choice of valves calls for types capable of being heated from the usual car starting and ignition battery, and also ones of flexible characteristics in the matter of plate consumption.

Components, including the speaker, must be of such physical dimensions as will permit of compact assembly with adequate shielding and rigidity.

The completed unit must have a high degree of sensitivity to compensate for the meagre pick-up afforded by a restricted aerial system and total absence of an earth.

The inclusion of a rapidly acting system of automatic volume control is an absolute essential in order to minimise the transient screening effects of buildings, bridges, power lines and other vehicles when the car is in motion.

In addition there is to be considered the elimination of electrically interfering noises generated by the car's ignition and lighting systems.

Practical Applications

Naturally 6.3-volt types of valves fill the requirements of a car set's tubes. Wired in parallel (just as they would be treated in conjunction with a transformer), they are heated directly from the car's accumulator.

The marked over-all decrease in the physical sizes of modern components simplifies the work of the builder of this receiver. Midget superheterodyne kits are now easily obtainable, and pack into very small spaces.

Sensitivity is the natural outcome of carefully-chosen parts and an optimum number of valves. In this model five valves are employed, but as there is no rectifier tube in that cascade the assembly is the replica of the ordinary a.c. operated six-valve receiver.

The speed at which automatic volume control (A.V.C.) comes in and out of operation is a matter of simple arithmetic. Here the system was calculated to come into full force in 0.08 of a second: tests show that the original model's system has a delay of only one-tenth of a second. This is so rapid that it can only be recorded by a stop-watch and is sufficiently fast to minimise the effect of passing under a narrow footbridge.

In the matter of the supply of smooth, direct current, plate potential two courses offer. A small motor-generator can be installed to run off the car battery and deliver around 250 volts a.c.; this, as with the ordinary household receiver, is fed through a transformer to a rectifier tube and is then smoothed by the usual combination of large capacity condensers and choke. Alternatively, and much more inexpensively, the six-volt accumulator's output can be stepped up in voltage by means of an interrupter and transformer, converted back by pulsating d.c. through the agency of a dry rectifier, and then smoothed simply. The latter method, besides costing less, is rather more compact than the former and can be completely enclosed in a common case with the set itself.

The chassis from the front showing the shafts of the condenser and volume control.

Consideration of the Circuit

Of the five valves in the cascade of this car radio receiver the first (VI) is an amplifier at incoming radio frequency.

Following comes the 6A7 mixer which feeds into a 175 k.c. transformer IF1 and thence to the intermediate frequency amplifying valve V3. This, in turn, via IF2 supplies the diodes of the 75 which functions simultaneously as a half-wave detector, high-Mu audio amplifier and automatic volume control tube. Lastly, the 75 is resistance capacity coupled to the type 41 power pentode which is capable of delivering 3.4 watts at full plate voltage.

Tuning arrangements are exactly the same as they would be in any standard 5/6-valve super-het employing a stage of radio amplification before the mixer and one of intermediate frequency amplification after it.

The A.V.C. System

Volume control is effected by means of VC, a 500,000-ohm potentiometer wired as the diode load resistor, from which the arm picks off the desired input to the control grid of the triode section of the 75, this valve corresponding to the 2A6 in the 2.5-volt series of tubes. A.V.C. is taken off the IF-2-end of VC and feeds through filter resistor R13 to tank condenser C12. This latter controls the delay, or, speaking inversely, the speed of operation, of the A.V.C. effect and is necessarily much smaller than in a broadcast receiver. Here it is listed as 0.015 mfd and it certainly should be no larger; on the other hand, if the action of control is required faster, it can even be as small as 0.01 mfd. For the same reason by-pass condensers C10 and C11 are smaller than usual, only 0.005 mfd each.

From the junction of R13 and C12 the control potential is fed directly to the grid of V3. This feed continues progressively to the grids of V2 and V1, but these circuits are de-coupled by the insertion of resistors R12 and R11 in the supply line.

When purchasing the kit, and its associated 3-gang condenser, it is essential to mention the presence of by-pass condensers C10 and C11 in tuned circuits AER-G1 and RF — G2. They tend, because of their smallness, to reduce the wave-band coverage in those circuits and this has to be compensated by an extra turn or two on those coils. If this mention is not made it will mean that the set will tune a little above 3AR but will not reach up to 2CO, and the latter is a useful station in the country.

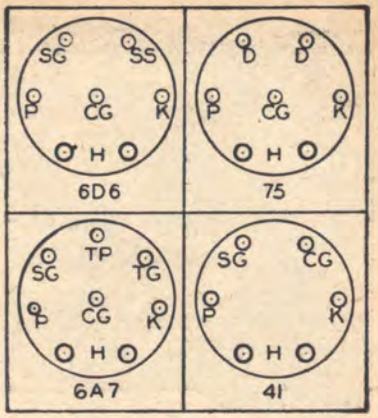
Unlike many car models, this receiver employs a dynamic speaker; the inclusion is desirable in order to take care of the pleasantly high out-put wattage of the 41. The field of the speaker is wound to a resistance of only six ohms, and is wired directly across the in-put from the car's battery.

The Parts' Lay-Out

The original model carries all components, including the dynamic speaker and the power unit, on an aluminium chassis 12½ x 7 inches top, with a depth of 2 inches, and there is no reason why recreations should not conform to these dimensions. As a matter of fact, the length (12½ inches) could be reduced to 11½ inches by the exercise of a very little care, but we decided that the extra inch in that dimension would make but little difference to a car's available space, while it gives the novice more room in which to work.

The lay-out employed can be better followed from the accompanying photographs than from a written description. It will be seen that the left-hand top end of the chassis has an appropriately sized hole cut in it through which the power unit is dropped to a depth of 2 inches. There is a bracket on the side of the unit at that distance from its base so that it can be securely bolted to the top of the chassis. At the other end of the chassis a segment of a circle is cut out to allow of the lower portion of the speaker's cone fitting flush with the edge.

As physical sizes of components vary, each assembly should be treated on its merits. A large piece of paper should be pinned to a drawing-board, or table-top, and the components laid out thereon and juggled around until they occupy a minimum of space. From this an accurate template can be made, showing all holes, cuts, etc., and from this again your metal worker can create a solid job. In consideration of the rough usage the set will get, rigidity of wiring and assembly is obviously of very great importance.



Sockets used in the car Radio Five as seen when viewed from below the chassis.

Our model has the shafts of the variable gang condenser and combined volume control and main switch, coming out in front with the speaker at the end. This arrangement was followed because it permits of the set being operated in two different ways. Firstly, the owner may fit an ordinary vernier dial directly to the outside of the casing for G1-G2-G3, with a knob for VC: these will be right in front of the driver or his passenger and easily accessible. Alternatively, but at increased initial outlay or at a later date, bowden-wire operated remote controls can be added: such a dual control is illustrated in the photo of the finished job and is bolted to the car's steering column, when in use.

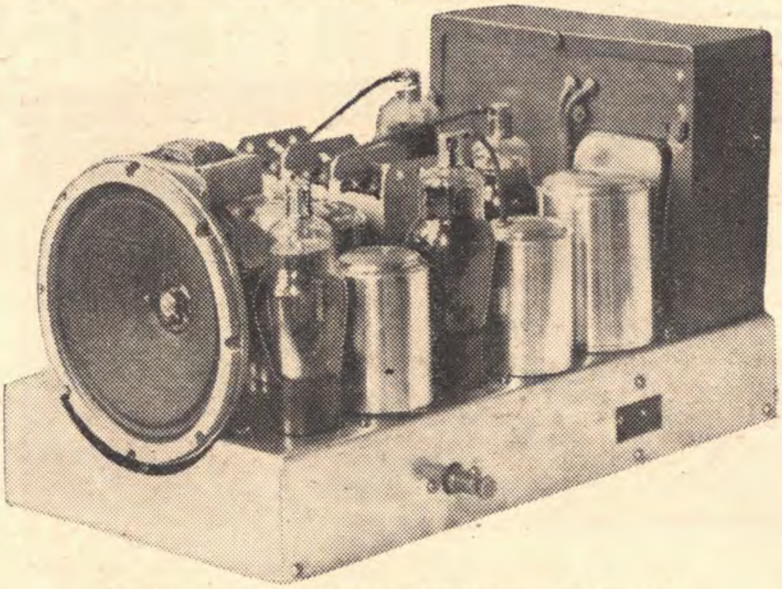
Beneath the chassis particular attention is directed to the manner in which a number of minor condensers and resistors are all mounted on a strip of ebonite measuring 2 by 7 inches.

Power from the accumulator is fed into the rear of the chassis through the agency of a Marquis polarised plug and socket. Its markings "+" and "—" are very useful, while its construction prevents accidental reversal of the plug. The insulated aerial terminal is also at the rear.

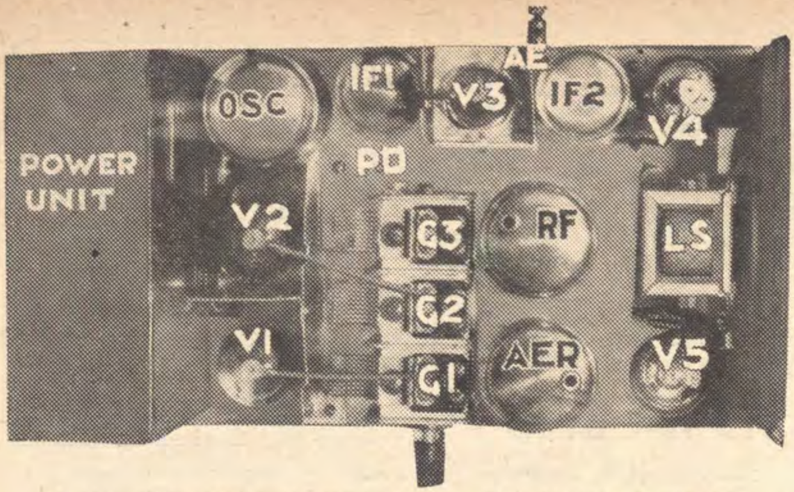
Ordinary valve-shields cannot be employed, as they are liable to shake loose. Actually we found it essential only to shield V3, and how this is done is shown in the plan view photo. The material used is No. 22 gauge aluminium which can be cut with scissors, and particular attention is directed to the piece that is bolted to the vertical portion and fits snugly round the internal shield of the tube. As an extra precaution we also put partial shielding on V1 and V2 as illustrated, but this may not always be necessary.

Wiring Hints

In mounting the Colonial Radio intermediate frequency transformers note that there is very little clearance between the lugs carrying the tails and the chassis top; put the spring washer between the bottom of each transformer and the chassis to give more spacing and, after soldering, bend the lugs well in. Use differently colored leads for the



Another view of the chassis including the aerial terminal and the MP power plug.



A plan photo of the car radio from which the layout can be followed. Note the very complete shielding of V3 and the partial shielding of V1 and V2.

tails (B plus, plate, A.V.C., aerial, etc.) and make a note of their applications. The resistor-condenser strip will be about the last thing to go in and for it many tails will be waiting. This color coding will avoid confusion, and possible search for a misconnection.

Fit all coil-cans, I.F. transformers, the padder, the gang condenser and the valve-sockets, but leave the speaker and power unit until almost the last. As usual, put a solder-lug under one bolt of each component and join these together and to the chassis with No. 20 gauge bare tinned copper wire. This will form a constant earth mat for various connections, and it is also the wiring of one side of each valve's heaters, to which latter it is to be connected. Be very careful to solder rigidly; have all leads as short as possible, taut but not tense. Using insulated wire, connect together the remaining heater terminals on each socket and go only to "plus" on MP. Now connect "—" on MP only to one side of the switch included in VC and earth that switch's other side.

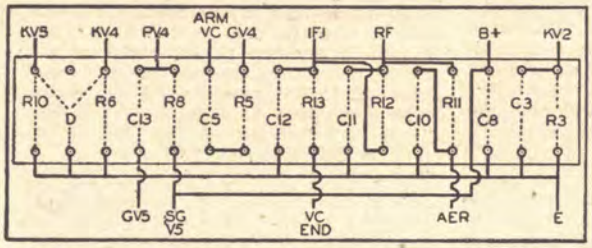
The coils' tails may now be wired up insofar as their connections to valve sockets are concerned. Note that R2 and C2 are soldered directly to TG on the socket of the 6A7 (vide drawing of socket's underneath connections) and take the other side of R2 direct to K of V2. In coil AER the small aerial winding has one end earthed. See that one end of the larger coil is NOT earthed, otherwise the A.V.C. will be inoperative on all valves.

Fit the speaker and take its field leads to the heater terminals in either of sockets V4 or V5. Its in-put transformer tails will go to the P and SG contacts of socket V5.

Mount the power pack. Solder its heavy silvered cable and the tail welded to its casing both to the set's earth network; the yellow heavy cable goes to "+" on MP. Connect the brown to the SG contacts of valves V1, V2 and V3 and connect condenser C9 between one of these points and earth.

Grouped Wiring

Turn now to the ebonite strip, herewith illustrated by a keyed drawing, which is to carry a collection of small resistors and condensers. It will be noticed that resistors and condensers are mounted alternately so that they can be placed close together without fear of short-circuits; R10 being at the end, approximately under the base of the loud speaker. The units are made fast to the strip by boring two rows of holes, each 1/16th inch diameter, through which their tails are threaded. Letters above and below indicate the external connections to be made; thus "GV4" indicates that that end of R5 is to be wired to the



Scheme of mounting and wiring sundry condensers and resistors on an ebonite strip.

grid-pip on top of V4, and also, of course, to leak resistor R7.

Before mounting the strip connect together, underneath it, all those points that are shown as going to earth (E). Also wire together such points illustrated as not going beyond the strip, e.g., ends of C5 and R5, etc. After mounting, note that the point marked "B+" carries the red wire from the power unit (B+ Max), and the B+ leads from RF, OSC, IF1 and IF2 coils in addition to the wire shown going off to one end of R8 and SG of socket V5. The latter also supplies that tube's plate via the speaker's input transformer.

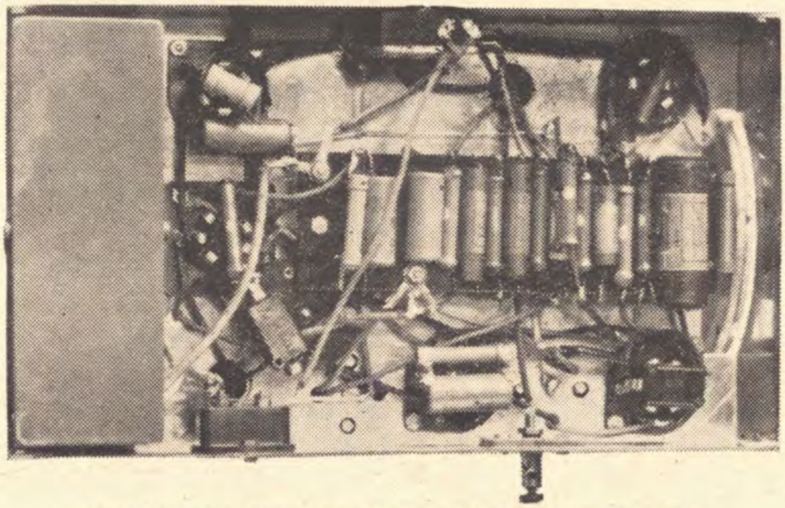
Testing Out

The car set will, of course, receive its first test on the work bench, and for this you will require a 6-volt accumulator and an indoor aerial with a length of around 25 feet. An earth is not required and this combination will give conditions about those obtaining in actual car usage.

The set is lined up in the usual manner that has been described so many times before. The original model went off from the word "Go," and there is no reason, other than faulty parts, why your recreation should not do the same thing. Proof of the A.V.C.'s operation is very easily obtained; set the dial off a station and turn the volume control full on. You should now get all the static explosions on the air, but turning to a station (especially a strong one) will automatically cut the static down to almost nothing if everything is in order. Conversely, the more distant the particular station is (weak signals), the more the static will be heard.

Do not be perturbed if you appear to get a slight hum through the speaker at this juncture. It arises from the power unit, but will disappear almost completely when the set is mounted in a car and directly to the metal thereof. Note that in this try-out the connections between battery and set and inside the power unit should be those which will be demanded by your car, according to whether the positive or negative pole of its battery is wired to car chassis.

While you must line the set up to a degree in order to test out its connections and the operation of the A.V.C., there is no need at this stage to worry about the exact lining of the interme-



Beneath the chassis many minor components are anchored to an ebonite strip to ensure rigidity. Note the downward protrusion of the power unit (left) and speaker (right).

diate frequency transformers. Both the adjustments of the triple-gang condenser's trimmers and of the IF's will change later when the receiver is fully enclosed in its steel cabinet.

Car Noise Suppression

In addition to the components listed and to the armored cable connecting the set to the battery, as many suppressor resistors as the car has plugs with another suppressor for the distributor and two 0.5 mfd. pig-tail condensers must be purchased. These are required to quell the noises generated by the car's ignition and lighting systems. Directions for their installation, for which we draw on the experience of the Eclipse Radio Co., are as follow:—

First: Remove one at a time the high tension lead from the top of each spark plug; mount in its place the spark plug suppressor. Connect the high tension lead to the terminal provided for it on end of the suppressor. Mount suppressor in horizontal position when possible. On some cars, such as Buick, Franklin and Nash, screw type suppressors should be used. These are installed by cutting spark plug leads about two inches from the plugs. Then screw one cut end into each end of suppressor. Be sure of a good contact.

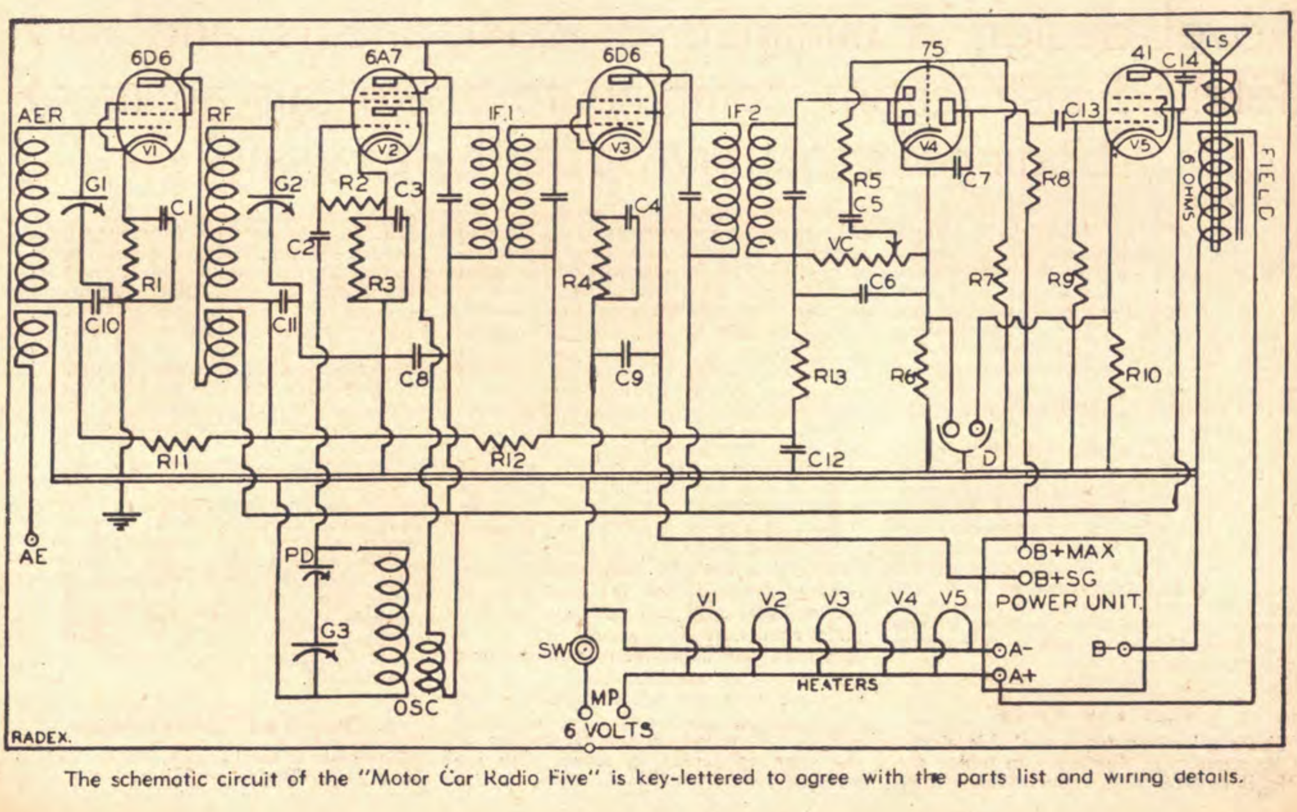
Second: Install the distributor suppressor in the centre socket of distributor head by removing high tension lead which runs from distributor head to coil. Plug the split end of suppressor into distributor head, making sure of a good contact. Plug high tension lead in other end of suppressor. If the car has cap type distributor the suppressor may be plugged in coil or the screw type suppressor may be used. In cars having two coils, a suppressor in each high tension lead is necessary. Always install the suppressor as close to the distributor as possible.

Third: Fasten lead of one condenser to generator side of cut-out relay of car generator and clamp condenser to frame of generator—the screw holding cut-out may be used for this purpose. Be sure that the condenser is securely fastened and a good ground connection is made.

Fourth: Fasten lead of other condenser to storage battery side of ammeter. Secure condenser to instrument panel (if it is metal) or to some metal part, being sure of a good ground connection. Sometimes this condenser is more effective when attached to dome light, stop-light or horn wires. The latter is usually necessary when car is equipped with roof antenna. This may be tried while motor is running and the effect on the interference noted and condenser connected to most effective point. It may be necessary in extreme cases to connect a condenser to more than one of these points. The above procedure should effectively eliminate motor interference in practically all installations. However, if this does not hold true it may be necessary to bond the motor to the dashboard and car frame and re-locate high tension leads that may be running adjacent to radio receiver or radio receiver wires.

LIST OF COMPONENTS

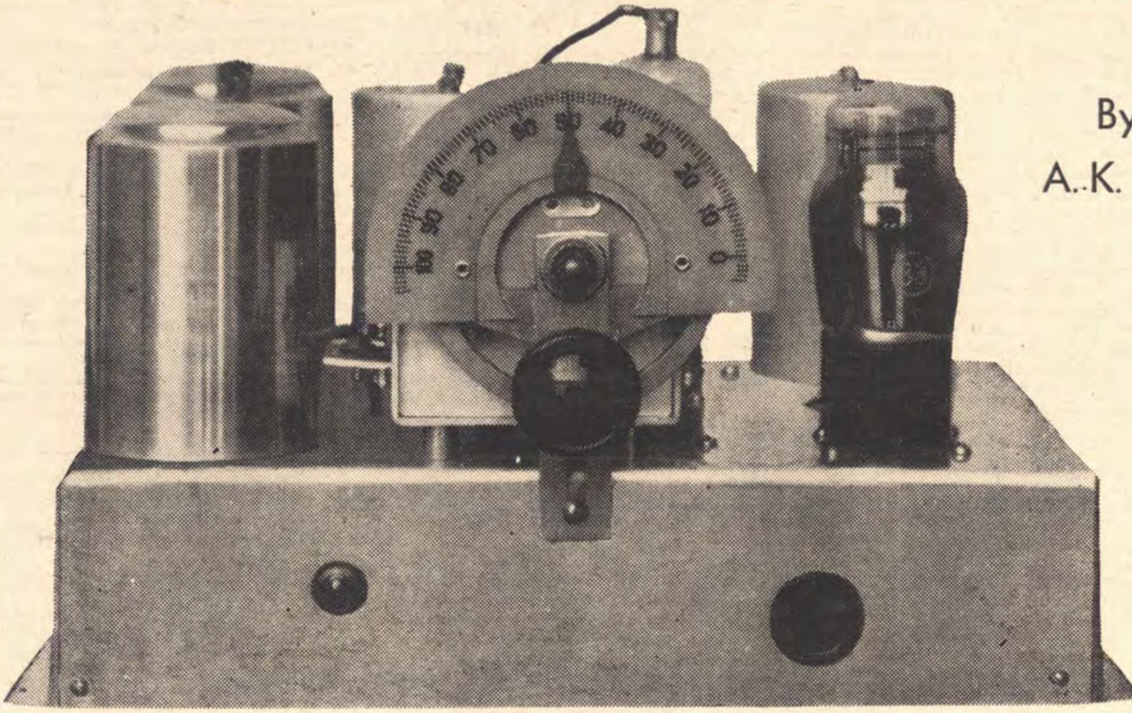
Kit—Comprising aerial r.f., and oscillator coils, two 175 k.c. I.F. transformers and padder. All midget sizes. See text. (Colonial Radio, Paramount, Precedent, Radiokes, Saxon, Velco).
C1, 3, 4, 8, 9, 13—0.1 mfd. tubular condensers.
C5—0.05 mfd. tubular condenser.
C10, 11, 14—0.005 mfd. tubular condensers.
C12—0.015 mfd. tubular condenser.
(Concourse, Raycophone, S a x o n, T.C.C., Wetless).
C2—0.0002 mfd. mica condenser.
C6—0.001 mfd. mica condenser.
C7—0.00005 mfd. mica condenser.
(Simplex, T.C.C., Wetless).
D—2 by 10 mfd., 25 volts working twin electrolytic condensers — (Ducon).
G1, 2, 3—Triple-gang midget condenser. (Raycophone, Saxon).
LS—Dynamic speaker match to 41 5-inch cone, 6 ohm field. (Amplion, Precedent, Saxon).
MP—Marquis polarised plug and socket.
Power Unit—"B" supply. See text.
R1, 4—350 ohms, 15 m.a. wire wound resistors.
R3—[illegible]0 ohms, 15 m.a. wire wound resistor.
R10—625 ohms, 50 m.a., wire wound resistor.
(Paramount, Precedent, Radiokes, Raycophone, Saxon, Stedi - power Wendel).
R2, 5—Resistor 50,000 ohms.
R6—Resistor 10,000 ohms.
R7, 9, 12, 13—Resistors ½ megohm.
R8, 11—Resistor ¼ megohm.
(I.R.C. Raycophone, Velco).
VC and SW—Combined potentiometer, 500,000 ohms and power switch. (I.R.C.).
Valves—Two 6D6, one each 6A7, 75. and 41. (Mullard, Philips, Radiotron, Triad).
Chassis—No. 16 gauge aluminium 12½ by 7 by 2 inches.
Sundries—Four 6 pin sockets and one 7 pin, for grid clips, terminal, scrap ebonite, belden wire, one foot single-shielded cable, two yards twin shielded cable, heavy usual hardware and No. 16 gauge steel case.
Remote Control—Combined dial and volume with bowden wire connections. (Saxon Effco).



The schematic circuit of the "Motor Car Radio Five" is key-lettered to agree with the parts list and wiring details.

THE "Simplex" Super "4"

By A. K. Box



A front view of the finished receiver. The set has only two controls, one for tuning and the other for volume. On the left is the battery switch.

Novel design, a minimum of components, and very detailed instructions combine to make this an ideal beginner's battery super-heterodyne

NOTWITHSTANDING his feeling that the popularity of the super-het. in the a.c. receiver field warrants attention from the viewpoint of battery operation, the average set-builder is rather chary of attempting such a job. This is due mainly to the fact that he believes that fundamentally the super-heterodyne is a more difficult type of receiver to construct than is the t.r.f. variety.

It is our aim in this article to point out the fallacy of this idea, and to show how a small but efficient battery super-het. can be built simply and with an absolute minimum of components. As will be seen from the schematic diagram of the four-valve receiver, the circuit embodies a 1A6 type tube as combined modulator and oscillator, a type 34 as intermediate frequency amplifier, a type 30 as second detector and a 33 pentode as audio tube.

Uses Few Parts

The outstanding feature of this circuit is its simplicity. Certainly in minor details it departs from conventional super-het. circuit arrangements, but, as will presently be explained, these modifications have been incorporated to good purpose, and have an important bearing on the receiver's ultimate performance.

First, it will be noticed that, instead of the more usual loosely coupled arrangement, the aerial is tapped into the aerial coil AER. In the experimental job three taps were provided. They were brought out at 5, 15, and 25 turns from the earth end of the coil. The object of this arrangement is to get as large a signal into the grid of the modulator as is possible.

The coil AER is tuned by the conventional .00047 mfd. gang condenser, of which G1 is the first section. The oscillator grid (Grid No. 1) is coupled to the oscillator grid coil through the .0001 mfd. condenser C1, across which is paralleled the 50,000-ohm oscillator grid leak R1. The oscillator plate (Grid No. 2) is fed with the full 90 volts through the oscillator plate coil. The oscillator grid coil is tuned by the G2 section of the gang condenser in series with the padding condenser PD.

The two intermediate frequency transformers IF1 and IF2 are interesting inasmuch as they are of the new Paramount air dielectric type, which are provided with means of variably coupling the plate and grid coils. The advantages of this type of intermediate frequency transformer are twofold. In the first place, the use of air dielectric tuning condensers (in reality small midget variables) reduces considerably the possibility, always present with compression type condensers, of frequency shift which would follow any slackening of the condenser adjusting screws. The more important point from the present angle is that the variable coupling between the two coils which comprise each transformer permits us to adjust the selectivity and gain of the receiver to suit any particular set of conditions. We shall have more to say about this later when we come to the question of lining up.

Only Two "B" Voltages

The plate of the i.f. tube, V2, the modulator plate (Plate) on V1, and the plate and screening grid of the pentode V2 all receive the maximum potential. The screening grid of the 1A6 (Grids 3 and 5), and the screening grid of the 34 each are supplied with a "B" potential of 45 volts, as is the plate of the 30 second detector tube. This valve is operated in a sensitive condition with a .00025 mfd. grid condenser and 2 megohm grid leak. The leak, R2, is returned to negative filament, although from the viewpoint of maximum sensitivity it should have a positive return. Still, we must make some concession to the power handling job of the second detector, and for this reason a negative grid return has been employed.

With the idea of making the receiver as simple as possible, a small 1½ volt torch cell has been used to provide bias on the i.f. amplifier tube. If the 10½ volt "C" battery used for the bias on the pentode were used for the bias of the i.f. valve as well, it would be necessary to provide a decoupling network made up of a series resistance and a by-pass condenser, a complication which we wished to avoid. For the same reason we used a 100,000 ohm variable resistor connected in parallel with the primary of the audio transformer to control the volume of the receiver.

The condenser, C3, included in the schematic circuit diagram was not employed in the original receiver. However, in some cases it may be advisable thus to by-pass the "B" battery, and for this reason the condenser has been shown. Its capacity should be from 2 to 4 mfds.

"B" Battery Voltages

We have gone rather fully into this angle of the receiver's design, and have come to the conclusion that really good results can be obtained with a miximum plate potential of only 80 volts. Naturally higher voltages increase the set's overall gain, and its power handling capacity, but these advantages are offset by the considerably increased plate current drain which follows. At 80 volts the total current drain is only 10 m.a. This rises to 12 m.a. with 90 volts, to about 19 m.a. at 135 volts, and to nearly 25 m.a. at 180 volts. Naturally for the man who is dependent upon non-rechargeable "B" batteries for his power supply source, there is no alternative to the lowest practicable working value.

LIST OF PARTS

A Battery, 2-v. (Century).

AER.—One aerial coil to spec. OSC-1 465 K.C. oscillator coil to spec. (Colonial Radio, Paramount, Precedent, Radiokes, Saxon, Velco.)

PD.—One 465 k.c. padding condenser.

IF1 and IF2.—465 K.C. air dielectric intermediate frequency transformers. (Paramount, Radiokes.)

G1, G2.—Two gang .00047 mfd. tuning condenser. (Precedent, Raycophone, Saxon.)

AFT.—3½-1 ratio audio transformer. (Paramount, Precedent, Radiokes, Raycophone, Saxon, Wendel.)

C1.—.0001 mfd. fixed condenser.

C2.—0.00025 mfd. fixed condenser. (Simplex, T.C.C., Wetless.)

C3.—4 mfd., 300 volt working, fixed condenser.

R1.—50,000 ohms resistor.

R2.—2 megohm resistor. (I.R.C., Raycophone, Velco.)

SW.—Single circuit toggle switch.

VC.—100,000 ohms volume control. (Marquis, Paramount, Precedent, Radiokes, Raycophone, Saxon.)

GB1.—1½ volt torch cell. (Diamond, Ever-Ready Stan-Mor).

Sockets.—Three UX, one UY and one 6-pin. (Marquis, Precedent, Saxon.)

Dial.—(Effco, Precedent, Radiokes, Raycophone.)

Chassis to specifications. — Machine screws, wire terminals, grid clips, knobs.

Valves.—One 1A6, one 34, one 30, and one 33. (Mullard, Philips, Radiotron, Triad.)

At the 80 volts (the potential on which our current readings were taken), we came to the conclusion that the best performance was obtained with a modulator plate voltage of 80 on V1, and an oscillator plate voltage of 67½ or 80; no increase in current drain was noted with the higher voltage, but the noise level of the receiver rose without any apparent increase in sensitivity.

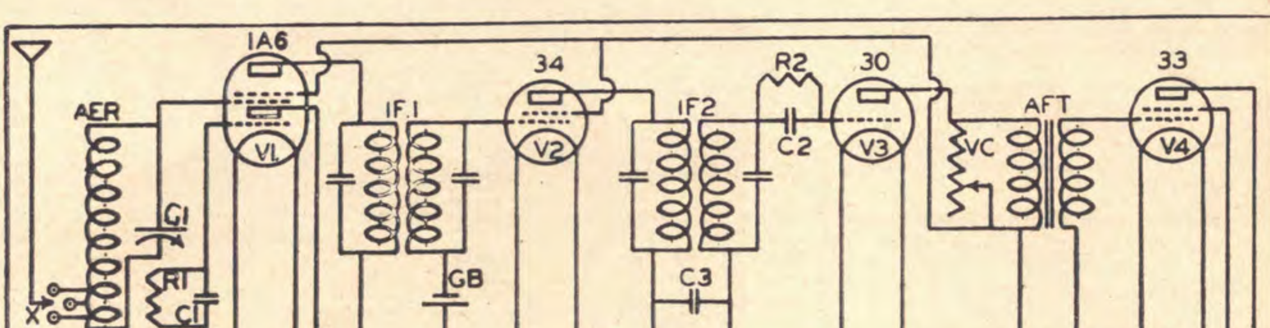
The same screen and plate potentials were applied to the i.f. tube, V2. It was found that either the 32 or the 34 could be used in this stage without altering either the performance or the battery drain. As the variable Mu characteristics of the 34 are not made use of in our present circuit arrangement, there is no reason why this tube should be employed. The 32 is slightly cheaper but, if in the course of later efforts the receiver is re-built and is to be volume controlled through a varying bias on the i.f. tube, the 34 will be necessary.

A point which should be watched is that the 30 should be operated, through transformer coupling, at no greater plate potential than 45 volts. This, of course, applies to its use as a leaky grid detector. The bias on the pentode should be kept at 10½ volts negative. This is the correct figure at 90 volts, although a little high at 80. The slight over-bias however, does not materially affect the tube's performance as a Class "A" amplifier, and aids in the reduction of plate current drain.

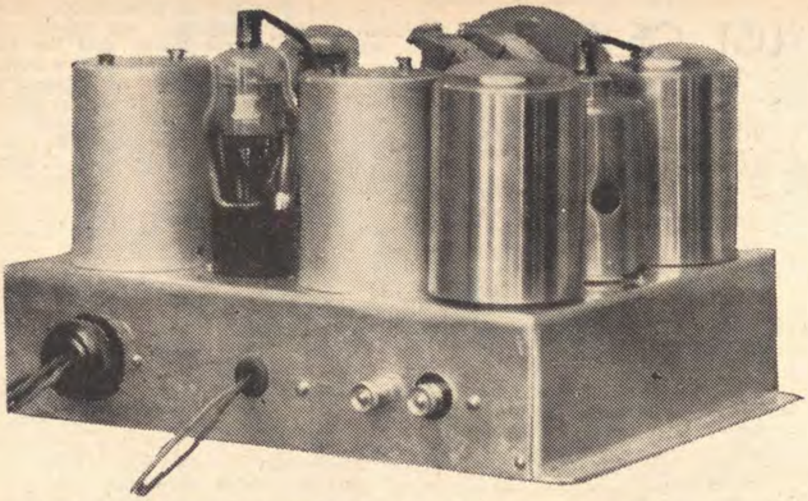
Assembly of Parts

The various photographs of the finished set show clearly the features of its construction. Because of the circuit design, it is possible to build up the assembly on a very compact chassis. That used in the original measures 11 inches in length, 8½ inches in width, and 2½ inches in depth. The layout of the components on the top of the chassis looking from the front, is:—

At the extreme front left comes the can containing the aerial coil, AER, between this and the OSC coil can, mounted in the back left-hand corner,



The schematic circuit diagram of the "Simplex Super 4" is key-lettered to agree with the parts list and wiring details.



A rear photograph of the Simplex Super demonstrates how the leads to the batteries, aerial and earth are made on this receiver.

is the socket for the 1A6 mixer tube, V1. Along the rear edge of the chassis, next to the OSC coil can, is the can containing the first intermediate frequency transformer, IF1. Between this transformer and the second i.f. transformer, IF2, mounted at the rear right, is the intermediate frequency amplifier tube, V2. The socket for the pentode, V4, is mounted in the front right-hand corner of the chassis, whilst the socket for V3 is mounted between V4 and IF2. The gang condenser is centrally disposed on the chassis, whilst the padding condenser is secured to the underside of the chassis between the gang condenser and IF1. A half inch hole, drilled to correspond with the adjusting screw of the padder, provides access to this component for lining the receiver.

On the front side of the chassis the volume control is mounted at the right, and the filament switch at the left. Along the rear side of the chassis the socket for the loud speaker and plate supply plug is mounted in line with IF2, the rubber grommetted hole for the "A" battery cable is in the centre, and the aerial and earth terminals are mounted in line with IF1 and OSC.

The only other components to be directly mounted to the chassis are the audio transformer AFT and the 1½ volt "C" battery, G.B. The latter is held by means of a metal strip, which clamps the battery to the chassis.

Preliminary Connections

As our aim in this article is to explain to the novice how to build a modern battery super-het, we propose to break our usual rule and detail the point to point wiring connections. It should be pointed out that the wiring of the receiver is best carried out with spaghetti insulated tinned copper wire, although Belden type braided flex will be more convenient for the coil leads to IF1, IF2, OSC and AER.

In this connection it is advisable to obtain one yard of each of four different colors in the braided flex because all leads will have to be soldered to the coils before the latter are mounted on the chassis. For this color code we suggest Red for the plates, Green for B plus, Blue for Grid and Black for C minus or earth. The correct way to wire the i.f. transformers is to connect the start (inside) of one coil to B plus, and the finish (outside) to the plate. The start of the second coil will go to C minus or earth and the finish to the grid. In the case of the oscillator coil OSC connect the top end of the larger winding to the grid and the bottom end of the small winding to the oscillator plate.

Although we advise against it, in this case there will be some set builders who wish to make up their own oscillator and aerial coils. For these the following data is provided. AER and OSC are wound on 1¼ inch diameter Marquis formers. AER consists of 112 turns of 28 gauge enamel covered wire tapped at the 87th, 97th and 107th turns from the start of the winding. The grid coil of OSC consists of 63 turns of 28 gauge enamel covered wire whilst the plate coil consists of 30 turns of 36 gauge d.s.c. wire separated from the earth end of the grid winding by 3-16 of an inch. This data is provided for use with an Essanay .0047 mfd. condenser.

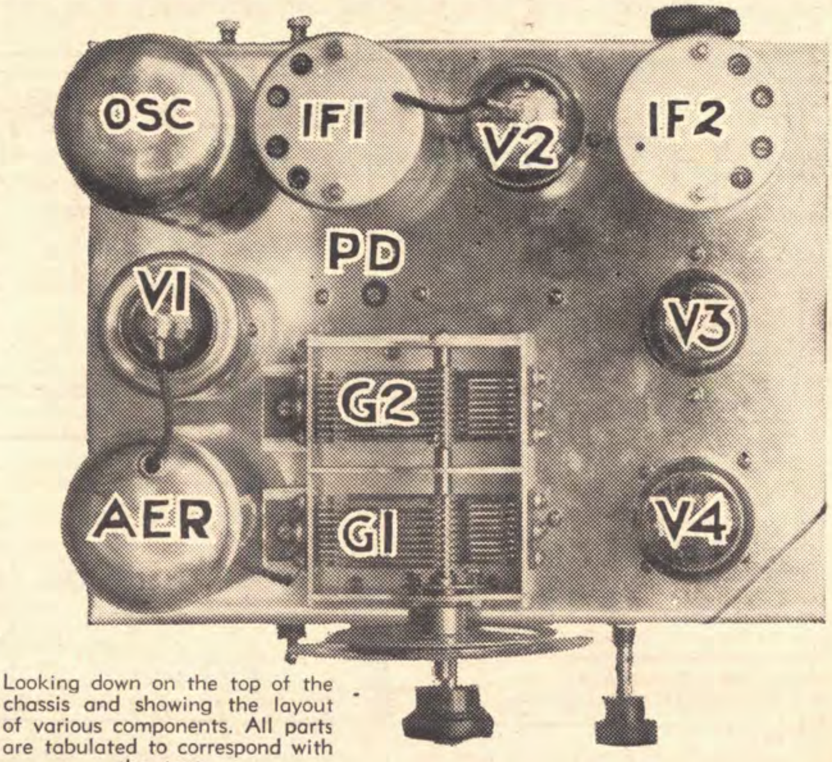
Point to Point Directions

Start the wiring by taking a lead from the A minus lug on the socket for V1 to the corresponding lug on the sockets for V2, V3 and V4. Run a lead from one side of the battery switch SW to the positive filament lug on the sockets for V1, V2, V3, V4. Now take a lead from the top (grid) end of the aerial coil AER to the grid clip which is to clip over the "pip" on V1. Run another lead from this point on AER, through a hole drilled in the side of the coil can, to the fixed plate lug on the front, G1, section of the gang condenser. Connect the earth end of AER to the nearest holding bolt on the socket of V1 and to the negative filament lug on that socket. The three aerial taps on AER should be left for the present.

Connect the plate lead from IF1 to the plate lug on the socket for V1. Join the B plus lead on IF1 to the B90 lug on the loud speaker socket (see the circuit diagram for these l.s. socket connections). Connect the screening grid lug (Grids No. 3 and 5) on the socket of V1 to the screening grid lug on the socket for V2. To this lug on V2 take a lead from the B plus terminal on the audio transformer AFT. Take another lead from the screening grid lug on the socket of V2 to the B plus 45 volt lug on the l.s. socket.

Connect the plate lead from OSC to the oscillator plate (Grid No. 4) on the socket for V1 and join the B plus lead from OSC to the B plus 90 lug on the l.s. socket. Solder one lug on the .0001 mfd. grid condenser C1 to the oscillator grid (Grid No. 1) on the socket for V1 and to this point on V1 solder one lead of the 50,000 ohm resistance R1.

The remaining lead on C1 is soldered to the remaining lead on R1 and to the grid lead from the oscillator coil OSC. A further lead from this point on C1-R1 is joined to one side of the padding condenser PD. The other side of



Looking down on the top of the chassis and showing the layout of various components. All parts are tabulated to correspond with the text.

PD goes to the moving plate lug on the G2 (back) section of the gang condenser.

Intermediate Connections

The grid lead from IF1 is taken through the top of the can and soldered to the grid clip to go on V2. The earth lead from IF1 is soldered to the negative (can) of the 1½ volt "C" battery GB, the positive (centre contact) of which is connected to earth. The plate lead from IF2 is taken to the plate terminal on the socket for V2, while the B plus lead from this i.f. transformer goes to the B plus 90 volt lug on the l.s. socket.

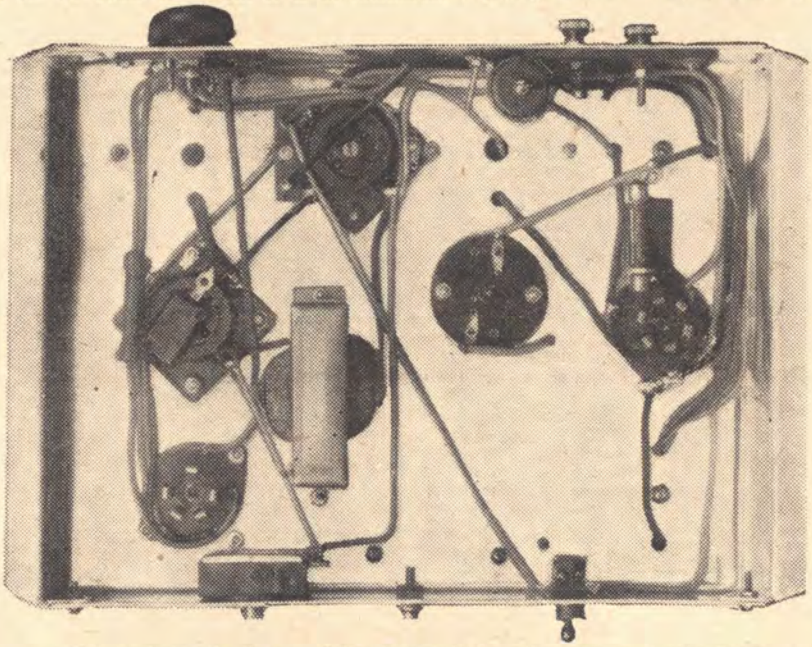
The G lead on IF2 is taken underneath the chassis to join to one lug on the .00025 mfd. fixed condenser C2 and to one lead of the 2 megohm grid leak R2. The remaining lug on C2 and the remaining lead on R2 are soldered to the G lug on the socket for V3. The plate lug on this socket joins to the P terminal on AFT and to one outside lead on the 100,000 ohms volume control VC. The arm terminal on VC joins to the B plus terminal on AFT.

The G terminal on AFT is connected to the G lug on the socket for V4. The P lug on this socket goes to the S lug on the l.s. socket, whilst the screening grid lug on V4 is taken to the B plus 90 volt lug on the l.s. socket. The C minus terminal on AFT is connected to the C minus lug on the speaker socket. It will be necessary now to attach the battery and speaker leads to the correct pins of the plug which is to fit into the loud speaker socket. Particular care should be taken with this part of the job in order to avoid dangerous short circuits. The remaining connections to be made are the soldering of the "A" positive battery lead to the vacant terminal on the switch SW and the "A" negative lead to the negative filament lug on the socket of V2.

When the valves and loud speaker have been plugged in, the "A," "B" and "C" batteries connected and the aerial and earth attached we are ready to test the receiver. It should be noted that the C minus lead on the l.s. socket goes to the 10½ volt negative tap on an external "C" battery, the positive terminal of which is connected to "A" minus and "B" minus at those units.

Checking Up On Intermediates

The alignment of the receiver is not difficult, and, if the following instructions are adhered to, no trouble should be experienced by the set builder. Assuming that no wiring mistakes have been made, the first job which confronts the set builder is the alignment of the intermediate frequency transformers. Because of their inherent design it is a difficult matter for the manufacturers to supply them already tuned to a predetermined frequency and at the same time provide for the flexibility of adjustment which is one of their cardinal points.



This underneath picture of the completed receiver shows clearly the disposition of the parts.

We have decided that the i.f. stage of this receiver shall be tuned to a frequency of 465 k.c. The point now is how to tune the transformers to this frequency without resort to a line up oscillator. The only way in which the job can be done is to remove the mixer tube V1 from its socket and to plug the aerial into the plate connection of this socket. This has the effect of feeding the signal direct through the i.f. stages, the second detector and the audio tube. Our object now is to tune the i.f. transformers to the upward harmonic of 3UZ. This station operates on a fundamental frequency of 930 k.c., so that the first upward harmonic will bring us out at 465 k.c., the desired i.f. frequency.

Start the job by rotating the coupling adjustments on the transformers until greatest coupling between plate and grid coils is obtained.

This done, adjust each of the trimmers until it is at maximum capacity. These preliminary adjustments had best be made before the i.f. transformers are mounted to the chassis and wired into circuit. Now, adjusting each trimmer a small fraction of a turn at a time, starting with the second detector grid circuit, then the i.f. plate circuit, then the i.f. grid circuit, and finally the mixer plate circuit, tune until 3UZ's harmonic is brought in at maximum strength.

Having done this we are ready to proceed with the conventional alignment of the receiver. It should be pointed out that this form of adjustment will not always be possible in daylight, and in areas far removed from the station it will be a difficult matter to pick the signal up. The alternative arrangement — rough and ready, but fairly exact — is to tune a regenerative broadcast set to 3UZ and then make it oscillate by increasing the capacity of the reaction condenser. An insulated lead wrapped round the detector plate lead of this receiver and taken into the plate connection of the mixer socket will also give a frequency for alignment of the i.f.'s.

Lining up the Gang

Assuming that these have been aligned to about 465 k.c., return the aerial from the mixer socket to its correct place on the receiver, to one or other of the three aerial leads, and plug the 1A6 in. Turn the gang condenser towards the zero position and endeavor to pick up 3AW, 7UV, 3GL or 2AY. It doesn't matter which of these is used for alignment, but get as low down the scale as possible. Adjust the trimmer on the G1 section of the gang until the greatest volume is obtained.

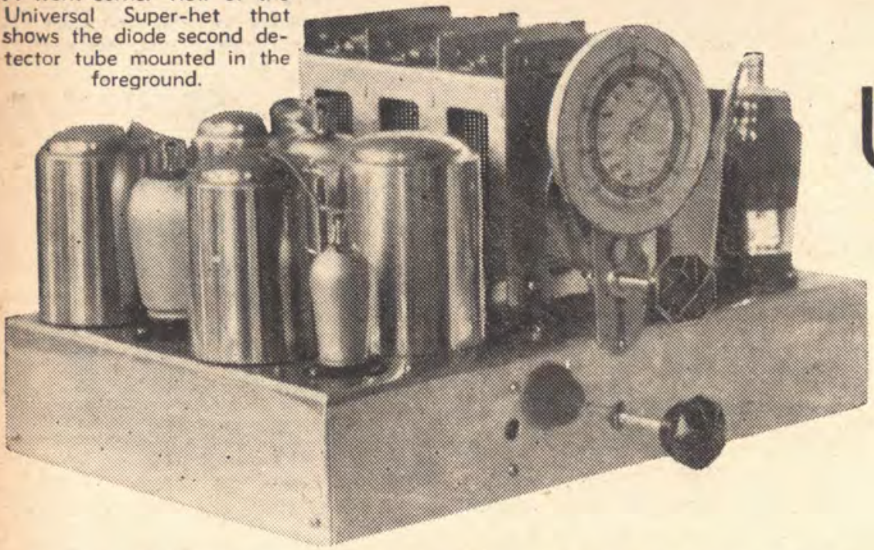
With the average setting of the trimmer on the oscillator G2, section of the gang condenser, 3AW should come in at about 15 on the dial. If the dial set is below this it will be necessary to screw the oscillator trimmer down slightly, or if above to reduce its capacity by unscrewing it. In either case a further readjustment of the trimmer on the G1 section will be required. Having done this, the oscillator trimmer must be left completely alone.

Next tune the receiver to the top end of the wave band and endeavor to bring in 2CO, 3AR or 5CK. In this case we also want a distant and fairly weak station for our adjustments, which then are more definitely determined. Having tuned in one of these top wave length stations, adjust the padding condenser until greatest signal strength is obtained. Screw the padder down at the rate of a fraction of a turn at a time. After each adjustment remove the screw-driver from the padder and "rock" the dial back or forwards over a few degrees until you again get the maximum tuning position. The correct setting of the padder is found when a slight movement in either one direction or the other results in a fall off in signal strength without greatly affecting the tuning position of the gang.

Having "padded" the receiver at the top end of the wave band, return again to the bottom end and, selecting the weakest station on about 3AW'S wave length, slightly readjust the trimmer on the G1 section of the gang. On no account touch the oscillator trimmer or your whole set of adjustments will be changed.

As far as performance is concerned, our experiments proved that the receiver would be admirably suited for use in any normal country district. Its "A" and "B" battery requirements are exceptionally modest (less than half an ampere "A" battery, and only 10 milliamperes "B" battery); its tone, sensitivity, and power output are good, and its selectivity, even under the crowded circumstance of our tests, was sufficient to give complete separation between the weaker stations and all but the most powerful of the locals. Naturally, the operating selectivity of the receiver would be considerably improved were the receiver used in an extra-urban locality.

A front-corner view of the Universal Super-het that shows the diode second detector tube mounted in the foreground.



A Universal

A 5/6-valve receiver designed for operation by either alternating or direct current supply, at any pressure between 200 and 260 volts, without internal or external modification. Very effective automatic volume control is a feature of the set.

A "UNIVERSAL" receiver is one that can be operated from either direct or alternating current with equal success. Basically, such a design does not include a power transformer, for that component is useless in conjunction with direct current. Its valves are heated by being wired in series with each other, and with some form of break-down resistor, right across the mains. A half-wave rectifier is included, which functions normally on an a.c. in-put, but merely idles when d.c. is applied. As with the normal type of all-electric set, the plate supply is fed through some form of smoothing system.

With one exception, the circuit of this 5/6-valve super-heterodyne is basically the same as that of any ordinary purely a.c. design employing four tubes and a rectifier. The sole difference lies in the fact that whereas the latter, were a diode de-modulator (or second detector) included, would employ a duplex-diode triode or duplex-diode pentode in that position, here the diode detector is a single valve, and the necessary audio amplification between it and the pentode out-put is developed in a separate driver audio stage.

This close similarity, be it understood, applies only to fundamental design. There are, on the other hand, drastic differences in wiring and in the system of voltage delivery; these will be indicated as and when occasion arises.

Running through the cascade, in spite of the fact that an intermediate frequency of 460 k.c. is used, it was decided to employ a pre-selector before the mixer. This takes the form, in the blue print, of in-put circuit AER-G1 and filter PRE-G2 which are capacitatively coupled by condenser C1. R1 is merely the de-coupler for the fluctuating grid voltage applied by the A.V.C. system.

Alternative Pre-Selection

While this system of pre-selection is used in the original, we are not in love with it for city use near powerful sources of interference. It has, however, the tremendous advantage of offering better response to stations high in the band (from 3LO up to 2CO) than does the inductively coupled system. On the other hand it is less selective from about 2UW downwards. In this case we would strongly advise its use in areas free from immediate local interference.

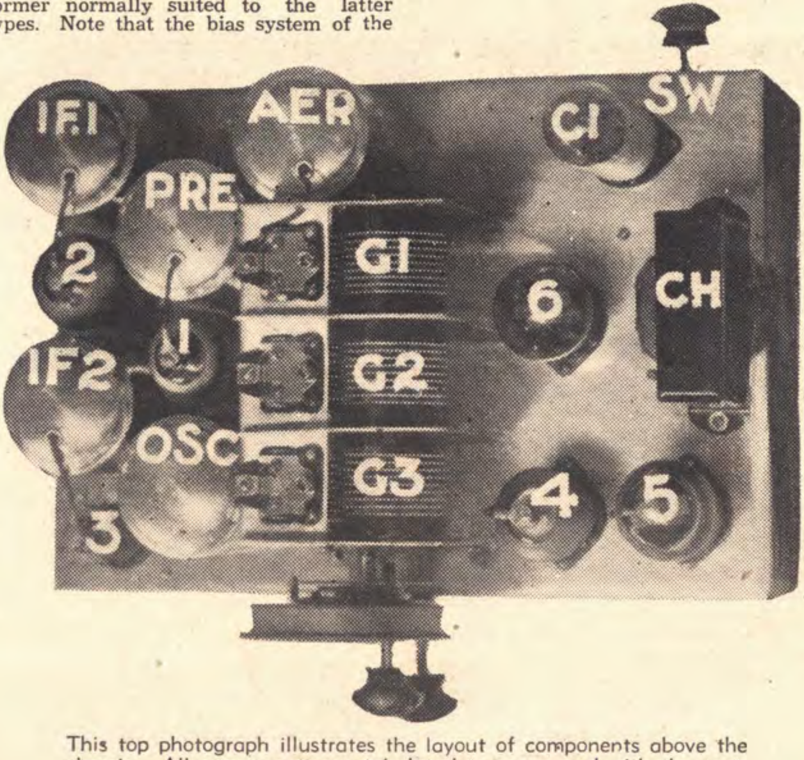
From a viewpoint of over-all selectivity there is no question that an inductively coupled pre-selector is the better for city and suburban use. Such an arrangement is illustrated in Fig. 1.

The intermediate frequency stage, centring around variable-Mu r.f. amplifier CF2, is perfectly conventional, and is followed by the straight diode detector CB1. This tube contains two diode plates, the one connected to its cap being used for detection. The other comes out to one of the 5-point phase connections and is thence wired to C9 and the A.V.C. system. Volume control potentiometer VC forms the diode load, the audio voltage being picked off by its moving arm.

The driver audio stage uses a CF1, normally a fixed-Mu r.f. tube which, again, is resistance-capacity coupled to the out-put pentode C12 for a 3-watt out-put. The characteristics of the CL2 are similar to those of the 2A5 or 42 so far as load is concerned, so the following speaker is matched by a transformer normally suited to the latter types. Note that the bias system of the CF1 (D1 and R11) also serves the diode detector plate of the CB1. Condenser C14 is of a value suited to the tone correction of the CL2.

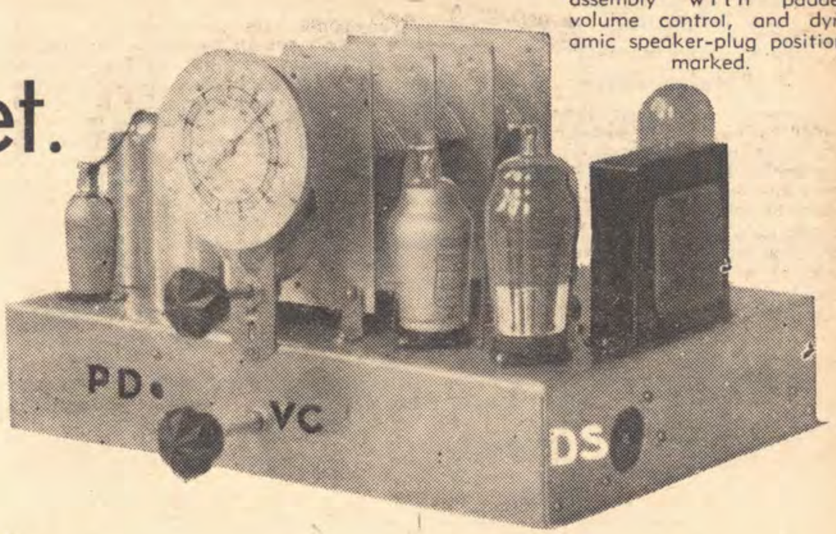
Power Arrangements

The mains are fed into a polarised Marquis plug, on which are marked "+" and "—" and of which the construction is such that the plug cannot be reversed in its socket. When the set is fed with alternating current it is, of course, immaterial which way the mains are connected, but when d.c. is applied the negative side must always go to chassis, as shown in the blue print. In order that, when the current is turned off, the chassis may be handled with safety, a double pole rotary switch SW is employed to break both sides of the mains, its negative side going directly to chassis.



This top photograph illustrates the layout of components above the chassis. All components are tabulated to correspond with the text.

Super-Het.



Another picture of the assembly with padder, volume control, and dynamic speaker-plug positions marked.

This is the model that is definitely demanded by Australia's itinerant public. It will operate at once on all our diversified forms of electric supply with safety and satisfaction. It is both fool-proof and tonally delightful.

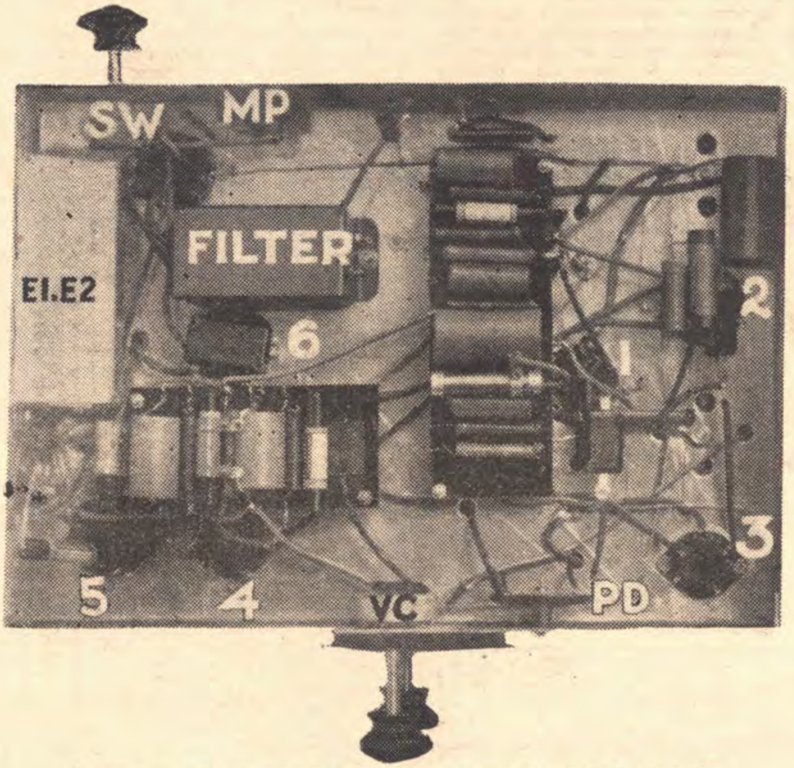
By "RADEX"

From the positive side of SW the input branches. One arm goes first through barretter C1, and thence through the heaters of the valves, which MUST be wired in the order shown; any variation in this order will introduce hum, and might even do damage as well. The other arm feeds to the parallel wired plates of the rectifier CY2. Of course, if d.c. is the source of supply, CY2 becomes a passenger, but it does serve the useful purpose of saving the electrolytics E1 and E2 from damage if the current is reversed. On a.c. the rectifier functions normally, and delivers pulsating d.c. at its parallel wired cathodes, which is smoothed in the usual manner by the combination of choke CH and the two electrolytics.

It is obvious that, as the maximum potential available is limited to that of the house mains without step-up, we cannot afford to waste voltage. In consequence, choke CH must be of very low internal resistance, and also that the field of the speaker (instead of substituting for the choke) must be wired across the rectified supply. It has, therefore, a resistance of 7500 ohms, and it should be noted that it is tapped off between choke and rectifier in order to avoid overloading the former.

Again, a voltage divider would form another source of waste, so series resistors are used to break down the initial voltage to the various values required by the valves and their screens. They also equalise matters, so as to permit of the application of mains varying in potential between 200 and 260 volts. Thus R6 reduces the voltage to the screen of CF2 and CL2, R5 performs a similar office for the screens of CK1 and CF1, and for the triode plate of the former, and R8 does likewise for the plate of the CF2. All these resistors are bypassed by condensers, C6, C5 and C8 respectively.

Irrespective of whether the in-put supply is a.c. or d.c., one side of the mains is always directly connected to chassis once the set is switched on; thus the chassis is always alive and should never be touched directly. This means also that it must be effectively insulated from the aerial and from true earth by means of fixed condensers C16 and C17 respectively.



An underneath illustration of the super-net chassis showing the arrangement and wiring of parts.

Parts in Assembly

Taking the plan view of the finished model, it will be seen that all five coil-cans are placed, in fact packed tightly, to the left of the triple-gang condenser, together with valves CK1, CF2 and CB1. This arrangement also offers the shortest of vulnerable grid and plate leads. Further, the socket of the CK1 is so located that its heater pair of contacts are those nearest to the condenser gang; this allows direct connections to OSC and IF1 without plate or grid leaks crossing each other.

The two audio valves are to the right of the gang with the speaker's output plug let into the chassis' right-hand side close to the socket of the CL2. This arrangement also offers short leads between the diode CB1 and the driver audio CF1 as they come via the volume control that is let into the front of the chassis below the gang. This front (left) also carries the padder, above which is OSC.

Power choke, rectifier valve and barretter tube occupy the major portion of the chassis' right side and are all very widely spaced. The Marquis plug is let into the rear with double pole rotary switch SW alongside of it, thus keeping the mains isolated at this rear corner, together with the barretter.

Beneath the chassis it will be seen that a number of minor components, fixed condensers and resistors, are mounted rigidly on two separate strips of ebonite, one of which measures 6in. by 2in. and the other 4in. by 2in. The components so treated are illustrated in diagram in Figs. 3 and 4, together with such wiring as is carried out under these strips before they are placed in position.

Mains Filter

Irrespective of which type of pre-selector is employed, sometimes proximity to a powerful station will force its signals through the receiver on almost any wave length. This condition is due to mains pick-up and delivery, and can only be countered by the insertion of a mains filter. This unit, enclosed in a mild steel case measuring 2½in. long by 2in. by 2¼in., is shown in the under view of the set.

It consists of two 0.006 mfd. condensers (mica T.C.C.) and two chokes. The chokes are both wound on the one piece of cylindrical dry wood 1½in. long and 1¼in. in diameter in which are cut two slots half an inch deep, quarter inch wide and three-eighths inch apart. Each slot is filled with No. 26 gauge enamel-covered wire.

The condensers are wired in series and their common centre is earthed to the set's earth terminal, NOT to chassis. An end of a choke is connected to the outer end of condenser. The mains are fed into the condenser-ends of this combination and those mains are picked up AFTER the switch SW; thus when SW is open there is no current in either choke-line. The other end of one choke goes to earth (negative line), the other side goes, by the previously described two arms, to barretter C1 and the plates of CY2.

Wiring Hints

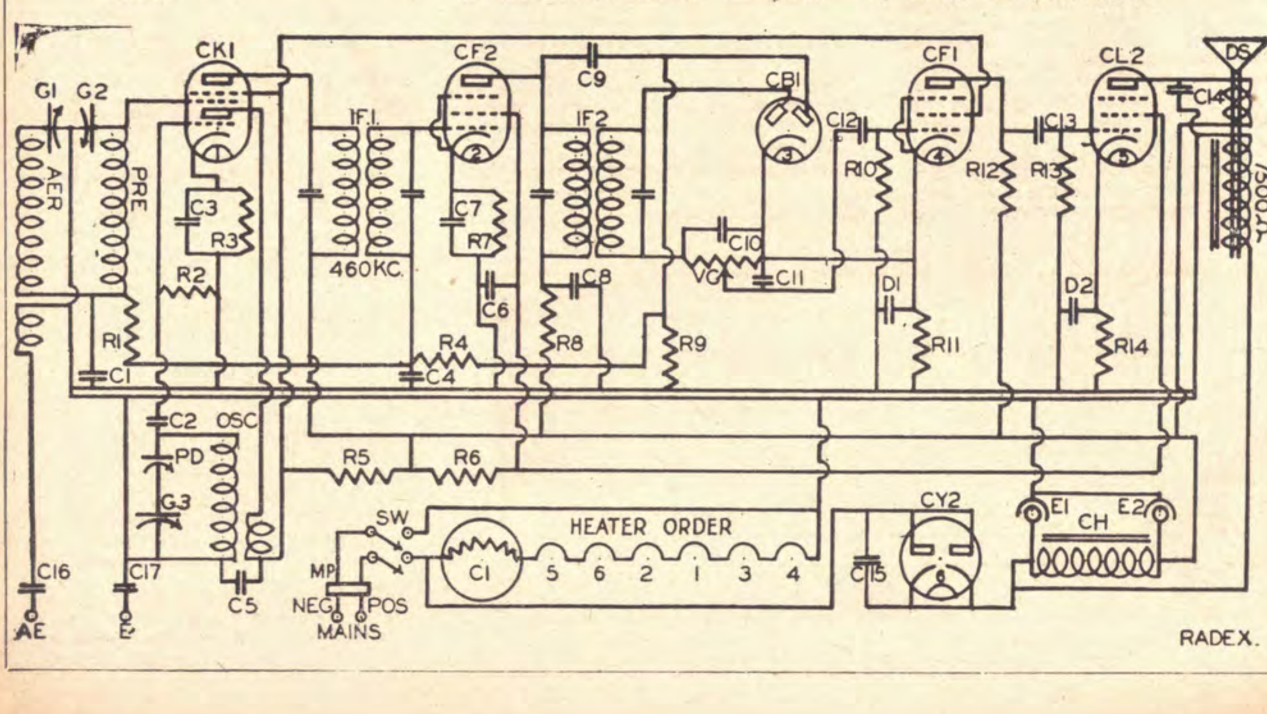
The normally earthed end of AER's secondary winding must not be earthed at the coil can in this instance or the A.V.C. will be inoperative. Similarly, the coil can of PRE must have its separate earth. The detector diode plate of the CB1 is on top of the tube, therefore the normal grid-lead of IF2 will come out of the top of that can. All other valves of this series, unlike the usual Philips design, have their control grids coming out to caps on top of the bulbs.

Low capacity shielded cable must be used to connect the following points: Triode plate of CK1 to P of OSC coil; Pentode plate of CK1 to P of IF.1; A.V.C. diode plate of CB1 to C9, R9 and R4; Normal earth end of secondary of IF2 to outer of VC; Arm of VC to C12, the latter being close to socket of CF1, but on strip (vide Fig. 4). C2 is soldered direct to the triode grid ("6" in Fig. 2) of CK1; C9 is similarly treated in respect of the plate of CF2 ("8" in Fig. 2).

After mounting everything on top of the chassis, put in a good earth-to-chassis network by connecting together all bolts by means of solder lugs and bare tinned copper wire of around gauge No. 20. This network is NOT wired to the main earth terminal. The latter,

PARTS LIST AND CIRCUIT DIAGRAM

C1, C17—Tubular condensers of 0.02 mfd.
C3, C4, C5, C7—Tubular condensers of 0.1 mfd.
C6, C8—Tubular condensers of 0.5 mfd.
C12, C13, C14—Tubular condensers of 0.005 mfd. (Concourse, Raycophone, Saxon, T.C.C., Wetless).
C2—Mica condenser of 0.0001 mfd.
C9, C10, C11—Mica condensers of 0.0002 mfd.
C15, C16—Mica condensers of 0.01 mfd. (Simplex, T.C.C., Wetless).
CH—Smoothing choke, 30 henries at least 75 m.a. (Paramount, Precedent, Radiokes, Raycophone, Stedi-power, Velco, Wendel).
D1, D2—Electrolytic condensers, 25 mfd, 25 volts working (Concourse, T.C.C.).
DS—Dynamic speaker with 7500 ohm field and input for CL2 (same as 2A5) (Amplion, Precedent, Saxon).
E1, E2—Twin 8 mfd. electrolytic condensers for sub chassis mounting 500 v. working (Dubilier).
G1, 2, 3—Triple gang condenser with aeroplane dial (Precedent, Raycophone, Saxon, Efco, Radiokes).
Kit—Comprises aerial, pre-selector (see text) and oscillator coils, two 465 k.c. intermediate frequency transformers and padder (Colonial, Paramount, Precedent, Radiokes, Saxon, Velco).
MP—Marquis 2-pin socket and plug.
R1—Resistor, 10,000 ohms.
R2—Resistor, 50,000 ohms.
R4, R10—Resistor, 50,000 ohms.
R5—Resistor, 30,000 ohms.
R6—Resistor, 15,000 ohms.
R8—Resistor, 5000 ohms.
R9, R13—Resistors, ½ megohm.
R12—Registor ¼ megohm (I.R.C., Raycophone, Velco).
(All above resistors 1 watt types)
R3—Wire wound resistor (see text).
R7—Wire wound resistor, 650 ohms 15 m.a.
R11—Wire wound resistor, 3000 ohms, 15 m.a.
R14—Wire wound resistor, 400 ohms, 50 m.a. (Paramount, Precedent, Radiokes, Raycophone, Saxon, Stedi-power, Wendel).
SW—Double-pole rotary snap-switch.
VC—Potentiometer volume control, 500,000 ohms (Paramount, Precedent, Radiokes, Raycophone, Saxon).
Valves—One each types CK1, CF2, CB1, CF1, CL2, CY2 and C1 (Philips).
Sockets—Six type "P," one type "V" (Philips) and one common 4-pin for D.S.)
Sundries—Five grid-clips, 2 terminals, ebonite 11 by 2 inches, beldon wire, 1 yard shielded cable, usual machine screws and soldering lugs.
Chassis—No. 16 gauge aluminium, 13½ by 9½ by 2½ inches high.



and that for the aerial, are both mounted on an ebonite insulating strip bolted to the rear of the chassis and then ends of C16 and C17 are wired to AE and E respectively; the other side of C17 is connected to the net work.

Fig. 2 should make clear the connections of the valve sockets in conjunction with the larger chart also included in these pages. In the case of the CB1, the letters K, CD and M indicate cathode, A.V.C. diode and metalised shield respectively. These are in the order as seen from below the chassis.

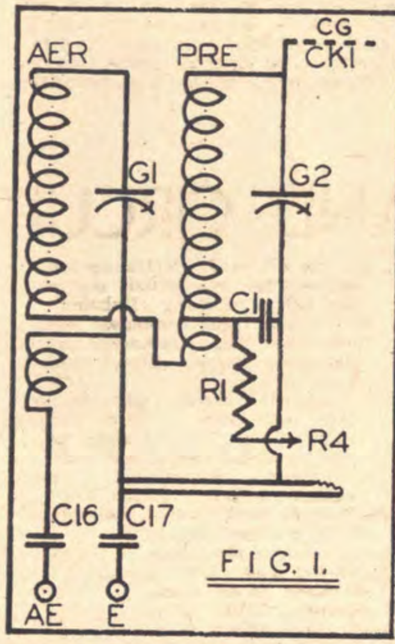
Figs. 3 and 4 are top views of the ebonite sub-mounting strips similar to those seen in the corresponding photo. In the case of Fig. 3, the end carrying R9 is that nearer to the front of the set. With Fig. 4, R14 and D2 form the bias system of the CL2 and so that end is nearer to the socket concerned. The letters off these drawings indicate external connections. Thus, in Fig. 3, K1 means that the linked ends of R3 and C3 go to the cathode (4) of socket 1; similarly, the union of R1 and C1 is marked CG1, indicating that that point goes off the control grid of the CK1 via the winding of PRE.

In Operation

On alternating current it makes no difference how the mains are connected to the in-put. With direct current the positive side must go to the positive of plug MP, and so to the plates of rectifier CY2; if the current is of the wrong polarity ("reversed connections") the valves will all light up, but the speaker will be dead owing to the complete absence of "B" supply to the plates. There is no need to go to a lot of trouble to test the polarity of the mains, as such a reversal will do no harm. If the speaker does not come "alive" after two minutes it is merely an indication that your mains plug in the house light or power point must be taken out, turned round, and re-inserted.

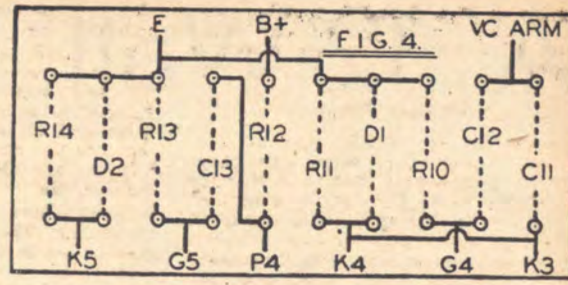
The process of lining up takes its usual course. From full in, open the padder about two turns; have all trimmers opened about a three-quarter turn. Set the dial on some station low in the band and not above 3KZ. Adjust the trimmers, starting with that of G3, and cut back volume as it rises progressively so that you are working always on a weak signal. Go to the top of the dial and on a station such as 2CO or 3AR, adjust the padder, meanwhile rocking the condenser to keep on the peak of the signal. Revert to the bottom end and give a final touch to the trimmers of G1 and G2, but do NOT touch that of G3.

As a certain amount of shielded cable has been used in the wiring of the intermediate frequency transformers, their tuning will be considerably "out," even though they left the factory in true alignment. The secondaries will remain very nearly at the fundamental 460 k.c., but the primaries will be the ones at fault; in both instances it will be found necessary to decrease the capacities across those primaries by turning IN the adjusting screws until a signal reaches a peak. This can be done roughly by ear, but, when the job is completed, it will then be found necessary to reline the condenser gang.



Alternative pre-selector circuit employing inductive coupling; the use of this type of in put is recommended in areas where interference may be expected.

This set is so quiet in operation, so effective on automatic volume control, and such an all round proposition, that it will repay the builder to get it properly lined up on a signal generator and output meter. The cost is never more than a few shillings, and it makes no difference if the line up is carried out on either a.c. or d.c.

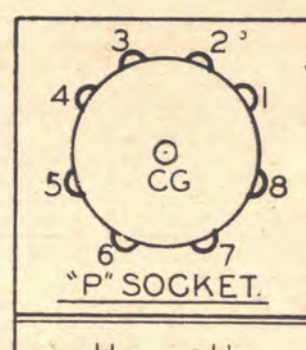


The second mounting strip is slightly the smaller; these are its connections.

Finally, the finished model should be completely enclosed, including the back, in a wooden cabinet provided with ample rear ventilation holes. Power should always be cut off at SW before the chassis is touched.

The only really critical value in the whole assembly is that of R3, the bias resistor for the CK1. Nominally this should be 400 ohms when under 200 volts is on the plates, but an a.c. input produces a higher voltage than that. If the set whistles on weak signals it is an indication that R3 is not large enough and that CK1 is in a state of self-oscillation. This instability will not be noticed on strong signals as the A.V.C. will then be in full operation, and so will hold down the CK1's stability.

The simplest thing to do, and a method that will handle any input voltage, is to purchase an unpainted 900-ohm resistor for R3 with a third, or slider, clip on it, which is connected by flex to one end of the unit. The set, after lining, is tuned to some normally weak station low in the band, and, by means of the slider, resistance is shorted out of R3 until the set reaches a peak of sensitivity. Beyond this peak a whistle will replace the signals.



Under view, as seen when wiring, of the special valve sockets utilised in conjunction with Philips series of A.C.-D.C., or "Universal" valves.

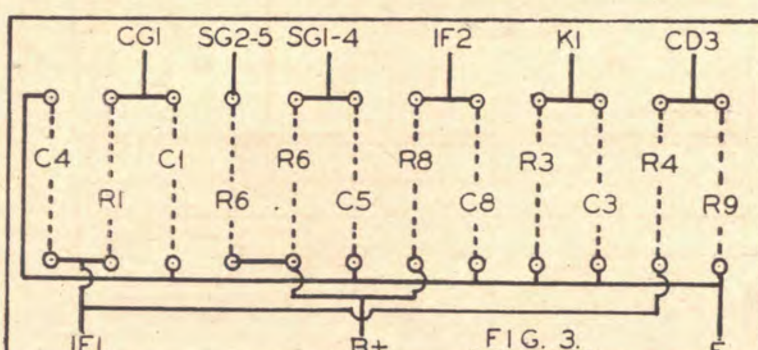


Diagram of the first mounting strip's wiring.

A 12-Watt P.A. Amplifier

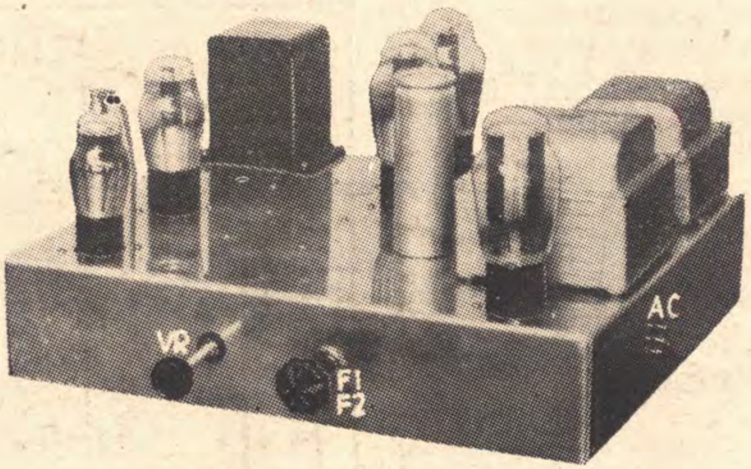
Ample volume for standard public address work and clarity of tone are features of this amplifier. The circuit employs two high gain driver stages which are fed to two 2A3's wired in push-pull.

By P. R. DUNSTONE

THE public address system described in this article should appeal not only to amateur radio enthusiasts, but to servicemen and radio dealers. It offers a reasonably cheap amplifier which will faithfully reproduce the complete audible range, and at the same time provide a new road to additional revenue. Disregarding the fact that audio frequency amplification offers hours of interesting experimental work, radio manufacturers are realising more and more that a very profitable source of income lies in the distribution of sound systems.

Just realise the numerous applications to which public address outfits can be applied, either for hire or permanent installation. Restaurants, dance halls, carnivals, churches, window demonstrations, lecture rooms, announcements for train or bus services, schools and hundreds of other applications that suggest themselves, all provide media through which this expedient equipment can be converted into a profitable proposition.

The amplifier has been extensively tested for both microphone and radio gramophone reproduction, and the final results obtained from this assembly have proved most pleasing.



A front view of the complete assembly. This picture illustrates the position of the volume and fader controls, while on the right hand side of the chassis is shown the A.C. input socket.

Avoid Driver Over-Load

Just as the strength of a chain is as strong as its weakest link, so is an amplifier as faithful as its weakest component. What numerous radio designers seem to overlook, when planning an amplifier which is to have a high output, is the fact that in order to obtain good all-round results, it is absolutely essential for the driver stages to be not only capable of handling the signal input, but also be able, through the medium of the valves and coupling devices, to load the grids of the final stage. It is obvious that if the signal is amplified to such an extent, or the bias is incorrect, on, say, the final driver stage, the signal must distort, with the result that the reproduction suffers.

In this particular amplifier it will be seen that in the first stage a type 2A6 valve has been used. This tube is ideal as an initial driver since it has a remarkably high amplification factor. From here the signal is passed through a resistance coupling unit to the grid of a 2A5. This valve, although containing a screen, and usually operated as a pentode, has in this instance been wired as a triode, the normal screen of the tube being connected to the plate. Now, since it requires a signal of at least 62 volts to swing the grids of the 2A3's fully, it is obvious that the use of a driver similar to the .56 variety would naturally overload before the actual grids of the output tubes were properly loaded. Therefore, it is necessary to choose a 2A5, or similar type, which is capable of handling a much greater signal.

Points in Design

On analysing the schematic circuit of this amplifier, the reader will notice a number of interesting points worthy of study. Starting at the input, a centre tapped potentiometer has been employed; this allows both pick-up and microphone to be constantly connected to the amplifier. With this method it is only necessary to rotate the knob of F1-F2, and one unit will fade out while the other comes into circuit. From here the signal passes through a potentiometer (VR) which is used for setting the volume at any desirable level.

The two diode plates of the 2A6 are completely ignored, the triode section is the only portion of the tube to be used. The signal from the plate of the 2A6 is fed through another coupling condenser (C2). In this instance, it will be seen that the capacity is exceptionally large, the reason for this being the need to obtain every possible atom of fidelity from the plate of the 2A6 on to the grid at the 2A5. Here, as previously mentioned, the tube is wired as a triode; the screen, which normally is taken to the maximum power supply, is connected to the plate of the valve.

Now, since the 2A5 when wired as a triode draws 31 m/a, it is obvious that in order to protect the primary winding and retain the characteristics of the push-pull transformer PP, it is necessary for another means to be adopted to supply the plate voltage to the 2A5. This difficulty was overcome by the use of a choke or impedance coupling, which not only provided a system to supply the required voltage to the 2A5, but at the same time removes all strain from the primary winding of the push-pull transformer (PP).

Notes on Push-Pull

At this point we arrive at one of the important components in the circuit. Unless the push-pull transformer can be thoroughly relied upon to do its job faithfully, it is an utter impossibility to obtain a high degree of fidelity from this outfit. It may, therefore, be wise at this juncture to give a few hints on what part it plays in the circuit, and the essential factors which it must contain.

The purpose for which the push-pull transformer is used is as a coupling device between the 2A5 and the two 2A3's, and so to deliver the greatest possible variations of voltage. This component must be capable of amplifying uniformly all the frequencies which come to it. Theoretically speaking the primary impedance of a transformer should match the plate impedance of the preceding valve. However, in this particular case, this is not essential since impedance coupling to the plate of the 2A5 is used. The plate voltage for the final driver is supplied through the choke CH2, while

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the signal is passed to the primary of PP via the coupling condenser C4.

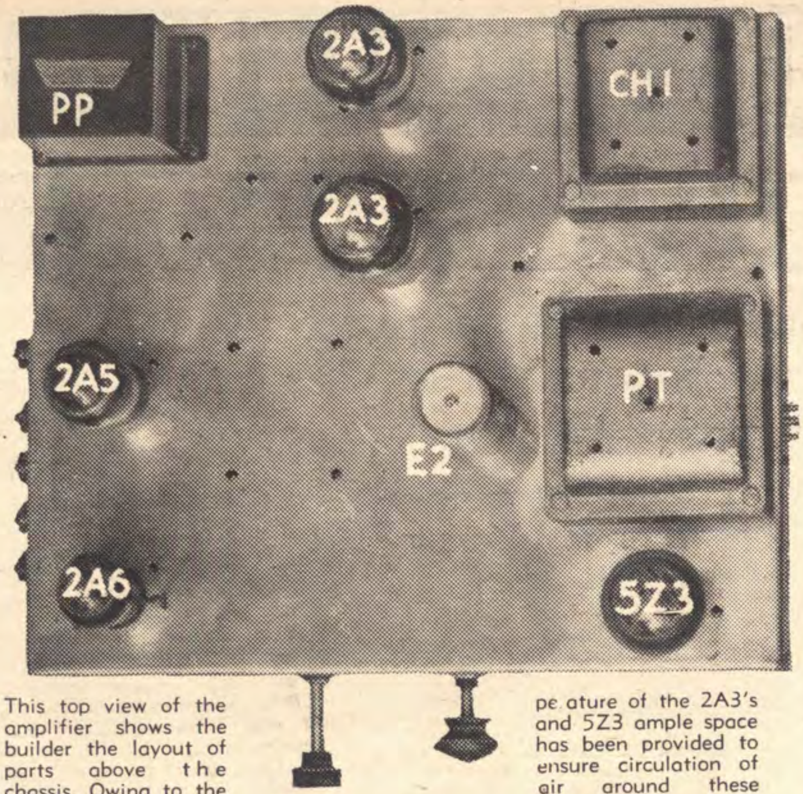
It is advisable to have the transformer completely shielded in order to prevent any feed back or hum pick-up from the power pack. Although the above-mentioned points are only briefly outlined, it should illustrate to readers some of the hazards attached to this component, and we therefore strongly recommend that only a well-known make of push-pull transformer be used in this amplifier.

Output Arrangements

The signal is passed from the secondary of PP to the grids of the 2A3's and finally from the plates of the tubes to the dynamic speaker input transformer. Here again another pitfall presents itself to the unwary, since it is of little use to go to the trouble of building a first-grade unit if the reproducer system is incapable of rendering reasonably faithful reproduction.

Owing to the high voltage and current drain of this amplifier it is not practical to place the field of the speaker in the B positive lead of the power pack, thus using it as a filter choke and at the same time gaining the necessary field excitation. But by increasing the resistance of the field to 15,000 ohms it was possible to connect it between E3 and earth, from which at this voltage an extra drain of 25 m/a was resultant. With this arrangement it is possible to excite the field of the speaker to approximately 9 watts.

In order to obtain the maximum power output from this assembly it is necessary to employ fixed biassing, the resistor R7 developing the required 62 volts negative across itself. In the original model this resistor had a value of 450 ohms and a current carrying capacity of 150 m/a. Now since there are actually 140 m/a's passing through R7 there was a slight tendency to warming, and it would probably be advisable for the intending builder to increase the current rating of this resistor to 200 m/a's. This gives it a safe working margin, and at the same time prevents the heating of the winding.



This top view of the amplifier shows the builder the layout of parts above the chassis. Owing to the high operating temperature of the 2A3's and 5Z3 ample space has been provided to ensure circulation of air around these tubes.

The Power Pack

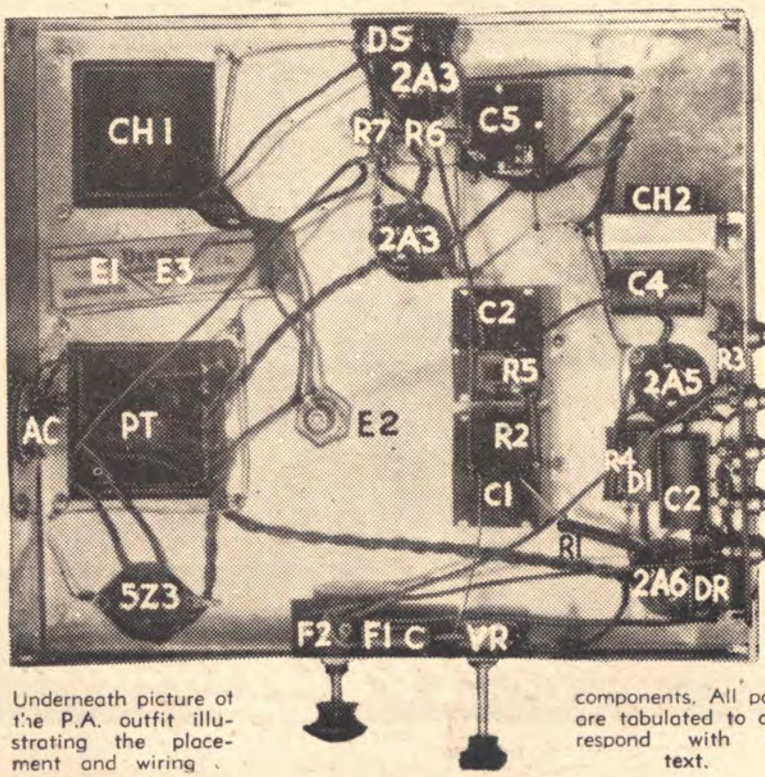
The power transformer PT should have a secondary winding of 400 volts each side of the centre tap and be capable of supplying at least 150 m/a's. In addition to this winding there should be two 2.5-volt and one 5-volt filament windings. All these should be centre tapped and be able to supply the current shown in the list of parts. Should the builder be desirous of placing a radio receiver in front of this outfit, and intend to derive its heater supply from the same windings, it will be necessary to increase their current carrying ratings accordingly.

Two other salient points in the design are the electrolytics and the filter choke CH1. The electrolytic condensers E1 and E3 can be of the twin type and be mounted below the chassis. E2 should be of the standard tubular type, and have a working voltage test of 600 volts. The filter choke CH1 must also be able to pass at least 150 m/a; its field, or core, should be erected at right angles to the power transformer PT.

Little can be said about the mounting of the components on the chassis, other than what is shown in the accompanying photographs. It will be noticed that considerable space is provided for the installation of parts. The reason for this is to allow sufficient air to circulate around the 2A3's and the 5Z3, since these valves, when in operation, radiate considerable heat. This would be detrimental to other parts in the circuit, should the design be reduced in size.

Wiring in Words

All components should be arranged to permit direct leads to be made to their respective points, otherwise it is likely that the amplifier will become unstable, due to inter-coupling of parts and wiring. Five terminals are provided on the left-hand side of the chassis for the input connections. Four of these terminals are mounted on bakelite, the necessary section on the side of the chassis being removed to allow the mounting of the insulating strip. The remaining terminal is fastened direct to the alu-



Underneath picture of the P.A. outfit illustrating the placement and wiring components. All parts are tabulated to correspond with the text.

minium chassis and is used as the earth terminal.

The two outer terminals on the fader F1-F2 are taken to two terminals mounted on the bakelite strip. The centre tap of this potentiometer is connected to two other terminals which are common to each other, and are used as the second lead of the input for both sections of the fader. The movable arm of F1-F2 is joined to one side of C. The other side of this condenser C is fastened to the movable arm of VR. One of the outer terminals of VR is connected to the grid on top of the 2A6, while the remaining terminal on VR is soldered to earth. The condenser C6 is connected between the two common terminals on the input strip and earth.

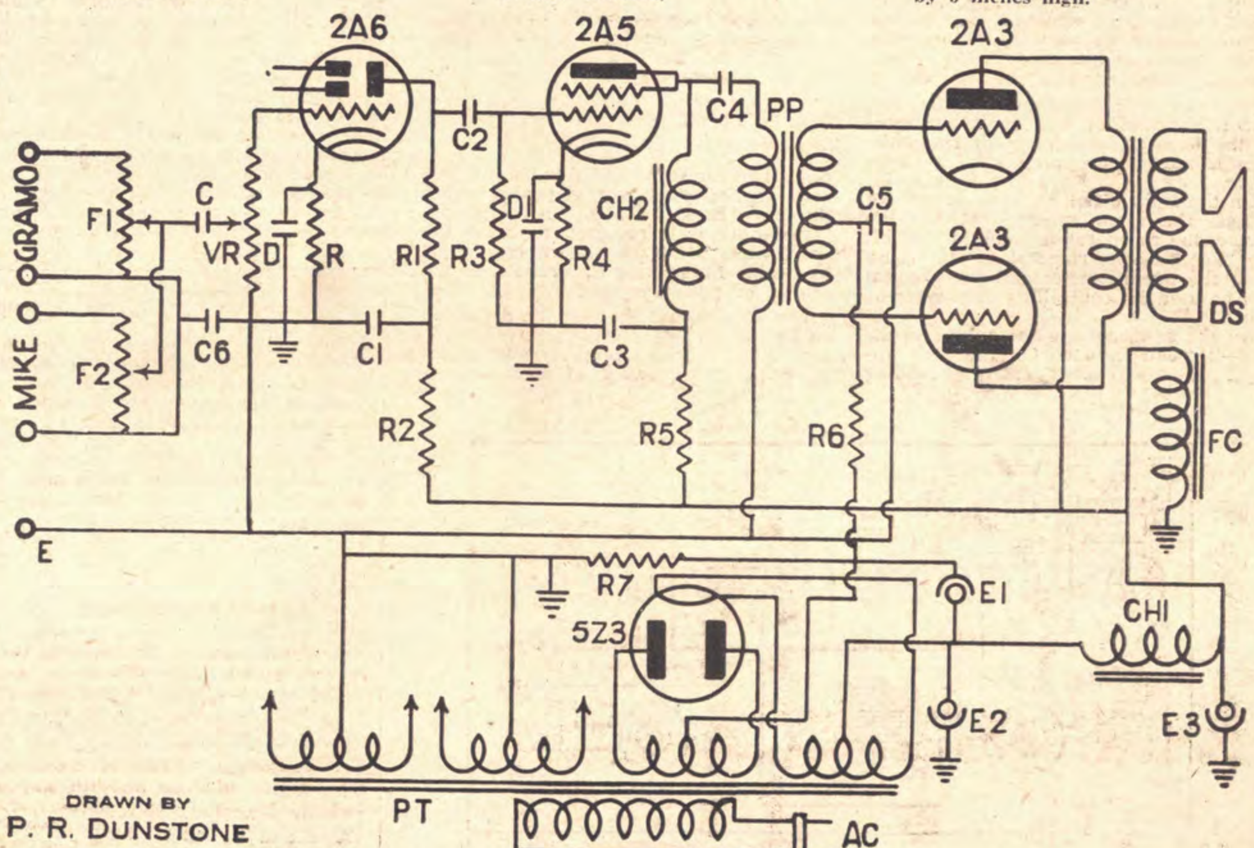
The positive end of D and one end of R are taken to the cathode terminal of the 2A6. The remaining ends of these two components are soldered direct to earth. The plate terminal of the 2A6 valve socket is joined to one side of C2 and R1. The other end of R1 is taken to one side of C1 and R2. The other side of C1 is soldered to earth or chassis.

The resistor R2 is connected to condenser C2 and to the grid of 2A5. The cathode terminal on the 2A5 valve socket is fastened to the positive side of D1 and to one end of R4. The ends of R3, R4 and (neg. end) D1 are joined to the chassis. The plate and screen terminals on the 2A5 socket are connected together and taken to one end of CH2 and C4. The other end of CH2 is soldered to R5. This resistor is decoupled by the condenser C3 to earth.

The remaining side of C4 is joined to the P terminal on the push-pull transformer PP. The B positive point of this transformer PP is taken straight to chassis. The two G terminals on PP are connected to the two grid terminals on the 2A3's valve sockets, while the centre tap or F terminal of PP is soldered to one end of R6 and C5. The other end of the resistor R6 is joined to the negative side of E1, to one end of R7, and to the centre tap of the secondary winding on PT. The other side of R7 and C5 are taken to earth or chassis.

PARTS LIST AND CIRCUIT DIAGRAM

A.C.—Voltage adjuster.
C.—0.1 mfd. tubular condenser.
C1, 3, 5.—4 mfd. block condensers.
C2, 4, 6.—0.5 mfd. tubular condensers. (Concourse, Raycophone, Saxon, T.C.C., Wetless.)
CH1.—30 henry 150 m.a. filter choke.
CH2.—30 henry 50 m.a. filter choke. (Paramount, Precedent, Radiokes, Raycophone, Stedi Power, Velco, Wendel.)
D1.—Twin 10 mfd. 25 volt test electrolytic condensers.
E1, 2.—Twin 8 mfd. electrolytic condensers, 500 volts working.
E3.—8 mfd. electrolytic condenser, 600 volts working. (Concourse, T.C.C.)
F1, 2.—100,000 ohms centre tap potentiometer. (Master Made.)
P.P.—Push-Pull audio frequency transformer. (Paramount, Precedent, Radiokes, Raycophone, Saxon, Wendel.)
P.T.—Power transformer; 400-0-400v.; two 2.5 v centre tapped, 4 amp, 6 amp respectively, and one 5 volt 3 amp. filament windings. (Paramount, Precedent, Radiokes, Raycophone, Stedi Power, Velco, Wendel.)
R1, 3.—500,000 ohm carbon resistors.
R2.—100,000 ohm carbon resistors.
R6.—10,000 ohm carbon resistors. (I.R.C., Raycophone, Velco.)
R.—6000 ohm wire wound 10 m.a. resistor.
R4.—650 ohm wire wound 50 m.a. resistor.
R5.—2500 ohm wire wound 50 m.a. resistor.
R7.—450 ohm wire wound 200 m.a. resistor. (Paramount, Precedent, Radiokes, Raycophone, Saxon, Stedi Power. Wendel.)
VR.—0—500,000 ohms potentiometer. (Marquis, Paramount, Precedent, Radiokes, Raycophone, Saxon.)
Sockets.—Two 6 pin; three UX; one UY. (Marquis, Precedent, Saxon.)
Valves.—2A6, 2A5, two 2A3's, 5Z3. (Mullard, Philips, Radiotron, Triad.)
Speaker.—10 inch dynamic suitable for push-pull 2A3's wired for fixed bias and a field resistance of fifteen thousand ohms. (Amplion, Precedent, Saxon.)
Sundries.—Belden wire, soldering lugs, screen grid clip, five terminals, piece of bakelite, screws, nuts, etc.
Chassis.—Aluminium gauge 16, measuring 15 inches by 13 inches by 3 inches high.



DRAWN BY
P. R. DUNSTONE

The plate terminals on both of the 2A3 valve sockets are soldered to the plate and cathode terminals of the speaker input socket mounted at the rear of the chassis.

The two outer terminals of the secondary winding on PT are connected to the two-plate terminals on the 5Z3 valve socket, while the five volt. winding on PT is soldered to the filament terminals of the same socket. The centre tap of this 5 volt. winding is joined to the positive side of E1 and E2, and to one end of CH1. The other side of CH1 is taken to the positive side E3, and to the grid terminal of the speaker input socket.

Operating Potentials

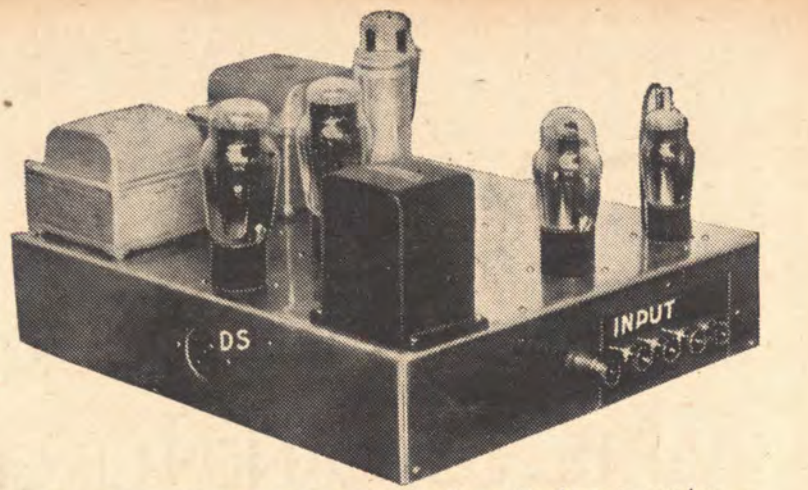
Voltage readings taken between points and chassis.
At E3—310 volts.
At plates of 2A3's—300 volts—40 m/a per plate.
At plate of 2A5—250 volts—31 m/a.
At plate of 2A6—100 volts.
At cathode of 2A6—1.1 neg. volts.
At cathode of 2A5—20 neg. volts.
At centre tap of secondary winding of PT—62 negative volts.
Milliamperage through choke CH1—140 approx.

A lead is joined from the grid terminal of the speaker input socket to one of the heater terminals on the same socket, and the remaining terminal on this socket (heater) is wired direct to chassis. A lead is taken from the grid terminal of the speaker input socket, and is connected to the remaining ends of R5 and R2.

The heater wiring is then done, the 2A6 and the 2A5 deriving their power from one 2.5 volt. winding, while the two 2A3's receive theirs from the other. The centre taps of these two windings are taken directly to earth or chassis.

This leaves only the primary of the transformer PT to be wired into the circuit to complete the assembly. Leads are taken from the a.c. voltage adjuster to the respective tappings on the transformer in order to permit the changing of the a.c. power at a moment's notice.

Having checked the wiring of the amplifier with the circuit, insert the valves in their respective sockets, plug in the speaker and a.c. power, and switch on the amplifier. If a volt meter can be secured for the evening, the various points shown in the panel entitled "Operating Potentials," should be checked to ensure that all valves are receiving their correct voltages.



This rear-corner photo of the amplifier shows the dynamic speaker socket and the input terminals.

The Scout Short-Waver

A simple one valve regenerative receiver, suitable for tuning from 15 to 200 Metres

By "LEAK"

BECAUSE of its size, its sturdiness and its general make-up, this one-tube-receiver has been aptly named the Scout by its designers.

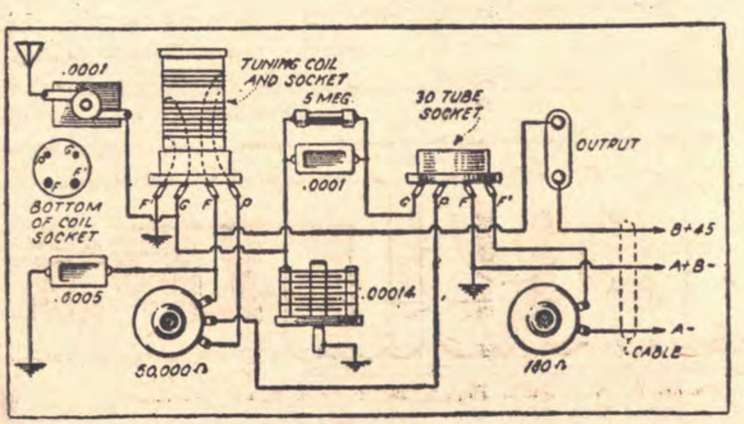
Figure 1 is a combined wiring and circuit diagram of the one-tube Scout in the form it has been built by many. The layout of the parts can be seen there, too.

On the front panel we have only three things, the main tuning dial in the centre, the regeneration knob at the left and the filament rheostat at the right. Both the potentiometer and the rheostat can be used for controlling the regeneration.

On the subpanel are the tube and the coil—the coil in use. On the rear upright of the chassis are the binding posts, two for input and two output. The aerial series condenser can also be at the rear. Besides the coil in the socket, three other coils required to cover the short wave band are also necessary. A line cable for making connections to the source of power is used.

The simplest set that can be depended on for results is the one-valve regenerator. When working properly such a receiver is the equivalent of several valves used in a circuit without regeneration. Naturally, the final results depend on the quality of the parts used and the skill with which they are adapted to the circuit.

Boys of Scout age throughout the country are becoming interested in short wave reception, either in their homes, at their meeting places, or even while on hikes. The simpler the circuit and the more sturdy the set the better it will fit into the strenuous lives of these youngsters.



A diagrammatic circuit of the Scout Short-Waver.

PARTS LIST

Set of four coils (15 to 200 metres) (Colonial Radio, Paramount, Precedent, Saxon, Velco).
Variable condenser, 140 mmfd.
Variable condenser, 100 mmfd.
(Precedent, Raycophone, Saxon).
Fixed mica condenser, 500 mmfd.
Fixed mica condenser, 100 mmfd.
(Simplex, T.C.C., Wetless).
Potentiometer, 50,000 ohms. (Paramount, Precedent, Radiokes, Raycophone, Saxon).
Grid lead, 5 megohms (I.R.C., Raycophone, Velco).
Rheostat, 10 ohms. (Paramount, Precedent, Radiokes, Raycophone, Saxon)
Panel and baseboard.
Two four-hole sockets (Marquis, Precedent, Saxon).
Terminal Strip. Phone Terminals.
Two knobs and one dial (Efco, Precedent, Radiokes, Raycophone).
Cable and hook-up wire.

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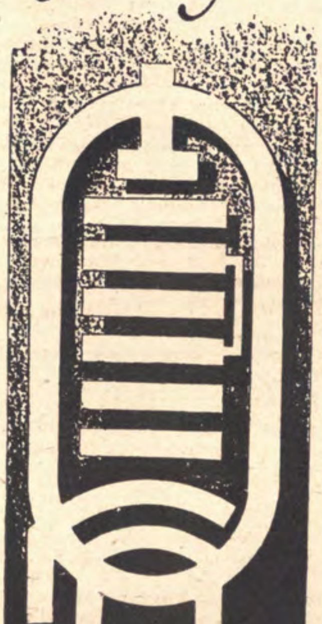

THE superheterodyne, once discarded because of the inherent background hiss which could not be eliminated, has now become the standard principle of modern receivers because of its many other outstanding features.

Due to the application of the Penthode principle to electron coupled frequency changers, the main drawback to the superheterodyne has now been obviated.

The low anode current (0.8 milliamp) which is achieved in the Philips Octode, renders impotent the background noise due to frequency conversion, the hiss being reduced by approximately 80 per cent.

This remarkable new valve finds its application in all modern superheterodynes, being particularly suitable for short-wave operation. In addition it permits of extended frequency response without unduly emphasised background noise.

Manufacturers and constructors throughout the world are now concentrating upon Octode-equipped receivers, with the realisation that the new electron-coupled frequency converter achieves new standards of excellence in radio performance.

by **PHILIPS**

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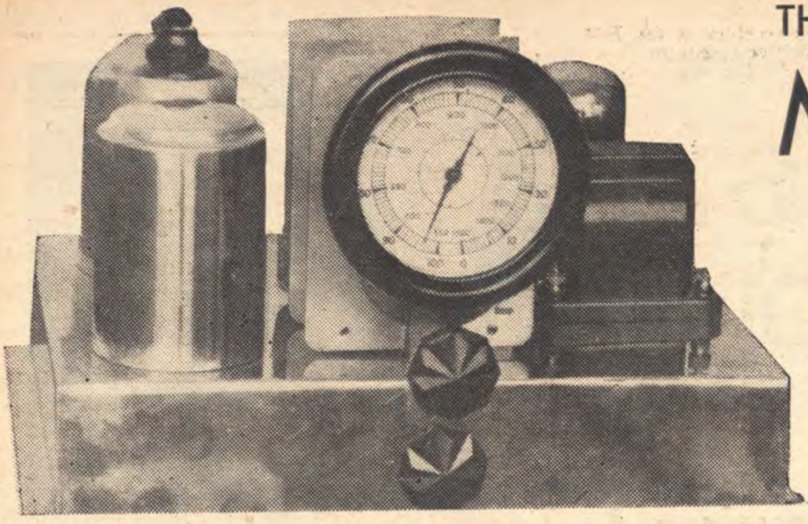


The completed set is professional in appearance. The lower knob controls reaction that governs volume indirectly.

THE... Melodious Three

A battery operated receiver with remarkably low consumption and reasonable output.

By A. K. BOX

IN the endeavor to reach a satisfactory compromise between economy of battery consumption and reliability of operation, battery set designers explored practically every avenue. Whilst the large receiver, capable of providing Australia-wide reception of broadcasting stations at power levels almost equal to that of the all-electric receiver, can and has been designed, the user of such is faced with the trouble and expense of frequent battery replacements. Provided, however, that the country set user is ready to content himself with reasonable daylight reception, say, over distances of 100 to 150 miles, and is modest in his demand for loud speaker volume, it is possible to design a battery receiver which will be exceptionally cheap to maintain.

Economical Valves

This is possible mainly because of the development of new low consumption battery valves. For example, the little receiver we intend to describe, using the new Mullard 2-volt valves, draws a B battery current of only 6½ milliamperes at 120 volts. This means that light duty "B" batteries can be used if desired, although the more robust heavy duty type batteries would give a proportionately greater service.

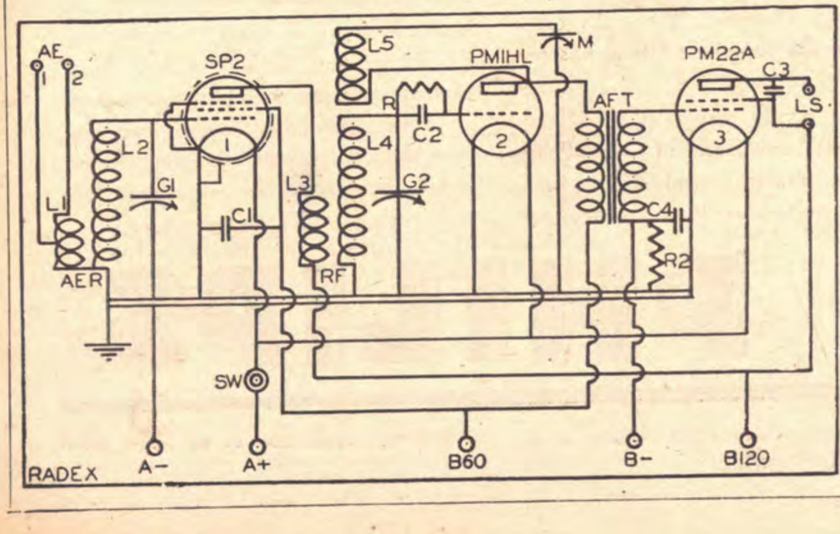
The "Melodious Battery Three," for such is the name we have given the receiver, is outstandingly economical in operation. Employing a tuned r.f. stage, a regenerative three element detector and a transformer coupled pentode audio amplifier, it is capable of good distance reception, will be sufficiently selective for the average country conditions, and will deliver sufficient audio power to the loud speaker to suffice in the average sized room. Possessing only two tuning controls, it is easy to handle, and by reason of the fact that it employs only a few components, is both easy and cheap to construct.

Now glance at the illustrations of the original receiver whilst we outline its salient constructional characteristics. On an aluminium chassis, measuring 11 inches by 8 inches by 2 inches, are mounted the two screened coils, L1-L2 and L3-L4-L5. The aerial coils, L1-L2, are at the front left-hand corner of the chassis, whilst the Mullard SP2 r.f. valve is mounted between L1-L2 and the RF coils L3-4-5.

The two-gang condenser, G1-G2, is in the middle of the chassis, and directly behind it is the detector valve PM1HL. The audio pentode, PM22a, is in the right-hand rear corner of the chassis, the audio transformer, AFT, being mounted alongside this valve. On the front of the chassis the 23-plate midget condenser, M, is fitted beneath the gang condenser, G1, G2.

Along the rear edge of the chassis are five terminals. Four of these are insulated from contact with the chassis, whilst the fifth, the earth terminal, is in direct contact. At the right-hand end, in line with the coil cans and the socket for the SP2, are the two aerial terminals AE1 and AE2, and the earth

CIRCUIT DIAGRAM AND PARTS LIST



A Battery, 2-v. (Century).

AER, RF.—Coil kit comprising aerial and R.F. coil with reaction (L1, L2 and L3, L4, L5). (Colonial Radio, Paramount, Precedent, Radiokes, Saxon, Velco.)

AFT.—Audio frequency transformer ratio 3½-1 or 5-1. (Paramount, Precedent, Radiokes, Raycophone, Saxon, Wendel.)

C1, C3.—0.1 mfd. tubular condensers. (C3 optional.) (Concourse, Raycophone, Saxon, T.C.C., Wetless.)

C2.—0.0001 mfd. mica condenser. (Simplex, T.C.C., Wetless.)

C4.—25 mfd. 25 volt electrolytic condenser. (Concourse, T.C.C.)

G1, G2.—Two gang tuning condenser to suit coil kit.

Dial.—(Efco, Precedent, Radiokes, Raycophone.)

M.—23 plate midget condenser (Radiokes, Raycophone, Saxon.)

R1.—2 megohm grid leak. (I.R.C., Raycophone, Velco.)

R2.—400 ohm 25 m.a. wire wound resistor. (Paramount, Precedent, Radiokes, Raycophone, Saxon, Stedi Power, Wendel.)

S.W.—Single pole battery switch.

Sockets.—One each, six pin, four pin and five pin. (Marquis, Precedent, Saxon.)

Valves.—One each SP2, PM1HL, PM22A. (Mullard.)

terminal E. At the opposite end are the two loud speaker terminals LS. The filament switch SW is soldered to two leads brought out through a hole in the left-hand end of the chassis.

An underneath view of the chassis reveals that only three fixed condensers, C1, C2 and C4, have been employed, although the circuit shows that an additional condenser, C3, has been connected across the output of the P.M. 22A. This condenser, having a capacity of .01 mfd., is not included in the original receiver. Although a desirable refinement, it is not absolutely necessary. The only other component underneath the chassis is the 2 megohm resistance R1.

Details of Mullard Valves

The wiring is extremely simple, but for the benefit of the novice we shall detail the point to point connections. First, though, a few words on the three Mullard valves used in the receiver may not be amiss. The r.f. valve is a new low consumption r.f. pentode, which has the exceptionally high amplification factor of 1100, a filament consumption of .18 amperes at 2 volts, and which requires a maximum plate potential of 150 volts. Normal operating conditions, however, call for a plate voltage of only 120, a figure at which the P.M. 22A pentode also operates satisfactorily.

The P.M. 22A is a remarkable pentode, inasmuch as it is capable of supplying a higher audio frequency output than the majority of battery triodes at a grid swing or input voltage of only a fraction of that of the three element tubes. Its second advantage is that it performs these particularly pentode jobs without the comparatively high plate and screen current drains required by the average of its type. The figures for the P.M. 22A are—At 120 volts plate potential the tube will deliver between 200 and 250 milliwatts of undistorted audio power, and uses a plate and screening grid current of between 3.5 and 4 milliamperes. The grid bias at this voltage is minus 3 and the filament consumption is .2 amperes at 2 volts.

The third valve of the trio used in this receiver is the P.M. 1HL, a highly sensitive medium impedance detector which has the high amplification factor—for low and medium impedance tubes—of 28. It is a .06 ampere filament type tube and, like the other two, requires a filament potential of 2 volts.

The only constructional feature by which the SP2 differs from standard 2 volt pentodes is that it is fitted with a six-pin base. To the extra two pins on the base are connected the suppressor grid inside the tube and the metal coating around the bulb.

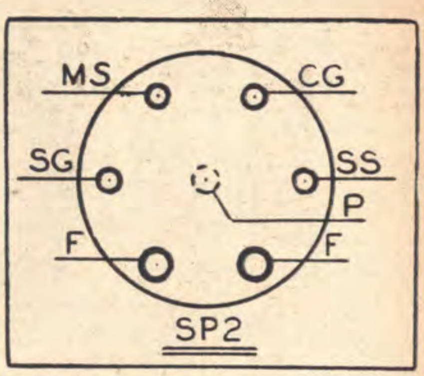
A non-standard feature of the circuit of the receiver is the inclusion of automatic "C" bias in which the grid potential for the P.M.22A is derived from the drop across the resistor R2.

Wiring in Words

Having dealt with the general arrangements of the receiver circuit we now shall proceed to a brief description of the wiring. Start the wiring by connecting a lead from the bottom end of the aerial coil L1 to the AE2 terminal on the chassis and from the tap on L1 to the AE1 terminal; the other connection on L1 and the bottom end of L2 are connected to the metal chassis. The top end of L2 goes to the control grid lug on the socket for the SP2. The lugs on this socket carrying the suppressor grid and metal screen connections are joined to the chassis. The fixed plate lug on the front section of the gang condenser G1, G2 is taken to the control grid lug on the SP2 socket.

The lead from the top end of the r.f. plate coil L3 goes through the top of the coil can to connect to the plate (top) terminal on the SP2. The other end of L3 carries the B plus 120 volt lead. The screening grid lug on the SP2 carries a lead to the B plus terminal on the audio transformer AFT and the B plus 60 volt lead. To this same lug on the SP2 socket solder one lead on the .1 mfd. condenser C1. The other lead on this condenser goes to the metal chassis.

The top end of the RF grid coil L4 is joined to the fixed plate lug on the G2



The 6-pin socket of the SP2 as seen from below the chassis. The letters indicate:—FF Filament, SG screening grid, MS metal screen, CG control grid, and SS suppressor. Plate terminal P is on top of the bulb.

section of the gang condenser, and to one lug on the .0001 mfd. condenser C2. The other lug on C2 is connected to the G lug on the P.M.1HL socket. The 2 megohm resistor R2 is connected in parallel with C2. The other end of L14 goes to chassis. The P lug on the detector valve socket carries one lead of the reaction coil L5, the other lead on this coil going to the fixed plate lug on the 23-plate midget condenser M. The P lug on the detector socket also is joined to the P terminal on AFT.

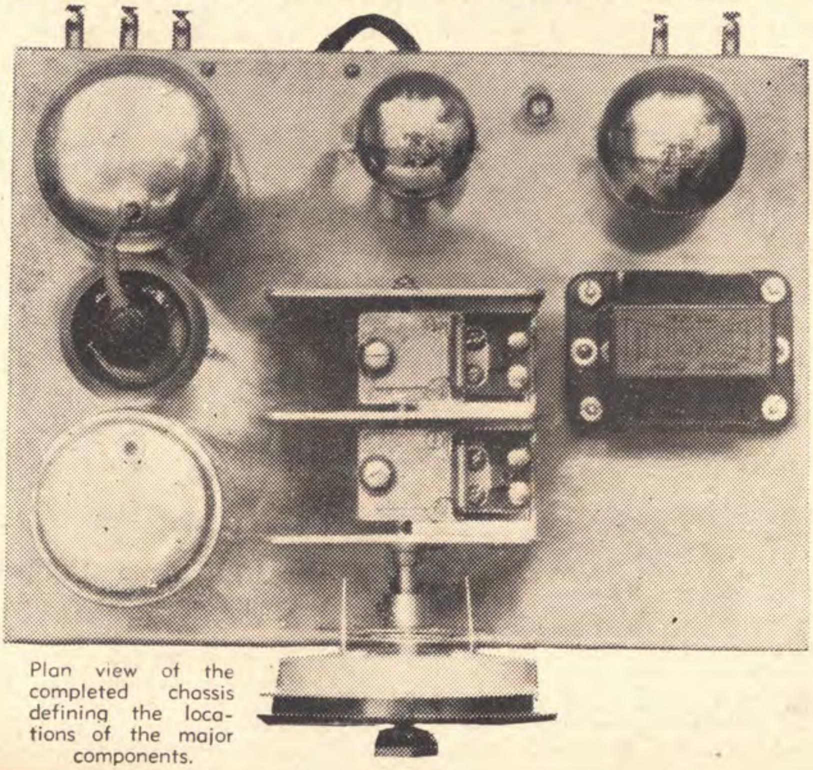
The G terminal on AFT goes to the G lug on the socket for the P.M.22A. The P lug on this socket goes to one L.S. terminal, whilst the S.G. lug goes to the other, to which the B plus 120 volts also are taken. If C3 is to be included it is connected between the two L.S. terminals. The C minus terminal on A.F.T. carries the B minus lead, the negative (black) lead of the 25 mfd. electrolytic condenser C4, and a lead from one lug of the 400-ohm resistor R2. The other lug of this resistor goes to chassis, as does the positive (red) lead on the 25 mfd. electrolytic condenser C4.

The filament wiring is carried out by taking a lead from one filament lug on each socket to chassis. The A minus battery lead must then be connected to chassis. The A plus lead is taken to one side of the battery switch SW, and from the other side of this switch a lead, joining to the vacant filament lug on each of the three sockets, is run. This completes the wiring of the receiver, which now is ready for the initial tests.

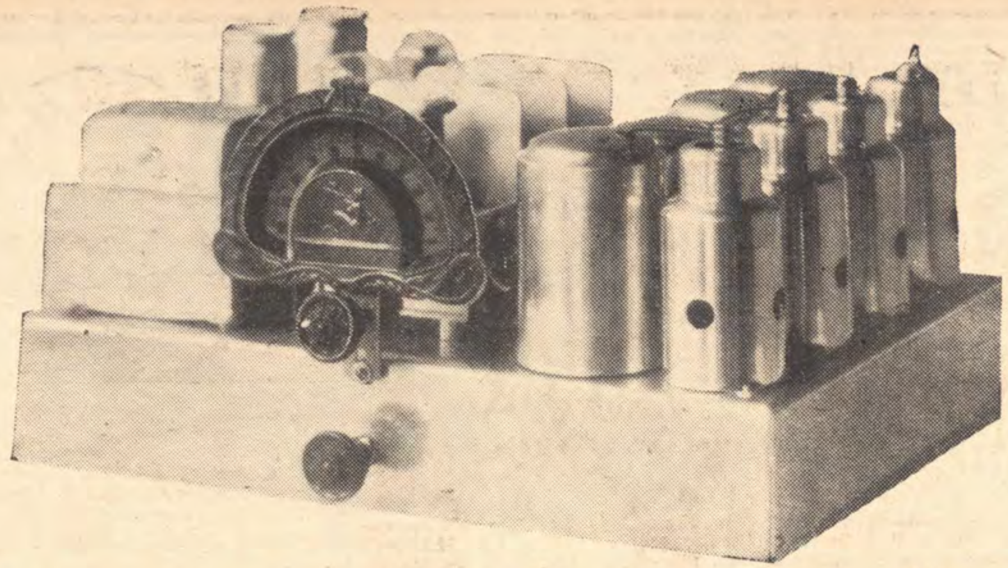
Practical Operation

After plugging in the three valves and connecting aerial, earth, batteries and loud speaker, rotate the tuning dial until a station such as 3AW or 3KZ is picked up on the bottom end of the dial. Then adjust the trimmer on the G1 section of the gang condenser for greatest volume, and try the effect of rotating the reaction condenser M. If the set refuses to oscillate when the plates of this condenser are fully enmeshed, it will be necessary to reverse the connections to the reaction coil L5.

Provided that the gang condenser has not been jarred out of alignment, the fact that the trimmers have been set properly at the bottom end on the dial will automatically ensure that the ganging holds good at the top. The receiver will be found to be an excellent performer, having range, selectivity, and tonal quality, whilst its low battery consumption makes it ideal for the country listener.



Plan view of the completed chassis defining the locations of the major components.



THE TUNEFUL T.R.F. "5/6"

Straight radio frequency amplification in combination with a diode detector gives good quality reproduction and useful sensitivity. Alternative methods of audio amplification are offered for either a pentode or parallel triodes.

By "RADEX"

IN order to avoid disappointment we must point out in the first place, that in spite of the number of valves employed, a straight radio frequency design is never so selective as a superheterodyne when used in a crowded area.

The maintenance of stability in T.R.F. work is of paramount importance; but if we endeavor to make such a model super-selective by the employment of minimum couplings, etc., we automatically increase the chances of instability. The cure of such an undesirable condition merely decreases sensitivity, and so it is wiser to steer a middle course from the circuit's inception.

The utterance of this warning must not be taken as a sign of pessimism as regards results. On the contrary, the original model brings in a great number of interstate programmes at entertainment value, and easily separates all national stations, and very many of the "B's." It will not, however, produce four or five transmissions between such closely grouped stations as, for example, 3KZ and 3AW. We would expect a 5-6 valve super-heterodyne to do this fairly easily, and hence the necessity for comparison here.

Of the six valves the first three (V1, V2 and V3) are radio frequency amplifiers of the variable-Mu type, through the characteristics of which volume is controlled. The fourth valve is a duplex diode High-Mu triode which functions as a half-wave diode detector and first stage audio amplifier. The series ends with a resistance-capacity coupled pentode output tube capable of delivering 3 watts of power to a dynamic speaker. The whole is empowered from a conventional 280 type rectifier.

In the drawing valves of the 2.5-volt heater series have been used; if desired, these can be substituted with 6.3-volt types, when they would become three 6D6's, a 75 and a 42.

De-Coupling Aids Stability

In order to avoid such circuit interaction as would result in instability, it is necessary that all stages be carefully de-coupled, but there is nothing difficult about this.

The system means that a voltage break-down resistor is in each screen lead. These are R4, R5 and R6, and for them R7 effects the initial potential reduction. Each screen is by-passed separately, also, by C4, C5 and C6. Instead of there being a common minimum bias resistor in the cathodes of the 58's, each is treated individually by R1, R2 and R3, by-passed by C1, C2 and C3 respectively. All three cathode leads then unite and go to one extremity of the manual volume control, VC. On this unit the aerial is wired to the other end, while the arm is earthed.

All plate circuits are de-coupled also. In series with each r.f. primary winding is placed an r.f. choke (CH1, 2 and 3 respectively), while condensers C7, C8 and C9 serve as by-passes.

This extensive system on paper is really not at all complex in fact. A little forethought allows each stage's de-coupling components to be grouped around its particular socket, as indicated in the accompanying under-chassis illustration. It also has the advantage of eliminating the inclusion of a voltage divider and the trouble of picking correct potentials.

Diode Detection

If the system described is carefully followed, straight r.f. amplification is followed very successfully with diode detection. Its efficiency hinges upon the quality of CH4, which should be of the honeycomb type, while neither of condensers C10 and C11 may be larger than 0.0001 mfd.

Gramo. pick-up terminals PU are wired right across grid-leak R10 of the 2A6. This means that these terminals are NOT shorted across when radio reception is taking place.

The inter-valve coupling to the pentode 2A5 is conventional resistance-capacity wherein R12 and C13 serve as de-couplers. Fixed tone correction for the pentode is offered in the combination of C15 at 0.03 mfd and R15 at 5000 ohms. These values give an even-toned out-put and appear very close to optimum. Although the production quality of this assembly is pleasing to the average ear, there are many listeners, both to radio and home gramophone reproductions, who demand the greater purity of triode power audio amplification. For such we would recommend a final stage comprising two 45's in direct coupled parallel and the description of such an alternative subtends this article.

While it is desirable that the power secondary of the transformer PT deliver 400 volts a side, one at 385 volts could be used at a pinch, although it is not recommended. The 2500-ohm field of the

THE PEAK OF EFFICIENCY

IRC
Metallised Resistors

LIST PRICE
1 Watt to 1 meg., 1/3.
1 Watt over 1 meg., 2/.
2 Watt to 1 meg. 2/6.
2 Watt over 1 meg. 3/-.

In 1 and 2 Watt Ratings.

2000 ohm to 5,000,000 ohms.

These resistors are accurately rated, and are obtainable in 1 and 2 watt.

All units will be found to vary less than plus, or minus 10 % of their rated value.

They will not exceed their rated tolerance after years of use, and may be depended upon to do their share of the work.

Low Noise Level.— Being metallised, these resistors have a very low noise level and are impervious to moisture

T.C.C.
ELECTROLYTIC

mfd.

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440 Volt.

500 Volt.

Type 602
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T.C.C.
Mica Condensers Type "M"
Made In Australia.

The Guarantee with every T.C.C. Type "M" Condenser is:—

1. That it is within 10 per cent of its rated capacity value.
2. That it is tested for at least two hours on 1200 volts D.C. (rectified, but not smoothed)
3. That the insulation resistance on 1000 volts D.C. is not less than 5000 megohms.

No Other Condenser manufactured either here or abroad is subjected to such severe tests.

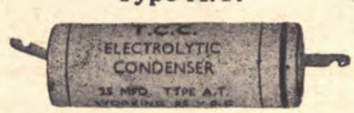
High Capacity Electrolytic Condensers

Capacity 25 mfd.

These Condensers are ideal for By-passing Bias Resistors, having a high capacity with a very low leakage.

Also Obtainable in 10 mfd.

Type A.T.



Manufacturers' Type

List Price 2/6

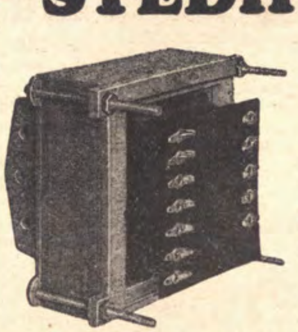
Working Voltage 25 V.D.C.

Are of the Dry Type, Electrolytic Type, for which T.C.C. are noted.

NOTE—The Red Band denotes + Terminal.

50 Volt Working.

STEDIPOWER
TRANSFORMERS



60 m.a. 385-0-385 .. at 17/6
100 m.a. 385-0-385 .. at 23/6
125 m.a. 385-0-385 .. at 26/9

Stedipower Transformers have been manufactured to exact Specifications and are fully Guaranteed to give Lasting Satisfaction and Service.

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"KESTER"
FLUX FILLED SOLDER

SOLD IN STICKS, 1LB. REELS, 5LB. REELS AND 20LB. REELS

Guaranteed to be the finest Solder Sold for Radio and Electrical Work.

In the manufacture of this solder only the best Virgin MATERIALS are used, thus ensuring a positive joint.

AUSTRALASIAN ENGINEERING EQUIPMENT CO.
415 BOURKE STREET, MELBOURNE

speaker serves as an adequate power smoothing choke. Of the heater secondaries Y serves the 2A5 alone and X feeds the first four valves; note that one side of each of these windings is taken direct to earth.

Chassis Assembly

Reference to the accompanying illustrations will show the salient points of the parts lay-out on and under the chassis. Notice is directed to the placement of the power transformer on the left of the condenser gang with the four canned coils and valves to the latter's right. This arrangement offers a minimum of crossed leads and should be followed exactly. Sockets V1 to V4 inclusive are so placed that their heater connections are those nearest to the right-hand end of the chassis.

The set's external connections all come in at the rear. The pick-up terminals and that for the aerial should be insulated on narrow pieces of ebonite bolted on from behind. The earth terminal screws right on to the aluminium. In front it is not necessary to insulate the volume control's mounting.

Apart from the order of the coils' connections this is a straightforward wiring job, and does not call for detailed instructions really. There are a few points, however, that warrant special notice.

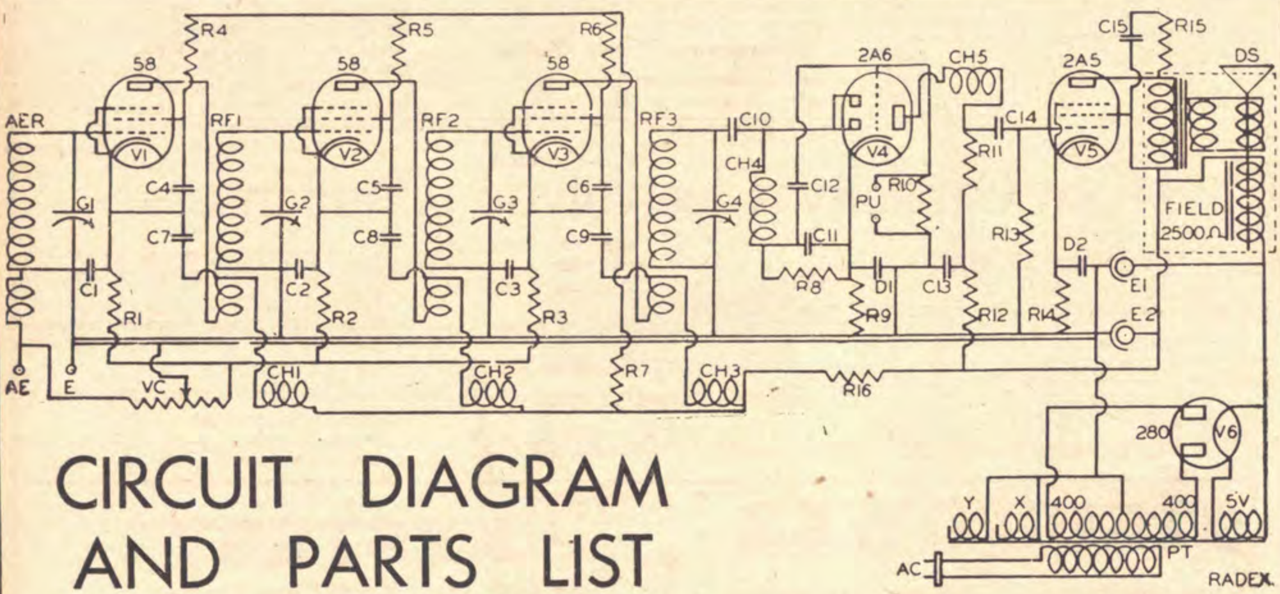
Commence by mounting all bolted parts except the five r.f. chokes. Place solder-lugs under both nuts, holding all sockets except DS under the screws of the four coils and under the nuts of the power transformer. Join up these lugs with a rectangular network of No. 20 gauge tinned copper wire pulled taut and soldered at each lug or cross. To this network solder the centre tap of the 400-volt winding to one end of each of the 2.5 volt windings of the transformer PT, and to one heater connection on each of sockets V1 to V5 inclusive. Take the remaining end of winding X to the remaining heater connections on sockets V1 to V4. The free end of winding Y goes only to the vacant heater contact on V5.

Now wire up the rectifier socket, V6, to the transformer, and work in the smoothing system, using points FF of socket DS for the speaker's field. Mount r.f. choke, CH5, and complete the audio stage between the speaker and that point.

Connect up all tails protruding through the chassis from the coils. In relation to RF3 first connect together the diode plates of V4 (DD, and to them attach an end of C10 and one side of RF4. The top of the secondary of RF3 then connects to the free side of C10. Again, first wire together C11 and R8, and then, as a unit, attach them across the free side of CH4 and K of V4. One side of C12 also goes to this same side of CH4. Wire R10 across the PU terminals and earth one of them. To the other connect the free end of C12 and a lead to go up through chassis to the pip on top of the 2A6.

You are now clear to get on with the de-coupling arrangements around the valve sockets, V1, V2 and V3. Take time over these, as neatness and symmetry, together with leads of minimum length, make for general efficiency.

As indicated in the List of Parts, the value of cathode bias limit resistor, R1, has been left open until now. As the circuit is designed, and using commercially wound coils, the stages surrounding valves V2 and V3 stabilise easily with bias resistors R2 and R3 at the correct value of 300 ohms. On the contrary, owing to its lighter damping load that around V1 will tend toward instability if it is not somewhat overbiased. Accordingly R1 should be of the rated value of 1000 ohms (to carry 10 or 15 m.a.), wound on glass with bare wire, and be fitted with a third sliding clip, after the fashion of a voltage divider. The slider is connected by a flexible wire to one end clip, so that a portion of its value may be short-circuited, and so reduced when it is slid along.



CIRCUIT DIAGRAM AND PARTS LIST

A.C. Adjustable A.C. voltage plug.
C1 to C9 0.1 mfd. Tubular condensers.
C12, C14—0.02 mfd. Tubular condensers.
C12—0.5 mfd. Tubular condenser. (Concourse, Raycophone, Saxon, T.C.C., Wetless).
C10, C11—0.0001 mfd. Mica condensers. (Simplex, T.C.C., Wetless).
CH1 to 5—Radio frequency chokes. (Radiokes, Saxon).
D1, D2—25 mfd, 25 volts working. Dry electrolytic condensers. (Concourse, T.C.C.)
DS—Speaker, field 2500 ohms, input for 2A5. (Amplion, Precedent, Saxon).
E1, E2—8 mfd., 500 volts working. Electrolytic condensers. (Concourse, T.C.C.).
G1 to G4—Four gang condenser. (Precedent, Raycophone, Saxon).
Dial—Efco, Precedent, Radiokes, Raycophone).
Kit—One aerial coil (AER), and three r.f. coils (RF1 to RF3). (Colonial Radio, Paramount, Precedent, Radiokes, Saxon, Velco).
PT—Power transformer. 400-0-400 and 100 m.a.; 5 V—2A, 2½ V—3A (Y) and 2½ V—6 to 8 A (X). (Paramount, Precedent, Radiokes, Raycophone, Stedi-Power, Velco, Wendel).
R1—Wire wound resistor; see text.
R2, R3—300 ohms, 15 m.a. Wire wound resistors.
R14—410 ohms, 50 m.a. Wire wound resistor. (Paramount, Precedent, Radiokes, Raycophone, Saxon, Stedi-Power, Wendel).
R4, R5, R6—Resistors 20,000 ohms.
R7—Resistor 40,000 ohms.
R8—Resistor 1 megohm.
R9, R15—Resistors 5000 ohms.
R10, R13—Resistors ½ megohm.
R12—Resistor 25,000 ohms. (I.R.C., Raycophone, Velco).
VC—Potentiometer, 5000 ohms. (Marquis, Paramount, Precedent, Radiokes, Raycophone, Saxon).
Valves, etc.—Three 58, one each 2A6, 2A5, and 280. Five 4 pin and two 4 pin sockets. Four valve cans and four grid-clips. (Mullard, Philips, Radiotron, Triad).
Chassis—No. 16 gauge aluminium 15 by 11 by 2½ inches.
Sundries—Four terminals, belden wire scrap ebonite, ¾ by 1-8 machine screws with nuts.

By this means it is possible to work the second and third stages at the full while damping down the first within the bounds of perfect stability.

Operation

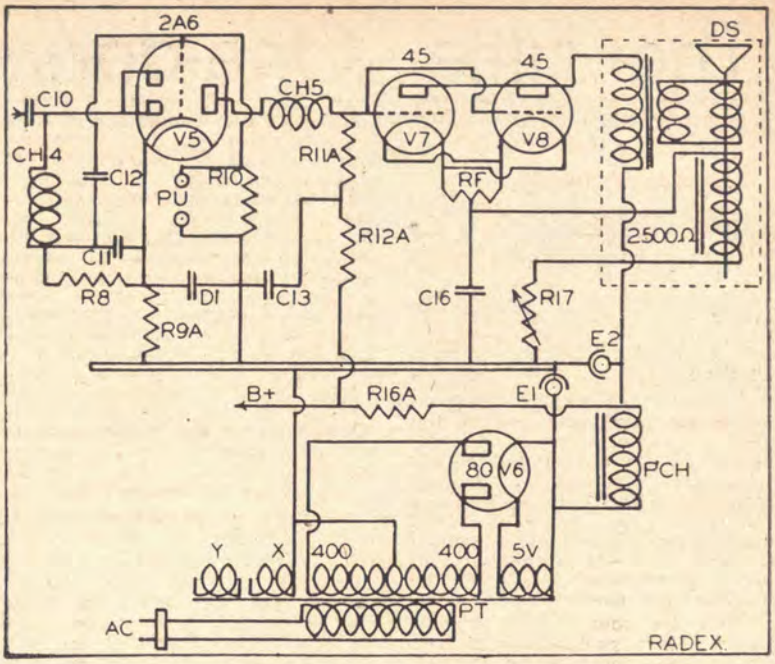
Use both an aerial and earth with this set in the normal manner but an indoor aerial of 35 to 40 feet is quite enough catchment. Before switching on the power screw down fully each of the four trimmers of the condenser gang and then loosen all equally about half to three-quarters of a turn. Volume is least (practically nil) when the arm of VC is turned hard over in the direction of its end that is wired to the aerial terminal; give the set about half volume.

Now turn the dial down and pick up some station as low in the wave-scale as possible, say somewhere in the region of 3KZ or lower. Starting with that of G1 and working through the gang toward the back, carefully adjust each trimmer to produce maximum volume.

As this is being done, and as the volume rises, keep on cutting back the volume control so that you are always working on a comparatively weak signal and so can notice small differences. Complete this line-up eventually by operating on a weak transmission that is so because of its distance away.

With tuning finished you can revert to R1 and set its clip at the minimum value to give stability when the volume is almost hard over in the "loud" direction. With a very lively collection of valves, or if your wiring is not quite as good as it might be, you may find that little, if anything, can be cut out of R1; should this condition arise here is a little stunt that will be helpful and also beneficial to the set's results:—

After removing its can, closely and tightly wind three turns of No. 30 gauge double silk covered wire around the top (grid end) of the large secondary coil. The beginning end of this wire will remain vacant, connected to nothing; the other end is soldered to the end of the small coil that goes to the aerial terminal. After the can has been replaced, it will be necessarav to readjust slightly the trimmer of section G1 of the gang in compensation for this addition.



Circuit of alternative audio power out-put stage, using two triode valves in parallel, and simplified direct coupling.

Alternative Triode Output

The accompanying additional circuit drawing shows how two direct coupled 45's in parallel may take the place of the single 2A5 and so give an improvement in quality over the pentode.

It should be noted that the same 2500-ohm speaker field is used, but it is wired now as a portion of the bias resistance for the 45's. Further, the speaker's in-put transformer must be matched for two 45's in parallel. NOT IN PUSH-PULL.

The variation, other than in the valves themselves, and in the above specified feature of the speaker, calls for little alteration to the existing List of Parts, and for no alteration in the lay-out of the assembly. One of the 45's takes the place of the 2A5 on the chassis, while for the other 45 there is plenty of room to the right of the first one. The essential power choke will find ample space below the chassis.

New parts values are:—

C16—Block condenser of 2 or 4 mfd.

PCH—Power choke, 30 Henries, 75 m.a.

RF—Centre-tapped filament resistor, 30 ohms.

R9A—Resistor, 10,000 ohms.

R11A—Resistor, 1 megohm.

R12A—Resistor, 100,000 ohms.

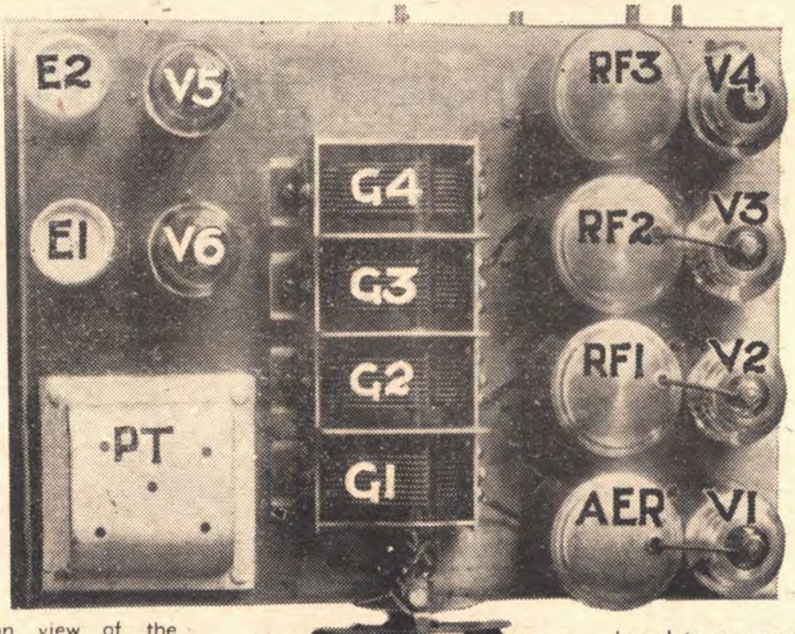
R16A — Resistor, wire - wound, 7500 ohms, 30 m.a.

R17—Resistor, wire-wound, 500 ohms, 75 m.a.

Components to be deleted from the main list are:—C14, C15, D2, R9, R11, R12, R13, R14, R15 and R16. Old R16 now becomes new R17, if it will carry the current; it should be fitted with a slider for future adjustment, as in the case of bias resistor R1.

So far as the transformer is concerned, there is only one important point to be observed: Secondary winding Y will serve the two 45's alone, and neither of its ends may be earthed. If winding Y has a centre-tap, then resistor RF may be omitted, and the connections that go now to the latter from C16 and the speaker's field, will go to the centre of Y.

The new smoothing choke PCH is essential to the circuit's operation at power. The replacement of resistor R16 with R16A fixes all r.f. B voltages at their required values without further trouble. Note that in this instance R12A goes to the low voltage side of R16A as against R12 going to the high voltage side of R16



Plan view of the 5/6-valve T.R.F. model, with the major components keyed to agree with the Circuit Diagram and List of Parts.

The Little "One-der"

A Simple and Efficient Battery Single Valver for the Novice.

By P. R. DUNSTONE

HERE is a simple, battery operated, one-valver, which should appeal to the beginner.

This receiver uses a modern battery valve that gives it an additional "lift" compared with the valves of yesteryear. At the same time the consumption of the later makes of valves is far below that of the older types.

Reaction has been included in this circuit, giving the necessary "boost" that is required on the weaker stations and at the same time having the tendency of sharpening the tuning. It must be kept in mind that the selectivity side of this set is its greatest problem, making it necessary to experiment with the number of turns on aerial coil L1 and the length of the aerial used, in order to obtain the maximum results. The set derives its power from a light duty 45 volt "B" battery and a 2 volt accumulator.

Winding the Coils

The standard commercially-made aerial coil will be suitable for this design, but for the builder who is desirous of winding his own coils the following data will be of assistance to him. A Marquis 1¼ inch former is used for winding L1 and L2.

Commence by drilling a 1/32nd inch hole at the bottom of the former and pass the wire through it, fastening the end to one of the soldering lugs mounted on the side of the former. Then wind on approximately 10 turns, taking the other end of this coil to another soldering lug at the bottom of the former. This winding is aerial coil L1.

The next coil, L2, will require 100 turns, commencing about a quarter of an inch from L1. The ends of this coil are also taken to soldering lugs as in the previous instance. Coil L3 is wound on a one-inch former and is used as a reaction coil. This will require 30 turns, the two ends being taken to soldering lugs at the bottom of the former. Two pieces of flex are connected to these lugs and the coil is then dropped down the centre of the Marquis former.

Care should be taken to see that all coils are wound in the same direction, otherwise they will oppose each other, and poor reception will result.

Making the Chassis

A piece of gauge 16 aluminium measuring 9 inches by 9 inches will be needed to make the chassis. Two-inch squares should be cut from each of the corners and the sheet bent into the shape of a chassis.

The pieces taken from the corners of the sheet of aluminum are placed in a vyce and bent at right angles, and are used for fastening the sides of the chassis.

Mounting the Components

An idea of the layout adopted in this model can be gathered from the photographs accompanying this article. The variable condenser C is mounted in the front centre, while the coil former and valve socket are mounted along the rear of the chassis.

On the front side of the chassis the reaction condenser C1 is placed to the left hand of the tuning condenser C, while a battery switch is fastened to the right hand side of C1, giving the finished receiver a neat and compact appearance.

Wiring in Words

Start the wiring by taking a lead from the beginning of the aerial coil L1 to the terminal mounted on the rear side of the chassis. This terminal, and the two output terminals which are used for connecting the headphones, should be insulated from the chassis.

The beginning of L2 is connected to the fixed plates of C and to one side of C2. The other side of C2 is soldered to one end of R and to the grid of the valve socket. The other end of L2 coil is joined to chassis. The fixed plates of the midget reaction condenser C1 is fastened to the end of L3 coil. The beginning of this coil is connected to the P terminal of the valve socket.

Another lead is taken from the P terminal of the valve socket to one side of the output terminals mounted at the rear of the chassis. The other output terminal is connected to one of the leads of the twin flex which is used for battery connections. The remaining end of R is soldered to the A positive terminal of the valve socket.

A piece of flex is soldered from the A positive terminal of the valve socket to one of the terminals of the switch SW, while the other lead of the battery cable is fastened to the remaining terminal on the battery switch SW. A terminal is mounted directly to the aluminium chassis and is used for earth, A and B negative connections. The A negative terminal of the valve socket is taken direct to chassis.

Operation

Having connected the batteries to their respective leads from the receiver, switch on the set and rotate C until signals are heard, then adjust C1 until maximum volume is obtained.

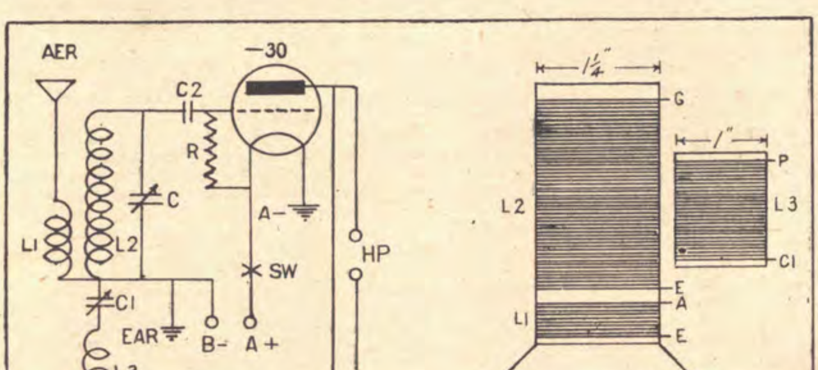
Should the receiver not oscillate when E1 is adjusted, it will be necessary to add a few more turns to L3 coil. In the case when the oscillation is too fierce the reverse method will have to be adopted—i.e., taking a few turns from L3.

It would be advisable to experiment with L1 coil by adding turns to this coil until interference from two broadcasting stations is experienced.

An aerial with an over-all length of 30 to 40 feet should be used in conjunction with this set. It is essential to see that the set is connected to a good earth lead if best results are to be obtained.

PARTS LIST AND WIRING DIAGRAM

C.—0.0005 mfd., variable condenser. (Precedent, Raycophone, Saxon).
C1.—23 plate midget condenser C1. (Paramount, Precedent, Radiokes, Saxon).
C2.—0.00025 mfd., fixed condenser C2. (Simplex, T.C.C., Wetless).
R.—3 megohm carbon resistor 1 watt. R. (I.R.C., Raycophone, Velco).
1—UX sub-panel valve socket. (Marquis, Precedent, Saxon).
4 terminals, 3 yards of twin flex.
1 Battery switch.
1 30 type valve. (Mullard, Philips, Radiotron, Triad).
1 Aluminium chassis (see text).
1 45 volt light duty "B" battery. (Diamond, Ever-Ready, Stan-Mor)
1 2-volt accumulator (Century).
1 Vernier dial. (Efco, Precedent, Radiokes, Raycophone).
Some flex for wiring and machine screws, etc.
1 1¼ inch marquis former and 1¼ inch length of 1 inch former, one reel of gauge 30 D.S.C. wire.



The schematic circuit diagram of the "Little One-der" is key lettered to agree with the wiring description and the parts list. The diagram of the tuning coils is shown at the right.

Complete information given in this article will enable the set builder to construct a highly sensitive A.C. short wave receiver.

By A. K. BOX

IN this article we propose to introduce to the short wave experimenter and set builder a receiver which, if it follows more or less standard lines, at least has the virtues of simplicity of construction and reliability of operation. The receiver is a four valve all electric one of the tuned radio frequency type. Before we deal with its salient features we will review briefly the advantages of the t.r.f. type of short wave receiver over the, perhaps, more fashionable super-het. type.

The outstanding characteristic of the short wave super-het. is its ease of control. One main tuning control and possibly a non-critical trimmer control is all that the super-het. requires. Against this we find that the regenerative t.r.f. receiver has three tuning controls, two of which are critical in adjustment. On the other hand, it is possible to obtain excellent results with a four-valve t.r.f. set, five valves including the rectifier.

Next we come to the question of noise level. No receiver is better than its noise level. If the inherent noise level of the set is low, it is possible to get much better long distance reception than if the internal noise makes it necessary only to tune to stations which put out a sufficiently powerful signal to override the noise. Now the noise level of a receiver is governed by two things: The internal noise in the set itself when neither aerial nor earth is connected, and the pick-up of electrical interference from nearby sources. When we judge the relative performances of the t.r.f. type of short wave receiver and the s.w. super-het on the basis of noise level we find that the t.r.f. set wins hands down.

The Experimenter's Set

Although the super-het. will provide an excellent output from any input signal of reasonable intensity, its high noise level and relative lack of sensitivity of the first detector will render impossible the reception of very weak signals. This is not hearsay; it is the result of dozens of tests with different types of short wave super-hets and t.r.f. receivers. Stations which the super-het. will not touch can be received clearly, although not loudly, on the t.r.f. set. This is particularly noticeable with very weak c.w. stations. The high state of sensitivity to which the t.r.f. set's detector can be brought by judicious use of regeneration is responsible for this.

To sum up the situation, we may say that for the man who requires only entertainment value reception from one or two powerful short wave stations the super-het. is the best proposition, whilst for the dyed-in-the-wool experimenter who is content to sit down and tune for weak and distant transmissions, and is content to use headphones when he can not get loud speaker strength reception, the t.r.f. type of short wave receiver will offer him a hundred per cent. more fun than the super-het. Personally, when we want to look for something interesting on the short waves, be it code or broadcasting, we usually hook up the t.r.f. receiver. If the noise level is low and the signal loud, then we put on the super-het. Otherwise the t.r.f. set with speaker or phones is kept on.

Now look at the circuit diagram. A study of this will show that the circuit we have used for the r.f. and detector sections of our short waver is the familiar old "tuned anode." L1 is the aerial coil and L2 the r.f. grid coil. L3 is the tuned anode coil and L4 the regeneration coil.

The valves used in the receiver are of the 6.3 volt series. V1 is the 6D6 (58 type) variable-Mu tube. The detector V2 and the first audio valve V3 are standard 76 triodes. The output tube is a 42 pentode. A type 80 rectfier furnishes the B supply. It will be noticed that, first, we have employed a driver audio stage in front of the pentode. This has been done to raise the audio gain of the receiver so that we can hear anything which the detector can de-modulate.

The couplings between the detector and first audio and the first and last audio tubes are of the resistance capacity type. Originally we had a 3/1 ratio audio transformer between V3 and V4, but because of instability and a.c. hum we replaced it with the lower gain resistance coupling scheme. The result was complete stability and the elimination of all hum. Even with resistance coupling the audio gain is very high, so that in order to eliminate the possibility of stability, and at the same time to keep hum out of the audio circuits decoupling resistors, R5 and R10 have been employed in the plate circuits of the two 76's and in the grid circuit, R7 of the first audio tube. Volume control is obtained on the r.f. stage by means of a potentiometer, the centre arm of which is connected to the 6D6 cathode through the limiting resistor R1. So much for the general aspects of the circuit.

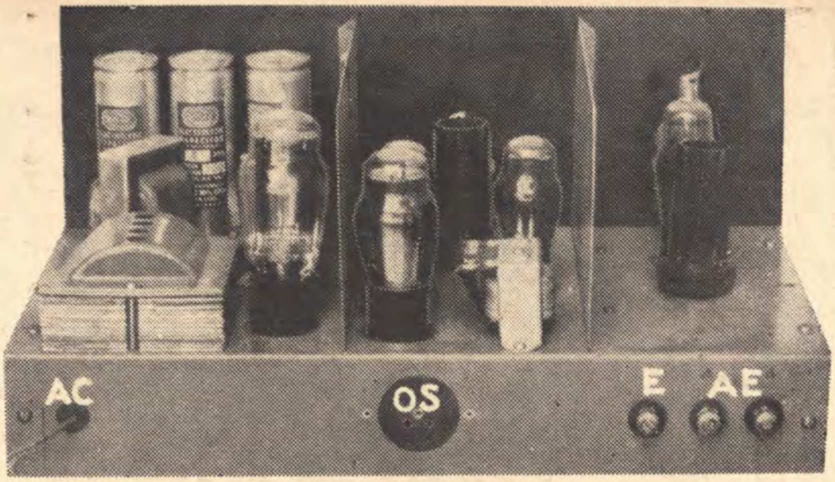
Reverse-Wound Reaction

The R.F. portion is notable chiefly for two things. In the original receiver a half-wave doublet aerial with a transmission line feeder was employed. A coil and condenser system is used to tune this, and matters were arranged so that the aerial tuning coil also became the coupling coil to the grid of the R.F. tube. This explains the absence of aerial windings (L1) on the illustration of the finished coils. However, L1 may be used when a standard aerial system is employed.

The second point is the use of a reverse wound reaction coil in the detector plate circuit. One of the greatest drawbacks of the average short-wave receiver of the regenerative type is the tuning effect of reaction. Various methods have been adopted to overcome the frequency shift which takes place as the regeneration control is adjusted, but we claim that the one used here is the simplest. The scheme used is to reverse wind the reaction coil so that, instead of tending to pull the grid coil into step with it, and so introduce frequency shift, it is inductively opposed.

Another reason for the stability of the tuning of the detector stage is the use of a comparatively large reaction condenser, RC. With correct adjustment of the reaction winding L4, its separation from the grid winding L3, and a suitable plate potential on the detector tube, it is possible to adjust the regeneration control over its whole range without materially affecting the tuning of the grid circuit.

A study of the power supply circuit will show that the conventional full wave rectifier system is employed. No precautions against hum, such as the connection of condensers across the high voltage secondary winding, are necessary because the filter system is so designed as to clean up all traces of A.C. ripple. The resistor R13 serves the dual purposes of breaking down the rectified voltage applied to the first electrolytic, E1, and assisting filtration by cleaning up hash.



A rear view of the chassis which shows clearly the division of the three main sections of the receiver.

Speaker and 'Phone Connections

The receiver has been designed for operating from either headphones or from a dynamic speaker of the permanent magnet type. For this reason, as well as for the more important one of hum removal, two 30 henry heavy duty filter chokes have been employed, in addition to three 8 mfd. electrolytic condensers, E1, E2 and E3. As will be seen from the illustrations of the completed receiver, the filter chokes have been mounted at a 60 degree (neutralising) angle in order to eliminate such hum as could be caused by mutual inductance between the chokes.

The final point, before we touch upon the construction and the wiring of the receiver, is the scheme used to couple either loud speaker or headphones to the last stage tube. As far as the loud speaker is concerned the output transformer will look after the heavy plate current of the 42, but it would be looking for trouble to attempt to pass this current through a pair of headphones. Apart even from the possibility of breakdown, there is the chance that when wearing headphones the operator is likely to get in contact with the 250 volt plate potential applied to the 42.

The scheme arranged in the circuit diagram, and shown more fully in Fig. 1, is simplicity itself. The four pin socket which provides the output connections to the loud speaker is so wired that when the headphones are plugged into circuit the plate supply for the 42 is taken through an audio choke CH3. In the original receiver this choke happened to be the primary of a loud speaker output transformer, but almost any sort of choke will do as long as it will carry the current. Don't try to use the primary of an audio transformer though! The return of the phones is made to chassis through the condenser C11.

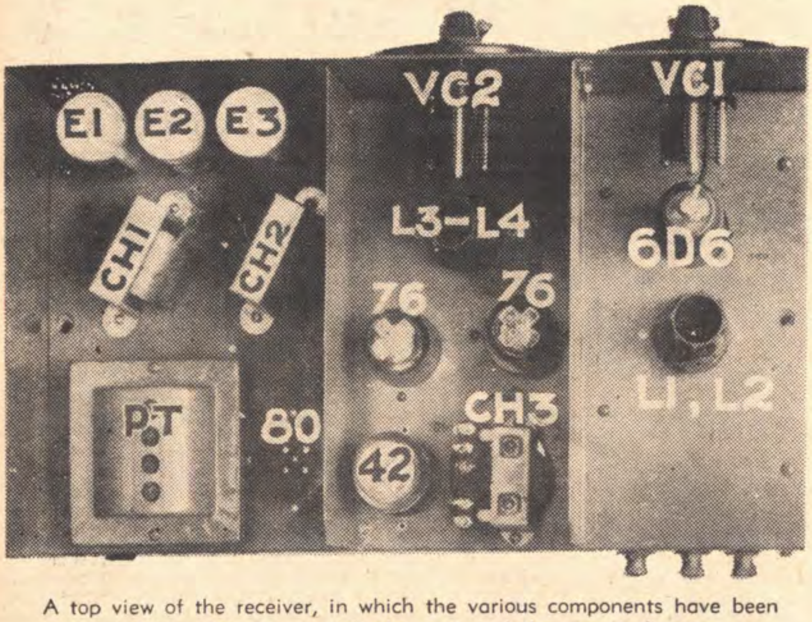
This may be of any convenient value, although, personally, we found that a .002 mfd. condenser was quite large enough to avoid loss of signal strength, and small enough to remove the residual hum which, although not loud enough to be heard when the speaker was connected, provided a somewhat tiring background to headphone reception. The .01 mfd. by-pass condenser C10 has been included between the plate and screening grid of the pentode for the purpose of clipping the "highs," and with them high pitched static and similar electrical interference.

Now study the illustrations of the original receiver while we outline its salient constructional characteristics. The steel chassis, aluminium will do if you don't fancy drilling and bending light gauge steel, measures 17 inches in length, 10 in breadth, and 2½ in depth. It is provided with two 5in. high partitions extended from the front of the chassis to the back. These are welded or bolted to the chassis at five and ten inches from the left hand front end. The front panel is of bakelite, and is bolted to the chassis and to the partitions.

Component Lay-out

Looking from the front, it will be seen that the first compartment contains the 6D6 r.f. valve with its associate coil, L1, L2, and tuning condenser VC1. The middle compartment contains the detector 76, the tuning condenser VC2, and the grid and reaction coils L3, L4. In addition in this compartment will be found the audio 76 and the output pentode, as well as the output choke CH3. The midget reaction condenser, RC, is mounted underneath the chassis in line with the tuning control for VC2. The volume control VC is similarly mounted in line with the control for VC1. It should be noted that VC's shaft is insulated from contact with the chassis.

In the third compartment is the power transformer PT and the filter gear, con-



A top view of the receiver, in which the various components have been key-lettered to agree with the text and the circuit diagram.

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sisting of E1, E2 and E3, with the filter chokes CH1, CH2. Along the rear of the chassis are the aerial and earth terminals (left), the loud speaker socket (centre) and the power supply inlet (right). It will be noted that three terminals have been provided. One of these is the earth, whilst the other two are aerials 1 and 2. The latter are insulated from the chassis. Two terminals have been provided so that a special short wave aerial of the twisted pair variety can be connected to the set if desired.

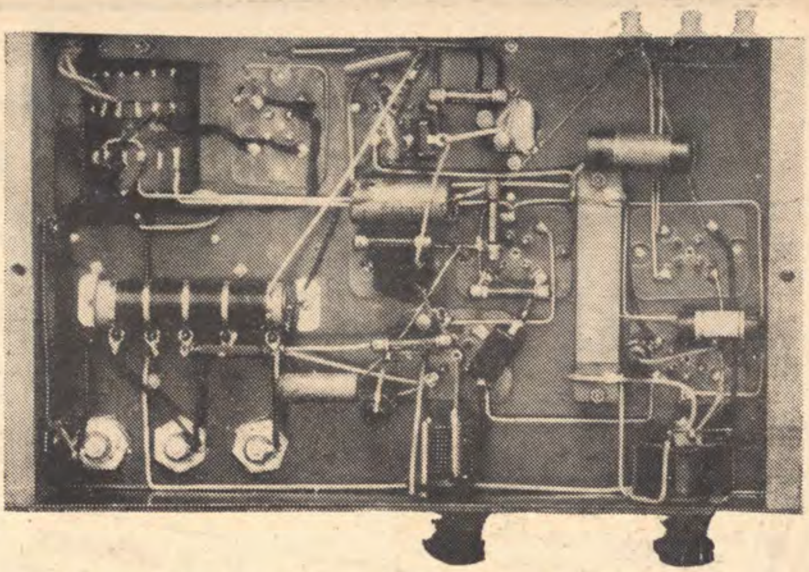
The underneath view of the receiver shows that the lay-out has been planned in such a way that the wiring is reasonably short. The three wire-wound resistors, R1, R8 and R12, are of the flat type and are mounted one above the other underneath the r.f. section of the set. The various by-pass and coupling condensers are soldered directly into circuit, as are the tubular type resistors. The voltage divider is secured to the underside of the chassis near the electrolytic filter condensers.

The wiring of the receiver has been carried out with 14 gauge tinned copper wire, sleeved when necessary with spaghetti. Incidentally it was not found necessary to twist the filament leads, although, despite the fact that one side of the filament is grounded to the chassis, a continuous wire was taken from each side of the filament winding on the transformer to the filament lugs on each socket. A study of the under chassis view of the original set will give the intending constructor a good idea of the wiring.

The next matter for consideration is the tuning coils. These are wound on standard Marquis ribbed formers, which have a total outside diameter of 1½ inches. Three sets of coils will be required to cover the tuning range from 18 to 85 metres. The winding specifications are as follow:—

Wave Range	Turns L1	L2	L3	L4
18-31 metres	4	5	5	7
30-52 metres	6	15	15	10
50-85 metres	10	24	24	12

All coils are wound with 26 gauge enamel covered wire. The grid coils L2 and L3 have their windings spaced to 15 turns per inch. The aerial windings, L1, and the reaction windings L4 are close wound. The separation between the grid windings and the aerial windings (the aerial coil is wound at the earth end of the grid coil) is quarter of an inch. The same separation exists between the reaction windings and the detector grid windings. Note that the grid end of the coils L2 and L3 is at the top of the former and that the aerial end of L1 is at the bottom. The plate end of the reaction winding L4, which is wound in the reverse direction to the grid winding L3, is nearest to the earth end of the latter winding.



An under-chassis view showing the disposition of components and their wiring.

The coil socket connections are key lettered to agree with the base connections on the coil formers. Make sure that your own coil and wiring connections correspond to this lettered code.

Now for some information on the plate and screen voltages. The r.f. plate voltage for the 6D6 is taken from the high voltage end of the divider and should be 250 volts to chassis. The plate of the two audio tubes are fed from the 250 volt point on the divider, but the detector plate, through the resistors R4 and R5 is fed from the 125 volt tap on VD. One side of the volume control VC is taken to the 40 volt tap.

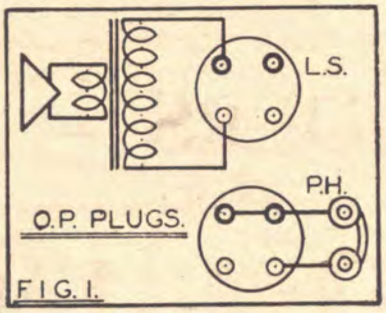
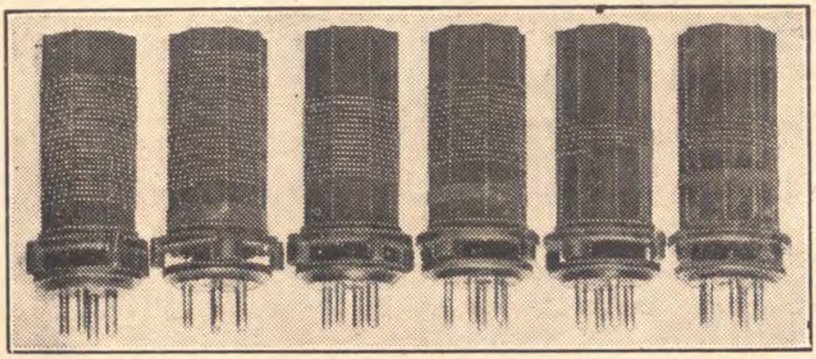


Fig. 1 shows the connections of loud speaker and phones to separate 4-pin plugs.

The initial adjustments to the receiver are few. After the coils, valves and loud speaker have been plugged in and the set switched on, it will be necessary to check up the operation of the regeneration control. If this is harsh in operation, i.e., brings the detector in or out of oscillation with a "plop," it will be necessary to reduce the plate voltage on the detector to remove turns from the reaction winding L4. Actually, if reasonable care has been followed in building and wiring the receiver and the coils have been made to specification, no trouble should be encountered.

The ideal operating characteristics of the receiver, much argument regarding the evils of tuning "interlocks" notwithstanding, is reached when, with the detector weakly regenerating the tuning of the r.f. stage to resonance, will throw the detector out, i.e., stop regeneration. When operating properly, and it should not be difficult to reach this stage of the set's functioning, the receiver will be found to be really outstanding. It possesses remarkably high sensitivity, which enables weak as well as powerful overseas broadcasters to be tuned in, a high quality audio output, and freedom from hum which is more the exception than the rule with all electric short wave receivers.

(Continued on page 46)



The set of six tuning coils necessary to cover the wave range between 18 and 85 metres.

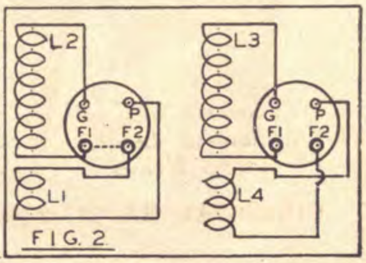


Fig. 2 shows the coil connections to the former pins.

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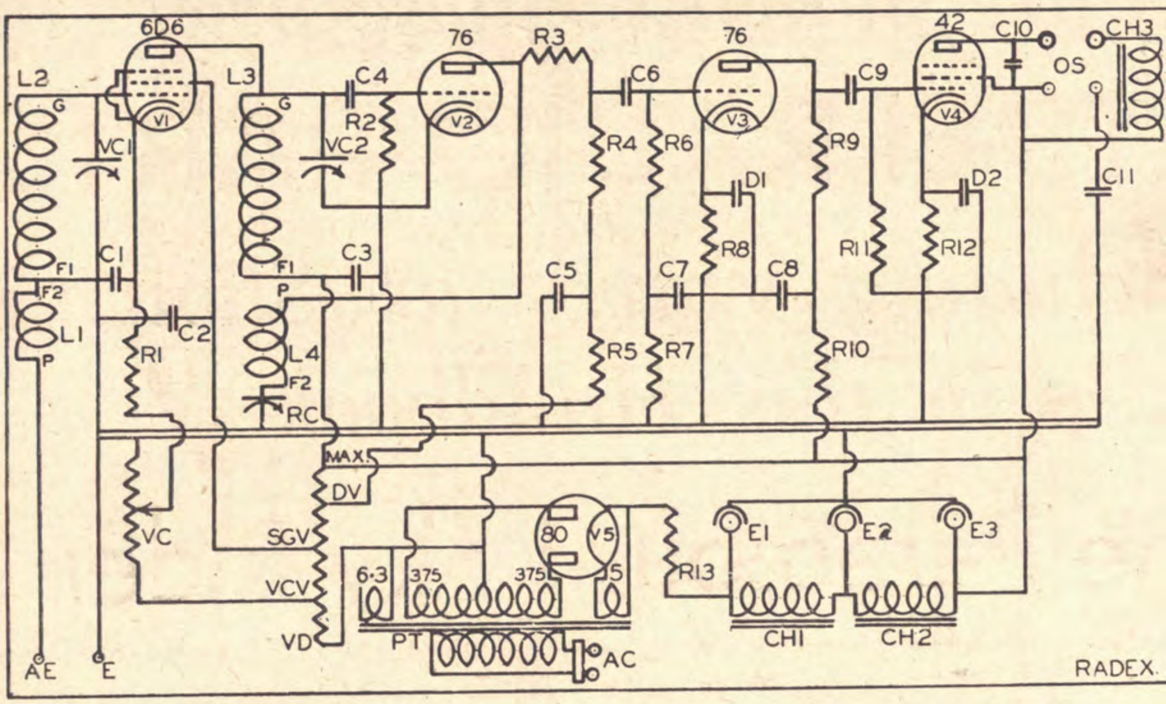
THE S.W.T.R.F.5—Continued from Page 42.

PARTS LIST AND CIRCUIT DIAGRAM



C1, C2, C3, C5, C8.—0.1 mfd. tubular condensers. (Concourse, Raycophone, Saxon, T.C.C., Wetless).

C4.—0.0001 mfd. mica condenser.

C6, C9.—.0:1 mfd. mica condensers. (Simplex, T.C.C., Wetless).

C7, D1.—0.5 mfd. tubular condensers.

C10.—0.01 mfd. tubular condenser. (Concourse, Raycophone, Saxon, T.C.C., Wetless).

E1, E2, E3.—8 mfd. 500 volt electrolytic condensers. (Concourse, T.C.C.).

CH1, CH2.—30 henry 60 m.a. filter chokes. (Paramount, Precedent, Radiokes, Raycophone, Stedi-power, Velco, Wendel).

CH3—50 henry audio choke. (Paramount, Precedent, Radiokes, Raycophone, Stedi-power, Velco, Wendel).

L1, L2, L3, L4—Tuning coils (see text). (Colonial Radio, Paramount, Precedent, Radiokes, Saxon, Velco.)

PT—Power transformer delivering 375-0-375 at 60 m.a., 6.3 v. at 1.5 A, and 5 v. at 2 A. (Paramount, Precedent, Radiokes, Raycophone, Stedi-power, Velco, Wendel.)

R1—350 ohm wire wound resistor 25 m.a.

R8—2700 ohm wire wound resistor 10 m.a.

R12, R13—430 ohm wire wound resistors, 60 m.a. (Paramount, Precedent, Radiokes, Raycophone, Saxon, Stedi-power, Wendel.)

R2—5 megohm grid leak.

R3, R4, R5, R7, R9—1 megohm resistors.

R6—25 megohm resistor.

R10—30,000 ohm resistor.

R11—.5 megohm resistor. (I.R.C., Raycophone, Velco.)

VC—5000 ohm W.W. potentiometer. (Marquis, Paramount, Precedent, Radiokes, Raycophone, Saxon.)

VD—25,000 ohm voltage divider. (Paramount, Precedent, Radiokes, Raycophone, Saxon, Stedi-power, Wendel.)

Chassis—See text.

Valves—6D6, 76, 76, 42, 80. (Mullard, Philips, Radiotron, Triad.)

Hardware, including wire, machine screws, dials, knobs, etc.

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

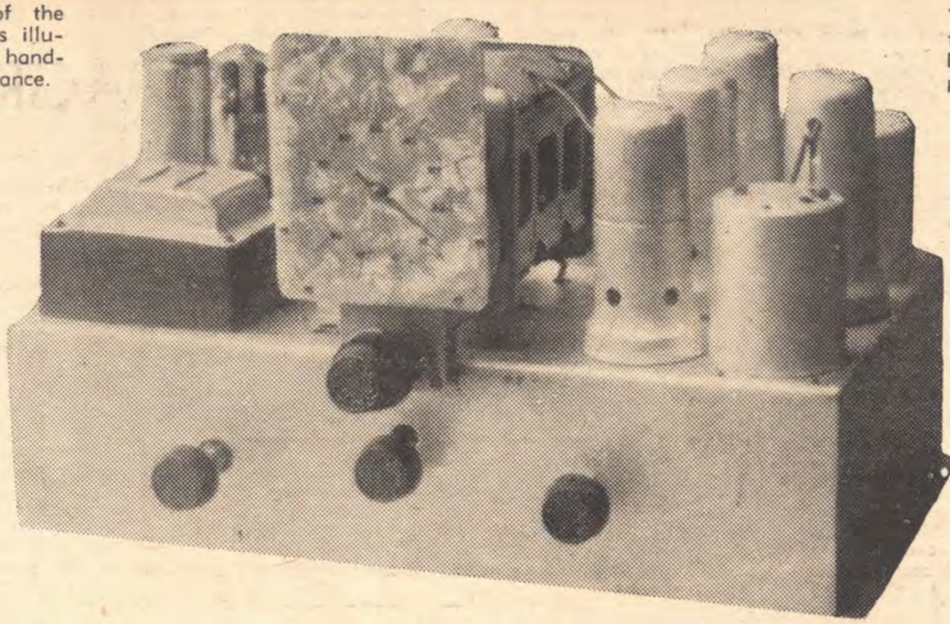
The body of the resistor is colored to represent the first figure of the resistance value. One end of the resistor is colored to represent the second figure. A band or dot of color, representing the number of ciphers following the first two figures, is located within the body color.

Examples:—

Ohms.	Body.	End.	Dot.
100	Brown	Black	Brown
150	Brown	Green	Brown
200	Red	Black	Brown
250	Red	Green	Brown
300	Orange	Black	Brown
350	Orange	Green	Brown
400	Yellow	Black	Brown
450	Yellow	Green	Brown
500	Green	Black	Brown
750	Violet	Green	Brown
1,000	Brown	Black	Red
2,000	Red	Black	Red
3,000	Orange	Black	Red
4,000	Yellow	Black	Red
5.000	Green	Black	Red
6.000	Blue	Black	Red
10.000	Brown	Black	Orange

Ohms.	Body.	End.	Dot.
15,000	Brown	Green	Orange
20,000	Red	Black	Orange
25,000	Red	Green	Orange
30,000	Orange	Black	Orange
40,000	Yellow	Black	Orange
50,000	Green	Black	Orange
60,000	Blue	Black	Orange
75,000	Violet	Green	Orange
100,000	Brown	Black	Yellow
150,000	Brown	Green	Yellow
200,000	Red	Black	Yellow
250,000	Red	Green	Yellow
300,000	Orange	Black	Yellow
500,000	Green	Black	Yellow
750,000	Violet	Green	Yellow
1,000,000	Brown	Black	Green
2,000,000	Red.	Black	Green

A front view of the Sky Rider chassis illustrates that it is handsome in appearance.



The uses of the four control knobs are explained in the text.

The Paramount Sky Rider 7

Complete information on the assembly, wiring, and adjusting of a remarkably sensitive dual wave receiver which does not use plug-in coils.

By A. K. BOX

BROADLY speaking, the greater the number of valves used in the signal selecting circuits of a given receiver the more sensitive is that receiver. Because of this it would appear at first sight that the chief problem of sensitive receiver design would be to keep a large "cascade" of signal amplifying valves in a stable condition.

If this were the only difficulty encountered by the set designer his job would be comparatively easy for, by using a large number of low gain stages, it is possible to build a stable receiver which has a tremendously high over-all gain. However, in the modern commercially designed receiver it is necessary to compromise. Space is at a premium and it is not possible to employ the total shielding which laboratory experiments prove is essential to an amplifier's stability.

On the other hand, with certain types of receiver, notably those intended for short wave reception, it is essential that the sensitivity—and conversely the set's overall gain—be "jacked" up to the very limit. The compromises in tuning circuits made necessary by the average set user's disinclination to change tuning coils manually when shifting from one wave band to another, make it necessary for every possible degree of stable amplification to be retained in the design of the receiver.

That such a degree of gain can be obtained without instability, and, more important perhaps than stability, without a high background noise level, is proved by the example of the Paramount Radio Co.'s new dual wave receiver which we have named the "Sky Rider."

This receiver follows modern trends in that instead of attempting to cover the whole short wave spectrum from 15 to 100 metres in addition to the usual broadcast band from 200 to 550 metres, only the most interesting (for the broadcast listener) section of the short wave spectrum has been selected.

The short wave tuning range of the "Sky Rider" extends from 17 to 52 metres so that the four short wave broadcasting bands on which all overseas transmissions are to be heard—19, 25, 31 and 49 metres—are covered.

Circuit Specifications

The set employs a radio frequency amplifying stage in front of the electron coupled mixer tube so that three coils are necessary for each wave band. The change from the broadcast to the short wave coils is effected by means of a low capacity switch of a type which also has a very sound contacting system designed to reduce electrical losses.

The three broadcast coils are mounted on one side of a metal can or "tank" which is mounted on the under side of the chassis. The short wave coils are on the opposite side of the tank through which the shaft of the rotary switch passes. The two coils for each stage, aerial, r.f. and oscillator, are widely separated and each pair is screened from the next pair so that circuit couplings are reduced to a minimum. So much for the coil system.

The mixer tube feeds into a high gain two stage intermediate amplifier, in which the intermediate frequency transformers are wound with Litz. wire, and are tuned by isolantite-mounted compression type condensers. The use of Litz. for the i.f. coils results in a large increase in the gain of the transformers as well as in an improvement in their selectivity. Both gain and selectivity are helped by the low loss dielectric used to mount the i.f. tuning condensers.

The valves used in the i.f. amplifier are 6D6's, which are very similar in characteristics to the 58. Their chief difference is that they operate with a filament potential of 6.3 instead of 2.5 volts. Experience with these 6.3 volt valves has proved that they are more silent in operation, have a lower internal noise level, and a slightly higher stable gain.

The r.f. tube also is a 6D6, whilst the mixer is a 6A7, the 6.3 volt counterpart of the 2A7. From the third i.f. transformer we pass to the second detector, which is a high mu diode-pentode, the 6B7. This tube operates as second detector, automatic volume control tube and first stage audio amplifier. Its output is resistance coupled to the 42 pentode, which operates as final stage audio amplifier.

Now glance at the illustrations of the original receiver whilst we touch briefly upon its lay-out. Look first at the top chassis view. It will be seen that the front, G3, section of the gang condenser controls the oscillator tuning, whilst the middle section, G2, looks after the modulator grid tuning of the 6A7, and the back G1, section, deals with the r.f. grid tuning.

The 6A7 tube itself is mounted at the front of the chassis near the G3 section of the gang. The r.f. 6D6 tube is mounted directly behind it. Conveniently to the right of the 6A7 is the first intermediate transformer, IF1, which is part of the cascade travelling around the outer edge of the chassis and consisting of:—IF1; the first i.f. amplifier, 6D6; the second i.f. transformer, IF2; the second i.f. amplifier, 6D6; the third i.f. transformer, IF3; the second detector and a.v.c., 6B7; the final audio, 42, and the 80 rectifier.

The power transformer PT is mounted in the front left-hand corner of the chassis, the two electrolytics, E1 and E2, being mounted between PT and the sockets for the 80 and the 42. The front view of the receiver shows that there are four control knobs.

The three of these protruding through the chassis are:—Left to right, the tone control TC, the wave changing switch, and the volume control VC. Above the wave changing control knob is the dual knob of the two-ratio tuning dial. The rear view of the chassis shows four terminals. The pick-up connections are shown as PU and E, and the aerial connection as A. The earth terminal at the left-hand end of the chassis is unmarked.

The port at the right-hand end of the chassis carries the five-pin socket for the loud speaker. Now let us study the illustration of the under chassis lay-out and wiring. This receiver is undoubtedly the most simply designed from the wiring and assembly viewpoints that we have yet come across.

Despite the fact that it employs seven valves, has a fairly complicated wave changing system, and requires a large number of small components, such as resistors and condensers, its wiring is neat and its connections extremely accessible.

Wiring Details

This is due both to the lay-out of the valve sockets and i.f. transformers, and to the fact that the bulk of the resistors and condensers are disposed on three mounting panels.

The first of these panels has eight pairs of connecting points, and is mounted at the rear end of the chassis near the loud speaker plug. From the front of the chassis to the rear this strip has mounted on it:—The 275 ohm W.W. resistor, R16, the .5 megohm resistor, R15, the .1 mfd. condenser, C19, the .5 megohm resistor, R14, the .01 mfd. condenser, C18, the .25 megohm resistor, R12, the .1 mfd. condenser, C16, and the 1 megohm resistor, R13, in that order.

Between the sockets of the 80 and the 42, the .005 mfd. condenser, C20, is wired into position. The .0005 mfd. condenser, C17, is wired into position between the sockets of the 42 and the 6B7.

Next we come to the second mounting panel, which is secured to the rear of the chassis between the aerial, and the left hand earth terminals. This panel has 10 pairs of mounting points. The connections to these points, from the 6B7 side of the panel are: The 5,000 ohm resistor, R11; the 25 mfd. electrolytic condenser, D; the .5 megohm resistor, R10; the .00025 mfd. condenser, C15; the 50,000 ohm resistor, R9; the .00025 mfd. condenser, C14; the .01 mfd. condenser, C13; the .5 megohm resistor, R8; the .1 mfd. condenser, C11; and the 100,000 ohm resistor, R17.

The .1 mfd. condenser, C12, and the 600 ohm resistor, R7, which constitute the bias and by-pass arrangements for the second 6D6 i.f. amplifier tube are mounted directly at this tube socket. The .5 mfd. condenser, C9, which acts as by-pass for the screening grids of the three 6D6's, is connected from the s.g. of the first i.f. tube to chassis. The 800 ohm bias resistor for the r.f. 6D6 and its associate .1 mfd. bypass condenser, C, are connected between the r.f. 6D6 cathode and ground.

The 600 ohm bias resistor, R6, and its .1 mfd. by-pass condenser, C8, are similarly connected between the cathode of the first i.f. 6D6 and ground. A similar connection is made for the .1 mfd. condenser, C1, and the 400 ohm bias resistor, R1, between the cathode of the 6A7 and ground.

One side of the .0001 mfd. condenser, C2, and one lead of the 50,000 ohm resistor, R2, are soldered to the oscillator grid lug on the 6A7 socket, the other

PARTS LIST AND CIRCUIT DIAGRAM

Chassis—16in. x 10in. x 4in. Stamped and drilled (Paramount).

Condensers:—

C, C1, C3, C4, C6, C7, C8, C10, C11, C12, C16, C19, C21—.1 mfd. Tubular (Concourse, Raycophone, Saxon, T.C.C., Wetless).

C9—.5 mfd. Tubular (Concourse, Raycophone, Saxon, T.C.C., Wetless).

C2—.0001 mfd. (Simplex, T.C.C., Wetless).

C4, C5, C13, C18—.01 mfd. (Simplex, T.C.C., Wetless).

C14, C15—.00025 mfd. (Simplex, T.C.C., Wetless).

C17—.0005 mfd. (Simplex, T.C.C., Wetless).

D—25 mfd. 25 volt Electrolytic. (Concourse, T.C.C.).

D.S.—Dynamic speaker having 1500 ohm field and matched to output of type 42 valve (Amplion, Precedent, Saxon).

Dial—Dual Ratio (Efco, Radiokes).

E1, E2—8 mfd. 500 v. Electrolytics. (Concourse, T.C.C.).

G1, G2, G3—Three Gang Condenser (Paramount).

Kit—Consisting of one DW dual wave tuning coil assembly and switch, padding condenser, and three 462 k.c. intermediate frequency transformers. (Paramount.)

PT—Power Transformer delivering 385-0-385 at 80 m.a., 6.3 v. at 4 a., and 5 v. at 2 a. (Paramount).

Resistors:—

R—800 ohms W.W. 10 m.a.

R1—400 ohms W.W. 10 m.a.

R6, R7—600 ohms W.W. 10 m.a.

R16—275 ohms W.W. 100 m.a. (Paramount).

R2, R9—50.000 ohms.

R3—10,000 ohms.

R4—4000 ohms.

R5, R17—100,000 ohms.

R8, R10, R14, R15—500,000 ohms.

R11—5000 ohms.

R12—250,000 ohms.

R13—1 Megohm. (I.R.C., Raycophone, Velco).

Sockets—Four 6-pin, two 7-pin, one 4-pin, and one 5-pin (Paramount).

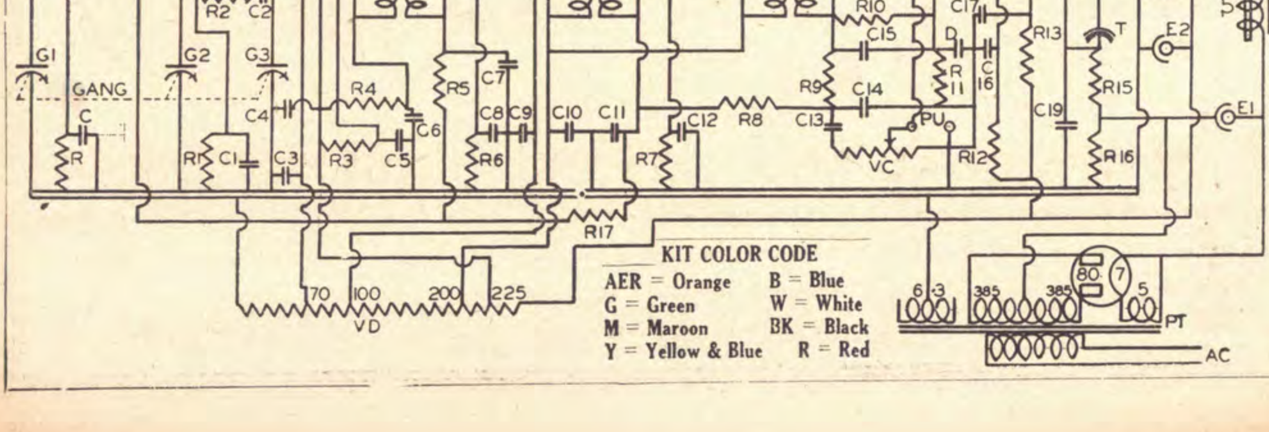
TC—Tone control (Octave or similar type).

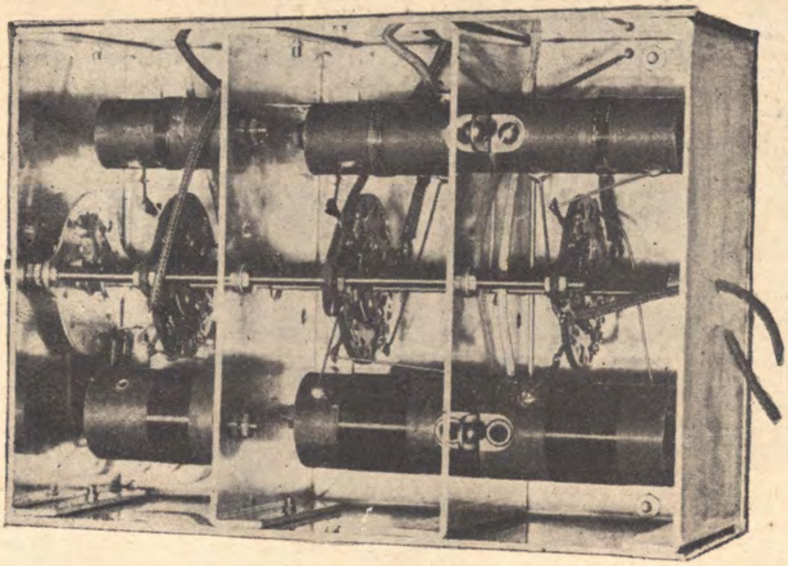
VC—500,000 ohm Potentiometer (Centralab, I.R.C.).

VD—25,000 ohm Voltage Divider (Paramount).

Valves—Three 6D6, one 6A7, one 6B7, one 42, and one 80 (Mullard, Philips, Radiotron, Triad).

Hardware—Hook-up wire and tinned copper earthing wire, two feet shielded cable, three mounting panels, four terminals (two insulated), four valve screens, knobs, 5 grid clips, and machine screws and nuts.





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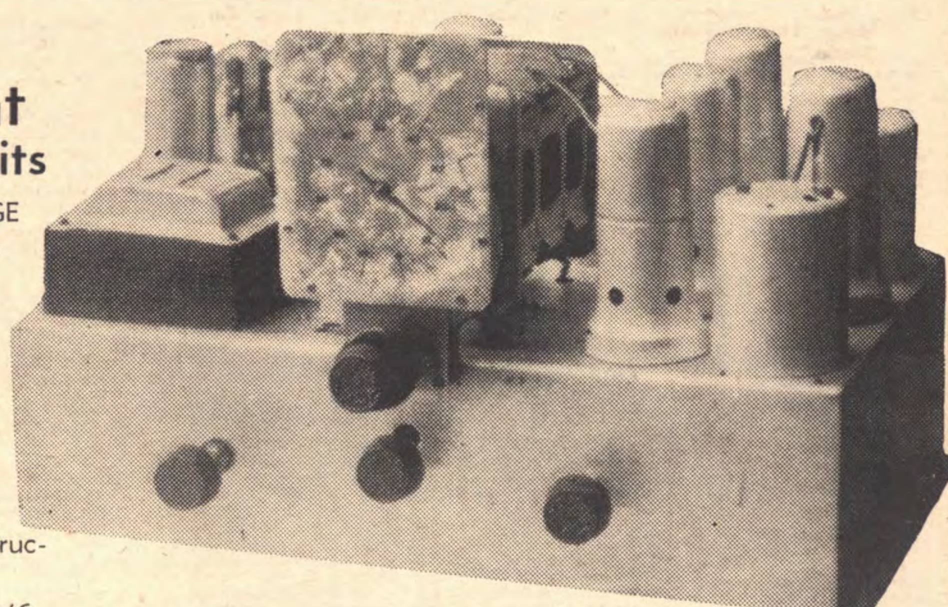

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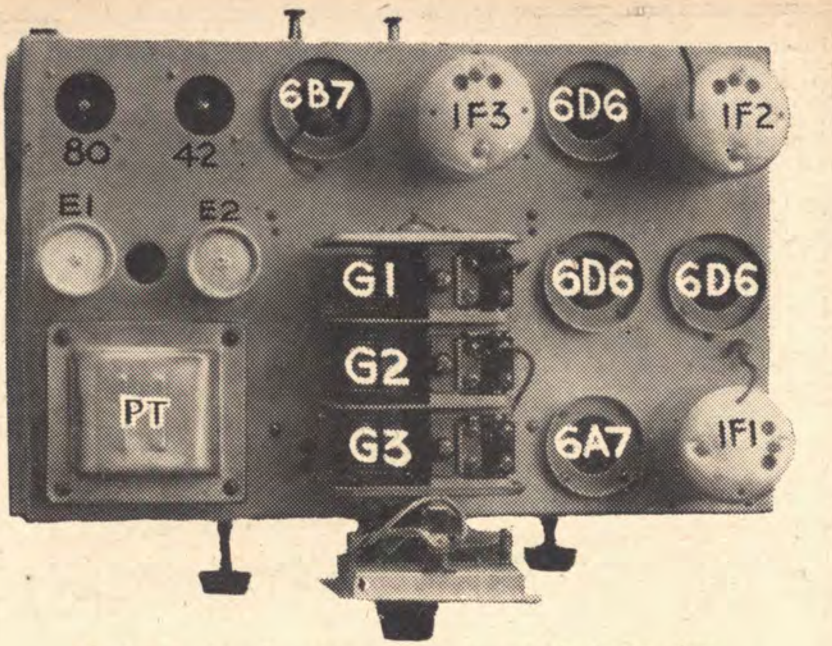
lead on R2 going to the 6A7 cathode. The voltage divided V.D. is mounted on the end of the chassis above the socket for the first i.f. tube. We now can deal with the mounting of components on the third mounting panel. This is secured to the underside of the chassis in the front corner near the sockets for the 6A7 and r.f. 6D6 tubes.

It has nine pairs of connection points. From the front of the chassis the components on this strip are: the .1 mfd. condenser, C7; the .1 megohm resistor, R5; the .01 mfd. condenser, C5; the 10,000 ohm resistor, R3; the .1 mfd. condenser, C6; the 4000 ohm resistor, R4; and the three .1 mfd. condensers, C4; C10, and 21, in that order. It will be noticed that C21 has not been shown in the circuit diagram. This condenser is part of the a.v.c. system and should be connected from W on the coil unit to ground.

Having dealt with the disposition of the components on the panels and with the connections of those mounted directly to socket points, we shall touch briefly on the method to be followed in assembling the receiver. The valve sockets, valve shield bases and i.f. transformers first should be mounted. The sockets for the 80, the 42, the 6B7, and the second i.f. 6D6 should have their filament lugs facing the rear of the chassis.

The filament lugs for the first i.f. 6D6 should face the left hand end of the chassis. The lugs for the 6A7 socket should face the front of the chassis, and those of the r.f. 6D6 should face the rear.

Next mount the power transformer, the electrolytic condensers and the tone and volume controls. On the back of the chassis mount the l.s. socket and the four terminals. Be sure to insulate the "A" and "PU" terminals from contact with the chassis. Now mount the gang condenser.



A photographic plan view of the assembled chassis, key lettered to agree with the wiring description and parts list.

Wiring Instructions

When this has been done go ahead with the filament wiring and make as many more wiring connections as possible. Then, after mounting the various components on each of the three panels, and making such "common" connections as are necessary between the components, mount one panel at a time and wire it into circuit.

It probably will be best to work from the power transformer end down, and, after hooking up the components in the first panel, to wire in condensers C20 and C17 before proceeding to panel number two.

When wiring panel number one into circuit also mount the tone control, TC, to the front of the chassis and hook it into circuit.

When wiring panel number two mount the volume control, VC, and wire it up. Note that one of the outside lugs of VC carries an earth lead, while the centre lug carries a shielded lead which goes to the P.U. terminal and to the control grid of the 6B7. This lead is carried in braided cable throughout.

The remaining outside lug on VC goes to one lug on C13 on panel No. 2. It also is carried in braided cable, the braiding of which is earthed. It probably will be more convenient to bring across all three leads from VC together bonding the earth lead to the braided cables every two or three inches before finally grounding it to the grounded lug of C14.

Next wire in the bias resistors and condensers for the r.f. 6D6, the 6A7, and the first and second i.f. 6D6's. Wire in the .5 mfd. condenser, C9, and the grid leak, R2, and condenser, C2, on the 6A7 socket. Now assemble, mount and wire, panel number three, leaving pigtails of sufficient length to connect to the voltage divider VD, which is to be mounted next.

Having gone this far we may now mount the tuning dial to the gang condenser shaft, and to the chassis. Make sure that the dial is working smoothly. The next job is to mount the coil assembly, which is secured to the underside of the chassis by four small brackets and mounting bolts. Before the coil assembly has been mounted, make sure that the leads from the filament winding on the transformer have been taken up and connected to the dial light. Now look at the color code shown on the DW kit in the schematic diagram. With the "tank" mounted in position all leads except the orange lead will come out on the 6A7 side of the can except the three blue leads from the rear, middle, and front sections of the can. These are connected respectively to the G3, G2, and G1 sections of the gang condenser.

The white lead from the rear section of the tank is connected to the unearthed end of C21, the red lead from the middle section is connected to the 225 volt tap on VD, and the yellow lead from the front section goes to the vacant lug on the oscillator grid condenser. The maroon lead from the front section goes to the oscillator plate, and the green lead from the middle section of the r.f. plate. The black lead from the front section of the can goes to the junction of R3 and C5.

The next job, after making sure that everything is working properly, is to align the receiver. In this regard it should be noted that once the set is aligned on the broadcast band it will

An under chassis view of the set shows it to be "clean" in wiring and quite accessible. The coil "tank" can be seen in the middle of the chassis.

function with equal efficiency on the short wave band. The padding condenser is adjusted from the top of the chassis. The usual method of super-het. circuit alignment is employed, although, because the set is fitted with A.V.C., it is necessary to make a couple of wiring changes before we can proceed with the alignment.

These are the disconnection of R8 from the junction between R9 and C13, and the reconnection of this R8 lead to ground. This removes the controlling A.V.C. voltage from the three 6D6's. It would be advantageous to open up the grounded end of A and connect a 5000 ohm variable resistance between this point and chassis in order to have some control over the set's sensitivity.

When properly aligned, the receiver is capable of a really amazing performance. Its sensitivity is higher than that of any all-wave receiver we have yet tested, and its noise level is astoundingly low. Tone quality and power output are in keeping with the set's broadcast and short-wave performance. It is easy to handle, and, aided by the dual ratio dial, easy to tune. To sum up, it is a receiver which will have a big appeal to the set-builder who requires something really out of the ordinary in the way of dual wave receivers.

A rear view of the receiver showing the disposition of the pick-up, aerial, and earth terminals.

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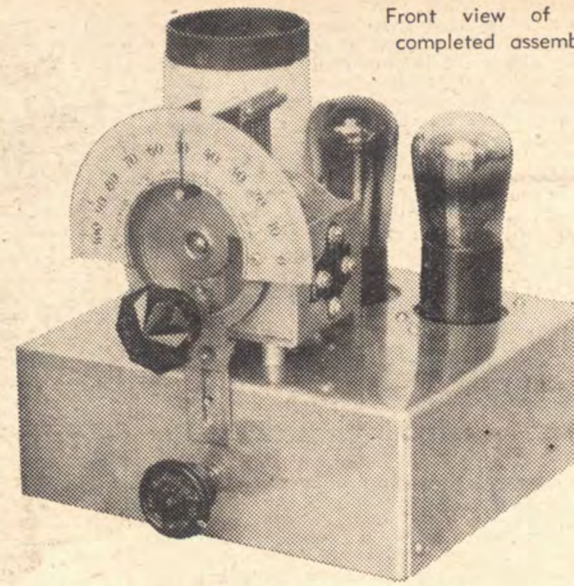
THE COUNTRY "TWO"

A simple receiver which has been designed primarily for head-phone reception. A feature of this set is its remarkably low battery consumption.

By P. R. DUNSTONE



Front view of the completed assembly.

THIS compact receiver has been primarily designed for head-phone reception. However, provided the set is situated within reasonable distance of a broadcasting station, moderate loud-speaker results can be expected. The circuit adopted is a standard Reinartz regenerative detector, and one stage of transformer coupled audio.

The circuit employs two 230 type valves, which are among the latest developments in the battery series. The feature of these valves is their improved sensitivity in comparison to the older types, and a most important factor is that they are remarkably low in their actual consumption of current. As will be realised by most readers, the battery consumption of a country receiver is a vital point, since, in numerous cases, it is necessary to transport the "A" battery some ten to twenty miles to have it charged, not forgetting the expense of its upkeep. Therefore, when designing a receiver similar to this, or, for that matter, any battery operated set, it is essential that the battery problem be dealt with first.

Coil Details

The coils L1 and L2 are wound on a piece of 2-inch diameter former measuring 3½ inches long, and are wound with gauge 26 D.C.C. wire. Commence by winding coil L1, which requires 70 turns. This coil should have part of the 55th, 60th and 65th turns bared and twisted into small loops to enable an aerial connection to be made to them at a later date.

After completing coil L1, start about ¼ to ½ an inch away from it and begin winding coil L2. This coil should have at least 25 turns wound on it. For the initial test of the receiver it would be advisable to have 30 turns on the reaction coil. Then, in the event of the reaction being found too fierce it will be a simple matter to remove some turns from L2.

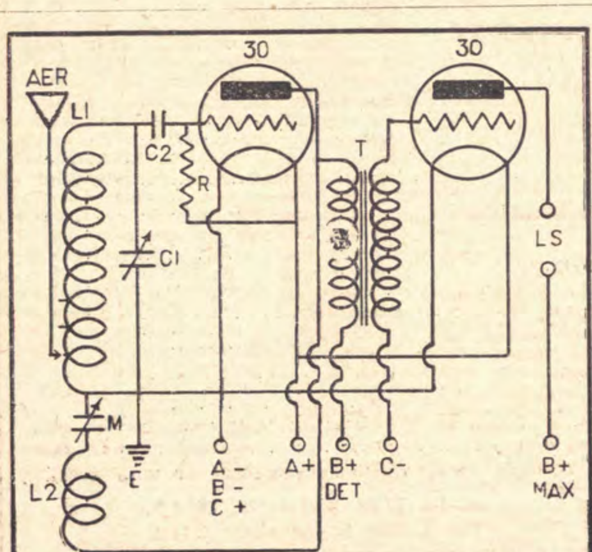
Operation

Having wired the receiver according to the schematic circuit, it is only necessary to connect the leads in the battery cable to their respective positions on the batteries.

The "A" battery should consist of a two volt 60 ampere hour accumulator, the "B" battery a 60 volt light duty, and the "C" a 4½ volt battery. The lead which is taken to the "B" positive terminal on the audio transformer T should be wired to approximately 25 to 30 volts on the "B" battery, while the B positive max. is fastened to the 60 volt terminal.

The C negative lead on the transformer T should be taken to the three volt tapping on the bias battery. The supply for the filaments of the two valves is connected straight on to the positive and negative terminals of the accumulator.

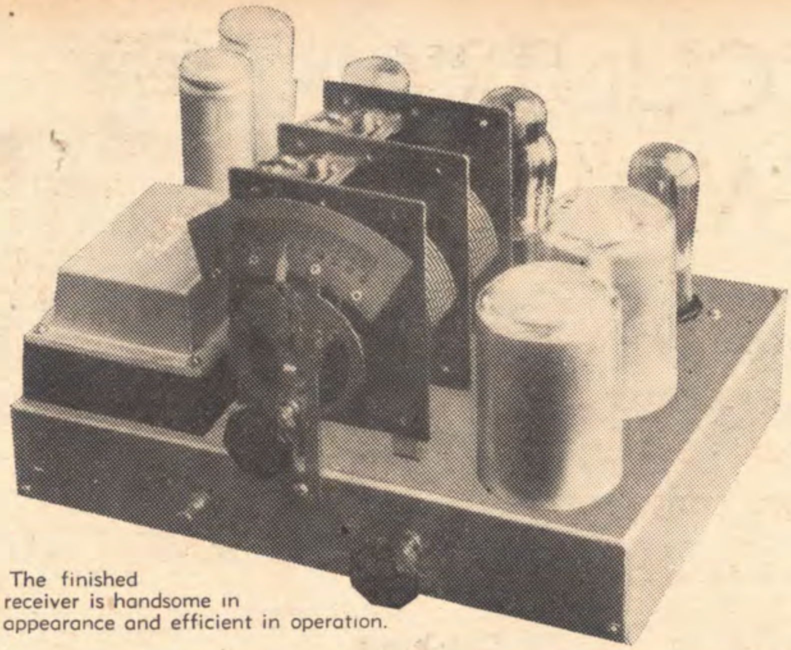
When the aerial, earth and headphones are joined to their respective terminals on the receiver, rotate the vernier dial on the variable condenser until signals are heard, then adjust the reaction condenser M until maximum signal strength is obtained. In the event of the receiver oscillating too fiercely it will be necessary to remove a few turns from the reaction winding L2. The reverse operation takes place if the set is found not to oscillate.



CIRCUIT DIAGRAM AND PARTS LIST

- A Battery, 2-v. (Century).
- C1—0.0005 mfd. variable condenser (Precedent, Raycophone, Saxon).
- C2—0.00025 mfd. fixed mica condenser (Simplex, T.C.C., Wetless).
- Dial—(Efco, Precedent, Radiokes, Raycophone).
- M—23 plate midget condenser (Paramount, Precedent, Radiokes, Saxon).
- R—3 megohm carbon resistor (I.R.C., Raycophone, Velco).
- T—3-1 audio frequency transformer.
- Two 30 type valves (Mullard, Philips, Radiotron, Triad)
- Two UX valve sockets (Marquis, Precedent, Saxon).
- Aluminium chassis depending upon parts used.
- Coil details (see text).
- Sundries: Four terminals, spaghetti, screws, etc.

Two Simple Receivers for the Beginner



The finished receiver is handsome in appearance and efficient in operation.

Pre-Selection makes these sets Selective

A.C. LOCAL RECEIVERS

By A. K. BOX

IN this article it is our intention to deal fully with the construction and operation of the simplest form of all-electric receiver—the two-valver.

There is no doubt that the needs of the metropolitan listener, who is looking for a reliable loud speaker strength service from the local stations, and is not interested in distance reception, are adequately met with a two-valve receiver. The only snag has been lack of selectivity, but with the aid of pre-selection it is possible to make the receiver tune quite sharply, and be capable of discriminating between stations operating 20 or 30 kilocycles apart.

The Problem of Selectivity

It must be remembered, however, that the additon of pre-selecton to the tuning circuits of the receiver definitely results in a loss of signal strength. The amount of this loss will depend upon the design of the pre-selector system, and its ultimate effect as far as the use of the receiver is concerned will be governed by the efficiency of the detector and audio circuits. If in the first place the receiver, using only a single tuned circuit, will not deliver really good signals to the loud speaker, it will be found that the addition of pre-selection will render the set almost un-usable except when it is operated comparatively close to a powerful station.

The reason for this is that there is a definite ratio between selectivity and sensitivity, which means that with a receiver of a given number of valves we can increase the selectivity only at the expense of sensitivity. This being understood, it can be realised that in any two-valve receiver, which is to be provided with pre-selection in order to obtain selectivity, it is necessary to pay close attention to the circuit design in order that we shall get sufficient volume for our needs.

With the aid of modern methods of receiver construction and the high amplification factors of the latest types of valves it is not difficult to make a two-valver which is both sensitive and selective. We shall deal with the design of suitable receivers shortly. Meanwhile, let us take up the question of valves.

Two circuits are shown. In the first a three-element detector is transformer coupled to a pentode, whilst in a second a screen grid detector is resistance coupled to the same type of tube. First let us see why it is advisable to use a pentode.

Modern methods of circuit construction, resulting in vastly improved performance, are used in the receivers described in this article.

The Output Stage

In view of all the nasty things which have been said about such types it might be expected that we would take steps to render the use of such a valve unnecessary. This has not been done for the reason that it is in circuits such as these that the pentode really justifies itself, and that is because the tube has a much higher "power-sensitivity" than a triode. In other words, it will give a greater audio power output for a small input signal voltage than will a triode. Naturally, with only a detector in front of the pentode the signal voltage delivered to its grid is quite small, so that we have need of all the pentode's efficiency.

As far as tone quality is concerned, it must be admitted that the pentode is not as good as a power triode, but we cannot have things all our own way. As we need the pentode's sensitivity we must put up with its distortion, which, after all, we must admit is not usually perceptible to the untrained ear.

Having settled this point we come to the consideration of the detector valve. In this position in the receiver we have the option of using either a screen grid detector or a standard three element valve. Which is to be used will be a matter for the individual constructor, but the pros and cons of the case are these:

Points on Detectors

The screen grid detector has the reputation of being more sensitive to weak signals than the triode. On the other hand, the triode is much easier to handle in a detector circuit in which reaction is employed. The screen grid tube has a much higher amplification factor than the triode, but, as circuit conditions do not permit the full utilisation of its powers in this direction, little appears to be gained from its inclusion where sensitivity is the only consideration. The triode, however, on account of its lower amplification factor, must be coupled to the audio valve by means of an audio transformer having a step up ratio of 3½ or 5 to 1. Besides this, as it is inadvisable to attempt to apply the full plate voltage to the detector tube when it is operated without bias, i.e., is not an anode-bend detector), we must employ a voltage dropping resistor, R2, to keep the detector's plate potential to reasonable proportions.

Now the audio transformer will cost from 10/ upwards, depending upon its quality, and the series resistor about 1/3. With the screen grid detector we find that the audio transformer is replaced with a resistance capacity coupling unit made up of R3, R4, and C3.

These components will cost approximately 5/3. In addition we shall require a voltage divider, VD, in order that we can obtain easily the critical adjustment of screen potential. This component's will cost about 4/6. The screen grid valve will be 6d more than the triode. From this it will be seen that even when a cheap audio transformer is used, and the tone quality consequently is sacrificed somewhat, the screen grid detector is a slightly cheaper proposition. However, as we indicated earlier, it is rather more difficult to make function satisfactorily than the triode.

Choice of Valves

In the second circuit we have shown alternative valves in the 6.3 volt range, which now is becoming popular. The 58 may be replaced with a 78 and the 2A5 with a 42, without changing the circuit constants in any way. At the time these diagrams were drawn the newly released 76 was not available, so no alternatives were offered for the tubes shown in the top circuit. With the release of the 76, which is the 56 equivalent in the 6.3 volt range, it now becomes possible to make up the top circuit with a 76 and a 42 or a 56 and 2A5, depending upon which type of tube is required. The general impression in technical circles appears to be that the 6.3 volt range of tubes are more sensitive than the 2.5 volt range, so that possibly these will give better results than the types used in the original receivers.

Incidentally, both circuits were employed by the writer, for two receivers were built up at the same time. Our remarks anent the performance of one receiver against the other, are backed by the experience of simultaneous tests.

The power transformer required for either circuit should have a high voltage winding delivering 385 volts on each side of the centre tap at a current of 60 m.a. It should be provided with a rectifier filament winding of 5 volts at 2 amperes, and should have a valve filament winding of either 2.5 volts at 3 amperes, or 6.3 volts at 1½ amperes. The margin in current rating in the case of the valve filament secondary is advisable in order to eliminate the possibility of voltage drop under load.

Notes on Components

The loud speaker should be a 2500 ohm field type, so that with a total current drain of 42 m.a., a voltage drop of 105 volts will take place across it, and the excitation of the speaker field will be in the vicinity of 4½ watts. In these circumstances the plate voltage on the 2A5 will be about 300 volts, which, although higher than the rated voltage for the tube, is quite a safe value.

In the case of the circuit using the screen grid detector, the current drain will be increased by about 10 m.a., the speaker field excitation will increase to 6¾ watts, and the potential on the plate of the 2A5 will be reduced to

LIST OF PARTS

L1, L2, L3, L4.—Aerial, pre-selector, and reaction coils (see text). (Colonial Radio, Paramount, Precedent, Radiokes, Saxon, Velco).

G1, G2.—Two gang variable condenser 0.0005 mfd. (Precedent, Raycophone, Saxon).

T.—Audio frequency transformer 3½-1 ratio. (Paramount, Precedent, Radiokes, Raycophone, Saxon, Wendel).

C1.—.00025 mfd. fixed condenser. (Simplex, T.C.C., Wetless).

C2.—0.5 mfd. fixed condenser 300 volt test.

C3, C5.—0.01 mfd. fixed condenser. (Concourse, Raycophone, Saxon, T.C.C., Wetless).

C4.—25 mfd. 25 volt electrolytic condenser.

E1, E2.—8 mfd. 450 volt test electrolytic condensers. (Concourse, T.C.C.).

R1.—2 megohm resistor.

R2.—25,000 ohm. resistor.

R3.—.1 megohm resistor.

R4.—.25 megohm resistor (I.R.C., Raycophone, Velco).

R5.—450 ohm wire wound resistor. (Paramount, Precedent, Radiokes, Saxon, Velco).

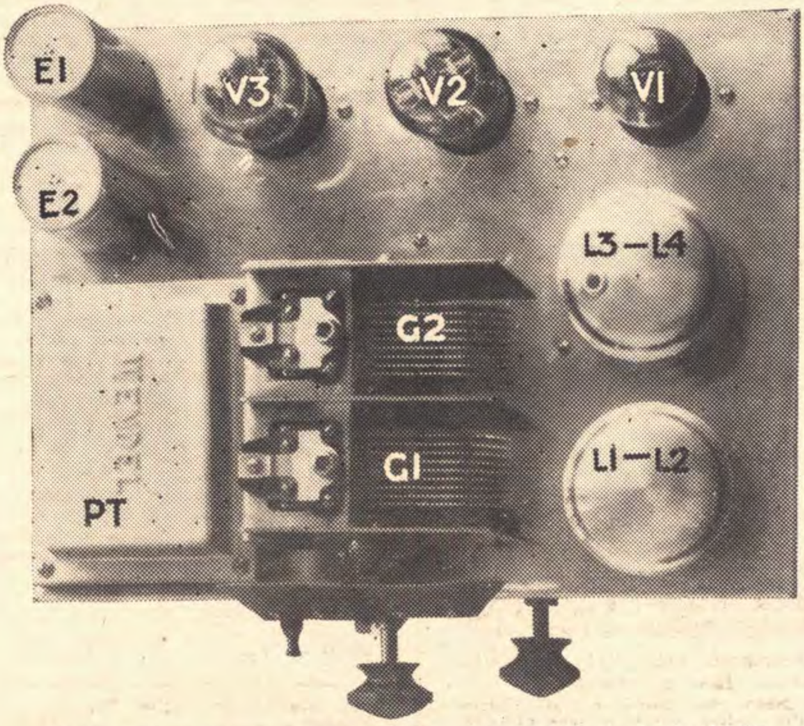
VD.—25,000 ohm voltage divider. Paramount, Precedent, Radiokes, Saxon, Velco).

M.—23 plate midget condenser (Paramount, Precedent, Radiokes, Saxon).

PT.—Power transformer (See text). (Paramount, Precedent, Radiokes, Raycophone, Stedi-power Velco Wendel).

V1, V2, V3.—Valves (See text). (Mullard, Philips, Radiotron, Triad).

DS.—Dynamic speaker. 2500 ohm field resistance to match 2A5 type valve. (Amplion, Precedent, Saxon).



A key lettered top-chassis view of the receiver which shows clearly the disposition of the valves, tuning units, and power transformer.

about 250 volts. Either system will result in excellent signal strength, combined with safe operation.

The coils L1 and L2 constitute the aerial unit, L2 being tuned by the G1 section of the gang condenser. L3, with which is associated a pick-up coil of three or four turns ("X"), constitutes the pre-selector winding turned by the G2 section of the gang condenser. The winding L4 is the reaction winding, the feedback being controlled by the midget condenser M. These coils, L1 and L2 on the one former, and L3, "X" and L4 on another, are shielded with 2½ inch diameter cans.

Home-Made Coils

The original coils were made by Colonial Radio, and are sold under the brand name "Colonial." Similar types are marketed by other manufacturers. For the benefit of those who may desire to wind their own coils, the following data is provided:—

The formers are standard Marquis 1¼ inch diameter type. The coils L2 and L3 are wound with 28 gauge enamel covered wire, 109 turns being laid on for L2 and 115 turns tapped at the 112th turn for L3 and "X." The aerial winding L1 is of 15 turns of 36 gauge d.s.c. wire wound on the bottom end of the former for L2 and separated therefrom by a quarter of an inch. The reaction winding L4 consists of 25 turns of 36 gauge d.s.c. wire wound on the bottom end of the former for L3 and "X" separated from the bottom end of the winding by 3/16 inch.

The grid condenser C1 of .00025 mfd. capacity and the leak R1 is of two megohms. It is probable that in areas where the absolute in selectivity is required, it would be advantageous to use an anode bend detector, but in most localities the grid leak type will be selective enough in addition to being more sensitive.

The by-pass condenser C2 in the triode detector circuit is of .5 mfd. capacity. This simply serves as an audio frequency return path, stabilises the reaction control and increases the detector's "pep." In the case of the screen grid detector circuit, the same capacity condenser, again C2, is used as the by-pass on the screening grid.

Some Minor Components

The conventional biassing arrangement for the pentode is employed. The 450 ohm resistor R5 is connected between cathode and ground and is by-passed by the 25 mfd. electrolytic condenser C4.

It should be noted that one side of the filament winding secondary for V1 and V2 is connected to chassis. This is a simple, cheap and highly effective method of reducing a.c. hum in the receiver, and overcomes the necessity for a centre-tapped winding or the use of a separate centre tap resistor.

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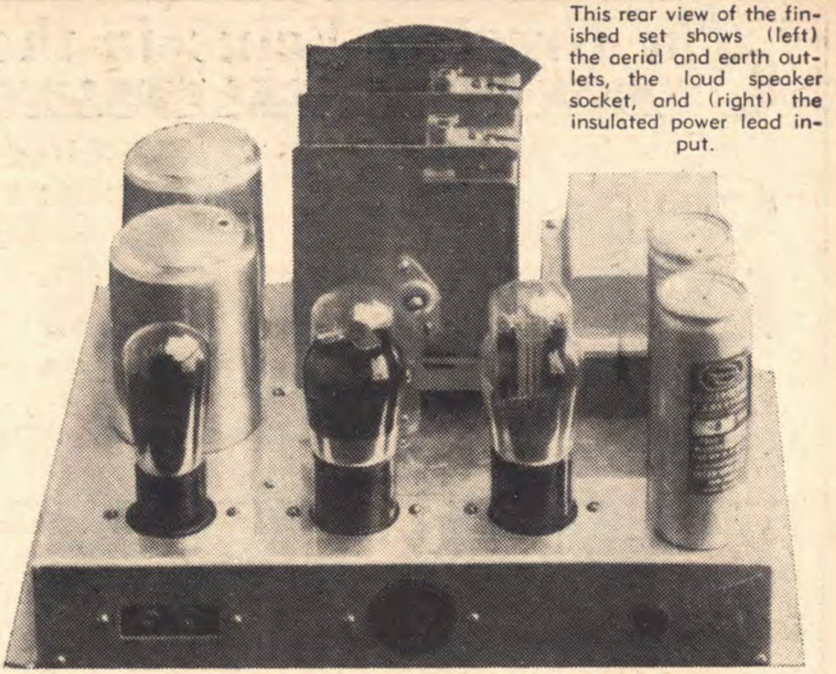
The circuit variations in the case of the screen grid detector circuit include the replacement of the audio transformer with a resistance unit consisting of a .1 megohm plate resistor, a .25 megohm grid resistor and a .01 mfd. coupling condenser C3. The voltage divider VD is connected between the high potential side of the "B" supply and chassis.

As can be seen from the illustrations of the finished receiver (the triode detector model is shown) only a small chassis is required. The dimensions of that used for our two sets were 12 inches by 9½ inches by 2½ inches. From the key-lettered illustration the position of the components on top of the chassis can be located while the underchassis view shows both the wiring and the placement of resistors, condensers and audio transformer. With these illustrations and the foregoing brief review of components, no difficulty should be experienced in building a receiver of similar design.



This rear view of the finished set shows (left) the aerial and earth outlets, the loud speaker socket, and (right) the insulated power lead input.

Point to Point Wiring

The wiring of the receiver (we shall deal first with the triode version) is begun by taking a lead from the aerial side of L1 to the aerial terminal on the chassis, and from the earth side of this coil to the earth terminal on the chassis. The top end of L2 is joined to the fixed plate lug on the G1 section of the gang condenser, whilst the bottom end of L2 goes to the outside end of the winding "X" on L3. (Note that in some commercial coil units this lead from L2 will go to the tap point between "X" and L3, and the bottom end of "X" will be earthed to the chassis.) The tap point between "X" and L3 is connected to the chassis.

The top end of L3 is connected to the fixed plate lug on the G2 section of the gang condenser, to one lug of the .00025 mfd. condenser C1, and to one lead on the 2 megohm grid leak R1. The other lead on R1 and the remaining lug on C1 are soldered to the G lug on the socket for V1. The P lug on this socket joins to the bottom end of the reaction winding L4, the other lead on L4 goes to the fixed plate lug on the midget condenser M.

The P terminal on the audio transformer T is joined to the P lug on the socket of V1, whilst one lead on the .5 mfd. condenser C2, and one lead on the 25,000 ohm resistor R2 is connected to the B plus terminal on the transformer. The remaining lead on C2 is connected to the C lug on the socket of V1 and to the chassis.

The G terminal on the audio transformer is connected to the G terminal on the audio valve socket V2. The P terminal on this socket is taken to the terminal on the loud speaker socket which, when the speaker is plugged in, will connect to one of the input transformer leads. The screen grid lug on the socket of V2 is taken to the loud speaker socket, which will connect to the remaining input transformer lead on the loud speaker. The .01 mfd. condenser C5 has one lug soldered to the P terminal on the socket for V2, and the other lug to the screen grid lug on the same socket.

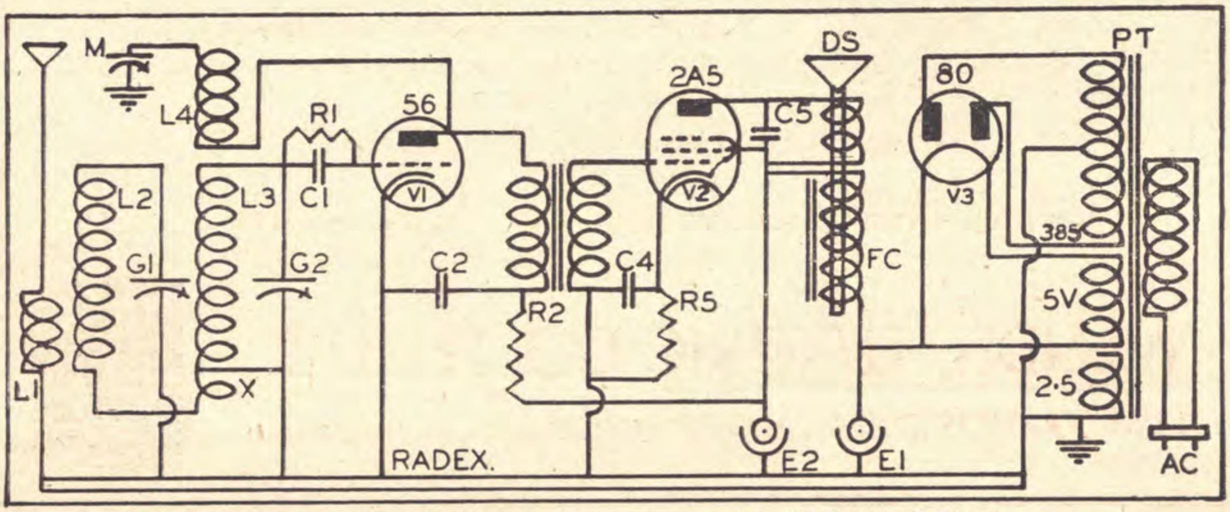
The vacant lead on the 25,000 ohm resistor R2 is soldered to the s.g. lug on the socket for V2. The C lug on the socket for V2 carries one lug of the 450 ohm bias resistor R5, and the positive lead of the 25 mfd. electrolytic condenser C4. The negative lead on C4, the C minus terminal on the audio transformer T, and the remaining lug on C5 are connected to the chassis.

Heater Connections

We are now ready to wire the valve filament and the power supply circuits. Start by soldering a lead to one F lug on the socket for V1, continuing the wire to one F lug on the socket for V2, and then to one of the lugs on the 2.5 (or 6.3) volt filament winding. This lug on V1 should be earthed to the chassis. A similar lead, twisted around the first, is taken from the remaining filament lug on V1, to the remaining filament lug on V2, and to the vacant lug on the 2.5 or 6.3 volt winding.

Now take a lead from the centre tap of the high voltage winding on the transformer and connect it to the chassis. Join one of the outside lugs of the high voltage winding to the P lug on the rectifier socket V3, and connect the G lug on the same socket to the remaining outside lug on the high voltage winding. Wire one side of 5-volt winding to F of V3, and to the positive terminal on the 8 mfd. electrolytic condenser E1. The negative of E1 should be connected to the chassis. Take other F of V3 to remaining side of 5-volt secondary.

From the positive lug on E1 take a lead to that lug on the loud speaker socket, which will connect to one of the field windings when the speaker is



The circuit diagram of the triode detector version of the "A.C. Local" Receiver.

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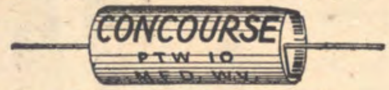

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plugged in. Connect the other field winding lug on the l.s. socket to the speaker socket lug, which joins to the screen grid lug on V2 and continue the lead from this point to the positive lug on the second 8 mfd. electrolytic condenser E2. The negative of E2 should be connected to the chassis. The attachment of the a.c. supply leads to the correct primary lugs on the power transformer completes the wiring of the receiver.

Detector Changes

The variations necessary to employ a screen grid detector are as follows:—The wiring of the coils L, L2, L3, "X," and L4 are the same with the difference that the grid leak R1 and the grid condenser C1 are soldered together and have one of their common ends soldered direct to the grid (top) lug on L3. This is best arranged by mounting R1 and C1 inside the coil former. The other end of R1-C1 carries a lead which connects to the grid (top) pip on V1.

The screen grid lug on the socket of V1 is joined to one side of the 0.5 mfd. condenser C2, the other side of this going to the cathode of V1 and to earth. The s.g. side of C2 carries a lead which goes to the tap point on the voltage divider VD. One extreme of this divider is connected to the chassis and the other extreme goes to the s.g. lug on the socket for V2.

The P lug on the socket for V1 is joined to one lead on the .1 megohm resistor R3 and to one lug on the .01 mfd. condenser C3. The other lug on C3 is soldered to the G lug on the socket for V2 to which also is soldered one lead of the .25 megohm resistor R4. These two resistors take the place of the primary and secondary of the audio transformer T, the 25,000 ohm resistor R2 and the plate by-pass condenser C2. The remaining lead on R3 goes to the S.G. lug on the socket for V2, whilst the remaining lead on the .25 megohm resistor R4 goes to one side of C4, one side of R5 and to the chassis.

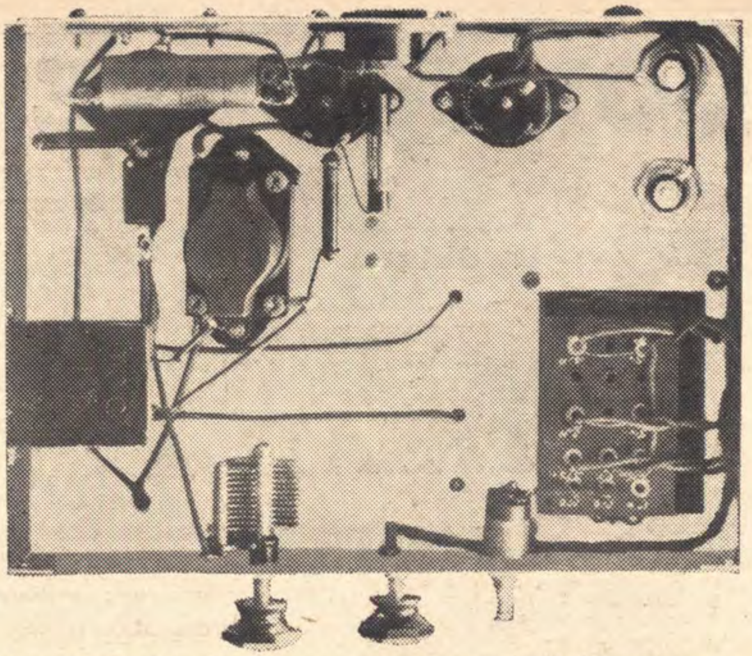
How to Get Results

The operation of either receiver is fundamentally the same. In the case of the triode version simply plug in the valves and loud speaker, attach the aerial and earth and tune the receiver to 3AW or 3KZ. With the trimmer of the G2 section of the gang condenser set about half way in 3AW should come in at about 10 on the dial.

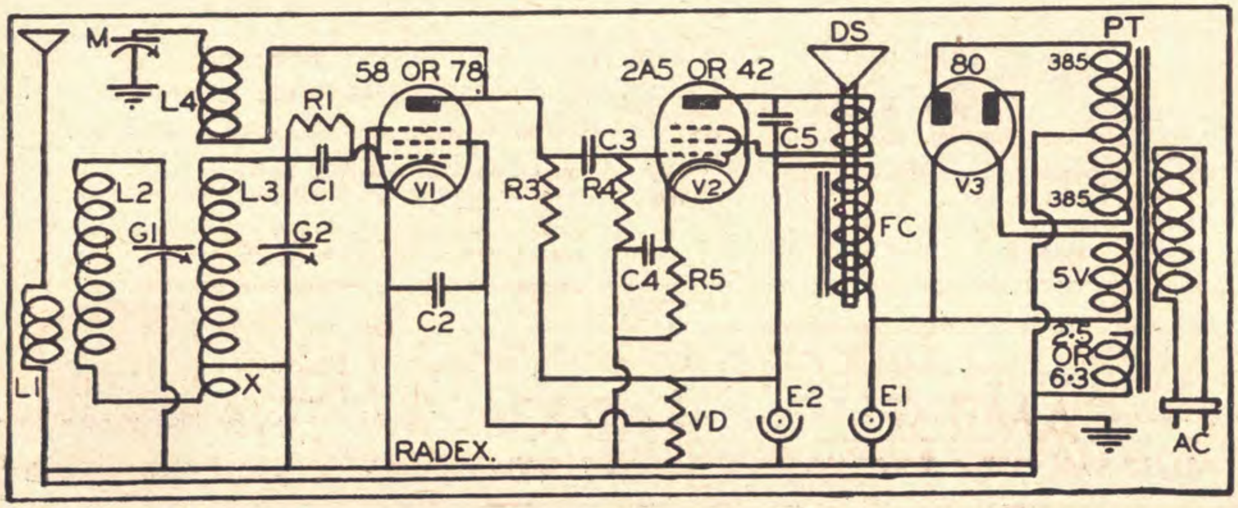
The volume at this stage probably will be fairly weak even though the reaction control is advanced almost to the point of oscillation. This condition can now be cleared up by screwing down the trimmer on the G1 section of the gang condenser until loudest signals are obtained. When built to the specifications given above it will be found that the receiver will oscillate smoothly over the whole tuning range.

In the case of the screen grid model it will be necessary to adjust the clip on the voltage divider VD so that oscillation is obtained over the whole tuning range and greatest sensitivity, and hence volume, is obtained. As a rough guide to this condition we suggest a setting about one inch from the earthed end of the divider.

As far as performance is concerned it will be found that either receiver will give excellent results on local broadcasting. Actually, during tests of the sets, when the earth was plugged into the aerial terminal, we found it possible to bring in 2CO, 5CK, 2FC, 4QG, 2UW, 2NC, 3GL and 7UV at good loud speaker strength and without interference from the local stations, which, of course, had plenty of punch. As can be appreciated from this, the receiver is really sharp in tuning and provides sufficient selectivity to fit in 3GL easily between 3KZ and 3AW.



A good idea of the few components necessary to build the receiver can be obtained from a study of this under-chassis illustration.



The circuit diagram of the screen grid detector receiver differs but slightly from that of the triode detector circuit.

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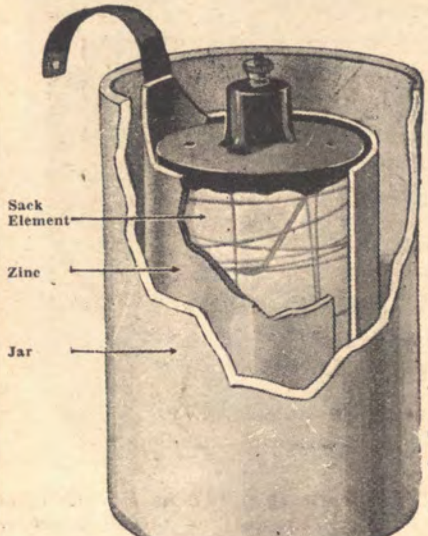

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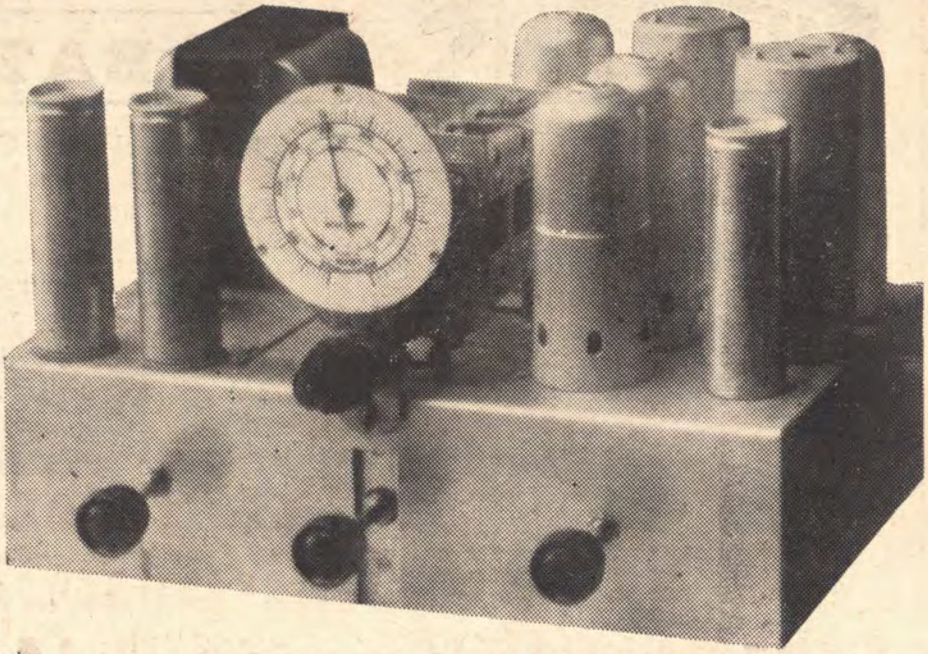

A front view of the completed assembly. From left to right: The controls are the Tone, the Wave-changing Switch (main tuning controls above), and the Volume Control.

IT is only a little more than twelve months ago that the first of the "all wave" receivers, i.e., receivers capable of covering the short wavelengths between 100 and 20 metres, in addition to the ordinary broadcast band, were made available to the Australian public. Their immediate success, from a commercial viewpoint, indicated that the old time "d.x" urge of radio was not dead, and that a large proportion of the radio public was interested in reception of other than Australian broadcasting stations.

Even admitting the rapid progress of radio, it is rather staggering to compare last year's all wave receivers with the newer "dual band" type being released on the 1935 market. Looking back, we can realise the comparative inefficiency of the all-wave receivers which used a complicated switching system and a number of coils to cover the various frequencies between 545 and 19 metres. This was due to the fact that the very complexity of the switching made it an manufacturing impossibility to include a radio frequency stage in front of the mixer circuit of the all-wave super-het.

With the dual band receiver, however, only two coils are necessary for each tuning stage, and it is possible to include a r.f. amplifier and yet keep the receiver's construction within reasonable bounds. The broadcast coils cover the usual 1500 to 550 k.c. spectrum, whilst the short wave coils cover from 6000 to 15,000 k.c., with generous overlaps at each end to take in the 19 metre overseas broadcasters, as well as those stations operating just above 50 metres.

So simple in construction are these new dual wave receivers that at least one prominent manufacturer, Radiokes to wit, has released a kit set which, with the aid of instructions which we will provide presently, can be assembled and made to function satisfactorily even by the novice. The Radiokes 12-35 kit can be assembled into a six valve superheterodyne. employing one r.f. stage, a combined modulator and oscillator, a single i.f. stage and second detector, a driver audio stage and a high gain pentode output stage. A.C. operated, it is powered from a suitable power transformer and type 80 rectifier.

R.F. amplification is available on both wave bands covered by the receiver, the switching from the broadcast to the short waves or vice versa being carried out by a multiple contact gang switch.

Outstanding features in the circuit design, besides the use of an r.f. stage on short waves, include the use of the high gain diode pentode 6B7, as combined intermediate frequency amplifier tube, diode second detector, and separate automatic volume control tube; a completely filtered driver audio stage, which incidently consists of the triode section of

LIST OF PARTS

1 Steel chassis.
1 Dual wave coil assembly and two 465 K.C. I.F.'s.
1 Power transformer type.
1 Dual ratio dial.

SOCKETS—2 four pin, 2 small 7 pin, 3 six pin.

RESISTORS—2 .5 megohm volume controls.
1 .2 megohm resistors.
2 .05 megohm resistors.
3 .1 megohm.
3 1 megohm.
1 4000 ohm maxome.
1 275 ohm 100 m/a maxome.
1 300 ohm maxome.
1 125 ohm maxome.
1 25,000 ohm voltage divider.
1 10,000 ohm volume control.

CONDENSERS—
3 8 mfd. Electrolytic condensers with insulating washers.
1 .5 mfd condensers.
3 .25 mfd. condensers.
5 .1 mfd. condensers.
2 .02 mfd. condensers.
1 .01 mfd. condensers.
2 .001 mfd. condensers.
2 .0001 mfd. condensers.
1 25 mfd. condensers.

SUNDRIES—
6 Terminals (2 red, 4 black)
4 Knobs.
4 Valve shields.
2 Pea lamps (6.3 v).
4 Grid clips.
1 Panel.
2 Mounting pillars.
40 3/8in. x 1/8in. round head brass screws.
50 1/8in. Hex. nuts.
2 1/4in. spacers.
1 yd. tinned copper.
5 yds. hook up wire.
1 yd. shielded braid.
3 yds. power flex.
1 Power plug.

EXTRAS (Not supplied).

SPEAKER—1000 ohm field input to suit 42 valve. Amplion, Precedent, Saxon, etc. VALVES—1 each type —6D6, 6A7, 6B7, 75, 42, 80. Ken-rad, Mullard, Phillips, Radiotron, Triad.

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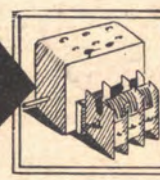
IN THE NEW 12-35 KIT SET

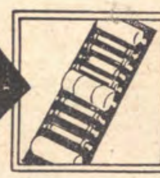
The usual Bugbear of assembling—the broadcast and short wave coil—is eliminated. Radiokes supply a complete coil assembly with the gang condenser mounted all ready for use.

Furthermore, each unit after assembly is tested under actual working conditions, aligned and sealed — it MUST work! All you have to do is fit the complete unit to the chassis, join up nine leads according to the simplified Radiokes instruction sheet supplied, and it must go!

Dual Wave Box already constructed



Resistance Panel is assembled.



Calibrated Dual Wave Dial

The Radiokes Kitset Type 12-35 is a 6-Valve Dual Wave Receiver, featuring the new wave changing by special switch with silverplated contacts, new type tone control, tuned R.F. amplification on both bands, calibrated dual ratio Aerovision dial, independent, A.V.C., filtered extended range audio system isolated from R.F. and detector, padding on each band, special air dielectric Isolantite I.F. transformers, Litz wound, provision for transposed aerial system.

Band Coverage: 19-52 metres; 200-550.

Chassis dimensions: 14in. x 9in. x 3½in.

Position of knobs: Tone on left, volume on right, dial in centre, 3in. between two outside knobs.

Speaker required: Amplion or Jensen. 1000 ohms. field, matched for single 42 Pentode.

Valves required: 1 6D6, 1 6A7, 1 6B7, 1 75, 1 42, 1 80.

FUNCTIONS OF VALVES:

1 6D6: Latest super controlled Multi-mu Radio Frequency Pentode.

1 6A7: Electron coupled Pentagrid Frequency Converter.

1 6B7: High-mu Pentode I.F. Amplifier. Duplex Diode as Demodulator and independent A.V.C. Control.

1 75: High-mu Triode in extended frequency audio filter and driver stage.

1 42: Pentode Output Tube.

1 80 Rectifier.

Price, £10/17/6 Excluding Valves and Speaker

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IMPORTANT NOTICE

The Battery version of the 12-35 Kitset will be released shortly

FREE Complete Wiring and Assembly Instructions of both the A.C. and Battery versions of the Dual Wave Receiver, free on application to Radiokes.

the high gain triode 75; and a new method of tone control. Mechanical and allied electrical features include the provision of a special "tank," in which are housed the tuning coils, padding and trimming condensers, and the switch gear for each of the three tuned stages. This tank assembly is aligned by the manufacturer, and ordinarily requires no further readjustment by the set builder.

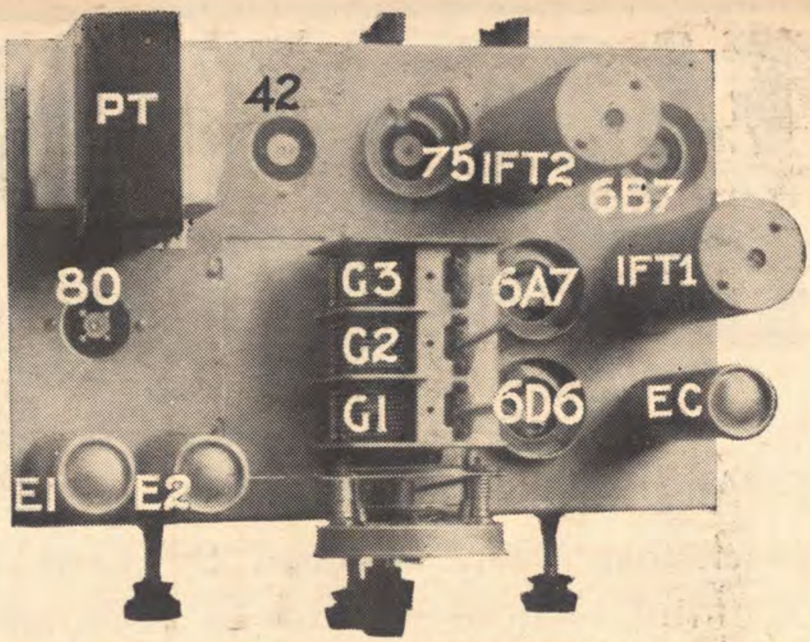
Litz wound intermediate frequency transformers tuned by air dielectric condensers, combine efficiency and stability of setting with exceptionally high gain. Full automatic volume control and terminal provision for the transposed aerial system, which is now becoming popular with users of short and all-wave receivers, are other refinements.

From the performance angle the receiver is all that could be desired. Highly sensitive—sensitive enough, in fact, to provide worthwhile loud speaker reception of the majority of international broadcasters, as well as reliable reception of the Australian stations—it still has a very low noise level.

A high speed a.v.c. system reduces short wave fading considerably, whilst the adjustable tone control permits the by-passing of much of the background hiss experienced with distant reception under bad conditions.

The various illustrations of the assembled receiver will illustrate those points of assembly and wiring which we shall now discuss. The receiver is built up on a drilled and stamped steel chassis which measures 14 inches in length, 9 inches in breadth, and 3¾ inches in depth.

Looking at the key-lettered top chassis view of the receiver, we find that the power transformer is mounted in the left hand rear corner of the chassis, whilst the two 8 mfd. electrolytic filter condensers are correspondingly mounted in the front right hand corner. Between the electrolytics and the power transformer is the socket for the type 80 rectifier tube.



A top plan view of the Radiokes Dual-Wave Six. All components are tabulated to correspond with the List of Parts.

Along the rear edge of the chassis, from left to right, we have the socket for the 42 pentode; the socket and shield mounting for the type 75 audio tube; the second intermediate frequency transformer, IFT2; and the socket and shield mounting for the 6B7, in that order. The gang condenser is mounted centrally on the chassis at its right, being the sockets and shield mountings for the 6D6 r.f. tube (to the front of the chassis) and the 6A7 mixer tube.

In the right hand front corner is the 8 mfd. electrolytic by-pass condenser and between this component and the 6B7 socket is mounted the first intermediate frequency transformer IFT1. The four controls seen on the front of the chassis are, left to right, the tone control, the wave changing switch and the volume control. Above the wave changing switch is the control for the two-ratio vernier dial.

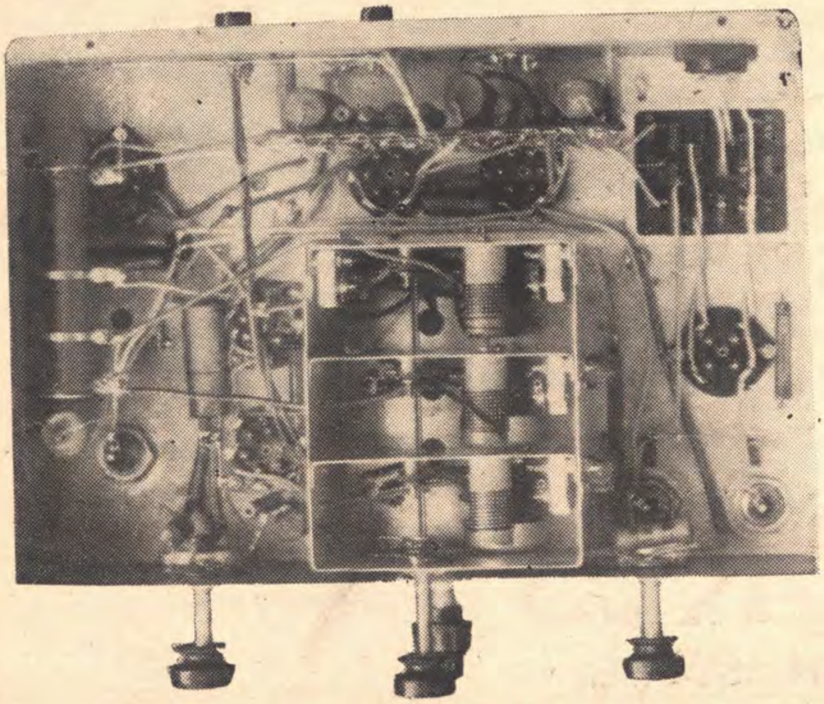
The rear view of the chassis shows two sets of three terminals, the loud speaker socket, and the socket for the power plug. The set of terminals nearest to the l.s. socket is for use with a gramo. pick-up, whilst the other set is for aerial and earth connections.

The two salient features of the under chassis assembly are the coil "tank," which contains the coils, padders, and trimmers for the aerial, r.f., and oscillator stages, and the switch gear which brings these coils into circuit. The coil tank is provided in an assembled condition, and is mounted to the chassis after a certain amount of the wiring has been completed. The other point worthy of particular note is the provision of a panel on which are mounted many of the condensers and resistors used in the receiver.

This panel is provided with key letters (See Fig. 1) so that the wiring of the components into circuit is easy to follow. The panel is supported away from the side of the chassis by means of brass spacing pillars.

The assembly of the receiver is carried out in three stages. First mount all sockets and power plugs on the chassis, making sure that these are mounted exactly as shown in the diagrams and, with the respective sockets, mount the shield bases for the shields of the 6D6, 6A7, 6B7, and 75 valves. Mount the power transformer, electrolytic condensers (Nos. 1 and 2 to be insulated) and the intermediate frequency transformers. Make sure that these latter are mounted correctly. Next mount the three sets of terminals, the red terminals being the top ones of each set of three. When this has been done up-end the chassis and mount the voltage divider, the volume control and the tone control.

At this juncture we can start the wiring of the receiver by connecting the



An underneath picture of the receiver showing the arrangement of parts. The can mounted in the centre front of the chassis contains the coil and switch assembly.

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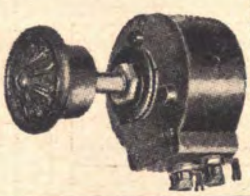

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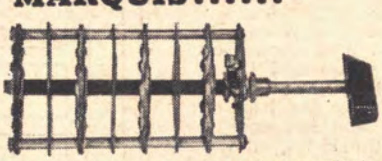

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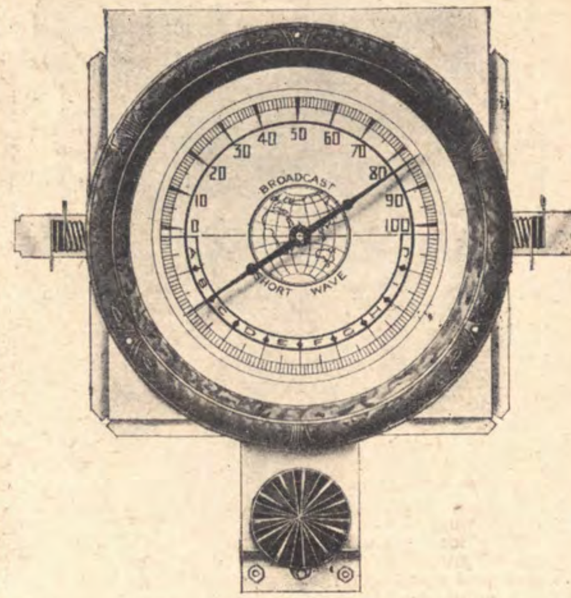

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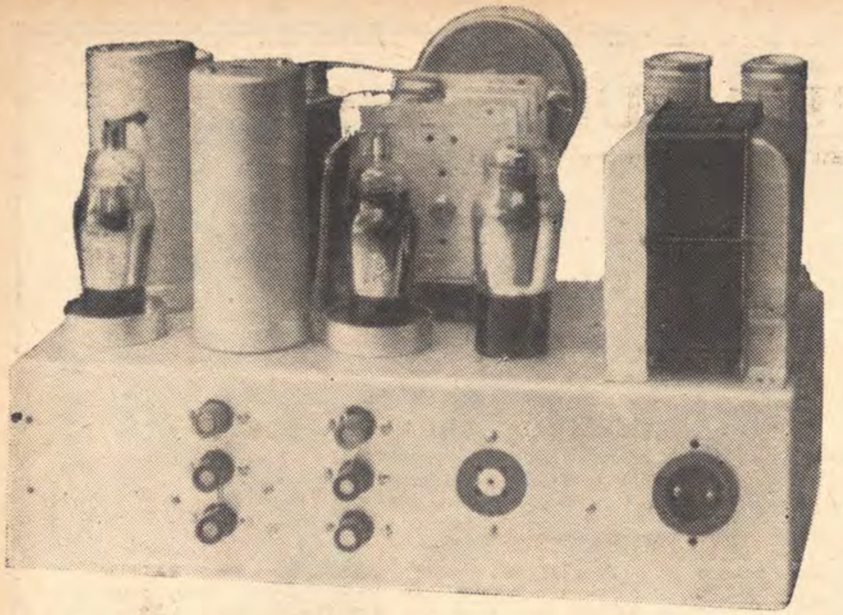

A rear photograph of the chassis. This picture illustrates the provision made for Aerial and Pick-up connections.

various filament circuits. With twisted flex, wire together the 42, 75, and 6B7 sockets, and connect them to the 6.3 volt lugs on the power transformer. Wire together the filaments of the 6D6 and 6A7 and connect them to the filament lugs on the 75 socket. The filament lugs on the 80 socket are taken to the 5v. lugs on the power transformer and a tinned copper wire is taken from the centre tap on the 6.3v. winding to chassis.

Next wire in the i.f. transformers, starting with IFT1. Following are the connections for this transformer:—

Red to P on the 6A7 socket. Yellow to B plus 250 v. on the voltage divider. Green to be wired in later. Orange to grid cap of the 6B7 valve.

The connections to the second i.f. transformer IFT2 are:—

Red to P on the 6B7 socket. Yellow to B plus 250 v. on voltage divider. Green to be connected later. Orange to DP on the socket of the 6B7 (see diagram).

These leads should all be as short and direct as possible. The shielded leads from the .5 megohm volume control should be connected. The leads should be run against the chassis and soldered to it. One lead goes from the centre arm (the shielding connects to the outside right-hand lug) of VC to the grid of the 75, the full length of the lead being shielded. The other lead connects from the .02 mfd. condenser (which is connected to the remaining outside lug on VC) to No. 2 pick-up terminal. Connect the positive terminal on electrolytic No. 3 to the 150 volt tap on the voltage divider, and from this tap connect a .1 mfd. condenser to earth.

Connect another .1 mfd. condenser and the 125 ohm resistor between the C lug on the 6D6 socket and earth. Join the C and "SUP" lugs of the 6D6 together and to the C lug on the socket for the 6A7. Connect a .05 meg. resistor between G1 on the 6A7 socket and SUP on the 6D6 socket, and solder a .0001 mfd. condenser to the G1 lug on the 6A7 socket so that it will be at right angles to the chassis. Connect the SG lug on the 6D6 to G3 and 5 lug on the 6A7 and to the SG lug on the 6B7. From the SG lug on the 6D6 take a 25 mfd. condenser to chassis. Join G3 and 5 on the 6A7 to the 90 volt tap on the voltage divider. Join the green lead on IFT1 to earth through a .1 mfd. condenser.

Solder a .001 mfd. condenser between the diode plates (DP) on the 6B7 socket. Connect a 1 megohm resistor between "d" (see diagram) and earth. Take one lead of another 1 megohm resistor to DP on the 6B7 socket (see diagram) and solder the other lead to one lead of a .1 megohm resistor. The remaining lead on this resistor goes to the green lead on IFT1. Connect a .5 mfd. condenser between B plus 250 on the voltage divider and earth.

Now solder an 8-inch lead to C on the 6B7 and leave this for connection to J on the panel. Connect the two DP lugs on the 75 together, and to the C lug on the same socket and provide a 4-inch lead from one of the DP lugs on this socket for connection to E on the panel. Wire in the .001 mfd. condenser between P on the 75 socket and C on the 42 socket, taking this C lug on the 42 socket to earth. Solder one lead of the .02 mfd. condenser and one end of a 3-inch long lead to the P lug on the 75 socket.

The other lead on the .02 mfd. condenser does to the G lug on the 42 socket, while the other end of the 3-inch lead is to join to R on the panel. Take a shielded lead from G on the 42 socket to one outside lug on the tone control and earth the shielding. Connect the P lug on the 42 socket to P on the l.s. socket, and the SG lug on the 42 socket to the 250 volt lug on the voltage divider. Join together the P and one F lugs on the l.s. socket.

Take a lead from the SG lug on the 42 socket to the positive terminal on No. 2 electrolytic condenser. The positive terminal on No. 1 electrolytic condenser goes to one of the 5 v. lugs on the power transformer, and to the vacant F lug on the l.s. socket. Take a lead from the P lug on the 42 socket to the G lug on the l.s. socket. Connect the negative terminals on electrolytic condensers No. 1 and 2 together with a piece of tinned copper wire and continue this lead to the centre tap of the 385 volt power transformer winding.

Join one outside lead of the 385 volt winding to the P lug on the 80 socket and the other 385 volt outside lead to the G lug on this socket. Wire the 275 ohm resistor between the negative terminal of electrolytic No. 2 and earth, and from this same terminal on electrolytic No. 2 take a lead to the remaining outside lug of the tone control, to which also is soldered one lead of the .01 mfd. condenser.

The other lead on this condenser is joined to the centre lug on the tone control. Join one side of the power plug to the C lug on the power transformer, and take the other side of the plug to the desired voltage (200, 230 or 250). Connect the bottom pick-up terminal to the bottom aerial-earth terminal, and to the negative end of the voltage divider. Earth this lead.

We now reach the second stage of assembly, i.e., the mounting of the component panel. This panel is lettered from A to J on one side, and from T to K on the other. The diagram Fig. 1 shows the components mounted on the panel, but it should be remembered that whilst the lettering is on top the components are mounted underneath the panel. When the components have been mounted on the panel and wired together as shown, it should be secured to the chassis in the position illustrated and connections made to the various parts of the circuit, as follows:—

D.E: to cathode of the 75 valve; F: through a shielded wire to No. 1 pick-up terminal; G,H,I,J: to the cathode of the 6B7 valve; L.K: to earth; M.N.O: to the Green lead on IFT2; R: to the plate

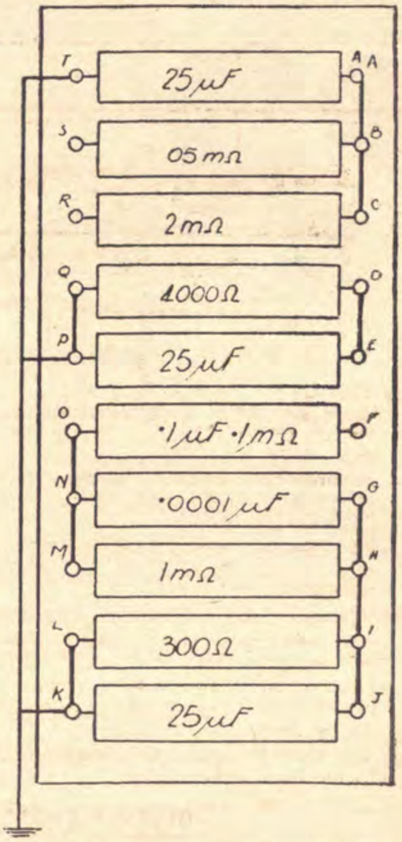

Fig. 7 shows diagrammatically the assembly and wiring of the components on the special panel. Note that the components are to be mounted and wired underneath the lettered side of the panel.

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Advertisement by WETLESS ELECTRIC MFG. CO. LTD., 281 King St., St. Peters of the 75 valve; S: to S.G. of the 42 socket.

Having finished this job we are now ready to fit the coil assembly in the chassis. Before this is done, however, it will be necessary to make some additions. Connect a .1 mfd. condenser from the green lead of Section No. 1 (right hand side of the box when it is in the chassis) to the earth lug on the side of the box. Similarly connect a .1 mfd. condenser to the green lead of Section No. 2 and earth. Join these two green leads together with a .1 megohm resistor. Now mount the gang condenser on the chassis, solder a pair of wires to the heater lugs on the 6D6 socket and bring them up through the front of the chassis for the dial light, and screw a half-inch ⅛in. screw through the hole provided in the front of the chassis to secure the tuning dial. Note that the head of the screw is on the inside of the chassis.

This done, place the coil box in place and bolt it to the chassis, making sure that it is very tightly secured. Continue the wiring of the receiver by joining up the tuning circuits.

The coil box wiring is:—

Section No. 1 (Left Side): Red to aerial No. 1; Green to Terminal No. 2 of aerial trio. (Right Side): Already Wired.

Section No. 2 (Left Side): Red to P on 6D6 Socket; Green to B plus 250 volt lug on Voltage Divider. (Right Side): Green to unconnected end of 1 megohm resistor from the DP lug on the 6B7 socket.

Section No. 3 (Left Side): Red to the G2 lug on the 6A7 socket; Green to the vacant lug on the .0001 mfd. condenser on G1 of the 6A7 socket.

Back: Red to B plus 150 volts on Voltage Divider.

The remaining wiring connections include the provision of a lead with grid clip from the stator lug of the front section of the gang condenser to the grid of the 6D6; a similar lead a clip from the middle section of the gang to the grid of the 6A7, and the connection of the dial light leads from the heater lugs of the 6D6 socket.

First it is necessary to mount the dial. Place the dial on the condenser spindle so that the mounting screw on the chassis protrudes through the slot in the dial bracket. Allowing the dial to find its own centre on the spindle, secure it to the chassis by means of a nut through the mounting screw. When this has been done the grub screws may be tightened to the condenser spindle. Wire the two dial lights in parallel and connect the twisted flex from the 6D6 socket to them.

All is now ready for test and alignment.

When all the wiring is completed the valves may be inserted in their respective sockets and the power turned on. Inspect the rectifier for flashes or blue glow, because if there are any shorts or breakdowns in the H.T. of the set they will show in this manner.

Everything being in order, the following points should be checked.

(1) The aerial and earth terminals.

There are three terminals colored—1 red, 2 black and numbered 1, 2 and 3 in the circuit diagram. Connections should be as follows:—Aerial—Red, No. 1. Aerial Black, No. 2. Earth—Black, No. 3. When using a standard aerial and earth system the aerial should be connected to Red (No. 1) and earth to Black (No. 3). No. 2 and No. 3 should be connected together. When using a transposed aerial lead—in the aerial connects to Red (No. 1) and the other lead to Black (No. 2) and earth connecting to Black (No. 3). Don't connect No. 2 and No. 3 together.

(2) The gramaphone pick up.

There are three terminals for the gramaphone pick up, colored, 1 red, 2 black, and numbered; Red, No. 1; Black, No. 2; Black, No. 3. The connections are as follows:—

For Radio use.—Connect Red (No. 1) and Black (No. 2) together.

For Pick up use.—Remove connection from Red (No. 1) and Black (No. 2) and connect pick up between Black (No. 2) and connect pick up between Black (No. 2) and Black (No. 3). The volume control on the set may be used as a volume control for the pick up. Before commencing to align the receiver the following alterations should be made:—

(1) Remove the 125 ohm Cathode resistor from earth and connect a 10,000 ohm. volume control between the resistor and earth. (2) Disconnect the A.V.C. leads (2 green on coil box and green on I.F.T. 1) and connect these leads to earth. Note.—The 10,000 ohm. volume control is included in the kit for alignment purposes only.

To make the aligning simple the removable side of the chassis should be taken out.

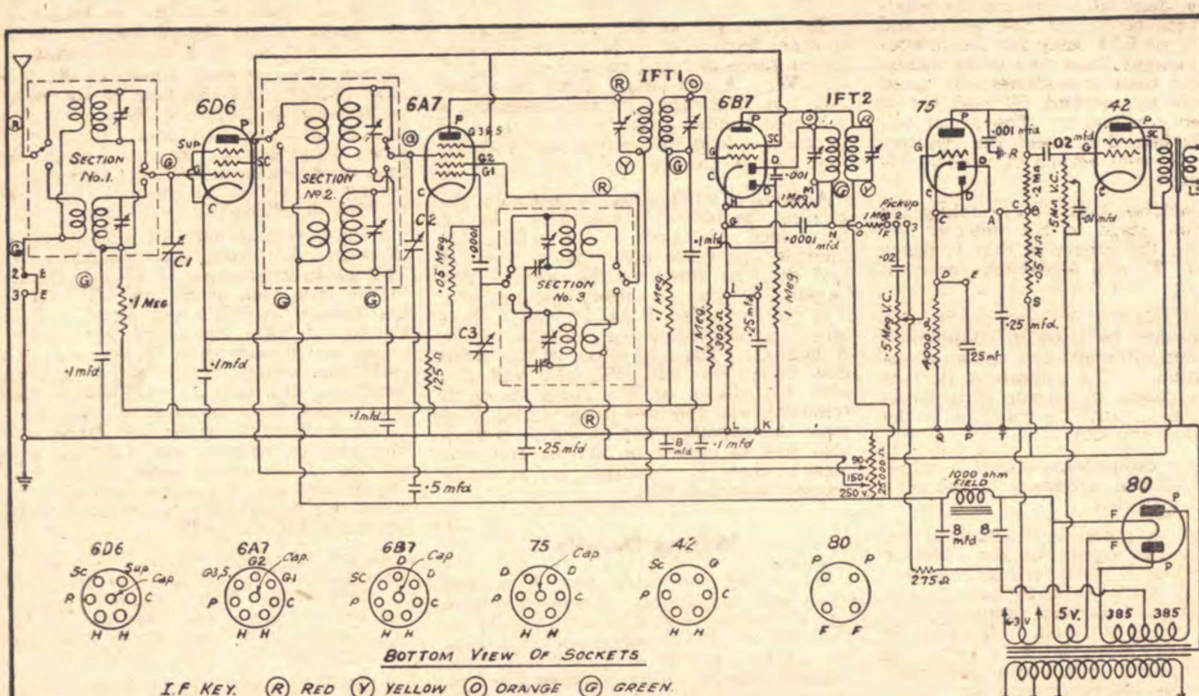
Turn the selector switch to the broadcast band and tune in a station at the bottom of the band (3AW or thereabouts). The trimmers have all been aligned at the factory and will only want a small adjustment. Don't touch the oscillator trimmer.

The Aerial and R.F. trimmers may be peaked again. There is no need to move Padder. Before shifting from this station the intermediates can be given a slight adjustment. When adjusting these screws their positions should be noted before movement. This completes the aignment of the broadcast section.

Incidentally a fairly weak interstate or distant station will give a more accurate adjustment.

Turn the selector switch to the shortwave band and tune in a signal near the 25 metre band and adjust the aerial and R.F. trimmers, only don't touch the osc. trimmer.

This setting will do for the whole band as the whole unit has been previously aligned and padded.

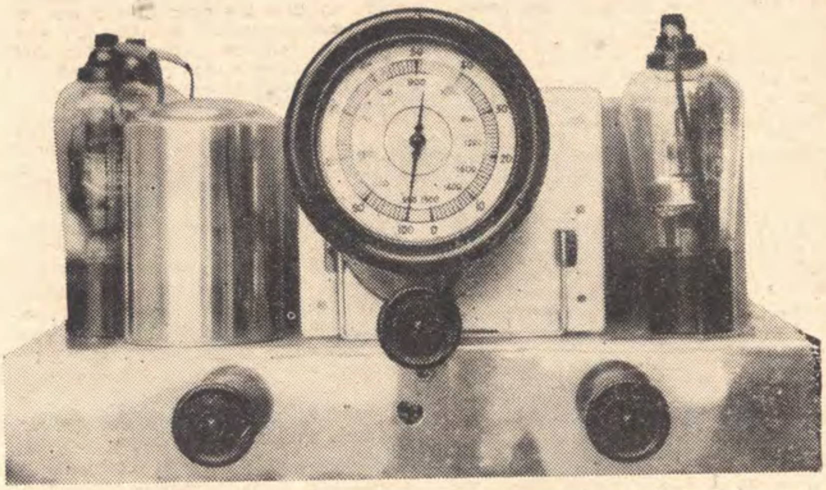


The schematic circuit diagram of the Radiokes Dual-Wave Six is key-lettered to agree with the parts list and wiring instructions.

THE S.G. BATTERY FOUR

Two stages of tuned radio frequency plus a reaction detector make a sensitive combinc... in this easily built model.

By "RADEX"



A front view of the finished assembly. The controls from left to right are: Reaction, tuning and volume.

FOR budding home set-builders a tuned radio frequency (T.R.F.) set can be confidently recommended because it is straightforward both in wiring and in operation, and it includes nothing in the way of a snag to catch the feet of the unwary. Into this T.R.F. class comes "The S/G Battery Four." Given the exact components listed in this article, and especially the proper coil-kit specified, results will immediately follow completion; for perfection of return for your labor all that is then required is a minute's work on the trimmers of the triple-gang tuning condenser.

Three of the valves are alike (PM-12A's); of them V1 and V2 (see diagram) are radio frequency amplifiers, while V3 is the regenerative detector. The power output tube is pentode PM22A.

The circuits surrounding V1 and V2 are practically identical. The smaller winding of AER being for the aerial and the smaller of RF1 being for the foregoing plate, makes these two units correspond, while their secondaries are tuned respectively by sections G1 and G2 of the ganged condenser. The aerial coil of AER is tapped to meet the requirements of external aerials of widely differing lengths.

The inductance unit RF2, coupling the second radio stage to the detector V3, differs from the others in that it has a third coil T as a feed-back reaction winding.

It is desirable that a permagnetic type of loud-speaker be used in conjunction with this set, although it is not an absolute essential. The important item is that the speaker, by means of a built-in transformer, must be matched to the out-put tube, the 22A.

The minor components are at a minimum, but all are necessary to the set's successful operation.

Particular attention is directed to the voltage on the screen of the detector V3. Its value is fairly critical between 22½ and 45 volts, while 30 volts is the optimum if your battery tappings will permit it being obtained. If the 30 volts are not available it is better to employ 22½, as at 45 volts the plate consumption rises disproportionately. Incidentally, with 60 volts on the screens of V1 and V2, 22½ volts on that of V3, a grid-bias of 4½ volts on V4 and a maximum of 135 volts, the total drain on the battery is only 7 m.a. The filaments draw 0.25 ampere from the 2-volt A battery.

Notes on Assembly

Fitting the components to the chassis is a straightforward job. Having located the condenser gang in the centre and pushed it far enough back from the front edge to accommodate the dial, the three canned coils are placed on its immediate left with AER nearest the back and RF2 closest to the front. To the left of the coils again are V1 and V2, the latter being the one seen in the accompanying front view.

To the right of the condenser gang, in order from front to back, are V3 (seen in the same picture), canned choke AFC and V4. A pea-lamp, acting as a fuse and not illustrated in the diagram, is mounted behind gang G1-2-3; it is wired in the B— lead just before that connection goes to chassis.

A word of explanation is necessary regarding the battery connections. In the first place, additional to the cable, two independent wires come from the set and they go direct to the positive and negative of the A battery accumulator. The positive side of the 4½ volt C battery is connected to the negative of the A battery. The five wires of the cable now carry: B—, B30, B60, B135 and C—, and this allows of B— going to earth (chassis), via the pea-lamp. The lead from the negative side of the A battery also goes to chassis on arrival and that means that C positive is similarly treated automatically.

Wiring Details

In wiring the cable and A battery leads will be the last things connected up. Commence operations by connecting together one F on each socket and continuing to one side of switch SW. Now connect together the remaining F's (one on each socket), and go to chassis.

In the temporary absence of the B135 lead use one of the LS terminals (the lower one in the diagram), as a jumping-off point; for purposes of reference we will call this particular one of the pair "LSB." Connect SG of V4 and one tail of C5 to LSB and earth the other tail of C5. Take P of V4 to the other LS. Connect the arm of VC to G of the same socket and to the latter point also attach an end of R2.

To one outer terminal of VC wire a tail of C4 and take the latter's other end to chassis. To the other outer of VC connect one side of C3. Take a wire from the bottom of coil T on RF2 to the free end of C3, one side of AFC and then leave sufficient length to reach up through the chassis to the top of V3. Wire together the top of coil T and the fixed plates of midget condenser M; the latter is already earthed by virtue of its direct mounting on the chassis.

From LSB go successively to the free side of AFC and the tops of the small plate coils of RF2 and RF1. To the bottom ends of these small coils attach wires long enough to go through the tops of the cans and connect to the preceding valves in the cascade, i.e., RF2 to V2 and RF1 to V1.

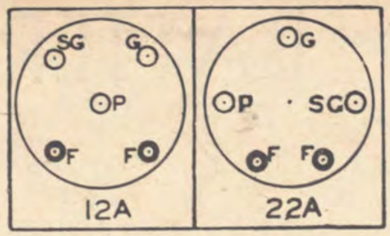
Solder ends of both R1 and C2 to G of socket V3; from top secondary of RF2 go to fixed vanes of G3 and thence to the free ends of R1 and C2. Earth the bottom of RF2's secondary. Take the top of RF1's secondary to the fixed vanes of G2 and so to G of socket V2; earth the bottom of the same winding. Similarly, the top of secondary AER goes to the fixed vanes of G1 and on to G of socket V1 while the bottom of that coil is earthed, too, together with the top of the green aerial coil. Take the bottom and the midway tap of the green coil respectively to insulated aerial terminals AE1 and AE2.

Mount the earth terminal directly on the chassis. Connect together points SG on Sockets V1 and V2, and continue to end of C1. Earth the other side of C1. We are now ready to connect the external leads.

Take a twisted pair of red and black leads for the A battery. Attach the red (positive) to the free side of switch SW, while the black connects directly to some convenient point on the chassis. These two, of course, go to the 2-volt accumulator, to the negative side of which is also wired the positive of the C battery.

Of the five-wire cable the black (B—) goes to the insulated socket of the pea-lamp fuse and the other side of this socket must be earthed to chassis. Do not forget to insert the pea-lamp. Red (B135) is taken to LSB, which will make a total of four connections at that point, and so some careful soldering will be necessary. Brown (B60) is taken to SG on socket V1, which point is already wired to its counterpart on V2 and C1. Yellow (B30) goes only to SG on socket V3. Green (C—), attaches to the free end of resistor R2, the other end of which is already soldered to G of socket V4.

It only now remains to connect up the three 45-volt sections of the B battery in series (full positive of first to full negative of second, and so on), and make the cable attachments at the points specified. If you find it impossible to get a tap to give 30 volts positive to B30, use 22½ volts instead.



Valve sockets for the PM12A and 22A as seen when wiring.

Operation

Turn the arm of the volume control VC over in the direction of its outer that is wired to C3. Very, very slightly enmesh the moving plates of reaction control midget M. Switch on the valves' filaments with SW. Rotate the ganged condenser until signals are heard, preferably at the lower end of the dial with the moving plates very much less than half engaged.

Leaving the dial alone, adjust the small screws of the trimmers, one of which will be found associated with each section of the gang. It is as well, before switching on at all, to adjust all these screws so that they are each open about half to three-quarters of a turn. When the test station is picked up adjustments must be made, of course, with the set in operation, and they must be made carefully; a small fraction of a turn makes a very big difference.

When, on this first station, signals of reasonable strength have been obtained, turn the dial to some other station well down in the wave-band such as 3KZ or below. On this new test transmission go over all the trimmers again very carefully. In order to get the best results, always work on a weak signal so as the trimmers' adjustment brings the volume up, keep on cutting it back to bare audibility.

On the completion of this trimming you can bring reaction into play with midget M, and this will offer a big increase in volume. The trimming effected on the shorter waved station indicated will hold good now throughout the wave-band.

PARTS LIST AND CIRCUIT DIAGRAM

AFC.—Audio frequency choke at least 200 henries and up to 400. (Paramount, Precedent, Radiokes, Stedi-power, Velco, Wendel.)

A—A+.—Two volt accumulator. (Century.)

B—B135.—B battery comprising three 45 volt units. (Diamond, Ever-Ready, Stan-Mor).

C—C+.—Grid bias battery, 4.5 volts. Diamond, Every-ready, Stan-Mor).

C1, C4.— 0.1 mfd. tubular condensers.

C3.—0.01 mfd. tubular condenser.

C5.—0.5 mfd. tubular condenser. (Concourse, Raycophone, Saxon, T.C.C., Wetless.)

C2.—0.00024 mfd. mica condenser. (Simplex, T.C.C., Wetless.)

G1,2,3.—Standard size triple gang condenser. (Precedent, Raycophone, Saxon.)

Aero Dial.—(Effco, Precedent, Radiokes, Raycophone.)

Kit.—Comprises canned special units AER, RF1 and FR2. (Colonial Radio, Paramount, Precedent, Radiokes, Saxon, Velco.)

LS.—Permagnetic speaker matched to type PM22A valve. (Amplion, Precedent, Rola, Saxon.)

M.—Midget 13 plate condenser. (Paramount, Radiokes, Saxon.)

R1.—Resistor of 2 megohms.

R2.—Resistor of ½ megohm. (I.R.C., Raycophone, Velco.)

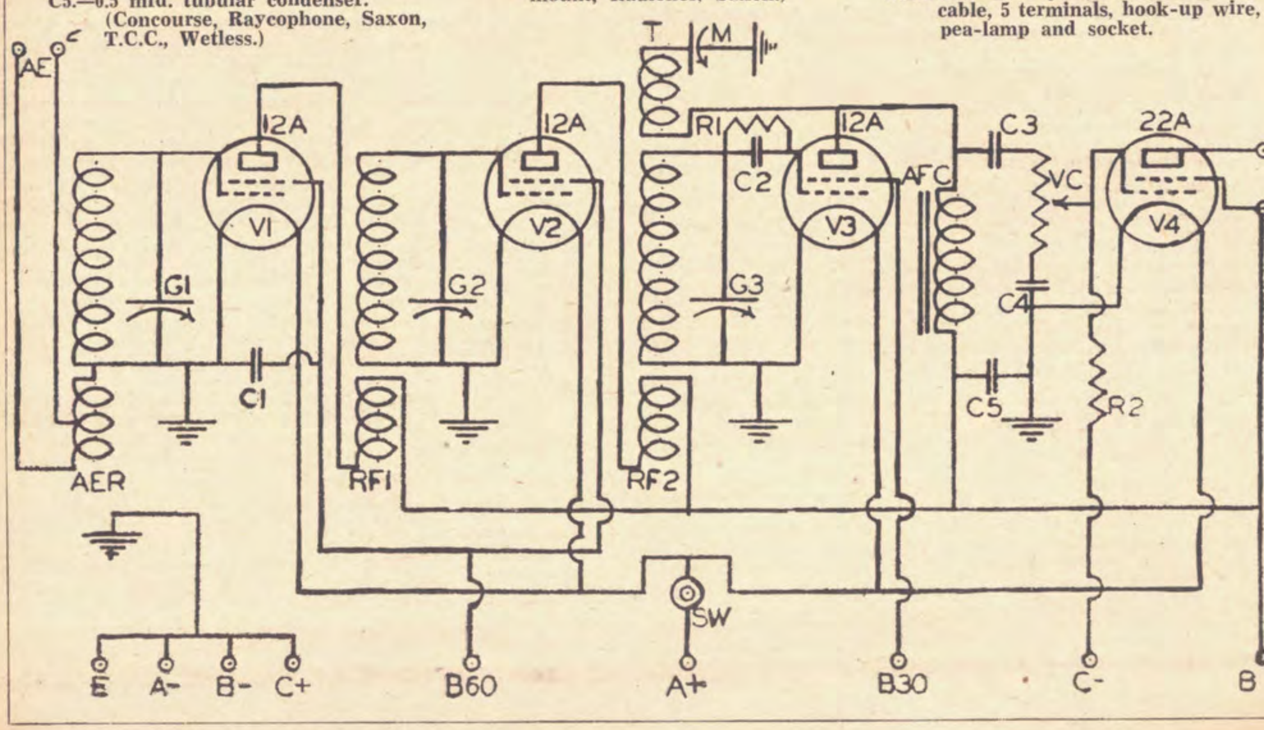
SW.—Filament battery switch.

VC.—Potentiometer volume control ½ megohm. (Marquis, Paramount, Precedent, Radiokes, Raycophone, Saxon.)

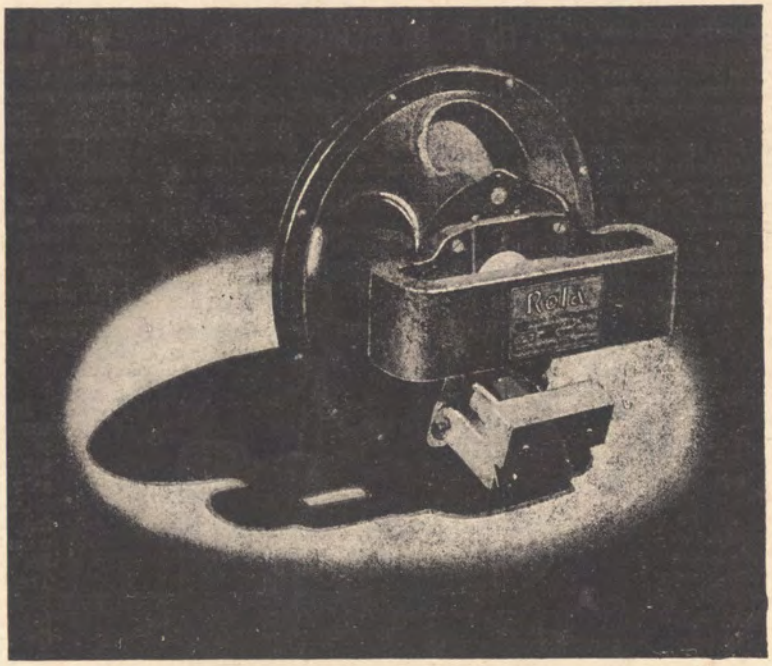
Valves.—Three PM12A and one PM22A with three 4-pin and one 5-pin sockets. (Mullard.)

Chassis.—Aluminium, 12½ by 8¾ by 2¼ inches.

Sundries.—Two yards 5 wire battery cable, 5 terminals, hook-up wire, pea-lamp and socket.



New Rola



Dustproof Permagnetic Speaker

● THE new Rola Dust-proof Permagnetic Speaker is undoubtedly the greatest advanced since Dynamic Speakers were invented.

It has a domed centre cap complete shielding the air-gap and voice-coil, and a radically new centering member and acoustic filter assembly.

Rola's new Dust-proof Dynamic Speakers are indeed a triumph for Rola technicians, skilled in pioneering new fields of loud-speaker engineering.

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● ROLA Permagnetic Speakers are briliant in performance, and these new high efficiency P.M. Dynamic Speakers are particularly adapted for use in hotels, schools, hospitals, theatres, restaurants and clubs. Rola brings a previously unknown performance to battery-energised radio sets where it is impractical to apply energy to the field coil.

Featuring new, exclusive vital parts, the new Rola Speaker is worthy of your closest consideration.

Completely sealed transformers from which all moisture has been excluded are fitted to P.M. Speakers. This feature has solved the problems caused by humid conditions.

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The All-Wave Battery "Two"

A simple regenerative receiver for use on short and broadcast wave-lengths.

By P. R. DUNSTONE

THIS set is particularly suitable for the novice, who is anxious to build an All-Waver, yet has not had sufficient experience to construct a complex receiver employing a large number of valves.

Plug-in coils are used for the reason they are by far the most efficient. Where in the larger types of receivers switching devices are employed and the loss of efficiency is usually counteracted by additional stages of R.F. or I.F., a set of this design is almost solely dependent upon the incoming signal, therefore, it is essential that only the most efficient coils be used.

The whole receiver is built on an aluminium chassis, the battery cable being wired directly into circuit, thus eliminating the use of a terminal strip.

The usual .0005 mfd. variable condenser is used for tuning over the broadcast band, but for the short waves a 0.00025 mfd. mica condenser is wired in the circuit, so as to be automatically connected in series with the variable condenser when the short wave coil is plugged in.

It is advisable to operate the set from a 90 volt "B" battery. The filament supply for the valves will be dependent upon the type used.

Winding the Coils

The coil data for the battery is shown in the table on the next page. The diagrams show the connections to both the coil formers and the coil socket from the underneath. It is important to remember this when connecting the wires to the coil former pins.

In all cases, the reaction coil, L3, is the first to be put on, since it is at the bottom of the former.

Drill a 1-6th hole at the bottom of the former and in line with the G2 pin. Insert the end of the wire and commence to wind on the required turns. When completed, drill another hole in line with the P pin on the former, and secure the end of the wire.

For the secondary, L2, measure up the former the specified distance and drill a hole opposite the H2 pin. Wind on the required turns and pass the end through a hole opposite the G1 pin.

The start of the aerial coil, L1, is made opposite the H2 pin, and finished opposite H1 pin.

To complete the coil the ends of the wires should be passed through the correct pins and soldered. Remember that the H2 pin carries two wires, these being the low potential ends of L1 and L2.

A rear view of the receiver showing the aerial-earth and output terminals mounted on the side of the chassis.

For the broadcast coil join the pins C and G1 together. When this coil is inserted into the coil socket this bridging piece will short circuit the condenser CX, so that the normal range of the variable condenser C1 will be available. On the short waves this bridge is not used.

There are several factors in All-Wave receiver design which may cause the above coils to be slightly out, and for this reason the grid coils, L2, should have their turns adjusted to give the best coverage without too much overlapping. This best can be done when the receiver is placed in operation.

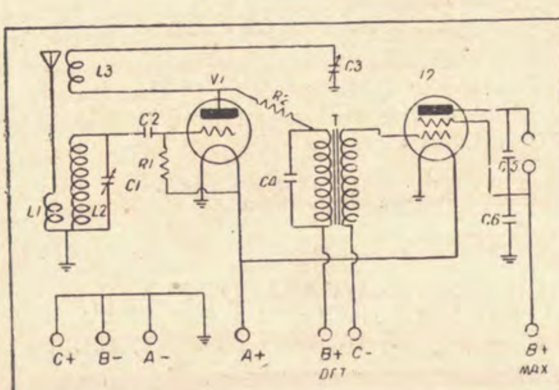
Wiring in Words

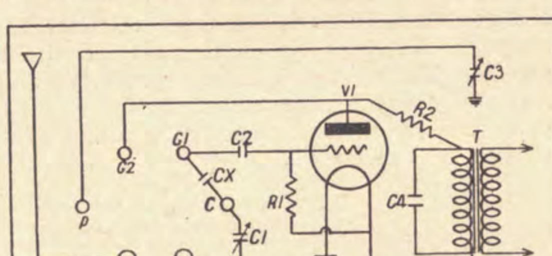
In short wave receivers it is essential that connections are well made, therefore particular attention should be paid to the soldering of the leads.

Commence the wiring by taking a lead from the aerial terminal to H1 on the coil socket. H2 is connected to the chassis. The P terminal of the coil socket is joined to the fixed plates of the reaction condenser C3, while G2 is soldered to the plate terminal of the detector socket V1. A lead is taken from the grid of V1 socket to one side of C2 and R1. The other side of C2 is soldered to G1 of the coil socket, and to one side of CX. The remaining side of CX is joined to C terminal of this coil socket and to the fixed plates of C1. The movable plates of C1 and C3 are automatically connected to earth through the medium of the chassis.

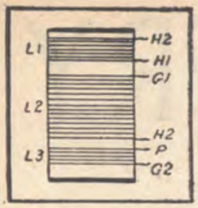
Resistor R2 is soldered to the P terminal of V1 while the other side is taken to the P terminal of the audio transformer T and to one side of C4. The remaining end of C4 is connected to the B terminal of T.

The G terminal of T is joined to the grid of V2. The plate of V2 is connected to one side of C5 and to one of the in-





Left: The schematic circuit of the All-Wave Battery Two. This diagram should be studied in conjunction with the coil socket drawing. Above is shown the diagram of the coil socket wiring.



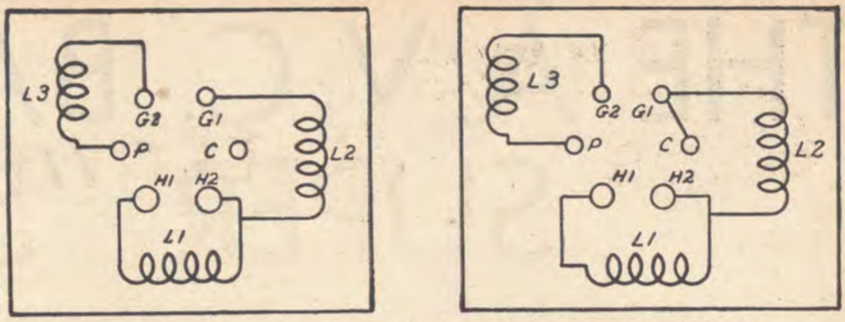
A sketch showing how the coils should be wound.

sulated terminals at the rear of the chassis. The screen terminal of V2 is fastened to C5, to one side of C6, and to the remaining terminal insulated from the chassis.

The other side of C6 is taken direct to the chassis. The grid-leak R1 is connected to the A positive terminal of the detector valve socket V1.

The A positive terminals of V1 and V2 are connected together. This leaves only the battery cable to be wired into the circuit. Three of these leads are connected directly to the chassis, and are used for the "C" positive, "B" and "A" negative battery connections.

The fourth lead is soldered to one of the "A" positive terminals on the valve sockets. The fifth goes to the "B" terminal of T, and the sixth to "F" or "C" terminal of T. The seventh battery cable lead goes to the insulated terminal that is connected to the screen of V2. A terminal is mounted at the rear of the chassis, and is used for the earth connection.



The wiring connections to the pins of the plug-in coils. Left, the short-wave coils and, right, the broadcast coil.

Operation

The voltage applied to the plate of V2 should be in the vicinity of 90, and that to the plate of the detector valve should be about 45 volts.

Plug in the broadcast coil, and tune the set. Should the set be found not to oscillate, it will be necessary to increase the turns of the coil L3.

When the short wave coils are used, the set should be set just on the verge of oscillation by means of C3, and the condenser of C1 slowly rotated until signals are heard. On the short wave bands it must be remembered that the tuning is very sharp and it is possible to pass over a station without noticing it. Particular attention should be paid to see that the set oscillates over the whole range of each coil if maximum results are to be obtained.

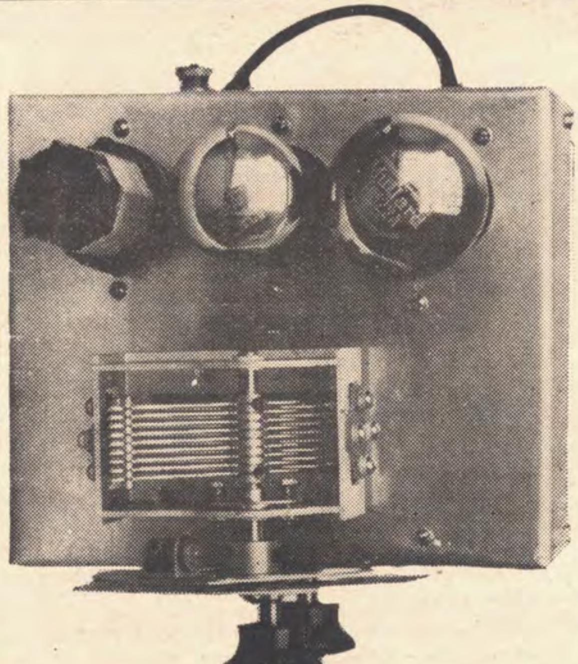
LIST OF PARTS

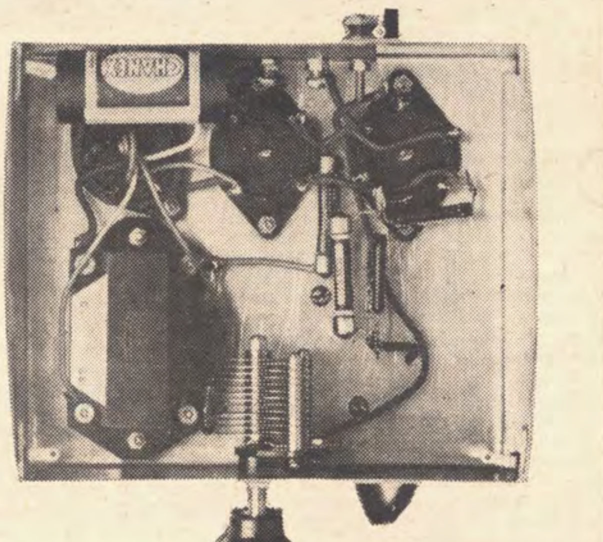
A Battery 2-v. (Century).
C1—0.0005 mfd. varible condenser (Precedent, Raycophone, Saxon)
C3—23 plate midget condenser (Paramount, Radiokes, Saxon).
Sub-panel valve sockets; 1 six-pin; 1 UX; 1 UY (Marquis, Precedent, Saxon).
T—Audio frequency transformer ratio 3-1 (Paramount, Precedent, Radiokes, Raycophone, Saxon, Wendel).
C2—0.00025 mfd. mica condenser (Simplex, T.C.C., Wetless).
C5—0.01 mfd. condenser.
C6—0.5 mfd. tubular condenser (Concourse, Raycophone, Saxon, T.C.C., Wetless)
R1—Resistor, 5 megohms.
R2—Resistor, 5 megohms. (I.R.C., Raycophone, Velco).
4 Terminals.
1 Vernier dial (Efco, Precedent, Radiokes, Raycophone).
1 Chassis, size depending upon the components used.
7 way battery cable.
2 Valves, types 30 and 33 (V1 and V2) (Mullard, Philips, Radiotron, Triad).
4 six-pin short wave coil formers, wire, screws, flex, etc.

COIL TURNS AND WAVE RANGES

Wound on Marquis Ribbed Formers, 1¼in. diam.

Wave band.	L1.	Wire	Space.	L2	Wire.	Space.	L3.	Wire.
19-30	3	22 d.s.c.	¼in.	6½	22 d.s.c.	⅛	5	30 d.s.c.
29-50	4	22 d.s.c.	¼in.	10	22 d.s.c.	⅛	8	30 d.s.c.
46-80	8	22 d.s.c.	¼in.	14	22 d.s.c.	3-16	11	30 d.s.c.
Broadcast	10	30 d.s.c.	¼in.	115	30 d.s.c.	¼	20	30 d.s.c.



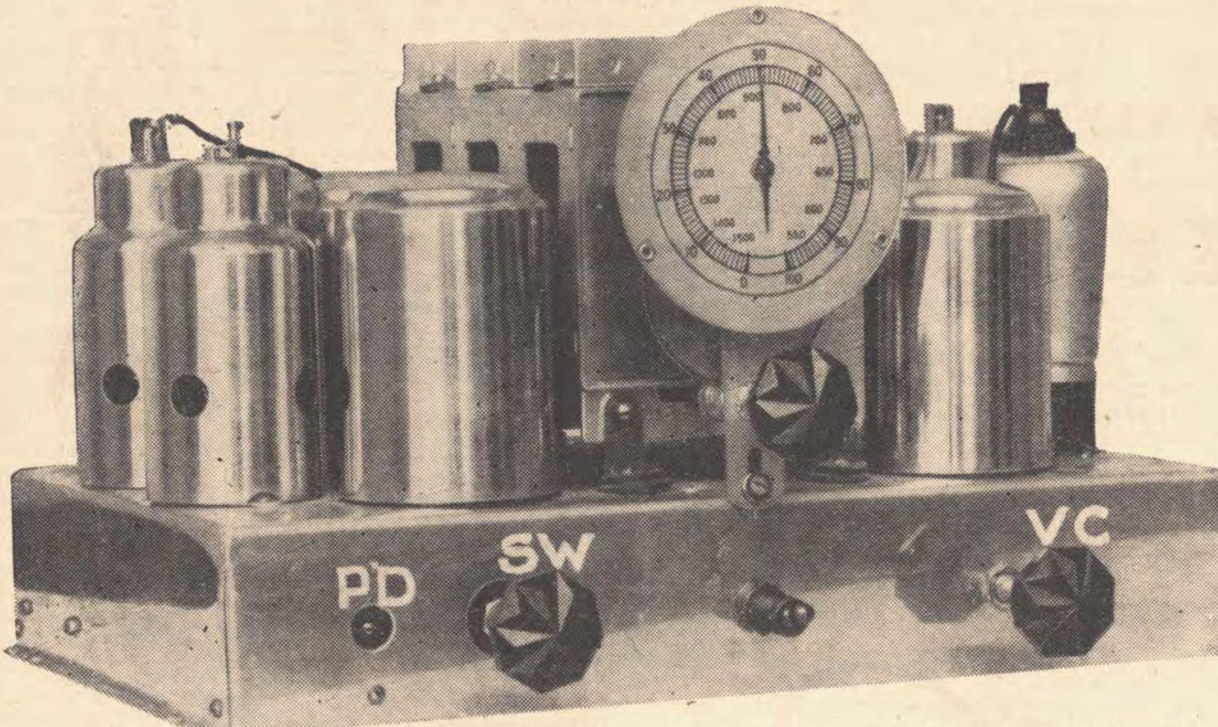


An underneath photograph which indicates the placement and wiring of the set. At the left is shown a top-chassis view of the completed set.

THE A.V.C. BATTERY SUPER "5"

Introduction of a new battery diode-triode valve makes possible simple automatic volume control and so economises in battery consumption on moderate to strong signals.

By "RADEX"



The completed A.V.C. Battery Super Five is workmanlike in appearance. Attention is directed to the padder P.D. The centre switch operates the dial lights as required.

OUR idea of a country battery super is one that will not demand a maximum of more than 90 volts "B" at a reasonable drain not to exceed 15 or 16 m.a., and this means comparatively inexpensive replacement. This, together with the simplest of A.V.C., which automatically decreases plate current consumption wherever signals are of moderate strength and over, is made possible by the new Philips double-diode triode valve KBC1.

The functions of the KBC1 will be investigated in their proper place under the circuit's description. Its value lies in the fact that on a moderate to strong signal—in other words, one of entertainment value — it decreases the total consumption of the set by between 1 and 3½ milliamperes.

General Circuit Details

In view of the definite limitations of battery type valves, and of the fact that a set employing them is generally used at some considerable distance from a broadcasting centre, we placed five tubes as the minimum for this assembly. The key of the cascade's super-heterodyne action is V2, the type 1A6 electron coupled oscillator-mixer; to this it is always desirable to feed as strong a signal as is available, and so the line actually starts with V1, an r.f. amplifier attuned to the in-coming frequency.

Following the mixer comes a stage of intermediate frequency amplification centring round V3, and at 175 k.c. This frequency was selected because of its greater "lift" as compared with 465 k.c., and every atom counts. The pre-mixer tuned stage obviates repeat points except on very strong locals, the presence of which is unlikely under normal operating conditions.

V4, the KBC1, functions as a half-wave diode detector, first stage audio amplifier and automatic volume control. As an amplifier it drives the final pentode output power tube V5. The triple function of V4 is operative at a moderate plate voltage and without addition to the normal number of valves for the circuit; that is to say, its main office is that of second detector or demodulator and the subsidiaries are obtainable without added drain on the batteries.

Radio frequency coupling coil RF has its primary wound over the larger secondary. When ordering the kit both this point and the individual connections of the coils of AER (as mentioned above) must be specified.

Oscillator coil OSC is standard for the 1A6 valve, but that tube's type should be named when buying the kit. The grid condenser, C4, and resistor, R4, in the grid lead of the triode section of the 1A6 are optimum at 0.0002 mfd. and 50,000 ohms respectively.

The two intermediate frequency transformers, IF1 and IF2, are normal types at 175 k.c. for battery work. Note that, while the grid-leak of IF1 comes out of the top of its can, both ends of the secondary of IF2 are taken out below the chassis for the diode's connections. For

LEADERS in SPORT
are legion – but there's
ONLY ONE LEADER
in the Dry Battery Field–
EVER-READY

There are champions in golf, tennis, wrestling, boxing, swimming; experts in every branch of sport whose exploits have won world fame.

But when it comes to Dry Batteries—for radio, torches, bicycle lamps, bells, buzzers or telephones, there is only ONE that sets the standard for the whole world, and that is EVER-READY.

For thirty-five years, EVER-READY has stood pre-eminent for POWER and LENGTH of LIFE. To-day, backed by the experience and research of a chain of laboratories which encircle the globe, EVER-READY Batteries for every purpose come to you sealed in factory freshness, to give the long and faithful service which alone means real satisfaction and definite economy.

Manufactured by:

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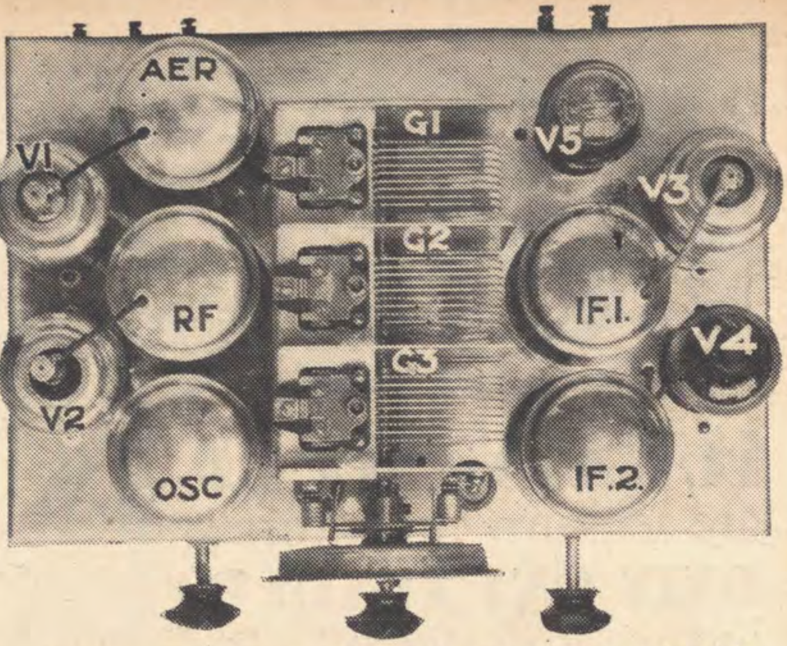
EVER-READY

TORCHES REFILLS & RADIO BATTERIES–

the sake of clarity the two diode plates of V4 are lettered to correspond both with their functions and with the separate drawing of their actual socket connections. DD indicates the detector plate, while CD shows the plate operating the A.V.C. effect. We will revert to the latter in due course.

Shunt-fed transformer coupling is used between V4 and V5. In this R10 is the plate resistor, C10 the coupling condenser, and T the audio transformer of which the "+" side of the primary is wired only to chassis, and NOT to main B+90. C11 is an optional condenser which may be inserted if the pentode's tones seem high to the individual listener. C12 is a necessary tank condenser; when the B batteries are new it does little work, but when they age it absorbs much of that irregularity that registers itself as crackling.



Plan view of this battery model with the major components keyed to correspond with the List of Components.

Power Supply

All batteries are fed to the chassis through a 6-pin plug and socket, as illustrated in the diagram of the circuit. Leads take the form a 5-wire cable plus an independent one to make up the six; this latter is safely used as the wire from the positive side of the 2-volt "A" battery accumulator.

The B battery is not tapped, full negative and full positive 90 only being taken from it. On reaching the set B— goes to chassis via resistor R12 across which is automaticaly generated a potential sufficient to minimum bias the grids of V1, V2 and V3, via decoupling resistor R11 and the A.V.C. line. Full B+90 is fed to the plates of all valves and for the screens of the first three tubes it is adequately broken down by series resistor R5, by-passed by C5.

Under test, signals did not cease with this set until the initial 90 volts had been lowered artificially below 60 volts, although there was a natural drop in volume. In practice, by the time a 90-volt battery fell to only 65 volts its internal condition generally would make it too noisy for real use.

The A.V.C. Circut

Before linking in the automatic volume control section of the circuit in theory, it is necessary to see that the valves so treated (V1, V2 and V3) are first supplied with their regular minimum bias. This for 135 volts on the plates is a full 3 volts negative but, as we are using only 90 volts of B, we can safely go a little under three. As explained already, this potential is generated across R12, run through R11 and then circulates via the "A.V.C. line" and resistors R1, R2 and R3 to the grids of the respective valves named above. In order to maintain the continuity of the r.f. circuits involved, each of the latter three resistors is by-passed to earth—vide C1, C2 and C3.

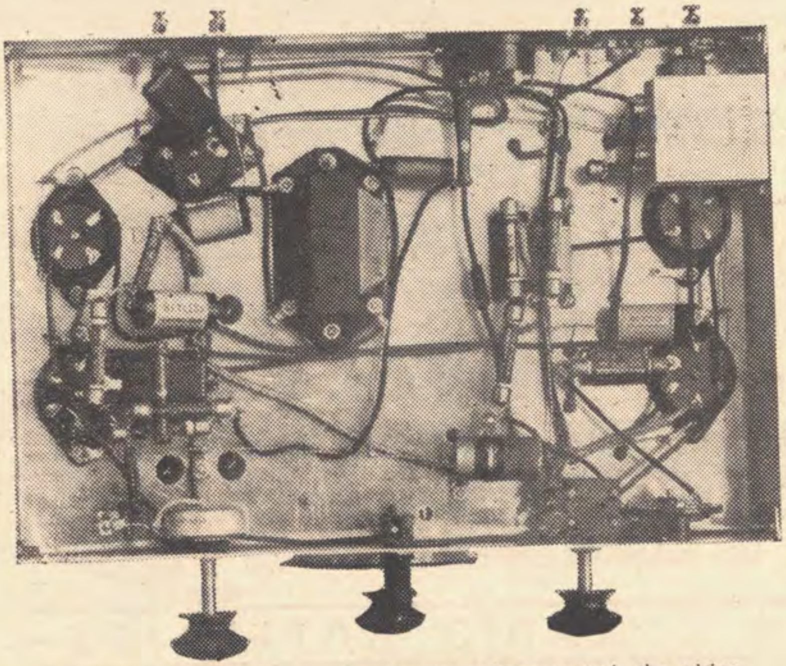
Adverting to the circuits around the KBC1; in the first place the secondary if IF.2 is taken to the POSITIVE side of the filament via volume control potentiometer VC by-passed by C7. The arm of VC feeds to the diode-triode's control grid (CG) via stopping condenser C6 and suppressor resistor R6.

Condenser C9 goes across the two diode plates and from control plate CD the line runs to the mid-point of a fixed voltage divider comprising equal resistors R7 and R8 wired in series. Note particularly that, unlike VC, R7 goes to NEGATIVE filament. C8 is the tank condenser of the A.V.C. system, while the de-coupling devices already demanded by the supply of minimum bias from R12, serve for the system also. In other words, the addition of A.V.C. only involves the inclusion of C8, C9, R7, and R8, plus the KBC1 itself.

A.V.C. is not a complete cure for fading. It does not make a set more sensitive than it would be normally, and it will not produce a signal that ordinarily disappears entirely. Its offices are to economise in battery consumption primarily, and to moderate the aural effects of fading to a comparatively even level; secondly, here, in those two endeavors, it earns its keep.

Lay-Out of the Parts

The accompanying photographs are sufficiently detailed to show that, on top of the chassis, valves and coil-cans are symmetrically arranged around the central triple-gang condenser. It is true that the method calls for one r.f. lead longer than usual, and it is the one connecting the pentode plate (P) of the 1A6 to the P point of IF.1. However, if this is made with the piece of metal braided cable specified in the list of parts, with the braiding definitely earthed to chassis, bad effects do not accrue.



In spite of the inclusion of automatic volume control, the wiring beneath the chassis of this battery super-het is fairly open.

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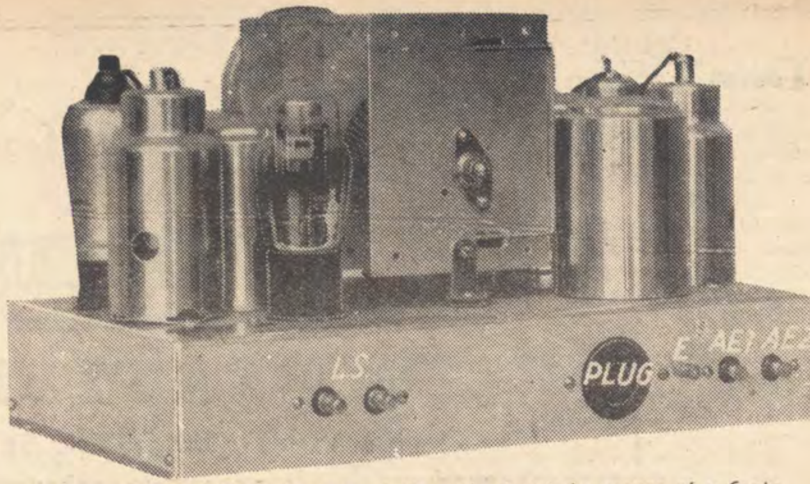
A switch appears in the lower centre of the set's front view, which is not included in the circuit diagram. It is in series with the dial lights and permits them to be switched off when there is no use for them, thus economising in "A" battery current.

In all instances, where such is demanded, a good "earth" to chassis is essential. The best plan is to clamp a solder lug under one nut or bolt of each component, and to join all these lugs together with bare tinned copper wire of around No. 20 gauge. Thus a sort of earth network is made which is soldered at each lug and finally to the true earth terminal. All earth returns are made to this network, which also forms the negative supply side of the filament circuit.



All batteries feed into the rear of the set's chassis by means of a 6-pin plug and socket.

Wiring Hints

Before commencing the wiring, carefully study the diagram of the various sockets' connections, as seen from below. Note that in the cases of the 1A6 and the KBC1 the contacts for the positive side of the filament supply are definitely marked, and must be so made. The 34's and the 33 are not affected in this respect. Again, with the KBC1 the diode for detection DD must be differentiated from that for control (CD) as illustrated.

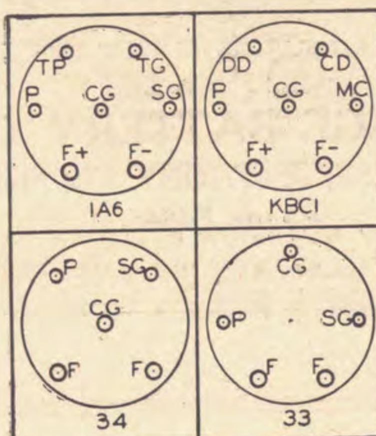
Wire all filaments first. A+ from the PLUG goes to one side of main battery switch S and thence to an F+ on each socket. Similarly wire together all the F— socket contacts and go to earth while the A—C+ of the plug also is taken to earth.

Tails will be protruding from the various coil cans, so these can be dealt with next. First arrange the de-coupler pairs R1—C1, R2—C2, and R3—C3; thus, in any one pair a resistor and a condenser tail are twisted together and are ready to take the return secondary lead coming to them from a particular coil. The pair is then anchored by soldering the condenser's other tail to the earth network. The remaining tail of the resistor will join up to the A.V.C. line. All B+ leads can be bunched and run together to the corresponding point on the main battery plug. Later one end of R5 can be soldered also to the latter point, its other tail being wired successively to the SG points on the sockets V1, V2, and V3.

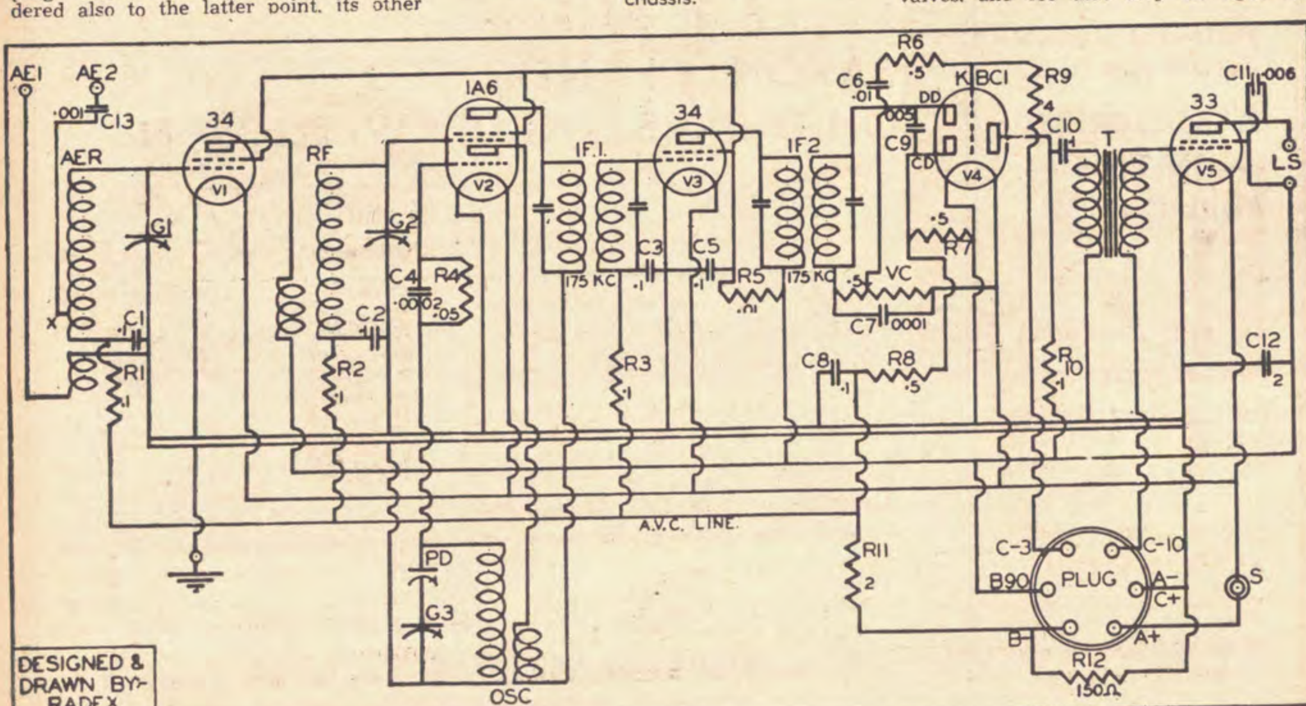
To B— of the plug connect both R11 and R12, the other end of the latter going to earth, while the opposite side of the former goes to A.V.C. line, etc.

C4 and R4 solder directly to contact TG on socket V2. Padder PD, as seen in the photos., is mounted inside the front of the chassis, and to it go the other ends of C4—R4 and the top of the larger coil of OSC. The other side of PD is wired to the fixed vanes of section G3 of the ganged condenser by a lead running up through the chassis. Obviously this is the stage at which the gang should be mounted.

Make very sure of the battery cable's connections before joining them to "A," "B" and "C" batteries, and, via the 6-pin plug socket, to the set. The five wires in the cable are differently colored; assign a use to each, and make a written note thereof. Check up the 6-pin socket to see that it corresponds. Finally, connect up the "A" battery only, insert the valves, and see that they all light up.



These are the valve sockets' connections as seen from beneath the chassis.



The schematic circuit diagram of the "A.V.C. Battery Super 5" is key-lettered to agree with the parts list.

but this test can only be made in a well-darkened room.

Lining-Up

Section G3 of the gang is the controlling one; its trimmer is the most delicate in action. Swing the dial to open the condensers' vanes and select some station low in the wave-band as a test point—say, 3KZ, or below. Although much increase in volume cannot be expected from it, finely set G3's trimmer. Then adjust the trimmers of G2 and G1, in that order, and from these a marked rise in out-put will be gained. As the volume increases, cut it back with VC so that you are constantly working on a comparatively weak signal.

Turn up now to the top of the scale to either 3AR for certain, or 2CO for preference. On one or other of these stations adjust the padder for a further increase in volume; after each adjustment of PD remove the screw-driver and rock the dial for the peak position, which will vary with the alteration to PD. Signs of interference between 3AR and 5CK indicate that the padder has not been set with sufficient care. Finally revert to the bottom end of the scale and give a last touch to the trimmers of G1 and G2 on a weak station. At this stage do not alter the trimmer of G3 or all your padding work will have to be gone over again.

According to the condition of the valves and batteries, a peak of sensitivity may be obtained by a variation in the value of R12. To this end, the list of parts notwithstanding, this unit might have an initial value of 200 ohms and be provided with a third clip, after the manner of a voltage divider, that can be moved about. In this case connections would be made to the moving clip and one end only. After the line-up, the position of this clip would be adjusted on a weak signal up to the point whereat the set becomes unstable, i.e.. whistles. There is no real necessity to go to all this trouble — the assigned resistor is of the correct value for certain results, but there are always builders who like to get just that little more, and so the point is mentioned.

LIST OF PARTS

A Battery 2-v (Century).
C1,2,3,5,8,10.—0·1 mfd. tubular condensers. (Concourse, Raycophone, Saxon, T.C.C., Wetless.)
C4.—0.0002 mfd. mica condenser.
C6.—0.01 mfd. mica condenser.
C7.—0.0001 mfd. mica condenser.
C9.—0.005 mfd. mica condenser.
C11.—0.006 mfd. mica condenser.
C13.—0.001 mfd. mica condenser. (Simplex, T.C.C., Wetless.)
C12.—2 mfd. block paper condenser. (Concourse, Raycophone, Saxon, T.C.C., Wetless.)
G1,2,3.—Triple gang condenser. (Precedent, Raycophone, Saxon.)
Dial.—Efco, Precedent, Radiokes, Raycophone.)
Kit.—Comprises aerial, r.f. and oscillator coils, two 175 k.c. intermediate frequency transformers and one 175 k.c. padder. (Colonial Radio, Paramount, Precedent, Radiokes, Saxon, Velco.)
LS.—Speaker matched to type 33 pentode, either magnetic or permagnetic. (Amplion, Precedent, Rola, Saxon.)
R1,2,3,10.—Resistors, 100,000 ohms.
R4.—Resistor, 50,000 ohms.
R5.—Resistor, 10,000 ohms.
R6,7,8.—Resistors, 0.5 megohm.
R9.—Resistor, 4 megohms.
R11.—Resistor, 2 megohms. (I.R.C., Raycophone, Velco.)
R12.—Wire resistor of 150 ohms. See text. (Paramount, Precedent, Radiokes, Raycophone, Saxon, S: di-power, Wendel.)
S.—Single battery switch.
T.—Audio frequency transformer, standard ratio. (Paramount, Precedent, Radiokes, Raycophone, Saxon, Wendel.)
VC.—Volume control potentiometer, 0.5 megohm. (Marquis, Paramount, Precedent, Radiokes, Raycophone, Saxon.)
Chassis.—No. 16 gauge aluminium dimensions 13 x 8½ x 2 inches.
Valves.—Two 34's and one each 1A6 33, and KBC1. (Mullard, Philips, Radiotron, Triad.)
Sockets, etc.—Two 4-pin, one 5-pin and two 2-pin, also one 6-pin socket and a 6-pin plug for battery connections. (Marquis, Precedent, Saxon.)
Sundries—Two yards 5-way battery cable, 1 foot metal braided cable, quantity belden wire and bare tinned copper, 3 valve cans and three grid clips, machine screws, nuts and washers.

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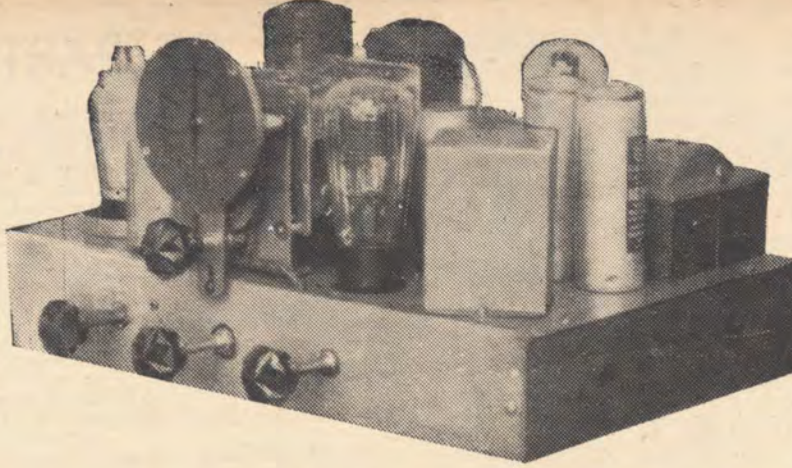


A highly sensitive DX Receiver

The GOLDEN GLOBE GIRDLER

Full constructional details of an amazingly sensitive plug-in coil type all wave super-het are provided in this article.

By A. K. BOX

THAT'S rather a high-faluting name for a radio receiver, but, when you've read what we have to say about its capabilities, you will agree with us that even a high-sounding name cannot dim the performance of this all waver super-heterodyne.

It is reasonably easy to build—providing that the instructions we will set out are followed—easy to operate, and, above all, possessed of unparalleled sensitivity. To this must be added a high degree of selectivity on the broadcast band and excellent tonal quality.

Frankly, the receiver is so much more sensitive than the average commercial all wave receiver, which has a sensitivity rating of about 50 microvolts per metre, against the .3 microvolts absolute of the "Globe Girdler," that it is probable that in many localities use cannot be made of its maximum gain. However, even in noisy areas it is possible to open out the receiver to a point which still makes it a far more sensitive proposition than the average job. This high degree of sensitivity is reflected in the ease with which Australian, New Zealand and eastern broadcasting wave length stations can be brought in and the high volume level of the tunable broadcasters on short waves.

London, Paris and Berlin all can be heard 100 yards from the loud speaker and Australian and American amateur phone stations have a good entertainment value—in fact, the receiver is very nearly the answer to the DX listener's prayer.

Now, before we go any further, let us understand clearly the advantages and disadvantages of the s.w. super-het; the compromises which have to be adopted when the broadcast as well as the s.w. bands are to be covered; and the snags which the constructor will most likely meet before a set of this type is made to "perk."

The outstanding advantages of the super-heterodyne over other forms of s.w. receiver are its ease of handling and its high sensitivity. This latter feature naturally depends to a large extent upon the number of tubes which are used. Ease of handling will depend upon the tuning arrangements of the receiver and on the steps which have been taken during the building of the set to make it quite "tame."

Double Spot Tuning

The main disadvantage of the s.w. super is that it is subject to "repeat points." That is to say it will persist in bringing in a given station at two points—one at the lower heterodyne position and the other at the upper heterodyne position or at a point above the original tuning position by the sum of the intermediate frequency. That is to say that with a 465 k.c. i.f. frequency a 10,000 k.c. station (30 metres) will come in again at 9535 k.c. (31.46 metres).

Unlike the broadcast band where tuning circuits of sufficient inherent selectivity can be used to reduce, if not entirely eliminate, these repeat points, the short wave tuning spectrum cannot be conveniently arranged to eliminate double spotting.

Certainly the use of high intermediate frequencies (1000 to 1600 k.c.) and the employment of tuning coils which are band spread to limit their frequency coverage so that a frequency range less than that of the intermediate frequency is covered, overcomes the trouble. Preceding stages of r.f. amplification or even pre-selection, such as is used with b.c. receivers, also is used. Our personal angle on the matter is that r.f. stages complicate an already difficult type of set, band spread coils are not worth while on an all-wave receiver which is not to be used only for phone reception, and that pre-selection will reduce the input circuit sensitivity of the first detector and will provide an additional control.

To sum up: If we must make a reasonably simple and efficient receiver, let us tolerate the double spotting. Furthermore, having agreed to tolerate it, let us arrange matters so that the double spots will be close together, so that at least we will be spared the confusion of widely separated repeat points on the lower frequencies 3500 to 6000 k.c. For this reason we decided in this receiver to employ an intermediate frequency of 175 k.c. This would bring together the repeat points, and at the same time give a higher i.f. gain than was possible with the 465 k.c. i.f.

Now, if the s.w. super-het. is really to do its job it must be made as sensitive as possible. This means the employment of two stages of i.f. amplification, in which the total stage gain may range from 225,000 to 625,000, depending upon the design of the i.f. amplifier and the steps which have been taken to keep it stable.

This is where we run into our first serious snag—noise—and with a capital N too! Part of the noise we will strike with a high gain super-het which uses a two-stage amplifier will be valve noise —"shot effect" and the like—but the most serious will be that which comes from the mixer section of the super. Now, theoretically, electron coupling as used in mixer tubes of the 2A7 class is ideal. Practically it suffers from certain defects. Most serious of these is the trapping effect experienced on short waves and brought about by internal coupling between the oscillator and modulator grids.

The Second Detector

Next comes the question of signal to noise ration. Experience has shown that this ratio is highest in favor of noise when comparatively large plate currents are required by the modulator section of the tube. Finally we must consider the problem of frequency shift which occurs when the bias on the modulator control grid is varied. This can become very serious on the high frequencies at which the s.w. superhet is to work. We went into all these details rather thoroughly before attempting to design the present receiver, and one of the results of our consideration of the problems involved was the decision to use the Continental type 4 volt tubes. This decision was brought about by two things.

Philips recently has developed a new Octode or eight element converter tube which on paper appeared to possess extremly desirable characteristics for our job. The AK1, for such is the tube's serial number, has a conversion gain of more than double that of the 2.5 volt tube, and, bearing this gain in mind, has a resultant signal to noise ratio five times better than its 2.5 volt prototype. So much for the AK1, which we will deal with more fully when we come to the actual construction of the receiver.

The second thing which resulted in the swing over to the four volt tubes was the higher amplification factors which were obtainable from the E447 type r.f. pentodes. Another point, although not of such importance as the preceding two, was that we could employ the high gain 424 triode as a second detector. Just at this juncture we can visualise some of our critics wearing a disgusted look. "What about a diode? What about a.v.c.? What about ——?" Oh! well, we'll let you fill in the rest for yourself!

The fact of the matter is that this particular receiver has been designed to have as wide a range of usefulness as possible. For this reason we have employed a regenerative second detector. This makes it possible to heterodyne c.w. signals, a feature which is not available on the standard a.v.c.-fitted diode-detector super-het. Naturally, we lose the advantage —if any — of automatic volume control. A.V.C. is all right when we have a high gain amplifier capable of delivering a signal of such a value as to overload the second detector. In these circumstances we can afford to employ a.v.c. and to restrict the gain of the set.

On a standard small s.w. super-het, such as the present one, however, there is not sufficient margin to provide for the losses of a.v.c.

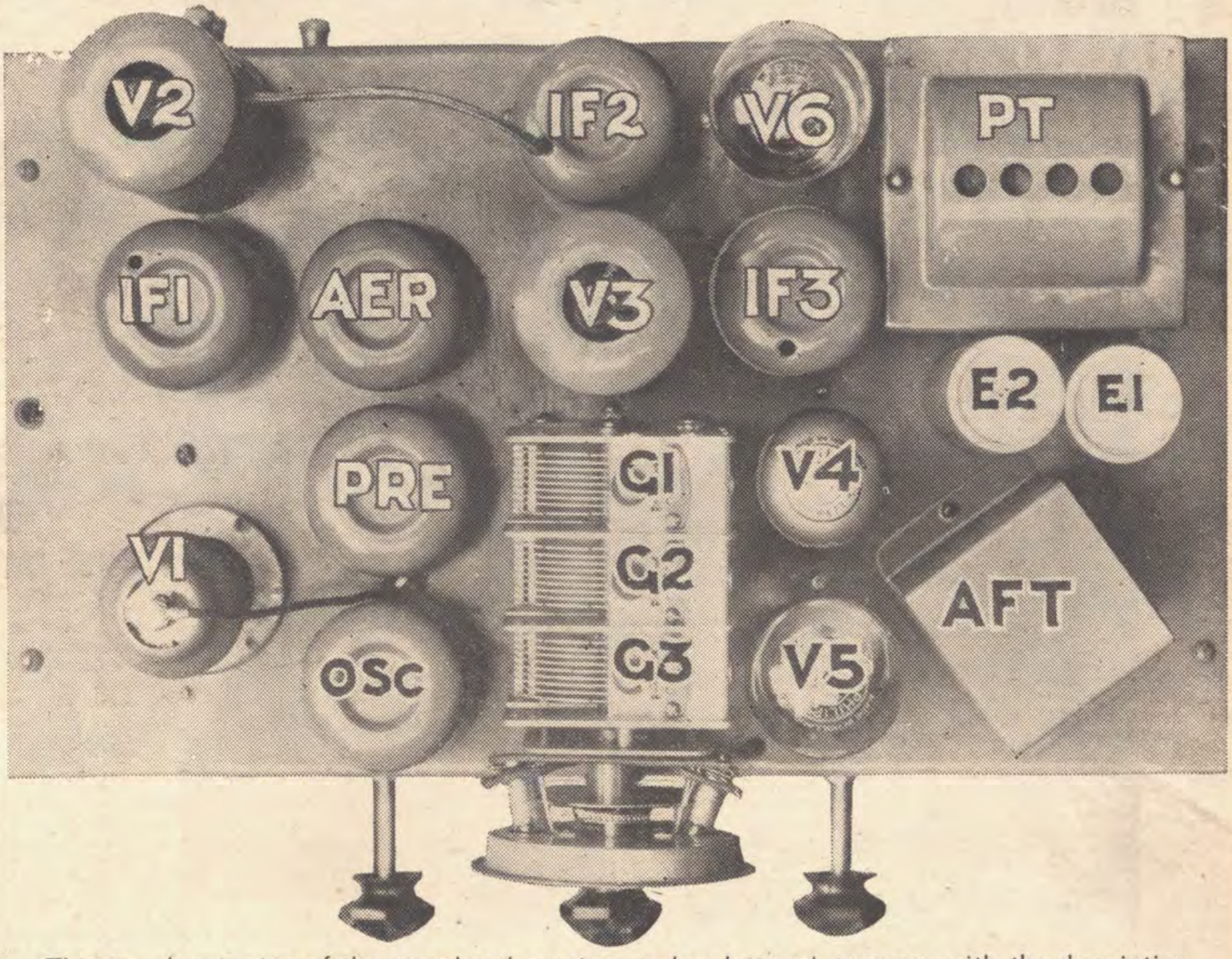
Plug-In Coils Or—?

In washing it out of our design we have had to put up with fading and swinging, but in recompense have been able to raise the sensitivity of the set almost to unbelievable levels. The final tube of our receiver was a standard directly heated pentode, connected to the second detector through a 3—1 transformer. The rectifier is a 1561 Philips four volt, equivalent of the 80.

We come now to the most contentious point of all—the tuning system. We must start off by understanding that in any all wave receiver in which the mixer tube functions on both short and broadcast wave lengths that the tuning on either one wave band or the other is merely a matter of compromise. For example, we could, and for efficiency's sake should, employ tuning condensers having a maximum capacity of 50 mmfd. (.00005 mfd.) to tune over the short wave band.

This would keep the L/C ratio of the tuning system within bounds and at the same time would permit reasonably easy tuning without the danger of passing over a station, as is the case when a large capacity tuning condenser is employed. But consider what will happen

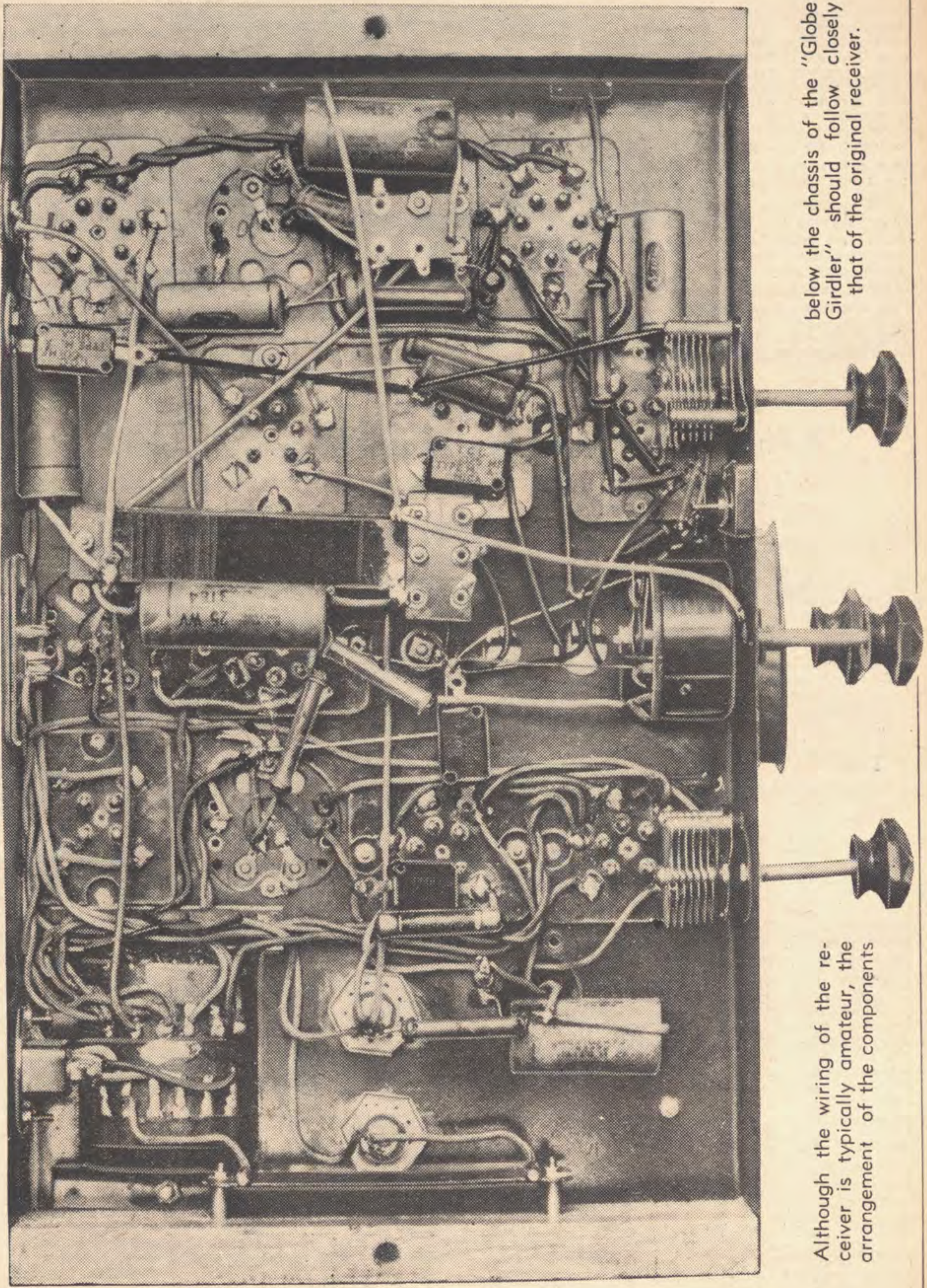
A Photographic Plan View of the "Globe Girdler" Chassis



This top-chassis view of the completed receiver is key-lettered to agree with the description of the assembly of the components.

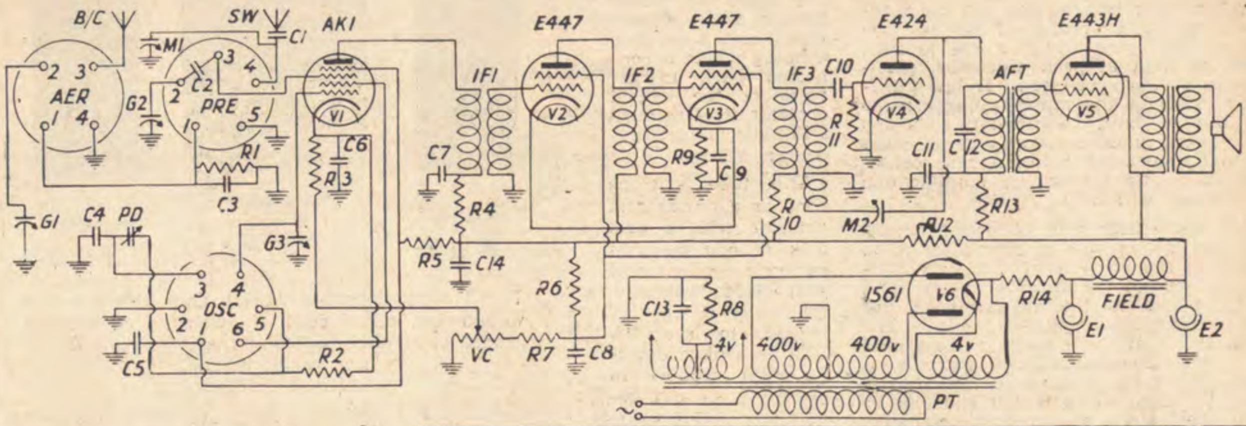
THE GOLDEN GLOBE GIRDLER

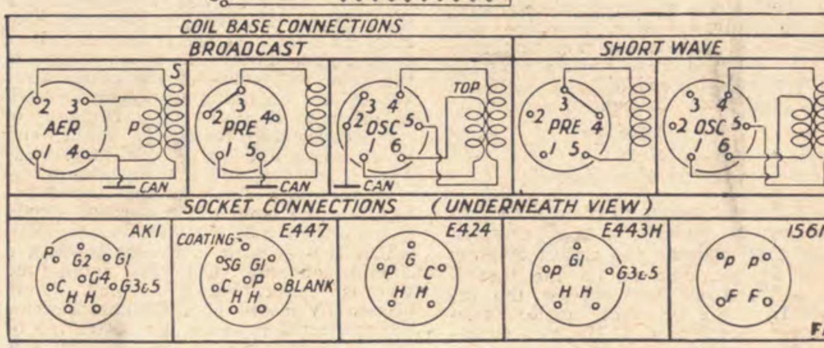
UNDERNEATH THE CHASSIS



Although the wiring of the receiver is typically amateur, the arrangement of the components below the chassis of the "Globe Girdler" should follow closely that of the original receiver.

CIRCUIT DIAGRAM AND PARTS LIST





Stamped and drilled chassis 17½ inches by 10 inches by 2¾ inches.

Aero Dial.—(Efco, Precedent, Radiokes, Raycophone).

G1, G2, G3.—Three gang condenser (Precedent, Raycophone, Saxon).

M1, M2.—13 plate midget (Paramount, Precedent, Radiokes, Saxon).

VC.—5000 ohms volume control (Marquis, Paramount, Precedent, Radiokes, Raycophone, Saxon).

PT.—Power transformer and voltage plug (Paramount, Precedent, Radiokes, Raycophone, Stedipower, Velco, Wendel).

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

IF1, IF2.—Standard 175 k.c. intermediates and IF3 with reaction (Colonial Radio, Paramount, Precedent, Radiokes, Saxon, Velco).

A.F.T.—Audio frequency transformer, ratio 3-1 (Paramount, Precedent, Radiokes, Raycophone, Saxon, Wendel).

Aerial and earth terminals.

Set of broadcast coils consisting of aerial, pre-selector, oscillator.

Three sets of S.W. coils. (Colonial Radio, Paramount, Precedent, Radiokes, Saxon, Velco).

Two valve shields.

C1, C10.—0.0001 mfd. condensers.

C2, C4.—0.00025 mfd. condensers.

C12.—0.001 mfd. condenser. (Simplex, T.C.C., Wetless).

C3.—0.02 mfd. condenser.

C5, C6, C8, C14.—0.1 mfd. condensers.

C7, C11.—0.5 mfd. condensers. (Concourse, Raycophone, Saxon, T.C.C., Wetless).

C9, C13.—25 mfd. electrolytic condensers (Concourse, T.C.C.).

R1.—15,000 ohms resistor.

R2.—50,000 ohms resistor.

R4, R10.—5000 ohms resistors.

R5.—20,000 ohms resistor.

R6, R7, R13.—25,000 ohms resistors.

R11.—1 megohm resistor. (I.R.C., Raycophone, Velco).

R9.—800 ohms W.W. resistor, 25 m.a.

R12.—2000 ohms W.W. resistor, 50 m.a.

R8, R14.—430 ohms W.W. resistor, 10 m.a. (Paramount, Precedent, Radiokes, Raycophone, Saxon, Stedipower, Wendel).

Speaker to match E443H with field of 1500 ohms (Amplion, Precedent, Saxon).

Ten valve sockets, three large 7-pin, two 4-pin, four 5-pin, one 6-pin (Marquis, Precedent, Saxon).

in our all-wave receiver which is fitted with these small tuning condensers when we come to the broadcast band.

At least four, and probably six, sets of inductances will be required to take the modulator tuning system over the broadcast frequency range between 1500 and 500 k.c. Such a state of affairs could not be tolerated. Next, let us consider the situation from the other angle. By means of the smallest satisfactory tuning condenser on the broadcast band —about .00035 mfd.—we shall be able to traverse this portion of our proposed tuning spectrum in one sweep.

On the short waves, however, we probably would tune from about 25 to 60 metres—say, 12,000 to 5000 kilocycles — in a single sweep of the tuning dial. This would be very nice indeed if it were not for the fact that the tuning scale would be so cramped that we'd probably need a vernier drive of better than 100/1 ratio in order to locate even the most powerful station of the s.w. band. We may make this clearer if we point out that in the usual 100 dial divisions we are endeavoring to cramp a frequency range of 7000 kilocycles—sufficient to fit in 700 broadcasting stations and probably 4000 to 7000 code stations. That is approximately seven stations for every dial division at best.

No. Mechanically it can't be done. The electrical question is just as serious for the inductance capacity, L/C, if you like, ratio would reduce the efficiency of the tuning system to the vanishing point. There are two ways in which we can overcome the difficulty.

The first is by use of separate condensers and coils, and the second is by electrically alternating the capacity of the tuning condensers and using special coils for the job. The latter is the only convenient way out of the difficulty. It might be called a compromise with a compromise.

By means of small fixed condenser in series with the main tuning condensers we have reduced the maximum capacity of the latter to about 150 mmfd., a figure whilst not ideal for the most efficient s.w. tuner, at least gives some hope of efficiency. The next point was to arrange for the coils which were necessary to cover the short wave bands. It was neither practicable nor desirable to cover the proposed tuning range 18 to 75 metres with one set of coils.

Switch System Difficulties

In order to cover this range properly and to provide the necessary overlaps between each coil, a set of three are required for both the oscillator and the modulator sections.

Realising this, we thought very seriously of embodying a switching system and of winding the necessary coils so that both the oscillator and modulator sections could be switched in at will. Experience both with home and commercially made switch operated all-wave super-hets has given us a very poor opinion of this method of obtaining wave coverage. Either the switches are faulty, in their contact, having high resistance between the blade and the contact studs, or they have losses due to the capacity between leaf type switch blades.

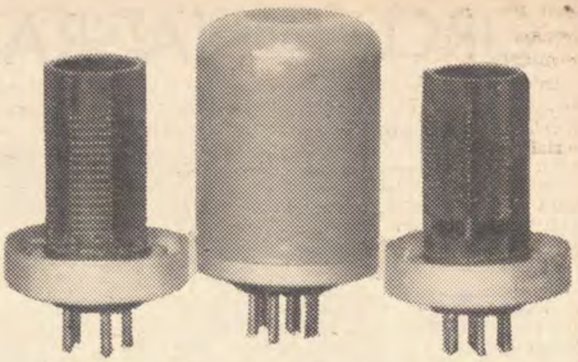
Either fault is a serious one in a receiver which, by reason of the low signal voltages with which it has to deal, must be kept at peak efficiency, particularly at the aerial end. If low efficiency exists in the input tuning circuits because of faulty switching, coils too near to the metal chassis, or because the mutual inductance between coils causes absorption, no amount of amplification afterwards will help.

All that a high gain i.f. or a.f. amplifier can do in this circumstance is to bring up the noise level. The only logical way out of the problem to our mind is to return to the old-fashioned but relatively efficient plug-in coils. The form factor of these coils, by reason of their suitably proportioned formers, is high. Their construction is such that at least the high r.f. potential end can be kept well clear of surrounding metal, and, generally speaking, they are well worth while, despite the fact that they must be plugged in to sockets mounted on the chassis instead of being switched into circuit from the control panel.

Review of the Circuit

Having dealt rather fully with the design features underlying this receiver, let us now examine the circuit diagram whilst we particularise on the technicalities. First we will discuss the receiver from the broadcast angle. Basically the receiver is a 175 k.c. superheterodyne employing a stage of preselection before the first detector which, as we previously explained, is an "Octode" electron coupled mixer. Tuning of the aerial, pre-selector and oscillator sections is carried out by means of the gang condenser G1, G2 and G3. All three coils are of the plug-in variety, the aerial requiring a four-pin socket, the pre-selector a five-pin socket, and the oscillator a six-pin socket. The extra contacts on the pre-selector and oscillator coil sockets are made necessary by the switching system used to cover the short-wave band. The mixer tube precedes a two-stage intermediate frequency amplifier, which is conventional in arrangement, except that for reasons of stability recourse has been made to filtration of the modulator and first i.f. tube plate supplies and to the overbiassing of the two i.f. amplifier tubes. Volume control is effected on the cathode of the mixer tube, which is provided with a fixed bias of 2.25 volts through the limiting resistor R3. The third i.f. transformer IFT3 is provided with a reaction winding which is connected back to the plate of the second detector E424 through a 13-plate midget condenser, M2.

This tube is being used as a power grid detector with a grid leak of one megohm and grid condenser of .0001 mfd. capacity. Originally it was intended to use the E424 as a plate detector, but trouble in obtaining smooth oscillation control was responsible for the change. However, it was found that even on broadcast wave lengths, where large signal inputs are to be expected, the tube will overload the power tube V5 before becoming overloaded itself. In order to keep the plate current of the E424 within reasonable limits, and at the same time to provide some measure of de-coupling and hum suppression, the plate supply to the second detector is fed from the maximum supply line through a 25,000 ohm resistor R13, which is by-passed to chassis through a .5 mfd. condenser, C11. The audio tube V5 is conventionally coupled, being biassed by means of a 430 ohm resistor R8, connected between the centre tap of the filament winding on the power transformer and chassis. This resistor is by-passed by the 25 mfd. electrolytic condenser C13. The "B" supply from the 400 volt power transformer is rectified in conventional manner by the 1561, V6, the positive lead from which is fed through a 430 ohm resistor, R14, to the first 8 mfd. electrolytic E1. The purpose of this resistor is both to limit the plate potential supplied by the rectifier and to assist in cleaning up hum and hash. It is very effective in the latter job, but as it gets rather hot it is mounted on spacers which keep it clear from the wooden end of the chassis to which it is screwed.



The Tuning Coils. — (Left) One of the space wound s.w. aerial coils. (Centre) A shielded broadcast oscillator coil and (right) an unshielded s.w. oscillator coil.

Constructional Details

We now shall deal with the constructional features of the receiver. First study the top view of the finished chassis whilst we elaborate the key lettering of the components. Looking at the receiver from the front, we see that the A.K.1 mixer tube is mounted in the front left-hand corner of the chassis, which, by the way, measures 17 inches in length, 10 inches in width, and 2¾ inches in depth.

In the same line as V1, but towards the back of the chassis, are the i.f. transformer IF1 and the first i.f. tube V2 in that order. Between the A.K.1 and the gang condenser is a line of three cans. The one nearest the front of the chassis contains the oscillator coils OSC, the middle one the pre-selector coil PRE, and the one nearest the back of the chassis the aerial coil AER. It should be noted, however, that when the receiver is being used on the short waves the broadcast aerial coil AER is left in its socket and the s.w. aerial coil plugged into the broadcast pre-selector coil socket PRE.

The oscillator coil, whether for short or broadcast wave lengths, go into the same socket. In the middle of the chassis is the gang condenser. From front to back are the gang sections G3, G2, and G1 in that order, the oscillator section of the gang being at the front, nearest to the oscillator coil. Behind the gang condenser is the second i.f. tube V3 and behind this, at the back of the chassis, is the second i.f. transformer IF2.

The rectifier valve V6 is to the right of IF2.

On the right-hand side of the gang condenser is a "line" consisting of three valves and a coil can. From front to back the E443H, V5, the E424, V4, and the third i.f. transformer, IFT3, are in that order. The rectifier, V6, already mentioned, is the remaining tube in the line. At the extreme right of the chassis, front to back, is the audio transformer, AFT, the two electrolytic condensers E1 and E2, and the power transformer PT.

Now, looking along the front of the chassis from left to right, we see the control knobs of the midget tuning condenser M1, the volume control VC and the midget reaction condenser M2. The mounting bolts and hole for the adjustment of the padding condenser PD can be seen between M1 and VC.

Along the back of the chassis, looking

A rear view photograph of the chassis shows the a.c., loud speaker, and aerial connecting points.

from the power transformer end, can be seen the a.c. power plug, the loud speaker socket and the aerial and earth terminals in that order. The two lower terminals are the aerial terminals, that nearest the end of the chassis being the broadcast aerial and the other the s.w. aerial. We next deal with the placement of the components underneath the chassis. Those above the chassis are quite important as far as placement is concerned, but the position of each of the under chassis parts has been carefully determined.

Looking at the underneath of the chassis from the front we see the voltage dropping resistor R14 screwed to the left-hand end block of the chassis. The grid condenser C10 and the grid leak R11 are mounted right at the socket of the second detector valve V4. Before we go further it might be as well to explain that there are several earth anchor points on the chassis. These include the back and right-hand securing bolts of the gang condenser, both holding bolts on the i.f. transformers IFT3 and IFT5 and one on IFT1. The other earth point is the actual earth terminal on the chassis.

These earthing points are important with this receiver, where every effort must be made to avoid instability and at the same time retain the exceptionally high amplification of the i.f. stages.

The .001 mfd. by-pass condenser C12 is carried to the gang condenser earth from the plate of V4. One of the 25,000 ohm screen resistors R6 is connected from the B plus lug on IFT3 to the screen lug on the socket for V3, the other resistor, R7, going from this lug on V3 to one side of the volume control, VC. Mounted laterally across the chassis can be seen the top one of the three resistor strips, R9, R12 and R8, the top one being the cathode resistor, R9, for V2 and V3. Alongside these resistors is the by-pass condenser for V5, C13. The suppressor resistor, R10, is soldered to the B plus lug on the i.f. transformer IFT2 (not shown in the diagram, to IFT3), and has its other lug connected to one side of the 2000 ohm resistor, R12, mounted in the middle of the chassis.

Against the rear side of the chassis can be seen the 25 mfd. by-pass condenser C9, which runs from the cathode resistor R9 to the earth terminal. Alongside the socket for V2 (in the right-hand rear corner of the chassis near the aerial terminals) can be seen the .1 mfd. bypass condenser C8, which by-passes the screens of the 447's. Near the i.f. transformer IFT1 can be seen three fixed condensers. These are the two .1 mfd. condensers, C5 and C14, which by-pass the screen grid of V1 and the B plus side of the plate resistor R4, respectively, and the .5 mfd. condenser C7, which bypasses the i.f. transformer side of the suppressor resistor R4. The AK1 cathode resistor R3 can be seen screwed to the right-hand end block of the chassis. The by-pass condenser on the cathode of the socket for V1 is a .1 mfd. one, C6, running from cathode to the ground. The 50,000 ohm grid leak, R2, can be seen above this socket. On the socket for the pre-selector coils (second from front of the chassis, in line with M1) can be seen the pre-selector condenser, C3, and the resistor, R1. In front of these components is the pre-selector (s.w. aerial) coil, .00025 mfd. series condenser, C2. The oscillator, .00025 mfd. series condenser C4, is tucked down alongside the padding condenser, which, incidentally, is made up of an adjustable compression type condenser connected in parallel with a .0005 mfd. fixed condenser.

A glance at the two aerial terminals will show that the broadcast aerial terminal is connected direct to the correct lug on the aerial coil socket, whilst the short wave aerial terminal is connected to the correct lug on the pre-selector (s.w. aerial coil) socket through the .0001 mfd. fixed condenser, C1.

The only point about the wiring which needs special stressing is that the leads from the various sections of the gang condenser are taken to their respective connecting points by means of bus bar wire insulated with sphagetti and kept as clear from the chassis as possible. The gang condenser also is independently earthed to one of its securing bolts on the chassis. The plate leads to the two i.f. tubes are taken (above the chassis) in metal braided cable, in which the braiding is earthed. The plate connection of the A.K.1 and the grid connections of the two 447's are similarly treated underneath the chassis. All leads should be kept as short as possible, particularly those carrying r.f. in the tuning circuits, but care should be taken to keep the plate and grid leads of the i.f. circuits as far apart as is conveniently possible.

The Short Wave Coils

The six short wave coils, three for the oscillator and three for the modulator, are wound on standard octagon shaped bakelite formers which are provided with the necessary connecting pins. In the case of the modulator coils (PRE socket in the circuit diagram) the connections of the coils are so arranged as to bring the s.w. aerial, and balancing condenser M1, into circuit and to introduce the series .00025 mfd. condenser C2, into the G2 section of the gang.

The necessary connections can be determined from a study of the circuit diagram in which the three coil sockets, AER, PRE. and OSC have their connections numbered to agree with the connections to the pins of the coil formers shown at the bottom of the diagram. It should be understood that in the case of the broadcast coils, which are "canned," a direct metallic connection must be provided to the "can."

In the case of the unshielded s.w. coils this connection is eliminated. Note also that in the case of the oscillator coils the plate coil connections reverse in the change over from broadcast to short waves. This is because the broadcast oscillator plate coil is reverse would in respect to the oscillator grid coil whilst in the short wave coils both windings are in the same direction. Now in the tabulated coil data for the s.w. coils it will be noticed that both aerial and oscillator coils have the same number of turns. This is due to the fact that the i.f. frequency, is low and consequently the difference in tracking between the oscillator and aerial sections of the gang is small.

Although the auxiliary trimmer, M1, has been included it is not needed on the two higher frequency bands, the tracking being aided by the fact that the oscillator tends to pull the modulator into step. The socket connections for the various tubes also are provided in the circuit diagram. Like the coil socket and coil base connections these valve socket connections are taken from the under chassis view of the sockets.

Having built up the receiver and inserted the tubes, loud speaker, and broadcast coils into their respective sockets, the first thing to do is to couple the set to the a.c. mains and take the voltage readings. These (from the various components to chassis) will be as follows:—

Voltage Readings

	Volts		Volts
V1 Screen	70	E1	340
V5 Screen	250	E2	250
V1 Cathode	2.25	V5 Plate	235
V2, V3 Cathode	3.5	V4 Pate	105
V4, Fil.C.T.	15.5	IFT3 B plus	220
Across R14	.25	V2, V3 Screen.	100

Aligning the Receiver

The next thing for consideration is the alignment of the receiver. Conventional methods are adopted for this job. First the oscillator gang condenser trimmer, on G3, is set so that 3AW will come in from 10 to 12 on the dial. Next the pre-selector trimmer is adjusted for maximum volume at this dial setting and finally the aerial trimmer is adjusted. The alignment should be carried out with M1 and M2 set at minimum. The receiver then is tuned up to 2CO and the padding condenser adjusted for maximum volume meanwhile rocking the gang back and forth over a few degrees to get a peak setting for the padder.

Naturally it will be necessary all the time to keep the volume control set well back in order that definite checks can be made of the peak condenser settings.

As supplied the i.f. transformers are accurately peaked to 175 k.c. but wiring connections and other stray circuit capacities will throw these settings out slightly. Failing absolute alignment against a signal generator it is possible to get fairly accurate alignment by ear. The method to be followed in this case is after aligning the r.f. tuning to leave the set tuned to a distant station and operating from the grid circuit of the second detector back to the grid circuit of the first i.f. tube to adjust each of the i.f. transformer trimmers for maximum signal strength.

Naturally a station should be selected which does not fade much. In adjusting the grid tuning of the second detector advance the midget condenser M2 so that the second detector is in a regenerative but non-oscillating condition. Don't touch the trimmer of the primary of IFT1, or the whole r.f. alignment will be thrown out.

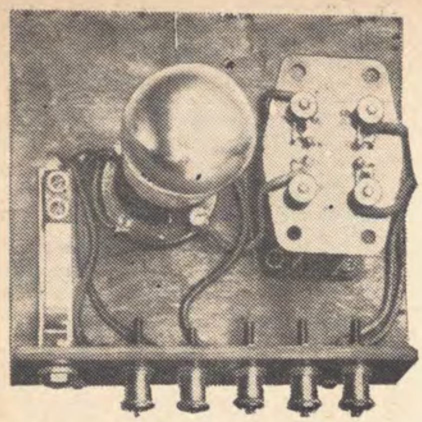
Outstanding Performance

When operating properly, the "Golden Globe Girdler" is truly a remarkable receiver. Without the use of regeneration on the second detector the broadcast wave band sensitivity is of the order of from two to three microvolts absolute, whilst regeneration increases this sensitivity to .3 microvolts. Naturally this degree of response to signals means that the set will dredge down below the noise level if desired, so that it will bring in practically everything that is on the air.

Short Wave Coil Details

Wave Range	Aerial Coil Turns	Osc. Plate	Coil Turns. Grid
19-30 metres	6	9	6
29-51 metres	15	12	15
45-84 metres	26	15	26

All windings with 24 gauge enamel covered wire. Grid winding spaced two diameters, plate windings close wound and 3-16in. from cathode end of grid coil. 1¼in. diameter Marquis formers.



Photograph of a Typical One-stage Battery-operated Amplifier.

AMPLIFIERS!

A collection of circuits ranging from a modest one stage magnifier to a powerful public address outfit.

By P. R. DUNSTONE

TO the writer's mind, audio frequency amplification is the most interesting side of radio, since it offers hours of interesting experimental work to the wireless enthusiast. Admittedly, there is a considerable amount of enjoyment attached to the radio frequency side of a receiver, but unless the amateur is in the fortunate position of possessing pounds' worth of testing equipment, he is invariably groping in the dark until the actual output is received.

With audio frequency amplification one is in the position to trace every advancement made by the signal, and thus rectify any little distortion which may develop. Provided an audio frequency amplifier is correctly designed in the first place, and the actual components employed in the circuit are of a reputable make, there is no reason why the final output from it should not be as life-like as that which is transmitted from a broadcasting station.

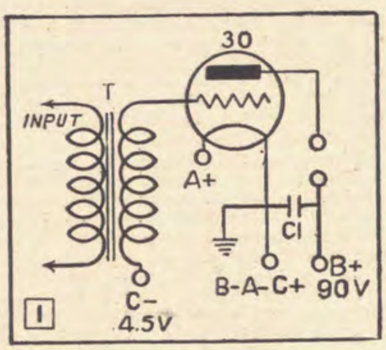
Probably one of the most useful instruments that the amateur can possess when testing an amplifier is a standard 0-1 milliampere meter. This meter, if correctly calibrated, can be made to give any current readings required, and, at the same time, can be converted into a 1000 ohms per volt meter at a moment's notice. Therefore, with an instrument of this description, it can be seen that, not only could the current be checked up in the various circuits, but the voltage readings could also be taken.

In this series, the writer has prepared a number of circuits, which range from a one stage triode amplifier, to a reasonably powerful public-address outfit, capable of supplying music or speech at any social or dance function.

A Necessary Definition

Before we itemise the description of these circuits, it may be just as well to say a few words on what actually an amplifier is. An amplifier can be regarded as an arrangement of valves and coupling devices used for the purpose of increasing the initial input signal received in the detector stage to a sufficiently high level to drive a loud speaker at some given volume.

The two most important systems of amplification on the audio frequency side of a receiver are known as class "A" and class "B." With class "A," which is the most commonly used of the two schemes, the signal is received on the grid of the valve. This variation is recorded across an impedance or a



A Single Stage Magnifier, which is suitable for amplifying the output of a crystal or a one valve receiver.

resistance in the plate circuit. These variations on the plate are essentially of the same formation as the input signal impressed on the grid, but in a much increased amplitude.

This condition is accomplished by applying a potential to the grid of the tube in order to ensure a constant flow of plate current at the most positive swing of the input signal, thus keeping the plate current swing proportionate to the input signal. This principle is probably known by most of the readers, but with class "B" amplification the operation is entirely different. Here the valve is operated at a relatively low plate current potential at no signal input. The valve is biassed to such a degree that a point is reached where the plate current is cut off. That is to say, there is practically no plate current when the valves are in a static condition, such as experienced when no signal is applied to the grids.

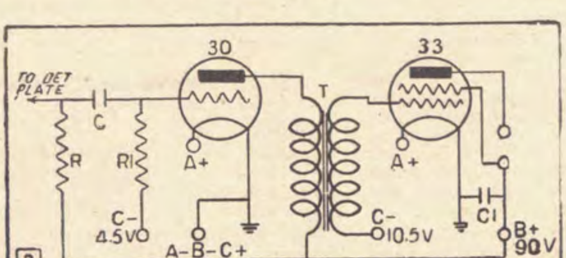
Peculiarites of Class "B"

In the case of the 53 valve design there is no necessity to use external bias to bring this condition about. When a signal is passed on from the preceding stage, the grids of the "B" class valve become positive during each half cycle, resulting in the plate current rising to maximum. In other words, plate current will flow only during the least negative excursions of the signal voltage.

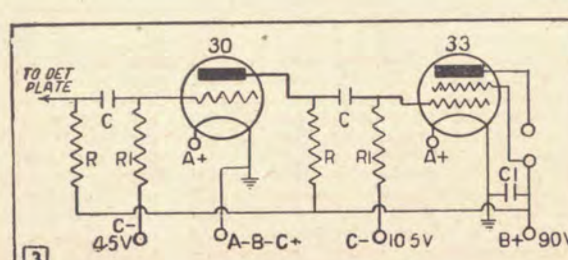
Should one valve be used in the output circuit a high harmonic distortion can be noticed. The difficulty is overcome by using two valves in a balanced push-pull circuit. In the case of the 53, or similar type of valve, we have two triodes in the one envelope, making it only necessary to use one of these dual valves in the output stage.

"B" class amplification has a number of outstanding features. A reasonably large output can be obtained with moderate size valves, while the consumption is low, since no plate current is drawn when no signal is applied to the grid. It is essential when designing an amplifier which is to employ "B" class to ensure a steady power supply, otherwise distortion will be introduced on loud signals simply because the pack is unable to supply the peak voltage demands made by this type of valve.

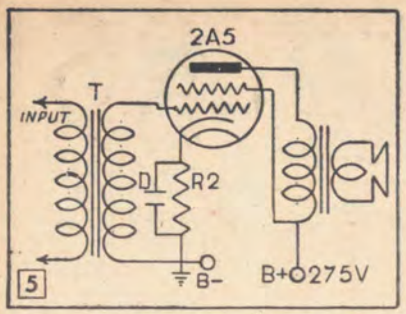
A "B" class audio frequency transformer, which is used for coupling the driver to the "B" class stage, is usually



A Two-valve Amplifier Circuit employing one stage of resistance coupling and one transformer.



A Two-stage Resistance Coupled Unit.

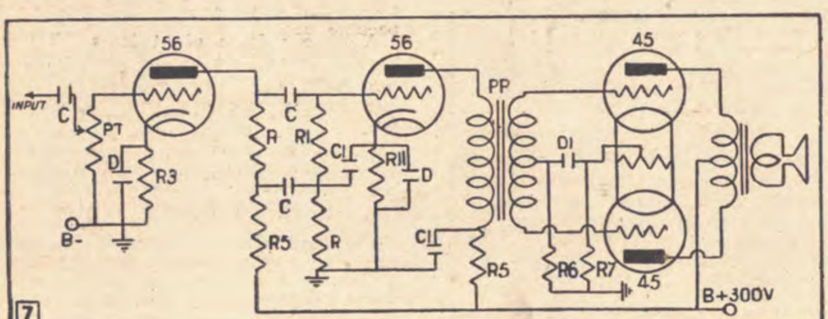


A transformer coupled 2A5 output stage.

a step-down type. It depends upon the following conditions:—

1. The characteristics of the driver valve.
2. The particular type of output valve.
3. The required load on the output valve.
4. Permissible distortion.
5. The peak power efficiency of the transformer.

Care should be taken to see that no distortion is introduced in the driver stage, as it will be reproduced through the "B" class stage in a very pronounced manner. It is advisable to work the driver into a load resistance higher than the normal value for optimum power output.



A reasonably powerful P.A. system, utilising two stages of resistance coupled 56's fed to two 45's in push-pull. Approximately 4 watts output can be obtained.

One of the most important points when operating an amplifier is to pay particular attention to the bias potentials applied to the grids of the various valves. In the case of the a.c. type, if the resistor values are incorrect, it is impossible to secure faithful reproduction. In battery operated amplifiers this point becomes even more important, since you not only spoil the tonal output of the amplifier, but at the same time the valves will draw more plate current, with the result that the life of the "B" batteries is greatly reduced. This point should be carefully watched if satisfactory results are to be obtained.

Practical Examples

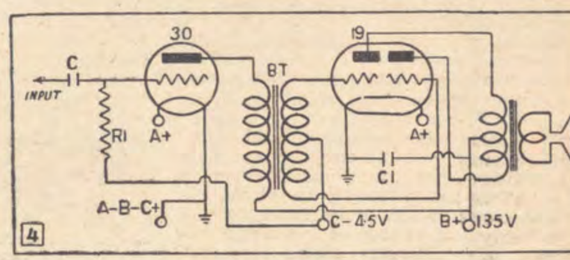
The amplifier shown in Figure 1 is a standard transformer-coupled one-valve unit, suitable for connecting to the output of a crystal, or one-valve, receiver, to raise the signals to a more desirable level. A type 30 valve has been chosen in order to reduce the actual current drain to the minimum amount.

Figure 2 illustrates a two-stage battery operated model employing resistance coupling for the first stage, and transformer for the final one. This system will provide ample loud-speaker volume for any moderately sized room, and can be operated from a 2-volt accumulator and 90 volts of "B" battery. A type 30 valve has been used as a driver for the 33 valve, which is a pentode, and is capable of supplying nearly twice the volume of a standard triode valve.

The next circuit shown (Figure 3) is a two-stage resistance coupled amplifier. Here it will be found that it is not possible to secure the same amount of volume as that delivered by Figure 2, since it depends solely on the amplification of the valves for the step-up of the signal. The quality obtained from this amplifier will be far superior to that of the transformer coupled method.

In Figure 4 diagram we have a circuit which is rapidly coming into the favor of many country listeners. This amplifier employs class "B" amplification, which, as previously mentioned, has the tendency of economising plate current drawn by it. It will be noticed in this particular circuit that we have included 4.5 volts negative bias to the grids of the 19 valve. This negative potential has been applied for the sole purpose of preventing an excess plate current flow on extremely loud signals. It must be realised, however, should this principle be adopted, that it is essential for a special "B" class coupling and output transformer to be employed in order to obtain satisfactory results.

This particular circuit uses a type 30 valve as a driver for the 19, which is a class "B" twin amplifier, actually having two triodes in the one envelope. Owing to the peak voltage demands made by this amplifier, trouble is usually experienced in keeping the plate supply steady, and we have therefore included condenser C1, which has a capacity of 0.5 mfd. in the circuit. With this capacity connected across the B supply a better regulation of voltage will be obtained.



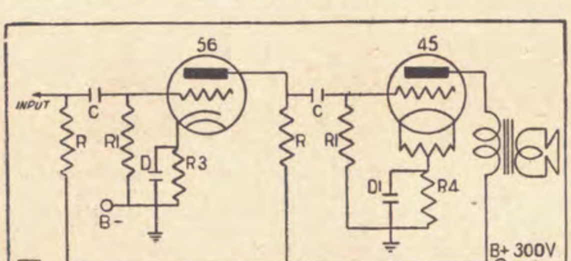
A Two-tube Outfit using "B" class amplification in the output stage.

We deal now with a number of a.c. amplifiers which cover a single 2A5 pentode output valve, suitable for coupling to a super-heterodyne, up to a reasonably powerful P.A. circuit using two stages of resistance coupled 56's as drivers for two 45's in push-pull. The latter design is capable of delivering four watts undistorted output, and it is, therefore, suitable for amplifying speech or music at any small social function.

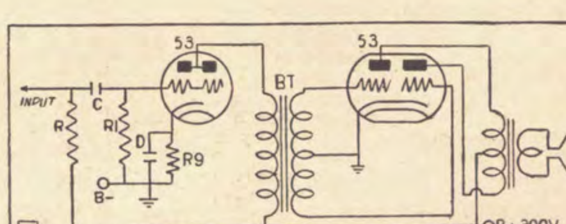
All the voltages, capacities and resistor values are shown on the accompanying diagrams, and if the builder is after faithful reproduction it is important that he strictly adhere to them. All the circuits are of standard design, and each one has been individually tested to ensure its practical value.

A Standard Type

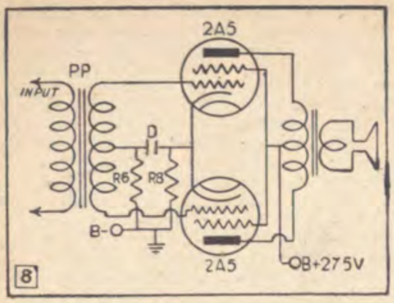
FIGURE 5 illustrates a conventional transformer-coupled 2A5 pentode amplifier circuit, capable of supplying



A Two-stage Resistance Coupled Amplifier employing a 56 as driver for a type 45 power valve.



Class "B" Audio Amplifier using type 53 valves. The first 53 is wired as a triode driver for the final stage.



This circuit is simply an improvement on Figure 5. Here two 2A5's are used in push-pull, giving better fidelity and greater power output.

approximately three watts, with a total harmonic distortion of 7 per cent. This design would be ideal for coupling after the second detector of a standard superhet. assembly in order to boost the signals to good loud-speaker level. The amplifier can be built either directly on the receiver chassis or mounted on a separate chassis, although we would advise the installation to be made on the same mounting as that of the actual receiver. The difficulty which confronts the builder, should the amplifier be designed on a separate chassis, lies in the long leads required to connect the two units together. These external leads would probably introduce hum, which would be absent if the two units were built on the same chassis.

The coupling transformer T should be of a reputable make and have a ratio of 3-1. The resistor R2 has a value of 410 ohms, and must be capable of carrying approximately 50 m/a. This resistor largely governs the quality which is to be received from the model, and it is therefore obvious that it should be of the above stated value and no other. R2 is by-passed to earth by D, which has a capacity of 25 mfd., 25-volt test. The dynamic speaker into which this amplifier is fed should have an input transformer having a primary impedance of 7000 ohms to match that of this particular valve. The actual resistance of the field to this speaker will largely depend upon where it is to be used in the power pack.

The Faithful Triode

The next circuit (Figure 6) uses a type 45 valve in the output stage, but since this valve requires a so much greater signal to swing the grid, it is necessary to employ a driver stage. A most suitable valve for this work is the 56, a triode with similar characteristics to that of the old 227 valve. This stage is resistance coupled to the 45 valve.

A feature of this triode output valve (45) over that of the usual run of pentodes is that it is possible to obtain a deep mellow tone totally lacking in the pentode series.

A Professional Amplifier

Figure 7 employs two stages of resistance coupled 56's fed into two 45's wired in push-pull. Although the expense involved in building this unit will be more than any of the other designs, the actual fidelity delivered by it will be of a very high order.

The amplifier is de-coupled, with the result that it is remarkably silent in operation.

The complete amplifier should be mounted on an aluminium chassis, the actual size thereof largely depending upon the dimensions of the components used. Particular attention should be paid to the fitting of these parts in order to keep the wiring as short as possible. The valve sockets, push-pull transformer, etc., should be arranged in such a manner as to enable direct leads being made from one point to another. The paired heater wiring for this model should be tightly twisted together in order to prevent hum arising from this source.

Push-Pull Pentode

Figure 8 is simply an enlargement on Figure 5, where, in the latter circuit, a single 2A5 valve was used, we have two 2A5's wired in push-pull in this design. Here, again, the coupling transformer PP is a very important factor, and must be of a reputable make in order to obtain faithful reproduction.

As in the other circuits, it is essential to have the speaker input transformer to match the plate impedance of the 2A5's. The resistor R6 is used as a decoupler for this push-pull stage and has a value of 50,000 ohms.

Class "B" in A.C.

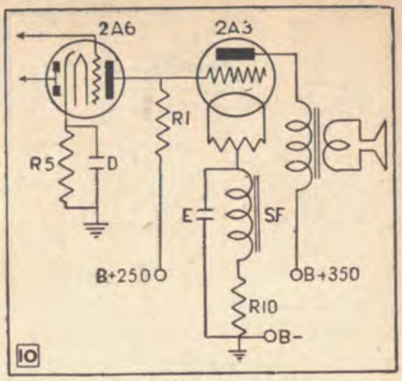
We already have dealt with the action of "B" class amplification, pointing out the advantages and disadvantages of the system. In Figure 9 we have a circuit of an amplifier employing this principle, using a 53 wired as a triode driver for another 53 connected for "B" amplification. The first 53, used as a driver, has the two grids connected together, likewise the two plates, and is operated as a standard triode valve. When using the valve under these conditions, it is necessary to employ a bias resistor with a value of 950 ohms, this developing a negative 6 volt. bias potential necessary for satisfactory operation when the valve is employed as a triode driver. The signal from this tube is fed through a "B" class audio transformer to the grids of the final 53 wired in "B" class.

Probably one of the greatest difficulties in getting faithful reproduction from this type of amplifier is to obtain a steady regulation of plate supply. This trouble is caused by the peak voltage demands made by the type of circuit, in which, as soon as a loud signal is applied to the grid, the plate consumption soars to 125 m/a. From this it can be seen that it is essential for a reliable power-pack to be used, otherwise when these peak supply demands are made, and if the pack is unable to supply the required power, it is obvious that something must be lost, and in this case the quality of the reproduction is sacrificed.

A plate voltage of at least 300 volts should be applied to the centre tap of the speaker input transformer, which will supply the required plate voltage. As can be seen from the circuit diagram of the amplifier, there are actually two valves in the one envelope, and they are wired in push-pull.

KEY TO ALL DIAGRAMS

BT—Class "B" audio frequency transformer (Radiokes, Wendel)
C—0.02 mfd. tubular condenser.
C1—0.5 mfd. tubular condenser.
(Concourse, Raycophone, Saxon, T.C.C., Wetless).
D—Electrolytic 25 mfd. 25 volt test condenser.
D1—Electrolytic 25 mfd. 75 volt test condenser.
E—Electrolytic 8 mfd. 500 volt test condenser (Concoure, T.C.C.).
PP—Push-Pull audio frequency transformer (Paramount, Precedent, Radiokes, Raycophone, Saxon Wendel).
R—100,000 ohms. resistor.
R1—500,000 ohms. resistor.
R5—10,000 ohms. resistor.
R6—50,000 ohms. resistor.
(Carbon resistors, I.R.C., Raycophone, Velco).
R2—410 ohms. wire wound 50 m/a resistor.
R3—5000 ohms. wire wound 25 m/a resistor.
R4—1500 ohms. wire wound 50 m/a resistor.
R7—775 wire wound 100 m/a resistor.
R8—200 ohms. wire wound 50 m/a resistor.
R9—950 ohms wire wound 10 m/a resistor.
R10—500 ohms. wire wound 100 m/a resistor.
R11—2750 ohms. wire wound 10 m/a resistor (Paramount, Precedent, Radiokes, Raycophone, Saxon, Stedi-Power, Wendel).
SF—Speaker field 2500 ohms.
T—Audio frequency transformer ratio 3-1 (Paramount, Precedent, Radiokes, Raycophone, Saxon, Wendel).



A standard direct coupled amplifier using the triode section of the 2A6 as driver for the 2A3.

Back to Loftin White

The final circuit (Figure 10) shows a direct coupled amplifier using the triode section of a 2A6 as a driver for a 2A3 valve. Where, under normal conditions, it is impossible to obtain a full drive from a 2A6 or 75 in a standard resistance coupling it is necessary, both in order to reduce the number of valves and the cost, to adopt a direct coupled circuit. This principle meets the conditions adequately.

Probably the most interesting feature of this model is the means adopted to excite the dynamic speaker. A standard 2500 ohms field is used, and is connected to the centre tap of the heater wiring of the 2A3, through the fixed resistor R10, to earth. Now, since the principle of direct coupling turns on the fact that the grid bias potential of the output valve must be the sum of the normal bias required by the valve (which in this case is 45 volts negative), plus the total positive voltage fed to the plate (120 volts) of the 2A6 through the resistor R1, it is obvious that a potential of 165 volts must be developed across the speaker field and R10. Therefore, in this particular circuit, where 55 m/a is drawn by the plate of the 2A3, it is necessary to insert a total resistance of 3000 ohms to obtain the desired effect. That is to say, 500 ohms 100 m/a wire wound resistor (R10) should be connected in series with the 2500 ohms speaker field.

From these figures it can be seen that not only is the speaker field excited to the extent of 9 watts, but at the same time it is used as portion of the necessary bias resistance.

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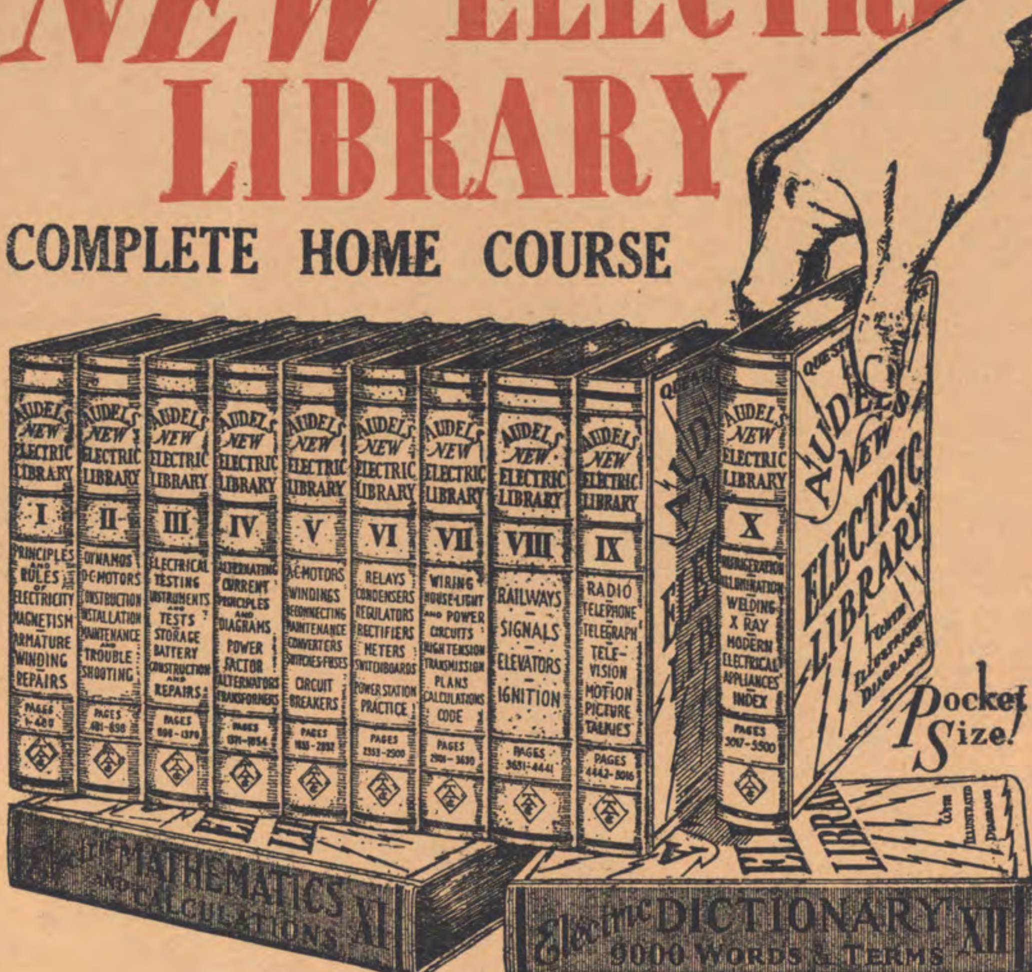

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