MODERN RADIO & HOME RECORDING

- ELECTRIC SETS
- BATTERY SETS
- SHORT WAVES
- HOME RECORDING

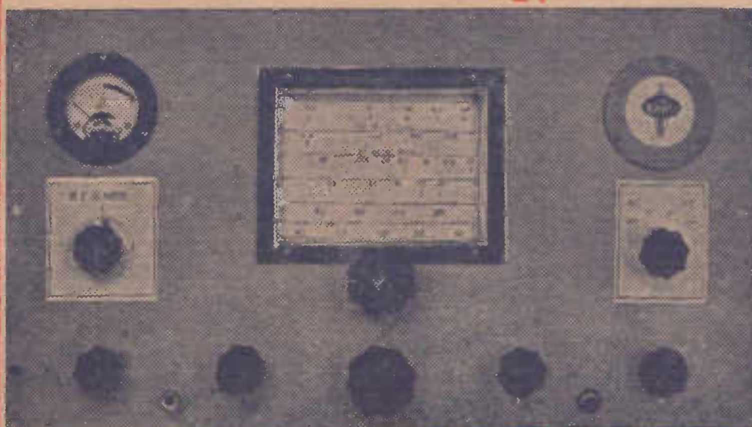
2/-

THE LISTENER IN HANDBOOK No. 16 . . .

"FERROTUNE"

NEWS FLASH!

"FERROTUNED" HAM BAND BASIC RECEIVER (Type K'CR'12)



Features of the Ferrotuned Ham Band Basic Receiver include:

- Turret changed coils
- Tunes and Band spreads the following bands: 40-20-11-10 and 6 metres
- B.F.O. (Ferrotune)
- Crystal Filter (optional)
- Speaker or Phone connections
- Noise limiter (variable)
- Signal meter
- Sensitivity and Audio Controls

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Type K.F.T. 1 = 5 Tube Table Model
" K.F.T. 2 = 3 " Reinartz
" K.F.T. 3 = 4 " Mantel

These outstanding FERROTUNE ferromagnetic gangless tuning units cover the broadcast band — include tuning mechanism, straight line dial, padding and trimming, etc.—does not need further alignment.

SPECIAL FERROTUNE EQUIPT.

- 6 and 10 meter Convertors Ferrotuned.
- FERROTUNED V.F.O. (Variable Freq. Osc.) for HAM TRANSMITTERS.
- Ferrotuned HAM Band Preselectors with turret changed coils.
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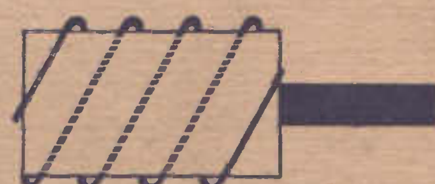

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For information on "Permaclad" components see inside Back Cover.

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and
HOME RECORDING

The Listener In Handbook
No. 16 — 1947

MODERN RADIO & HOME RECORDING

The Listener In Handbook
No. 16 - - 1947

EDITED BY A. K. BOX

foreword . . .

BEGINNING in 1932 The Listener In, as a further service to its technically-minded readers, began to produce handbooks which provided the army of home set-builders with the information necessary to help them get the best from their hobby.

Each year a new handbook epitomising past improvements and giving advance information about those to come were produced and distributed throughout every State in the Commonwealth. In some years two manuals were published.

The latest to appear was Handbook No. 15 which, published under the title "Short Waves," took its place on the bookstalls just after the outbreak of World War II.

IT was the last of a series of technical handbooks — the aggregate circulations of which totalled several hundreds of thousands of copies—which The Listener In was to produce for seven years. Lack of staff, technical radio, and newspaper equipment, and the scarcity of components needed to build radio sets prevented any serious interim attempt to cater for the younger groups of radio enthusiasts. . . . Today, however, staff and newsprint restrictions have eased slightly and there is an increasing flow of component parts to the retail radio market. Added to this is the important series of radio developments which have taken place during wartime.

THESE trends, and the desire to cater for the big groups of juniors and ex-servicemen radio technicians who have returned to radio as a hobby, have influenced us in our decision to resume the well-regarded series of The Listener In Handbooks.

It would have been easy for us to embark on this initial post-war handbook with a series of articles on the construction of the very latest types of equipment and to have disregarded all that had gone before.

However, as it was felt that the needs of the younger class of radio enthusiasts should be provided for adequately, it was decided to include elementary as well as advanced material in the No. 16 Handbook.

PRACTICAL needs have been catered for by descriptions of efficient battery, vibrator and a.c.-operated receivers, both broadcast and dual-wave types, while attention has also been given to the recent perfection of Permeability Tuning and VHF receivers.

Despite the standardisation of many of radio's techniques there is still a large and untouched field awaiting exploration, and it is in this field that the true radio hobbyist will find most of his interest and entertainment.

The Editor

Introduction to . . . HOME RECORDING

A BRIEF description of how the sound is put on the disc will be given first, in order that the more detailed information which is to follow may be more fully understood.

The disc itself is composed of a flat circular piece of metal (for strength) usually aluminium on which a coating of lacquer has been sprayed to a thickness of several thousandths of an inch. This lacquer has a cellulose base and has certain other materials associated with it to control its hardening.

Upon this lacquer the cutting head, via the cutting needle, cuts a groove of varying width, due to the cutting needle varying in its swing from side to side, according to the electrical impulses impressed upon it.

The sound waves generated by the voice cause the air to vibrate in sympathy. These air vibrations strike the diaphragm of the microphone and cause it to respond in the same way, thereby generating minute electrical currents. These in turn are amplified by means of an audio amplifier until they reach sufficient proportions to cause the cutting head to develop the side to side mechanical movements which have been spoken about previously.

Equipment Required

WHEN playing the finished record, the pick-up operates in exactly the reverse direction, that is, the side to side movement of the pick-up in the groove generates small electrical currents, which are again amplified. The amplified currents flowing through the loud speaker winding start its diaphragm vibrating, and per medium of its diaphragm it disturbs the air, and so we are back to where we started.

The equipment necessary to commence home recording is as follows: —Cutting head; traverse mechanism; motor and turntable; amplifier or amplifier section of radio receiver; discs and pick-up.

We may use a pick-up as a cutting head, providing we make certain modifications.

Several makes of pick-up have been used by the writer with great success as cutting heads. Of these the most suitable were the "Webster," nickel or gilt "B.T.H." and the "Audak." All of these were of the vertical type and are therefore much easier to mount than the horizontal types.

Before we go into the matter of modifications a brief description of record characteristics will help the amateur in appreciating the need for these modifications.

> HOME Recording can be compared with taking pictures. The first few pictures may not be very good, but the amateur photographer knows that he can make good pictures with a little thought and perseverance and the same can be said of Home Recording. Records can be made at home with average apparatus within the range of the average bank balance, that compare more than favorably with commercial pressings, if the amateur recordist is prepared to take the trouble to understand the proper working of his equipment.

The main problem with recording on disc is that of over-cutting, that is cutting into the previous groove. The cutting head when fed with varying frequencies of the same volume level will cut a groove at 50 cycles per second twice as wide as when fed with a frequency of 100 c.p.s., and four times as wide as when fed with a frequency of 200 c.p.s., and so therefore unless the swing of the cutting needle is controlled there is the greatest tendency for two adjacent grooves (the spacing of which is mechanically controlled by the traverse gear) to cut into each other at the bass frequencies.

In commercial recording units this is accomplished by means of bass attenuation equalizers associated with the equipment or in the design of the cutting head.

Cutter Adjustment

THE amateur recordist will require to adjust his pick-up cutter so that this overcutting does not occur. Most of the pick-ups of the type mentioned had an adjustment whereby this could be done. It involved adjusting the rubber damping that is used to stop the armature from touching the pole pieces till the armature had very little side to side movement.

The degree of stiffness required can only be found by experience, but it should never be so tight that it cannot be moved by the pressure of the fingers. It must also be remembered that the tighter the adjustment of the armature the more power is required to operate the cutter, with consequent lower volume of sound on the disc, and, worse still, possible distortion due to the overloading of the amplifier, caused through trying to obtain the required volume. However a few trial cuts will soon indicate to the amateur the adjustment necessary.

Next we come to the coil of the cutter. As most pick-ups have an impedance of from 5000 ohms upwards, the only way they can be used in their existing form is across the primary of the speaker transformer, which is not recommended.

Besides reducing the load on the output valve, and thereby causing distortion, it will also allow a certain amount of the d.c. plate current of the output valve to flow through the coil with consequent reduction in efficiency and possible burning out of the coil.

Traverse Gear

THE best method is to have the pick-up rewound to suit the load of the amplifier or radio that you intend using. As most amplifiers have an output load impedance of 500-600 ohms it is not much trouble to rewind the unit to this value. In the case of a radio set, the pick-up can be wound to the same impedance as the voice coil on the speaker and substituted for the voice coil when being used.

Though very encouraging results can be obtained by using pick-ups as cutters, it should be borne in mind that at their best they are only substitutes for the genuine cutting head, which is designed for the purpose.

Next in importance comes the traverse mechanism.

The function of this piece of equipment is to drive the cutting head across the disc, in such a manner as to space the grooves a predetermined distance apart, usually in the vicinity of 92 grooves to the inch. Attached in most cases to the centre spindle of the turn-table, by a shaft which in turn, through a system of gears operates the feedscrew, the pitch of which, in conjunction with the gear ratio, determines the number of grooves to the inch.

Though the amateur may wish to manufacture his own traverse gear, it is not recommended unless he is skilled in mechanical engineering, because the precision required for this piece of equipment is quite beyond the average enthusiast.

Cause of "Rumbling"

IF, for example, there is play in the bearings that hold the cutting head, it will cause the grooves to be spaced unevenly, with the possibility of one groove cutting into the next. This fault is purely mechanical, and is not to be confused with the overlapping of the cutter as mentioned earlier in this article.

Bad bearings can also cause a form of rumbling sound to be heard on the disc, the vibration being transmitted mechanically to the cutter and thence to the disc. It will be obvious that whether the cutting needle is moved by electrical or mechanical means, that movement will be recorded on the disc.

In the same way badly cut gears can also affect the recording. The importance of vibration-free traverse gear cannot be over-stressed.

The problem of vibration can also be encountered in the turntable. Actually there are two problems with this part of the equipment—vibration and lack of power in the motor.

The vibration can be traced in the case of the ordinary electric gramophone motors to badly cut gears, faulty bearings or because the motor itself is not belanced. This vibration, particularly in the case of the motor itself, usually takes the form of a hum which is transmitted to the turntable, thence to the disc, and has the effect of modulating the recording to such an extent that in bad cases it reproduces with a gurgling sound.

The power requirement is another important factor, for the power needed to cut a disc is much greater than that required to play an ordinary record. The cutter has to cut into the disc and this drag requires power from the motor to overcome it if the turntable is to be kept at the constant speed, which is essential. Any variation of the speed will cause a corresponding variation in pitch.

The Amplifier

THE gramo motor as used in radio combinations will cut up to eight inch diameter records quite satisfactorily, but for ten or twelve inch discs it is advisable to use a turntable that is powered by a separate motor. This has the added advantage that all vibration problems so far as the motor and turntable are concerned are eliminated.

Though a lot could be written about recording amplifiers, it is sufficient to say that if the following hints are observed very good results can be obtained. Whether the amplifier be one built for the purpose or the audio section of a home radio, it must be capable of delivering an undistorted volume output of at least two watts, for, though the average power required by the cutter is only approximately half a watt, the transient peaks that give life to the reproduction may reach many times this value.

by
JOHN WALSH

Hum level from the power supply must be very low, otherwise the same trouble will be encountered as with the motor — it will modulate the recording.

The response to frequencies from about 50 cycles per sec. to 5000 cps needs to be reasonably linear. The greater freedom from peaks in the response of the amplifier, the more natural the recording.

Recording

HAVING arrived at the stage where we are ready to commence recording, we first of all must make sure that the cutting needle is held tightly into the chuck of the cutting head. This is important, as any needle chatter here would not only give rise to distortion, but there would be a considerable loss of high notes. Remember to fit the needle so that its flat surface is facing the direction of the turntable's rotation.

Next the whole of the assembly of the traverse is lowered on to the disc. With the cutter resting on the disc, ready to cut, the needle should be at an angle of 90 deg. to the disc. If the needle slopes in towards the disc it will dig in to the lacquer and will cause the cutting head to bounce with consequent damage to needle and cutting head.

If the slope is away from the disc it will tear rather than cut and the general effect will be poor quality reproduction and a lot of background noise.

With a fresh disc and sharp needle the recording should be almost noiseless; at least quieter than a commercial pressing.

It is advisable before commencing recording to try a few sample cuts. A few revolutions of the turntable will do, and if the disc is hard, the cutting angle wrong, or the needle blunt, it will be noticed in the form of a whistling or scratching sound from the cutter.

It is a good idea when the angle of the needle has been adjusted, to leave the needle in position till such time as it is necessary to replace it, as the needle will never go back into the identical position that it was in before, and in the case of steel needles, the life will be reduced due to uneven wearing of the cutting surface.

Record Care

THE discs should be kept in airtight containers till they are to be used. In the event of the disc being hard, it will soften in a few hours if suspended in a tin about the size of a household boiler, on the bottom of which has been sprinkled about a teaspoonful of amyl acetate. This tin must be airtight. The fumes only of the amyl acetate penetrate the disc and soften it. On no account must the liquid touch the disc. If it does the lacquer coating will run. The term "soft" means only that the disc is soft enough to cut without noise.

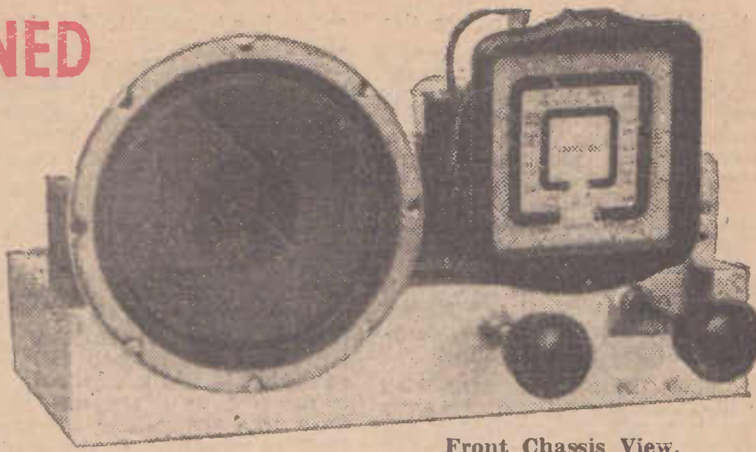
Having finished the recording, it is a wise precaution to rub over the disc with a hardening preparation that can be obtained when purchasing the discs. A few drops on a piece of cloth will be suffiicient.

This hardens the disc almost immediately and reduces the possibility of damage due to faulty pick-up tracking whilst in a soft state.

Whilst on the subject of pickups, it is to be remembered that home recordings will last a greater number of playings only if a light weight pick-up, and one that has little tracking error, is used.

PERMEABILITY TUNED
REINARTZ A.C. THREE

Selective and Sensitive— Tuned by Iron Core — Large Audio Output — Extremely Simple to Build.



Front Chassis View.

IN the early days of broadcasting the simple Reinartz receiver was the immediate goal of almost every novice who was building a valve receiver. Unfortunately, the Reinartz, and similar type sets, fell into disfavor as Australian broadcasting services developed.

This was due to the increase in the number of broadcasting stations, which resulted in demands for selectivity which the Reinartz and similar circuits were unable to meet. However, because of wartime developments, the Reinartz makes its reappearance in a new and streamlined form which is calculated again to bring it into favor with set builders.

The secret of the 1947 model Reinartz lies in the use of iron cored and permeability-tuned coils, which not only raise the sensitivity of the receiver to unprecedented levels, but also increase its selectivity to a point where little if any inter-station interference is likely to be experienced in even the most unfavorable localities.

At a distance less than one mile from the centre of Melbourne it is possible to bring in 3GL, 1350-k.c., at good loud speaker strength, without interference from either 3AW or 3XY which respectively are 70 k.c. below and above the 3GL frequency. This is not a really bad performance from a regenerative detector-cum-audio receiver.

Another point about the design is the simplicity of the circuit and the fact that a single-gang condenser—a type difficult to obtain these days—is eliminated and replaced by the more efficient permeability-tuned iron core-tuned coils which have special advantages when applied to regenerative-detector type receivers.

Another point of interest in the present design is that it is possible to purchase a pre-fabricated chassis on which to assemble the loudspeaker and the other components which make up the set. In these times, when aluminium chassis are difficult to obtain, and when the labor of cutting holes and mounting "ports" in a steel chassis is a job for a mechanic who has access to a kit of good tools, the "pre-fab." chassis is not to be despised.

Assembling the Components

START the assembly of the receiver by mounting the three valve sockets, arranging them so that the Nos. 2 and 7 lugs on the sockets for V2 and V3 face the rear wall of the chassis and the corresponding lugs on the V1 socket face towards the tuner unit.

Next, mount the power transformer in the cut-out provided for it. The filter choke, CH, should be bolted to the underside of the chassis near the power transformer. Then mount the Ferrotune unit, securing it to the front wall of the chassis by means of the two screws provided and to the rear top of the chassis by means of the mounting bracket on the rear of the tuner unit.

Mount the potentiometer, VC, on the front wall of the chassis.

It is not desirable at this stage to mount either the tuning dial or the loudspeaker. The speaker can be mounted during the final stages of wiring, and the tuning dial just before the receiver is being tested for correct operation.

Rear View of Chassis.

REINARTZ A.C. THREE PARTS LIST AND SCHEMATIC DIAGRAM

CHASSIS: Stamped steel chassis with mounting holes for coil unit, loudspeaker, dial, valves and power transformer.

COIL UNIT: Kingsley Radio Ferrotune Unit, type KFT2 (L1, L2), with dial.

C1, C2: 3 30 uufd. Trimmer Condensers (in coil unit).

C3: 50 uufd. Mica Condenser (in coil unit).

C4: .0004 ufd. Mica Condenser.

C5: .0001 ufd. Mica Condenser.

C6: .5 mfd. 400 Volt Tubular Condenser.

C7: .001 mfd. Mica Condenser.

C8: .01 mfd. Mica Condenser.

C9: 25 mfd. 25 Volt Electrolytic Condenser.

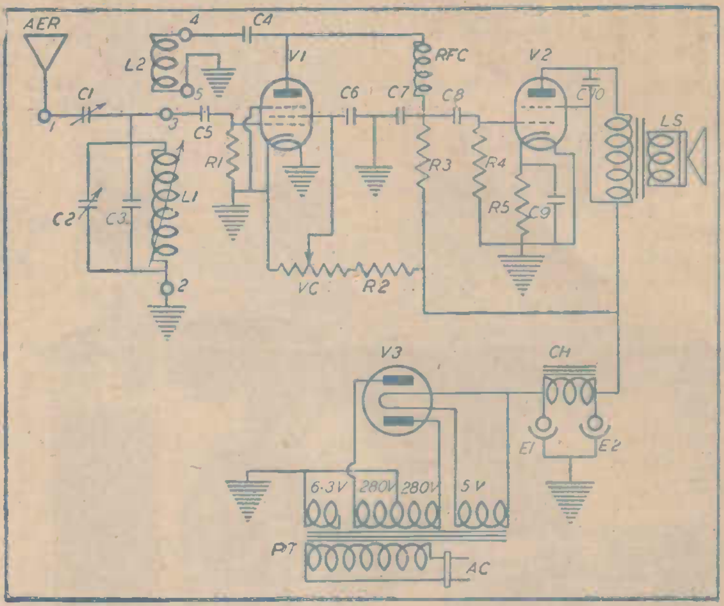
C10: .005 mfd. Mica Condenser.

CH: Permagnetic Speaker, 5 inch (output to match 6V6G).

E1, E2: 8 mfd. 500 Volt Electrolytic Condensers.

PT: Power Transformer: 250-0-250 v. at 60 mA, 6.3 v. at 1A, and 5 v. at 2A.

RFC: Radio Frequency Choke.



R1: 2 megohm ½ watt Resistor.

R2: 50,000 ohm ½ watt Resistor.

R3: 250,000 ohm ½ watt Resistor.

R4: 1 megohm ½ watt Resistor.

R5: 250 ohm 3 watt Wirewound Resistor.

VALVES: One each 6J7G, 6V6G and 5Y3G.

VC: 500,000 ohm Potentiometer.

SUNDRIES: Hook-up wire, two knobs, three octal sockets, flex, one grid clip, one ½ in. grommet, 10 ft. of power flex.

Point To Point Connections

START the wiring by running one of the 250 volt high voltage secondary leads to the number 4 lug on the V3 socket, and the other 250 volt lead to the number 6 lug on the same socket. One of the 5 volt leads from this transformer goes to the number 2 lug on the V3 socket, and the other 5 volt lead to the number 8 lug on the socket. To this number 8 lug wire the positive lead of one of the 8 mfd. electrolytics. Join the negative lead of this elecrolytic, the high voltage centre tap of PT and one lead of the 6.3 volt winding on PT to the No. 1 lug on the V3 socket. Join one lead of the filter choke, CH, to the number 8 lug on the V3 socket and the other lead to the positive lead on the second 8 mfd. electrolytic condenser, E2. Join the negative lead of E1 and E2 to a solder lug under one of the transformer securing bolts and wire this lug also to the No. 1 lug on the V3 socket. Join the same lug on the V3 socket to the number 1 lugs on the V2 and V1 sockets. Join the No. 1 and number 2 lugs on the V3 socket.

Wire the number 7 lug on the V1 socket to the corresponding lug on the V2 socket, and to this point join the remaining 6.3 volt filament lead from the power transformer, PT.

To the junction of the choke, CH, and the positive lead of E2 solder a lead which joins to the No. 4 lug on the socket for the 6V6G valve, V2. To this same lug on V2 solder one lead of each of the resistors R2 (50,000 ohms), R3 (250,000 ohms) and the .005 mfd. condenser, C10. The remaining lead on C10 is wired to the number 3 lug on the V2 socket.

To the number 8 lug on the socket for the 6V6G valve V2, solder one lead of the 250 ohm resistor, R5, and the positive lead of the 25 mfd. electrolytic condenser, C9. Join the vacant leads of these two components to the number 1 lug on the V2 socket. Wire one lead of the .01 mfd. condenser, C8, and one lead of the 1 megohm resistor R4, to the number 5 lug on the V2 socket and connect the other lead of R4 to the number 1 lug on the same socket.

Join the vacant lead of the 250,000 ohm resistor R3, one lead of the .001 mfd. condenser C7 and the vacant lead of the .01 mfd. condenser, C8, to one lead of the radio frequency choke, RFC, and wire the vacant lead of this choke and one lead of the .0004 mfd. condenser C4 to the No. 3 lug on the V1 socket.

To the number 4 lug on the V1 socket join one lead of the .5 mfd. condenser, C6, and a lead which terminates at the centre lug on the potentiometer VC. The vacant lead on C6, one of the outside lugs of the potentiometer, VC, and one lead of the 2 megohm resistor, R1, should be soldered to the number 8 lug on the V1 socket. This lug should also be joined to the number 1, number 2, and number 5 lugs on the same socket. Join the vacant lead of the 50,000 ohm resistor, R2, to the vacant lug on VC.

Coil Box Wiring Details

A SMALL piece of bakelite should now be fitted with a solder lug and mounted on the underside of the chassis, near the V1 socket, in such a manner that the solder lug will not make contact with the chassis. To this lug solder the vacant lead of R1, one lead of the .0001 mfd. condenser, C3, and a lead which passes up through the chassis to terminate in the grid clip for V1.

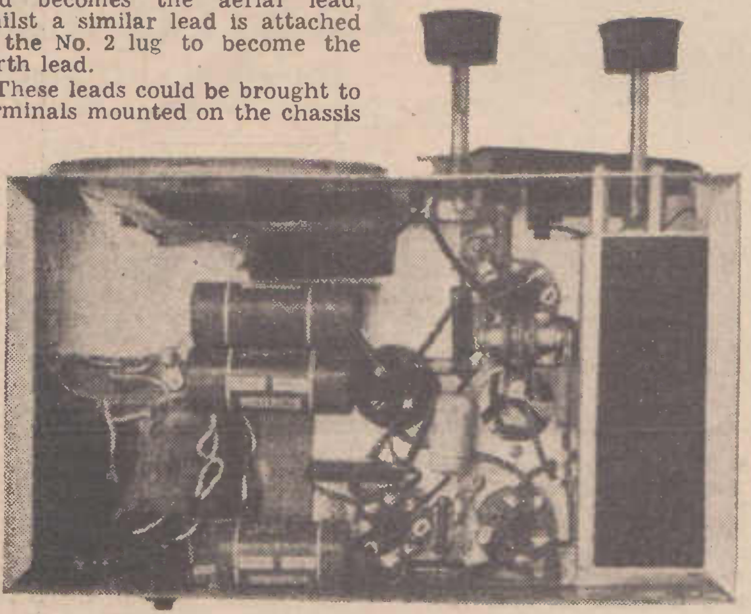
The vacant lead of condenser C5 next is joined to the No. 8 lug on the coil box. A lead is attached to the No. 1 lug on the box and becomes the aerial lead, whilst a similar lead is attached to the No. 2 lug to become the earth lead.

These leads could be brought to terminals mounted on the chassis if desired—the aerial terminals being insulated, of course, but this is not essential.

The No. 2 lug on the coil box in any case should be connected to the No. 1 lug on the V1 socket, as is a lead from the No. 5 lug on the coil box. Complete the coil box wiring by attaching the vacant lead on the .0004 mfd. condenser, C4, to the No. 4 lug on the coil box.

Next, mount the loudspeaker in the cut-out provided at the left-hand front end of the chassis. Join one of the loudspeaker leads to the No. 3 lug on the V2 socket for the 6V6G and the other lead to the No. 4 lug on the same socket.

The wiring is completed by fitting the rubber grommet to the hole through which the power flex is to pass, threading the flex through it, and soldering it to the AC input lugs on the power transformer.



View of components beneath the chassis.

Testing the Receiver

TO test the receiver, plug in the valves, fit the grid clip to V1, attach the aerial and earth to their respective leads from the coil box and switch on the set. Allow it to warm up for a few seconds, and then, with the reaction control potentiometer advanced fully to the right, tune over the dial until a whistle is heard.

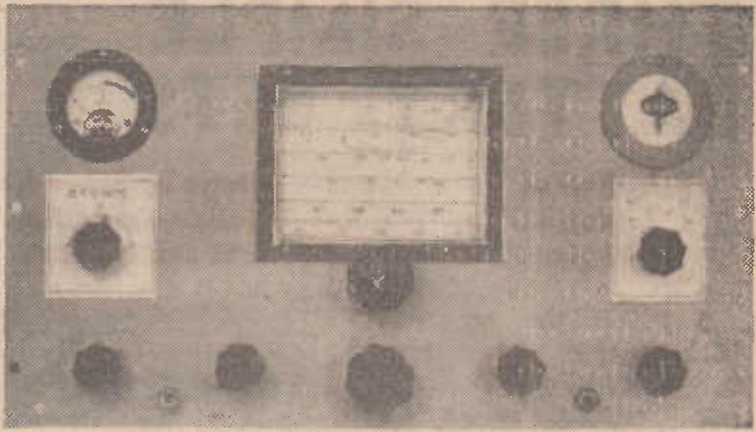
Bring the receiver out of oscillation by slowly turning the reaction control to the left, and when the set is just on the verge of oscillating—whistling—slightly retune the main control.

RADIO BATTERY SPECIFICATIONS

Weights, dimensions, type numbers and permissible current drains of "Diamond" "A," "B" and "C" batteries.

Type	Description	Outside Dimensions Length inches	Width inches	Height inches	Weight	Recommended Maximum Current Drain
"B" BATTERIES						
Tripledyne	45 volt Triple Duty	8 ⅛	4 ⅛	7 ¾	10lbs. 6oz.	20 ma
Tripledyne "P"	45 volt Triple Duty "Plug-in"	8	4	7 7/16	10lbs. 6oz.	20 ma
P 45	Portable "B" 45 volt	4 ⅜	2 ½	5 ⅞	2lbs. 8oz.	10 ma
3482	Portable "B" 45 volt "Plug-in"	3 19/32	1 27/32	5 ½	1lb. 14oz.	10 ma
3467	Portable "B" 67½ volt	1 ⅜	2 13/16	3 11/16	12oz.	4 ma
RC 304	Portable "A" and "B" ("A" 1½v.—"B" 90v.)	7 ¾	4 9/32	5 ¾	8lbs. 3oz.	10 ma
"A" BATTERIES						
Powerfil	1.5 volt Triple Duty "A"	8 ⅛	4 ⅛	7 ¾	10lbs. 6oz.	300 ma
Powerfil "P"	1.5 volt Triple Duty "A" "Plug-in"	8 ¼	4 ⅛	6 ⅛	10lbs. 4oz.	300 ma
P 1.5	1.5 volt Portable "A"	5 1/16	2 ½	4 5/16	2lbs. 13oz.	300 ma
No. 315	1.5 volt Portable "A"	2 9/16	2 9/16	4 ½	1lb. 8oz.	300 ma
3745	1.5 volt Portable "A" "Plug-in"	3 ⅞	1 7/16	10 13/16	2lbs. 13oz.	300 ma
Buzzer	1.5 volt No. 6 Type Cell	2 ½	diameter x	6 ½	2lbs. 0oz.	300 ma
X.	1.5 volt Square Cell	1 7/16	1 7/16	4 ⅛	6oz.	250 ma
"C" BATTERIES						
4½ HDC	4.5 volt Heavy Duty "C"	4	1 5/16	3 ⅜	12oz.	—
9v. C	9 volt Light Duty "C"	5	⅞	3	10oz.	—

RECEIVER *for the* AMATEUR



The receiver is designed for rack and panel mounting or for table mounting in a metal box.

- **Turret Type Coil Selection**
- **Variable Crystal Filter**
- **High Sensitivity**
- **Low Noise Level**

ONE of the essentials for the radio transmitting amateur or for the DX enthusiast who takes a really keen interest in the reception of international broadcasting is a really good communications type receiver.

With such a receiver the amateur or the short wave b.c.l. can tune back to a given frequency at any time with the knowledge that he will be "right on the dot" and not 200 or 300 k.c. off the beam.

One of the first of the post-war locally manufactured communications type sets to come off the production line is the Kingsley K/CR/12, built by an organisation which during the war made thousands of communications sets for Army and Air Force.

The K/CR/12 is a nine valve permeability tuned super-het which employs a new turret type of coil assembly permitting rapid change to any of four selected bands and providing high calibration stability, uniform gain on all bands and an extremely large dial coverage, together with a vernier logging scale.

The receiver is designed as a basic set and consists of a mixer stage (ECH35) followed by two permeability tuned I.F. stages on 1.9 megacycles (6SK7's), a second detector—AVC (6SQ7) and an audio stage (6V6GT).

A 6SN7 tube functions as a BFO and "S" meter tube, and the 5Y3 rectifier is stabilised with a VR150 regulator tube. The BFO is Ferrotuned and AVC is switched out of circuit when the BFO is needed.

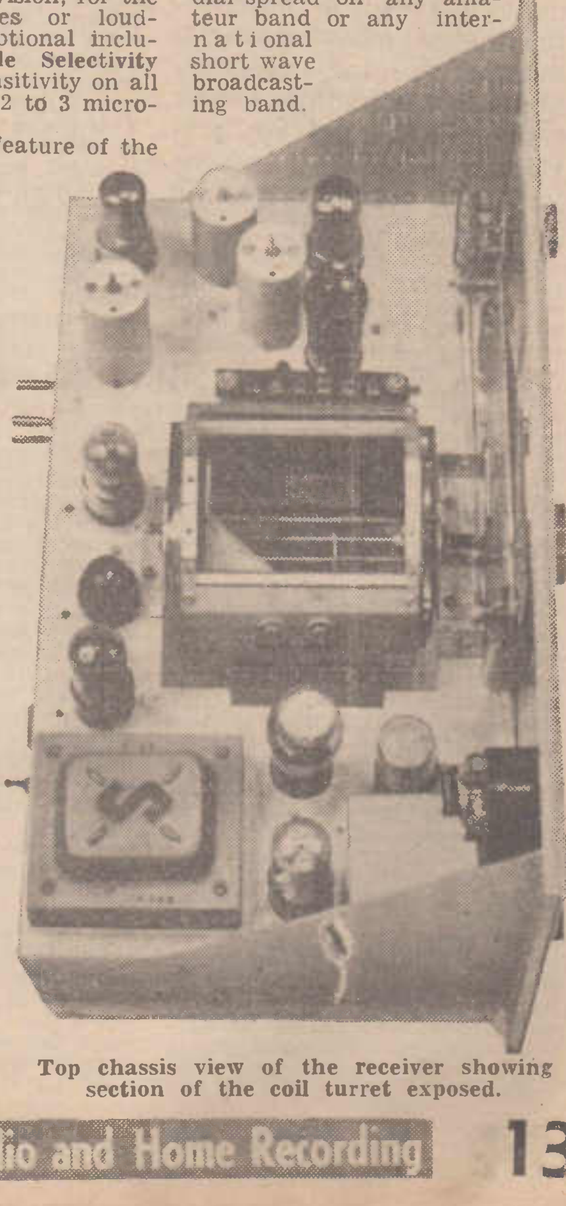
Other features of the K/CR/12 include a very effective noise suppression circuit provision, for the use of either phones or loudspeaker and the optional inclusion of a **Variable Selectivity Crystal Filter**. Sensitivity on all bands ranges from 2 to 3 microvolts.

Most interesting feature of the set, however, is its tuning system. In the central turret are mounted four sets of coils, each of which covers a specific band. These coils are connected to contact pins which engage positive wiping contacts as the turret is rotated.

Each set of coils is adjusted before installation in the turret and is secured in the latter by means of four screws.

Thus — and this is a very important point to the amateur interested in point to point com munication or the short wave b.c.l. who must listen on different bands at different times of the day and at different seasons of the year—the waveband combination can be changed at will to cover any four bands from 50 to 3 megacycles (6 to 100 metres).

Furthermore, the band-spreading of the coils is so planned as to give a full dial-spread on any amateur band or any international short wave broadcasting band.



Top chassis view of the receiver showing section of the coil turret exposed.

THREE SIMPLE BATTERY SETS

Selection of Valve Types — Stage by Stage Construction — Coil Winding Details — Addition of Automatic Bias — Alignment Instructions.

AFTER the novice set builder has played around with crystal sets—sometimes before he has tackled this stage of his radio education — he becomes interested in the more sensitive although slightly more complex, valve types of receiver. It is with the object of catering for his needs in this direction that the following general information and constructional details on three simple types of valve set are provided.

There is nothing difficult or complicated in any one of the circuits shown and they can be relied upon to give reliable reception anywhere. Naturally, the two and three valve receivers will give better results than the one-valver, but the beginner would be well advised to start in on the simple one-valver and graduall add to this. In this way a ground work of knowledge is built up which will be very useful when the change from battery to A.C. sets is contemplated.

The first question which arises when the construction of a valve type set is decided upon is the type of valve to use. It is not intended to detail any special type of valve for these receivers, but to give the builder some details on the type of valves that are suitable and let him decide for himself the one most suitable for his purpose.

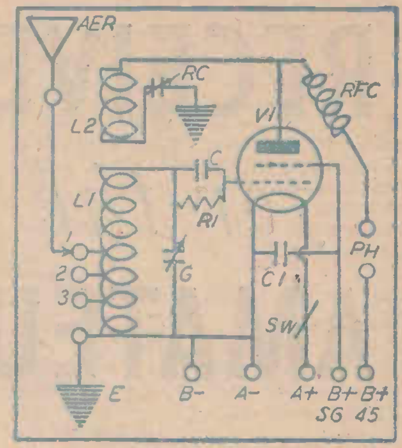
The choice of valve brings us first to the batteries available for sets of this type. In the case of the one-valve set we require two batteries. The first is known as an "A" battery and is employed to heat or light the filament of the valve. The second is called a "B" battery and its purpose is to apply a fairly high voltage to the plate of the valve. In the past battery valves have been made in a wide variety of filament voltages including 1.4, 2, 3, 4 and 6 volts. The modern trend however is to stick to the 1.4 and two volt types and for the purpose of these articles we propose to standardise on these types. It should be understood though that other valves may be employed, providing the manufacturers' ratings for filament-plate voltages are used.

In the case of 1.4 volt valves a single dry cell type of "A" battery is used to light the filament of the valve. For the two volt type valves we have a choice of wet or accumulator type cells or dry cells arranged in series. For instance, two dry cells connected with the positive of one to the negative of the other provides a total of three volts as an "A" battery supply. This would require a dropping resistor of some kind to reduce the three volts to two required for the valve filament. The latter would be burnt out if too high a voltage was used. Alternatively, the old-fashioned rheostat can be employed if care is taken to see that the valve filment is not overloaded when the batteries are new.

The One-Valve Receiver

THE one-valve set employs a screen grid type valve as a regenerative grid leak detector. As in the case of the crystal receivers a single gang tuning condenser is employed as a station selector and the coil or inductance. L1. is tapped to provide various degress of selectivity. Coil L2. is known as a reaction winding and its purpose is to provide feedback between the grid and plate circuits of the detector valve, V1. The circuit shown here is usually known as a Reinartz, and high efficiency commercially wound Reinartz coils are available from the radio houses. However, if the constructor so desires he may adapt the tapped coil described for the crystal receivers. It will be necessary of course to add the reaction winding, L2. This should consist of about 30 turns of finer gauge wire than the main coil wound in the same direction as it, but spaced about ¼ inch from the earthed end.

As in the case of the crystal sets the layout should be such



Single Valve Receiver.

that short direct leads are possible between components. This is even more important in the case of the two and three valve receivers. The constructor should give careful consideration to the layout of each and every set.

The one-valver may be built up on a panel and baseboard, or the far-seeing constructor who wishes to advance in the hobby may care to make up or have made a metal chassis with provision for later adding to his one-valver the necessary parts to convert it into the two or three valve receiver, dealt with later in this article.

Aluminium is again becoming available and as this semi-soft metal is easily worked, even by the amateur, a chassis of this material, about 12 inches by 9 inches could be used, and the one-valver built upon this. For the purpose of this article we will assume that eventually the original one-valver is to be added to and subsequently will become the three-valve T.R.F. battery set mentioned above.

Mount the tuning condenser, G, together with its dial assembly in the centre of the chassis. Directly behind this condenser mount the socket for the valve, V2. On the front of the chassis and on either side of the main tuning control mount the switch, SW and the reaction condenser, RC.

The switch should be mounted at the right of the tuning control. The coils L1-L2 are mounted on the right hand side of the tuning condenser and close to the valve socket. The aerial and the two phone terminals. which must be insulated from the metal chassis, are mounted on the back wall of the chassis. The earth terminal which screws straight on to the metal, and the aerial terminal are at the right hand rear side of the chassis and the phone terminals are on the left.

The radio frequency choke, RFC, must be provided with a small bracket as both its connections must be insulated from the metal. This unit is bolted down close to the valve socket below the chassis. A hole fitted with a rubber grommet should be drilled near the phone terminals. Through this hole will pass the battery leads.

Wiring The One-Valve Set

BEGIN the wiring by joining a bare tinned wire lead to a lug under the earth terminal and connecting this in turn to the moving plate lugs of both the variable tuning condenser G, and the reaction condenser, RC, the earth end of the coil, L1, and the filament lug of the valve socket. To this point also connect a length of Black covered wiring flex and pass this through the hole in the back wall of the chassis.

Label this lead "A" negative, "B" negative.

Connect the start or G end of the coil L1 to one side each of of the grid resistor, R1 and the grid condenser, C, and to the fixed plate lug of the tuning condenser, G. The unconnected lugs and R and C wire to the grid clip, which connects to the grid pip of the valve. To the P or plate lug of the valve socket join one lug of the radio frequency choke RFC, and the P or outside lead to the reaction winding, L2. The other lead from this winding joins to the fixed plate lug of the reaction condenser, RC. The other lug of the RFC joins to one phone terminal. To the other phone terminal attach a yellow flexible covered lead and pass this through the battery lead hole in the back of the chassis. Label this lead "B" positive.

A red lead should be passed through with the other battery leads and this must be wired to one lug of the filament switch, SW. The remaining lug of SW joins to the filament positive lug of the valve socket. Attach a lead to the insulated aerial terminal and join this to the centre tap on the coil, L1. If desired a three point tapping switch may be used to change the aerial tappings from the front panel. If this is done, it must be insulated from the chassis and the arm of it connected to the aerial terminal. The three tappings on the coil then would join to the tapping lugs of the switch. Connect another long battery lead to the screen lug of the valve socket. Label this lead "B" positive screen grid. To the screen grid lug also connect one lead of the .1mfd. condenser C1, and join the other lead of this condenser to "A" negative.

Battery Connections And Testing

THIS completes the wiring of the set. A 45 volt battery will be required for the receiver, but the "A" battery will depend on the valve selected. To operate from a single 1.5 volt dry cell battery suitable valves are types 1N5G or 1P5G. If a two volt accumulator or two dry cells in series are employed either a 1C4 or a 1M5G will do. If the two dry cells are used, a 9 ohms rheostat or a fixed resistor should be connected in circuit between the "A" battery positive lead and the positive terminal of the "A" battery. This will reduce the voltage to a value suitable for the filament of the valve.

The other battery connections are quite simple. Join the negative terminals of the "A" and "B" batteries and to them connect the lead marked "A" and "B" negative. The lead marked "B" positive joins to the 45 volt terminal of the "B" battery, whilst "B" positive screen grid joins to the 22.5 volt tapping. Once the set is working this lead may be tried on the 45 volt tap and the connection which gives best results finally used. The remaining "A" battery lead joins to the "A" battery positive unless the rheostat or resistor is necessary. In the latter case they connect between the "A" positive set lead and the "A" positive battery connection.

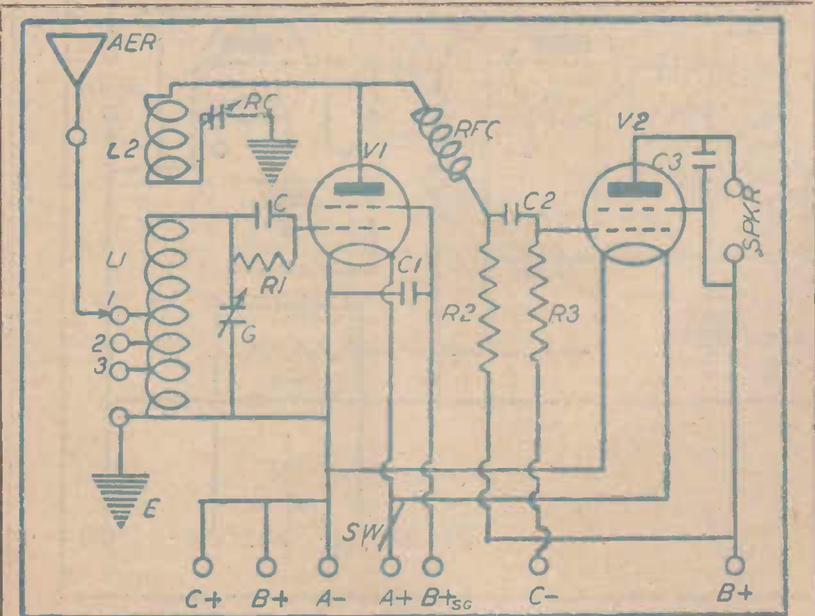
To test the set attach the phone leads and the aerial and earth wires and switch on. Rotate the reaction condenser towards the full-in position until a dull "plop" is heard. Then adjust tuning condenser to a station and reset the reaction control until the whistling stops. The set is in its most sensitive condition when just on the verge of "whistling," or oscillating.

Adding The Second Valve

THE changeover to two valves is comparatively simple. Mount the second socket to the left of the tuning condenser. Wire the filament negative lug of this socket to the filament negative lug of the socket already in use. Do likewise with the positive filament lug joining it to the positive filament lug of the detector socket.

Disconnect the wire on the phone terminal which joins to RFC and connect this instead to the .02 mfd. tubular condenser, C2, the other side of this condenser joins to the grid lug of the socket for the second valve, V2. To this point also connect one lead of the 1 megohm resistor R3. The unconnected end of this resistor solders to a battery lead which must be labelled "C" negative. To the junction of RFC and C2 join one lead of the 250,000 ohm resistor, R.2. The other side of resistor R2 connects to the phone terminal which has the "B" positive battery lead attached to it.

To this point also attach a lead from the screen grid lug of the



Schematic Diagram of Two Valve Receiver.

socket for V2. The plate lug of this socket joins to the vacant phone lug. Across the phone terminals now connect the condenser, C3.

With the additional valve added it will be possible to work a small permagnetic speaker with a matching transformer for the particular valve used as V2. The speaker will connect to what were previously the phone terminals. This completes the alterations to the set, and all that is necessary to set the receiver in operation is to join the positive terminal of the "C" battery to the "A" and "B" negative leads and to connect the "C" negative battery lead to the required negative voltage tap on the "C" battery for the particular valve employed.

For one dry cell operation, valves 1A5G or 1Q5GT are suggested for V2. Each of these valves requires 4.5 volts "C" bias. For two volt accumulator or two dry cells 1D4 or 1L5G valves are suggested. These also require 4.5 volts "C" bias, when the "B" positive supply is 135 volts. The rating of 4.5 volts for the 1.4 volt valves is for 90 volt "B" positive operation.

This means that an additional 45 volt battery must be added to the one used for the single-valver. The negative of the new battery is joined to the positive terminal of the other one and the "B" positive lead from the set transferred to the positive lead of the new battery.

Although the 2-volt series valves give best results on 135 volts they will operate on 90 volts and the "C" bias could be reduced to 3 volts under these conditions. With two 2-volt valves the 9 ohm filament resistor should be reduced to 3 ohms. The operation of the receiver will be the same as before, but due to the added stage of amplification, volume will be much greater than was the case with the one-valver.

The Three Valve Receiver

THE stage just added to the two valve receiver is known as an audio frequency amplifying stage, as it amplifies the signals after they have been detected and changed into audible frequencies.

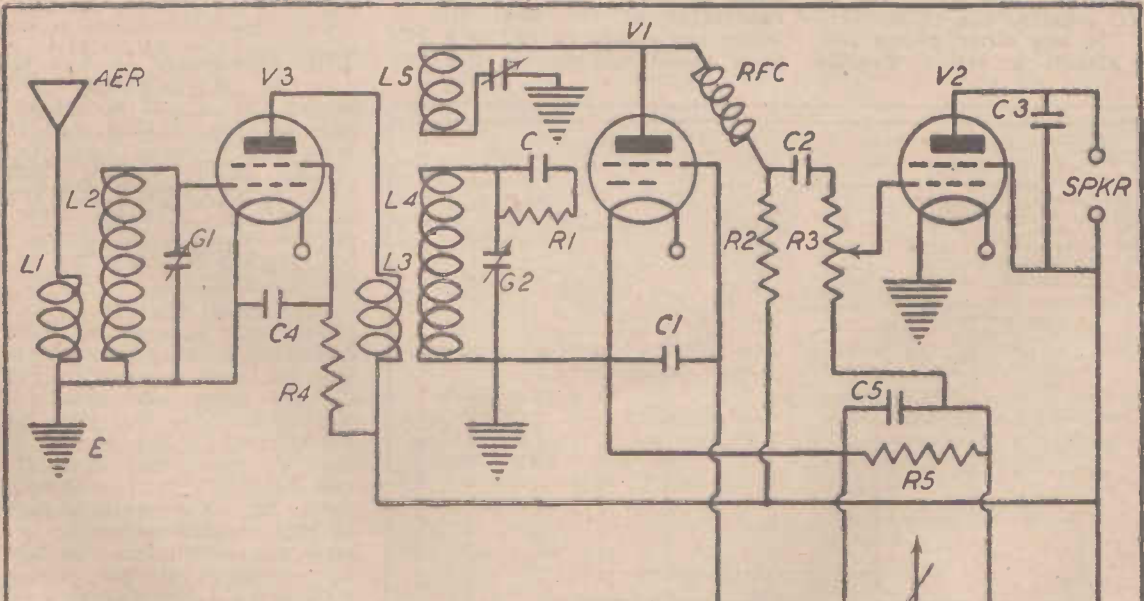
The valve which we are about to add to the receiver is known as a radio frequency amplifier, because it amplifies the signals prior to detection, whilst they are still in the form of alternating radio frequency currents.

The changeover to the three-valve receiver is more difficult than the one described for the two-valve set. For it we need a two-gang condenser with matched coils. This prevents the possiblity of effectively using home wound coils. For the change we require a two-gang condenser with a suitable dial, a pair of matched coils, i.e., an aerial and an RF coil with reaction to suit the gang condenser and dial employed. Another valve and socket also are necessary together with a couple of resistors and condensers. In this set we are doing away with the "C" battery and employing what is known as automatic bias.

The first step is to remove the single gang tuning condenser and its coil, and to replace it with the two-gang unit. The new coils, which will be in metal cans, are then mounted close to the right-hand side of the new tuning condenser, the aerial coil being opposite the front section of the condenser and the RF coil with reaction opposite the rear section of the gang.

The socket for the new valve is mounted close to the aerial coil, and this valve should be provided with a "form-fitting" valve shield, the earth clip section of which should be bolted down under the valve socket. Wire the G.E. detector plate and reaction condenser leads of the R.F. coil to the points from which the previous coil's leads were removed.

SCHEMATIC DIAGRAM OF BATTERY THREE



COMPONENTS REQUIRED TO BUILD THE THREE SETS

One Valve Set

C: .00025 mfd. fixed condenser.
C1: .1 mfd. tubular condenser.
L1, L2: Aerial and grid coils. (See Text).
G: .0005 mfd. variable condenser.
R1: 2 megohm fixed resistor.
RC: 23 Plate midget variable condenser.
RFC: Radio frequency choke coil.
SW: SPST toggle switch.
V1: Valve. (See Text).
SUNDRIES: Chassis, one valve socket, hook-up and battery connection wire, six terminals, tuning dial knobs, and one grid clip.

Two Valve Set

(Plus One Valve Set Parts)

C2: .02 mfd, tubular condenser.

C3: .005 mfd tubular condenser.

"C" Battery to suit output valve. (See Text).

R2: 250,000 ohm ¼ or ½ watt resistor.

R3: 1 megohm ¼ or ½ watt resistor.

V2: Output valve. (See Text).

SUNDRIES: Hook-up wire and additional battery leads for "C" battery negative and positive.

Three Valve Set

(Plus Two Valve Set Parts)

MATCHED AERIAL (L1-L2), and R.F. coil (L3-L4-L5) with reaction.

C4: .1 mfd tubular condenser.

C5: 10 or 25 mfd low voltage electrolytic condenser.

G1, G2: Two gang condenser with dial to suit coils. To replace G. With trimmers or separate trimmers to attach.

R4: Screen resistor. (See Text).

R5: Automatic bias resistor. (See Text).

VC: .5 megohm potentiometer for a volume control to replace R3.

V3: Valve. (See Text).

SUNDRIES: Hook-up wire, one valve socket, one valve shield, one knob for VC, and one grid clip.

Connect the R.F. plate lead of the new coil to the plate lug of the new valve socket and the "B" positive lead of the same coil to the "B" positive battery lead. The negative and positive filament lugs of the new socket join to the corresponding lugs on the old detector socket.

Turning now to the Aerial coil, join the E and A.V.C. leads to the chassis or earth terminals and the aerial lead to the aerial terminal. The G lead of the Aerial coil connects to the fixed plate lug of the front section of the two-gang condenser and to a lead which terminates in the grid clip, for the grid cap of the R.F. valve. The fixed plate lug of the rear section of the gang condenser is next wired to the G connection of the R.F. coil and to the grid cap of the detector valve.

We now have only the screen grid lug of the R.F. valve socket to wire. If two volt series valves are employed types 1C4 or 1M5G will be suitable. In this case the screen lug of the valve socket has attached to it one lead each of a 75,000 ohm resistor, R4, and a.1 mfd. tubular condenser, C4. The free lead of the .1 condenser earths, whilst that of the resistor joins to the "B" positive lug of the R.F. coil. In the case of 1.4 volt valves 1N5G or 1P5G types are necessary and although the .1 mfd condenser is connected as above the resistor is not necessary and the screen grid lug of the socket joins directly to the "B" positive lead on the R.F. coil.

Automatic Bias Connections

To incorporate the automatic bias it will be necessary to run a separate "B" negative lead to the "B" battery instead of connecting it directly to the negative "A" battery terminal. A resistor is then connected between the negative "B" battery lead and earth or chassis, and the current drawn by the plates of the valves causes a voltage drop across this resistor.

By connecting the lead which previously was joined to the "C" battery negative to this point the bias for the output valve is obtained. The value of the resistor will vary for various valve combinations. For any combination of the two volt valves mentioned the value of the resistor will be 400 ohms. This resistor is bypassed to earth with a 10 or 25 mfd. electrolytic condenser, C5.

For various combinations of the 1.4 volt valves the values will be as follows:—For the purpose of calculation we can disregard the current drawn by the detector valve in the combination so this will not be mentioned in the alternative combinations. The first valve mentioned will be the R.F. valve, and the second the output valve, and the number following the value of the resistor required for automatic bias.

IN5-1A5, 800 ohms; 1P5-1A5, 650 ohms; 1N5-1Q5, 750 ohms; 1P5-1Q5, 650 ohms; 1N5-1C5, 700 ohms; 1P5-1C5, 600 ohms.

For most economical operation the combination of 1N5 R.F. detector and 1A5 output valve with an 800 ohm resistor should be selected. For higher output a 1C5 may be substituted for the 1A5 and the resistor reduced to 700 ohms.

A further refinement in this set is the addition of a volume control in the grid circuit of the output valve. The grid of the valve is connected to the centre or arm contact of the control. One outside lug connects to the "B" negative side of the automatic bias resistor whilst the other lug joins to the grid side of the coupling condenser C4.

This completes the three-valve receiver. This set requires aligning before it is finally ready for use. Connect the speaker and batteries and join the aerial and earth to their correct terminals. Locate a station at the high frequency end of the dial, i.e., with the tuning condenser plates near the "full-out" position. Have the detector on the verge of oscillation and, with volume reduced to a minimum, adjust the trimmers on the gang condenser for maximum signal strength.

Tune to the other end of the dial and check the setting. If the adjustment remains the same the receiver is correctly aligned. In some cases it may be necessary to bend the outside plate of one section of the gang condenser closer to or further away from the fixed plate to obtain correct alignment.

LOUDSPEAKERS AND PA SYSTEMS

PM and Electro-Dynamic Types — Impedance Matching — Remote Speaker Operation — PA Installations — Loudspeaker Volume Control — Output Transformer Table.

IT is of little use building a sensitive and selective receiver and one which is capable of delivering good quality sound if attention is not paid of the selection of the loudspeaker with which it is to be used and care is not taken to ensure that correct electrical matching exists between the loudspeaker and the receiver output valve with which it is to be used.

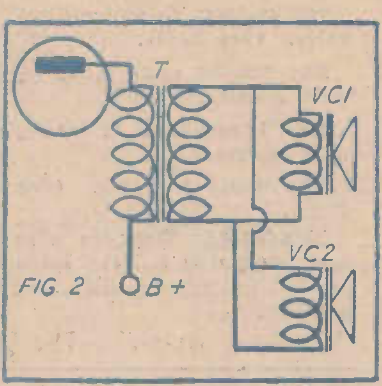


FIG 2

The average dynamic loudspeaker has a frequency range extending from 100 to 5000 cycles, a range which apparently meets the acoustic requirements of the majority of radio listeners. For those who look for better quality reproduction there are the auditorium type loudspeakers with a frequency coverage of 70 to 7,000 cycles, and for still better fidelity, auxiliary "tweeter" type loudspeakers which extend the upper register to about 10,000 cycles.

When used with properly circuited output valves any of these types of loudspeakers deliver a substantially even response over the whole of their frequency range. Transient response, that important characteristic of the loudspeaker, which gives intelligibility to speech and "life" to music, is especially good in any of the modern loudspeakers for new methods of design have reduced the "mass" of the moving parts and raised the general efficiency of the loudspeaker by greatly increasing its magnetic efficiency.

Matching the Valve And Loudspeaker

ANOTHER point to which modern designers have paid particular attention is the matching of the loudspeaker to its output valve. It has long been recognised that most of the distortion present in the output of a radio set emanates from the output valve, and not from the loudspeaker. Today, loudspeaker manufacturers are not content merely to know the type of output valve which is being used and to specify say, a 7,000 ohm load, for the average pentode. They want also to know the voltage conditions under which the pentode or any other valve is being used, the particular method under which it is being operated and the output power which is required.

Output power handling capacity of the average loudspeaker is about half a watt for the new 3½ inch miniature types, 3 watts for the 5 and 6-inch types, and 7 watts for the 8, 10 and 12-inch types. The de luxe, auditorium type 12-inch speakers will handle about 15 watts of audio power.

Until recently, the generally used dynamic loudspeaker in A.C. operated radio receivers was the electro magnet type in which the magnetic field was provided by the passage of a direct current through a high resistance field winding. Usually the field was used as part of the filter circuit for the receiver's plate supply system, its resistance helping to drop the high voltage direct current output from the rectifier to the, usually, 250 volts required for operation of the receiver valves.

The average power dissipated in the field winding of the loudspeaker ranged from 3½ to 9 watts for the standard type loudspeakers and 18 watts for the auditorium types. Later, we shall discuss the advantages and disadvantages of this method of dynamic speaker operation, but first let us consider the design methods to be employed when selecting the correct field resistance to be used for a loudspeaker connected to a given receiver.

Field Resistance Calculations

SUPPOSE we have a standard five-valve receiver employing a mixer stage, an i.f. amplifier, a second detector, and a 6V6G output tube. The rectifier is an 80, or its equivalent, the 5Y3GT and the power transformer is de-

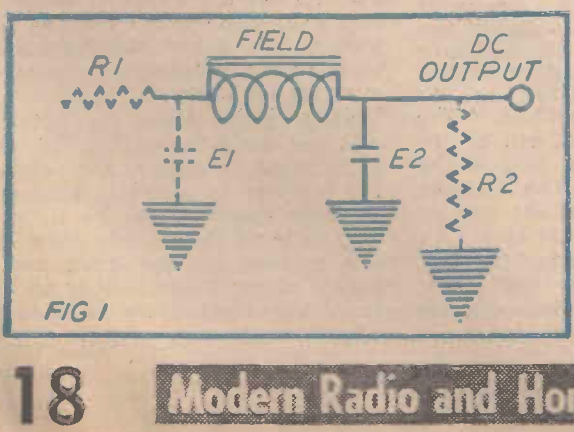


FIG 1

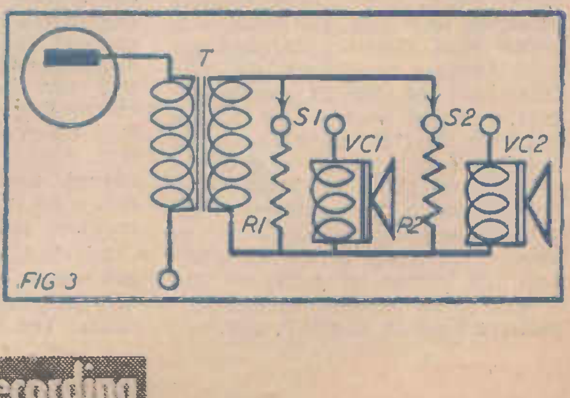


FIG 3

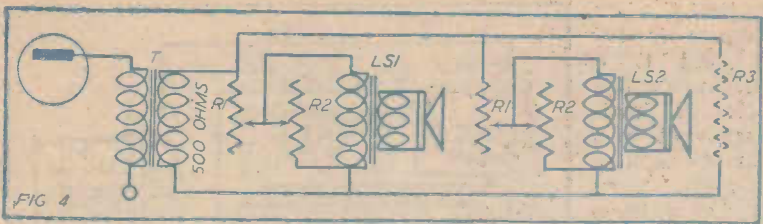


FIG 4

signed to deliver 75mA at 350 volts. Under this load condition the D.C output to the filter input will be about 380 volts. The 6V6G requires 250 volts for its plate and 12½ volts for cathode bias so that the required potential at the set side of the filter will be 262½ volts.

Subtracted from the input voltage of 380 this leaves 117½ volts to be dropped in the filter choke a potential which, multiplied by the current to be drawn, 75mA., gives us a wattage of 8.8. This is about right for our K10 or K12 type speaker. The next thing to do is to determine the value of the field resistance to drop 117½ volts at 75mA. To determine this divide the required drop, 117½ volts by the current drain, 75mA and multiply the result by 1000.

The answer in this case is 1560 ohms. This is the value of the field resistance. The nearest practical value for a loudspeaker field in this range is 1500 ohms. As this is only 4 per cent. low there is no need to worry about it.

Permanent Magnet Type Speakers

WE come next to the permanent magnet type of dynamic and its special application to A.C. operated receivers. P.M. type dynamics have been in use for a long time but it has only been during the war years that they have come to the present stage of efficiency. Where the electro-magnet type of dynamic loudspeaker depends on the passage of a direct current through its field winding to supply the necessary magnetic excitation to actuate the voice coil and thus the cone, the P.M. speaker uses a powerful permanent magnet to do the same job. In the past this type of speaker has chiefly been used with battery sets where it was uneconomical to provide the power necessary for the excitation of an electro-dynamic type speaker. Today, however, there is an ever-increasing trend to use them in A.C. operated receivers.

This is due to the following:—

(1) New magnet materials have made the P.M. type speakers more efficient than the corresponding electro-magnet types.

(2) Because there is a much lower voltage drop across a standard filter choke — there is

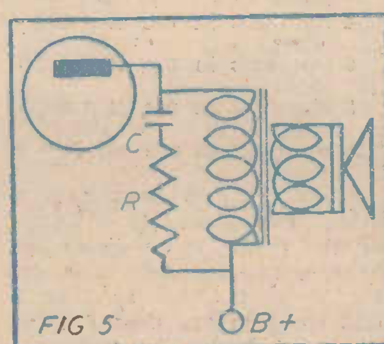


FIG 5

no excitation power needed — a lower voltage, and correspondingly cheaper, power transformer may be used.

(3) Because the input voltage to the filter is lower the life of the first electrolytic condenser, E1 in Fig. 1, is lengthened, and this component is less likely to break down.

(4) Loudspeaker replacements, should they become necessary, are much more easily carried out than with the electro-magnet type of speaker where the field resistance as well as the output transformer impedance must be considered.

Remote Operation Circuits

The employment of extension loudspeakers wired so that the radio receiver can be used in more than one room of the home are becoming increasingly popular. It is because they require no high-

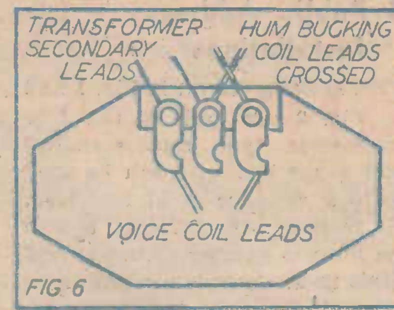


FIG 6

voltage-carrying leads for field excitation and impose no extra current drain on the receiver power pack that P.M. type speakers are the logical choice for remote operation.

In Fig. 2 is shown the simplest method of connecting a remote loudspeaker.

VC1 is the voice coil winding of the original loudspeaker whilst VC2 is the voice coil winding of the extension speaker. The voice coil of the latter is merely connected in parallel with the secondary winding of the output transformer, T. A switch may be connected in series with the voice coil of each speaker so that one or both speakers may be used at a time.

The disadvantage of this arrangement is that when two loudspeakers are being used simultaneously there is a bad impedance mismatch present and distortion and loss of power will result.

A much better arrangement is diagrammed in Fig. 3 where the transformer, T, is wound to match the impedance of two or more voice coils connected in parallel. Switches S1 and S2 are single pole double throw switches arranged to cut in either one or two speakers as required, whilst R1 and R2 are dummy load resistors which simulate the load of the unused speaker when the switch is in the "Off" position.

R1 and R2 should each have a resistance 25 per cent. greater than the impedance of the loudspeaker voice coil with which they are being used. These "dummy load" resistors will slightly reduce the output volume from the receiver but there is usually more than ample margin in the available power output of the modern set.

Public Address Installations

THE systems shown in Fig. 1 and Fig. 2 are both of the Low Impedance type and standard 1/20 gauge bell wire can be used up to a distance of 37 feet from the receiver. Any attempt to run the lines to greater distances will result in an impedance mismatch unless the size of the conductor is materially increased. This is because the D.C. resistance of the total length of wire — "go and return" must not exceed 25 per cent of the voice coil impedance.

Where long line lengths are necessary and where several speakers are to be fed from one audio channel the best plan is that outlined in Fig. 4 where the secondary of the output transformer, T, is wound for an impedance of 500 ohms. In this case the primaries of the input transformers must be wound to match the line impedance.

For example, if only one loud speaker is being used its primary must have an impedance of 500 ohms. If two speakers are used, each primary must have an impedance of 1000 ohms, and so on. If it is desired to make provision for additional speakers at the time of installation then the system must be calculated on the basis of the line impedance by the number of speakers ultimately to be used.

Say that the line impedance is 500 ohms and it is planned ultimately to use 10 loudspeakers but only two are to be used for a start. Then each of these speakers—and the subsequent ones as they are added — must be fitted with a 5000 ohm input transformer.

In order to maintain a correct impedance match it will be necessary to connect the following values of resistance across the line of our proposed speaker network.

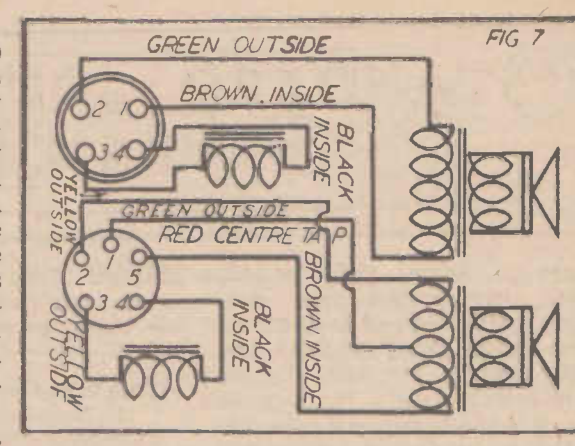
When:

2 Speakers in use R = 625 ohms
4 Speakers in use R = 833 ohms
6 Speakers in use R = 1,250 ohms
8 Speakers in use R = 2,500 ohms
10 Speakers in use use R = 0 (open)

In each case R must have a wattage rating capable of handling the power to be dissipated. If the complete system is to deliver 10 watts, then as from 2 to 10 speakers are used R must dissipate 8, 6, 4 and 2 watts respectively.

Independent Control Of Volume

IN this system of remote speaker operation we have included individual volume control at each speaker.



Each volume control consists of ganged potentiometers. R2 should have a resistance at least five times the input impedance of the speaker transformer with which it is to be used, 25,000 ohms in this case.

The resistance of R1 is calculated from the following formula:

$$R1 = \frac{R2 + Z}{5}$$

Where R2 is the resistance of the potentiometer connected across the loud speaker

Z is the line Impedance.

In our example of a loud speaker hook-up employing 10 speakers on a 500 ohms line the formula would become:

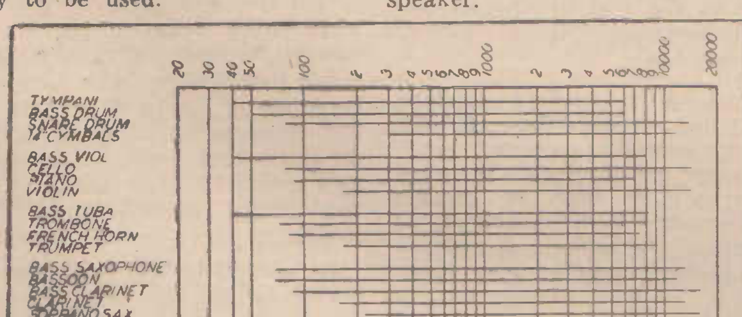
$$\frac{25,000 + 5,000}{5}$$

or 6,000 ohms.

This type of volume control can be used with any remote speaker installation.

Mention has already been made of the necessity for balancing the output of a pentode to the impedance of the loudspeaker input transformer. Output valves are designed to work into specified values of load impedance in order to give the maximum power output and the minimum of distortion. Load impedance variations, especially where pentodes or tetrodes are used, will cause low power output and high distortion.

In order to keep the impedance relationship reasonably constant filters such as that shown in Fig. 5 are used. In this filter, as the frequency increases the impedance of the condenser falls off, thus countering the voice coil's impedance rise as the frequency increases. Correct proportioning of R and C will permit a very nearly constant load to be obtained regardless of frequency. Usually, with standard 7000 ohm power pentodes, R will have a capacity of .02 mfd. and C a resistance of 10,000 ohms.



Frequency Ranges of Musical Instruments.

STANDARD LOUDSPEAKER OUTPUT TRANSFORMERS

The table below sets out the type numbers of standard loudspeaker output transformers manufactured by the Rola Co. to suit given valves under the stated operating conditions.
Type E is a compact open type transformer intended for use with 5C used in A/C operated receivers (voice coil 3.7 ohms). Type D is an isocore transformer used with 3C, 5C detached and with 6H attached or detached (voice coil 3.7 ohms). Type C is also an isocore transformer used with 8, 10 and 12-inch speakers (voice coil 2 ohms). Type B is a large non-isocore transformer for use with G12 and G12 PM (voice coil 8 ohms).

SINGLE-ENDED OPERATION

Valve	Nominal Load	TRANSFORMER TYPE B	C	D	E
1A5, 1A5GT, 1A5G	25,000		CBL32	DCL35	—
1C5, 1C5GT, 1C5G	8,000		CDL38	DEL42	—
1D4	15,000		CBB42	DCL46	—
1D8, 1D8GT, 1D8G	12,000		CDL31	DEL34	—
1F4	20,000		CBL36	DCL39	—
1J6	10,000CT		CUL14	DWL15	—
1L5, 1L5GT, 1L5G	As for 1D4.				
1Q5, 1Q5GT, 1Q5	As for 1C5.				
1S4	5000	—	CFL31	DFL42	Not recommended
1S4	8,000		CEL31	DFL33	
2A3	2,500	BGG72	CHG29	Not recommended	
2A5	7,000	BAG178	CBG64	DBG96	ECG70
3S4	5,000		CFL31	DFL42	—
6F6, 6F6GT, 6F6G	As for 2A5.				
6L6, 6L6GT, 6L6G	2,500	BCH198	CDH75	Not recommended	
6V6, 6V6GT, 6V6G	5,000	BBH169	CBG81	DCG87	EDG68
19	As for 1J6.				
42	As for 2A5.				
45	4,600	BGB52	CBG26	DHL29	EIL23
47	As for 2A5.				
AL3	7,000	BAG178	CBG64	DBG96	Not recommended
CL4	7,000	BAG178	CBG64	DBG96	
EL2	8,000	BAG160	CBG61	DCG65	EDB53
EL3, EL3NG	7,000	BAG178	CBG64	DBG96	Not recommended
KL4	19,000	BAL95	CBL37	DCL40	ECL40

PUSH-PULL OPERATION

Valve	Operating Conditions	Plate Voltage	Nominal Load	TRANSFORMER TYPE B	C
IF4	AB1	180	20,000CT		COL37
IL5, IL5GT, IL5G	Class A Pentode		30,000CT		CNL36
2A3	Class A1, self bias	250	5,000CT	BTL50	CTL24
	Class AB1, self bias	300	5,000CT	BTL50	CTL24
	Class AB1, fixed bias	300	3,000CT	BTL65	Not recommended
2A5	Class A1 Pentode, self bias	250	14,000CT	BNL114	CNL55
	Class AB2 Pentode, fixed bias	375	10,000CT	BOL109	Not recommended
6F6, 6F6GT, 6F6G	As for 2A5.				
6L6, 6L6GT, 6L6G	Class A1 Pentode, fixed bias	250	5,000CT	BPL126	Not recommended
	Class A1 Pentode, fixed bias	270			
	Class A1, self bias	270	5,000CT	BPL126	Not recommended
	Class AB1, fixed bias	360	6.600CT	Not recommended	
6V6, 6V6GT, 6V6G	Class AB1 Pentode	250	10,000CT	BOL109	COL53
		285	8,000CT	BOL124	Not recommended
42	As for 2A5.				
45	Class A1	275	9,200CT	BSL46	CTL18
	Class AB2	275	3,200CT	BSL79	Not recommended
47	As for 2A5.		Class A1 Pentode, self bias.		
AL3	Class A Pentode	250	14,000CT	BOL90	CPL35
CL4	Class AB, self bias, Pentode	250	4,000CT	BRL73	Not recommended
EL2	Class AB, self bias, Pentode	250	8,000CT	BQL77	CRL31
	Class AB, fixed bias, Pentode	250	8,000CT	BQL77	CRL31
EL3, EL3NG	As for AL3.				
KL4	Class B Pentode	135	35,000CT	BQL36	CRL14

DE LUXE RECEIVER AND RECORDING AMPLIFIER

Combined Radio and Recording Unit — Provision for Pick-Up, Microphone and Playback — Two unit Construction — Audio Stage Built Along Proved Lines.

THE problems arising in home recording and the results which may be obtained have been described in a separate article. Here we have a truly de-luxe radio receiver and recording amplifier combination which will serve as a practical guide to those about to commence this fascinating side of their radio hobby.

In deciding upon a suitable amplifier for the job we were influenced by the results of the three last years' entries in the Victorian Amplifier Contest. Each of the three contests so far conducted have resulted in decided victories for triode type output valves, 2A3's in particular. It was decided, therefore, to employ one of the winning amplifier circuits in this receiver and incorporate with it a reliable radio tuner and an additional amplifier stage, so that recording enthusiasts can employ a microphone with the set-up.

At this juncture it may be as well to mention that although a push-button tuning arrangement was provided in the original receiver the parts list shows that a gang condenser and dial together with suitable coils is specified.

This was because complete push-button units are not available at present. The mixer valve used with the push-button arrangement was a type EK2, but in the published circuit we show a 6K8G. If individual builders are able to obtain push-button assemblies it will be essential for them to use the mixer valve specified with the particular unit supplied to them and to see that the circuit and parts values are correct for the mixer valve employed.

● Points on the Tuner Unit

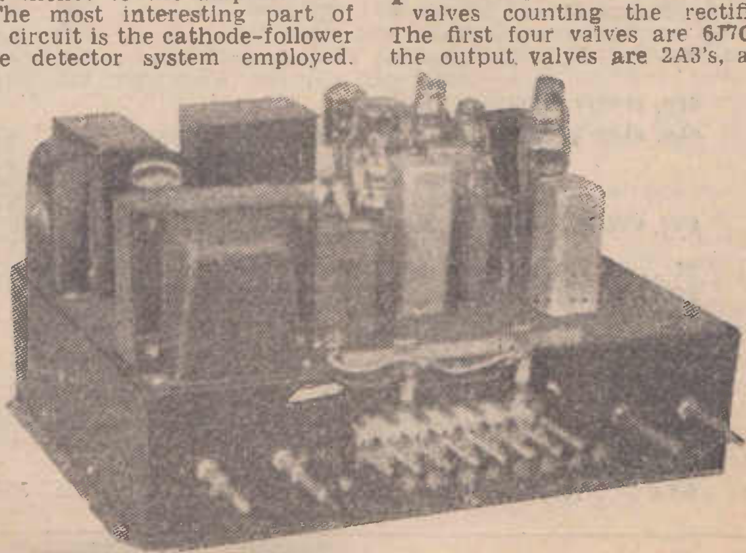
THE tuner unit is capable of giving high quality reception of local radio programmes. The mixer and I.F. stages are quite conventional but for the fact that the aerial coil and the windings of the I.F. transformers have been shunted with resistors.

This has been done to broaden these tuned circuits so that the higher audio frequencies will be passed through to the detector and thence to the amplifier.

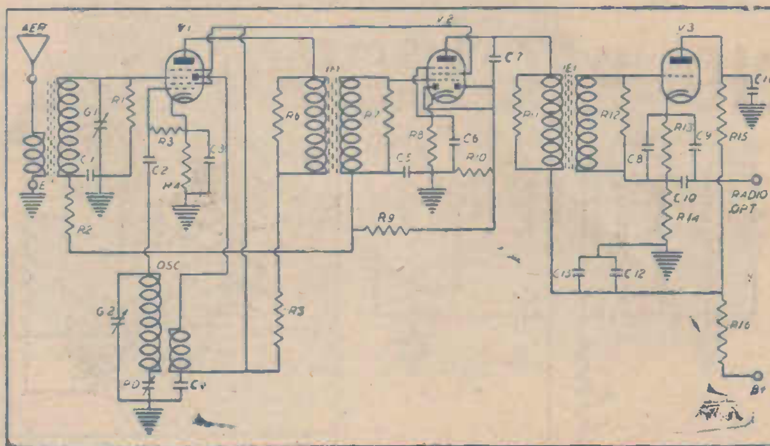
The most interesting part of the circuit is the cathode-follower type detector system employed. Some may know this as an infinite impedance type detector but this particular circuit is different from this arrangement because another resistor and condenser, R13 and C9, have been added to the cathode of the detector valve in such a manner that they act as a high frequency discriminating network. With an increase in frequency, the effect of R13 decreases due to the shunting effect of C9, and a high frequency boosting effect is obtained. This, in conjunction with the broadening of the resonant circuits, gives this tuner a decided advantage over the ordinary one using diode or other forms of detection.

● Amplifier Connections Described

IN the amplifier we have seven valves counting the rectifier. The first four valves are 6J7G's, the output valves are 2A3's, and



TUNER SCHEMATIC AND PARTS LIST



CHASSIS—See Photographs and Text

COILS: Permeability-tuned, iron-cored aerial and oscillator coils, 455 k.c., with suitable padder.

C1, C3, C4, C6: .1 mfd. tubular condensers, 400 volt.

C2, C7, C8: .0001 mfd. mica condensers.

C5: .05 mfd. tubular condenser, 200 volt.

C9: .01 mfd. tubular condenser.

C10, C13: .5 mfd. tubular condensers, 400 volt.

C11, C12: 8 mfd. tubular electrolytic condensers, 400 volt.

G1, G2: Two gang condenser to suit coils (with dial and trimmers).

I.F.1, I.F.2: Intermediate frequency transformers (permeability tuned and iron-cored, 455 k.c.).

PD: Padder condenser to suit coils.

R1, R2, R6, R7, R11, R12: 250,000 ohm, ¼ or ½ watt resistors.

R3: 50,000 ohm, ¼ watt resistor.

R4: 250 ohm, wire-wound bias resistor.

R5: Two 25,000 ohm, 1 watt resistors, in parallel.

R8: 40 ohm, wire-wound bias resistor.

R9: 750,000 ohm, ¼ or ½ watt resistor.

R10: 1 megohm, ¼ or ½ watt resistor.

R13, R15: 20,000 ohm, ½ watt resistors.

R14: 100,000 ohm, ½ watt resistor.

R16: See note in text.

VALVES: One each 6K8G (V1), 6G8G (V2), and 6C5G (V3).

SUNDRIES: Tinned solder lugs, nuts and bolts, tinned copper wire, valve sockets, two valve shields (V1 and V2), aerial, earth and output terminals, two grid clips and control knobs.

the rectifier is a 5V4G or 5Z3. The 5Z3 is the better if available.

A 150 milliampere power transformer was used in the original receiver together with two chokes in the filter circuits. As these components vary somewhat it should be pointed out that the total "B" positive potential at the junction of E3 and CH2 must be close to 295 volts. Some constructors may wish to use existing low resistance field coils in place of one or both chokes so no definite valves will be given for the power pack.

If the voltage at the point mentioned is too high a resistor should be connected between the two chokes to drop the voltage to the required value.

It will be noticed that E3 is specified as being of 16 mfd. capacity. Although this will give good results, a slightly higher capacity here will help to improve the final bass reproduction.

In the original chassis it will be noticed that the switch, SW, and the volume control, VC, are mounted near the socket for V5 and fitted with extension shafts for control from the front of the chassis. This is essential if the tuner and amplifier units are on the same chassis, as it makes possible short leads to the microphone and pickup pre-amplifier stages.

Another point arises here. It is the annoying habit of 6J7G's when connected as high gain pre-amplifiers to exhibit a tendency towards undesirable A.C. hum. Decoupling of plate and grid circuits will not correct this as it is due to leakage between heater and cathode.

This leakage effect can be overcome by making the heater positive in respect to cathode and this has been done in this amplifier by connecting a light "bleed" across the power supply and by taking the centre tap of the pre-amplifier heaters to a point about 15 volts above earth.

It may also be mentioned that where a microphone pre-amplifier is used it is essential to provide a fully shielded plug of some kind to connect the microphone to the amplifier. In the original set-up, the microphone socket is mounted on the motor board right above the pre-amplifier valve, V4, and a shielded lead is taken direct from the grid of V4 to the socket. In this way, a continuous earthing of the mike lead is obtained. If this is not done, a strong hum will be the result. It will also be necessary totally to shield and earth the frame of MC.

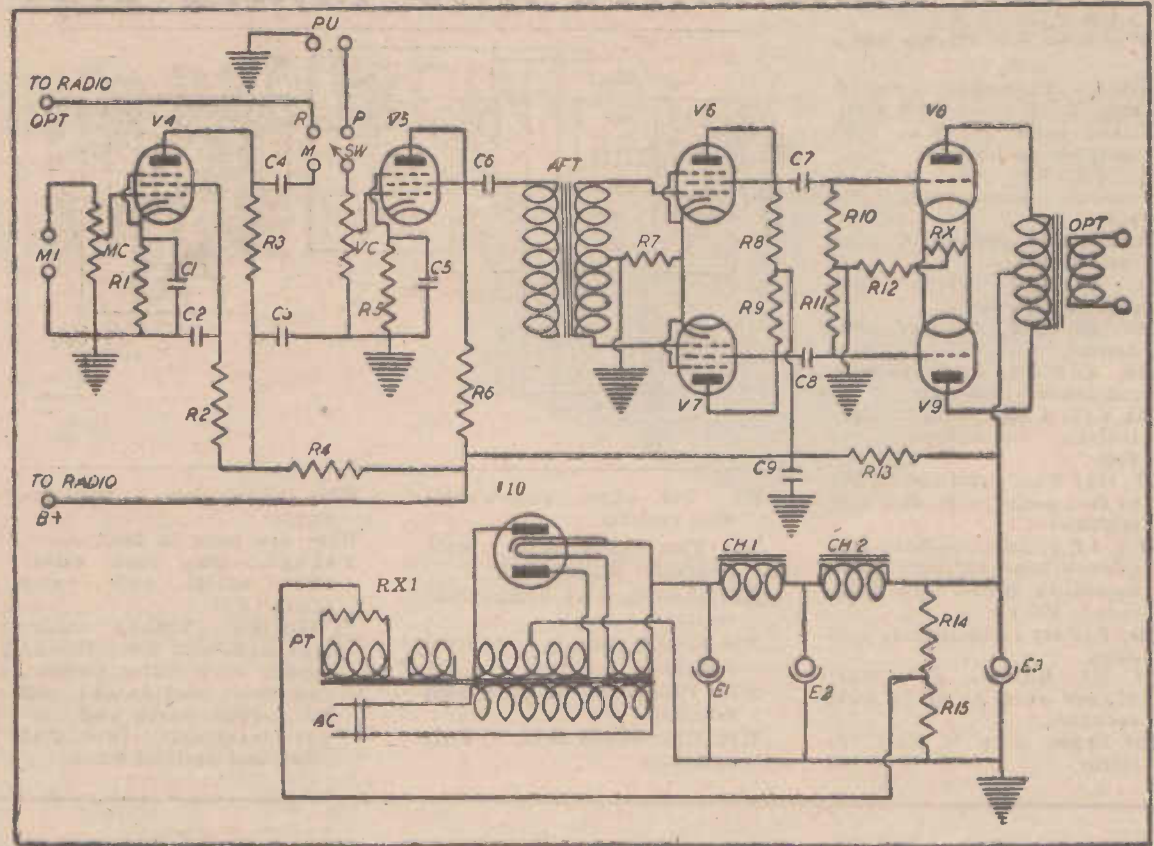
In the original amplifier, OPT had a single 8 ohm secondary which fed both speaker and cutting head and was wired to a switch so that either speaker or cutting head could be switched in at will.

● Monitoring Proved Difficult

THIS arrangement was found to have limitations inasmuch as it was not possible to monitor or listen to the radio programme which it was desired to record. It is suggested, therefore, that OPT should be provided with two secondary windings, one for the loudspeaker, and one for the cutting head. If this is done, the secondary winding for the cutting head may be wound to suit either a home-made or a commercial unit.

Another refinement added to the original was an output level indicator. This was made up from an 0-1 milliampere meter fitted with a suitable rectifier and series resistor and connected across the leads to the cutting head.

RECORDING AMPLIFIER SCHEMATIC



CHASSIS: See text.

CH1, CH2: Filter chokes, see text.

C1, C5: 25 mfd. electrolytic condensers (low voltage).

C2, C4: .05 mfd. tubular condensers, 400 volt.

C3, C9: 8 mfd. 400 volt electrolytic condensers.

C6: .5 mfd. tubular condenser, 400 volt .

C7, C8: .1 mfd. tubular condensers.

E1: 8 mfd. 600 volt electrolytic condenser.

E2, E3: 16 mfd. 6o volt electrolytic condensers.

PT: Power transformer, 385 volts a side at 150 milliamperes, with 2.5, 6.3 and 5 volt windings to suit valves.

R1: 1300 ohm 1 watt bias resistor.

R2: 1.5 megohm ½ watt resistor.

R3: 250,000 ohm ½ watt resistor.

R4, R13: 20,000 ohm 1 watt resistors.

R5: 3000 ohm 1 watt bias resistor.

R6: 50,000 ohm 1 watt resistor.

R7: 1500 ohm 1 watt bias resistor.

R8, R9: 100,000 ohm 1 watt resistors (matched, if possible).

R10, R11: .5 megohm ½ watt resistors (matched if possible).

R12: 375 ohm 150 m.a. wire-wound bias resistor.

R14: 250,000 ohm 1 watt resistor.

R15: 15,000 ohm 1 watt resistor.

SW: Single-pole three-way switch.

TRANSFORMERS: AFT and OPT. High fidelity interstage coupling and output transformers (see text).

VC, MC: 500,000 ohm volume control potentiometers.

VALVES: Four type 6J7G's (V4, V7), two matched 2A3's and a 5V4G or 5Z3 rectifier (see text).

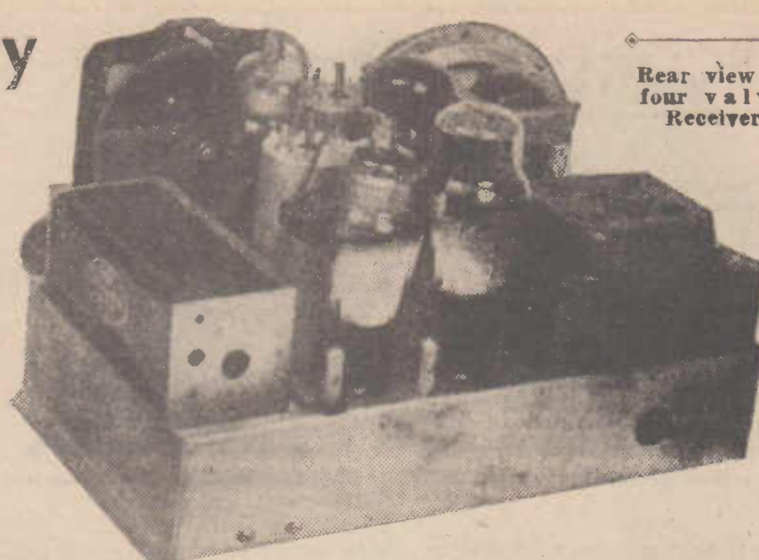
SUNDRIES: Tinned copper wire, solder lugs, bolts and nuts, hook-up wire.

MICROPHONE plug and socket (see text), pick-up terminals, knobs, A.C. flex lead, and centre tap resistors, RX and RX1.

The original radio amplifier recorder has been in use for a considerable time now, and has proved itself capable of excellent reproduction both on radio and pick-up. Naturally the recording side leaves little to be desired once the operator has mastered the intricacies of his equipment. It might be added that, to take full advantage of the outstanding high frequency response of the combination the baffle in the cabinet was inclined so that the high frequencies were brought up near ear level when one was sitting in the average chair. To sum up—the tuner and amplifier can be thoroughly recommended to those in search of high quality reproduction of radio and recorded music and for a small home recorder leaves little to be desired.

Permeability Tuned A.C. Super Hets

Dust Core Tuning — High Selectivity and Good Sensitivity—Direct Coupled Audio Stage — Easy to Align.



Rear view of four valve Receiver

HERE are two modern AC operated superheterodynes, one a super efficient 4-valve mantel type and the other a 5-valve receiver using a high fidelity directly coupled audio system. Both are simple to build, have been designed on commercial lines to use as few components as possible, and employ permeability tuning and the latest high efficiency type slug-tuned IF transformers.

Use of permeability tuning in home-built superhets. not only simplifies their construction but permits even the novice to track the oscillator and mixer tuning without having to use a signal generator and output indicator. These latter instruments are desirable if the utmost sensitivity is to be obtained, but for practical purposes alignment of the tuned circuits by aural methods will suffice.

To illustrate the use of permeability tuning, or to give it its trade name, ferrotuning, two standard circuits have been selected. One is a four-valve super which uses the latest Continental types of 6.3 volt valves, whilst the other is a 5-valve receiver using American series tubes. In the four-valve circuit a high gain power pentode, resistance coupled to a diode triode has been used.

In the five-valve circuit a beam tetrode 6V6G has been wired as a triode and directly coupled to a 6B8G diode pentode.

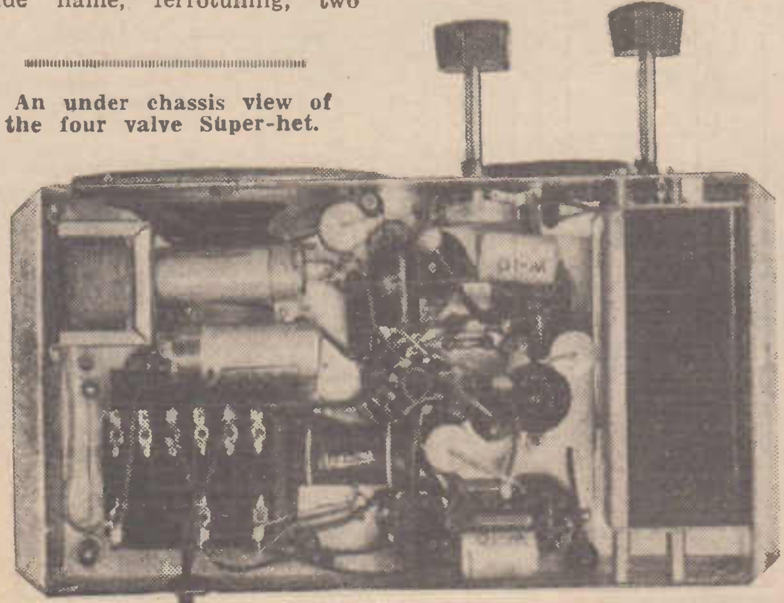
In the following pages will be found circuit diagrams and components parts lists for each receiver. Pictures of the front, rear and under chassis views of each set illustrate the main features of the layout of components.

Most builders of A.C. superhets. are fully conversant with schematic wiring diagrams, so it is not intended to give point-to-point wiring descriptions.

There are a few points, however, which are worthy of mention and these will be dealt with in discussing each set.

First, we shall take the four-valve circuit. Examination of the diagram will show that this receiver consists of a mixed stage followed by one I.F. amplifier stage which feeds into a diode-pentode second detector, automatic volume control, and first audio amplifier tube.

An under chassis view of the four valve Super-het.



● Features of the Four Valve Receiver

THE pentode portion of this valve, V2, is resistance coupled to the output valve, V3.

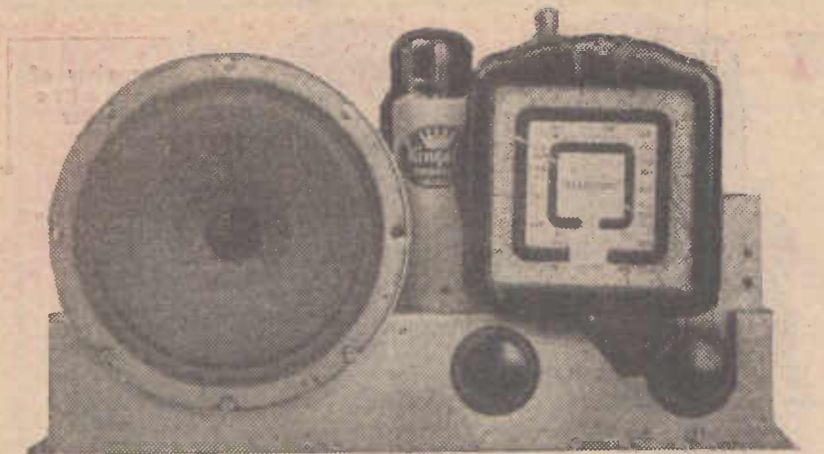
AVC voltage is obtained by feeding portion of the RF signal voltage from I.F.2 to the AVC diode of V2 via the small coupling condenser C5. The rectified voltage is developed across R5 and R7 and is applied to the grids of the IF valve, V2, and the mixer valve, V1, through resistor R4. At the same time a standing negative voltage (direct current) is produced across R8, R7, which are connected between the high voltage centre tap of the power transformer, PT, and earth.

The part of this voltage which is available at the junction of R7, R8, is used to apply a negative bias to the grids of V1, V2, so that the usual cathode resistors are not needed for these valves.

The full negative voltage developed across R7-R8 is used to bias the grid of V3 through resistor R6.

On looking over the power supply circuit it will be noted that a filter choke, FC, is used in place of the more conventional loudspeaker field winding.

This is because a permanent magnet type speaker is used. Chief advantage of this arrange-



Front view of the four valve receiver with the loudspeaker mounted on the chassis.

ment is that a high voltage output of only 285 volts is needed from PT and the safety margin on the electrolytics, E1, E2, is raised.

Incidentally, when wiring E1 and E2 into circuit be sure to connect their + leads to FC, and, if they should be grounded can type electrolytics, to insulate E1 from the chassis.

Look at the pictures of the four valve super het. As the front view illustrates, this set is intended primarily as a mantel receiver and its 5 or 6 inch PM loudspeaker is bolted directly to the chassis.

Only two controls, the main tuning control and the volume control, are provided.

The top view picture of the set shows the Ferrotune coil box at the left.

The valve at the rear of the set near the coil box is the ECH35 mixer valve, V1. Next to it and alongside the power transformer, PT, is the type 5Y3G rectifier valve, V4.

Looking towards the front of the set it will be seen that in line with V1 are the first I.F. transformer, I.F.1, and the EHF35 second detector—AVC tube, V2. To the right of the latter are the second I.F. transformer, I.F.2, and the output valve, V3, which is a EL3NG pentode.

No screens are used on V1 or V2, but it is desirable to use braided wire to join one lug of C9 to the grid of V3. The other lug of C9 should be soldered directly to the centre lug of VC.

The under-chassis view of the receiver shows that with the exception of the filter choke, CH,

FOUR VALVE SUPER HET PARTS LIST & CIRCUIT

COIL KIT: Kingsley type KFT3 Ferrotune unit.

C1, C5, C6: .0001 mfd mica condensers.

C2: .00025 mfd condenser.

C3: .01 mfd mica condenser.

C4, C8: .1 mfd 400v. tubular condenser.

C7, C9: .05 mfd 400v. tubular condenser.

C10: .005 mfd 400v. tubular condenser.

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

FC: Type 6/60 mA. Filter choke.

IF1, IF2: Types KIF5, KIF6, 465 K.C. permeability tuned I.F. transformers.

PT: Power transformer—285-0-285 v. at 60 mA.; 6.3 v. at 3A, and 5v. at 2A.

R1: 50,000 ohms ½ w. carbon resistor.

R2: 50,000 ohms 1 w. carbon resistor.

R3: 40,000 ohms 1 w. carbon resistor.

R4, R5: 100,000 ohms ½ w. carbon resistor.

R6: 500,000 ohms ½ w. carbon resistor.

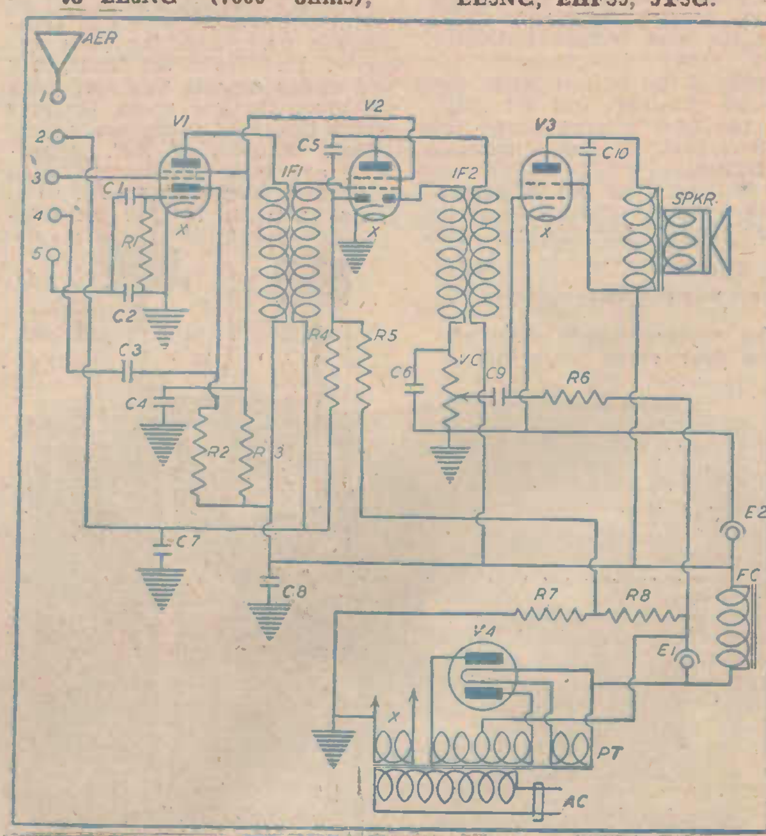
R7: 40 ohms 2 w. wire wound resistor.

R8: 100 ohms 2 w. wire wound resistor.

SPEAKER: 5 inch permanent magnet dynamic matched to EL3NG (7000 ohms),

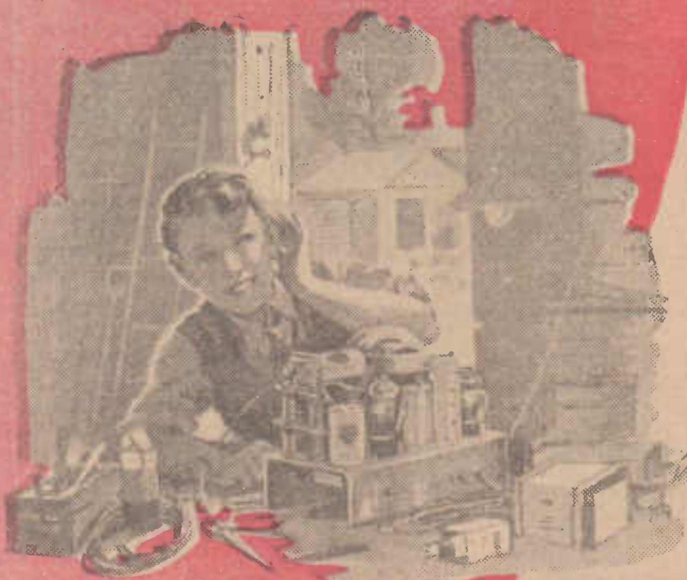
V.C.: 500,000 ohms carbon potentiometer.

VALVES: One each ECH35, EL3NG, EHF35, 5Y3G.



AEGIS AGAIN

A 4-Valve Broadcast Kit Assembly which has even more features than the "Little Companion." The Metropolis 4, illustrated below, is supplied complete to the very last nut and bolt, and Aegis-engineered to ensure trouble-free assembly and trouble-free radio enjoyment. See this sensational kit soon—all its features are attractive — its simplicity, its appearance and its price.



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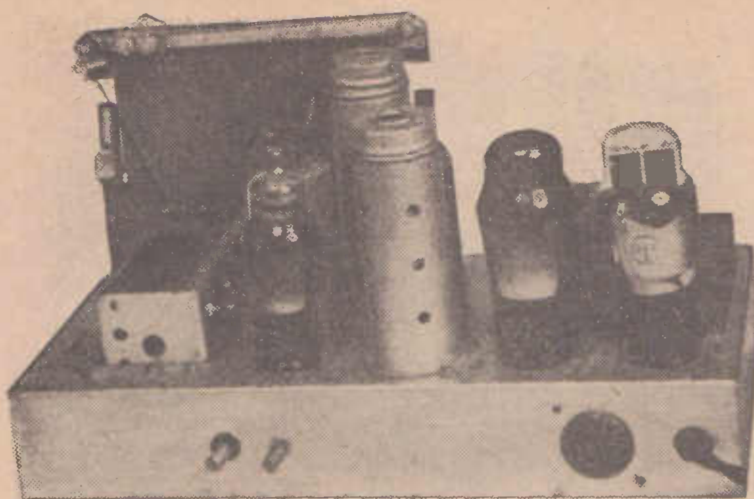


Top chassis picture of the completed five valve receiver.

which is mounted on the end wall of the chassis near the loudspeaker, all the components are wired directly into circuit.

In building the receiver the best plan is to mount the power transformer, filter choke, I.F. transformers, valve sockets and volume control potentiometer first and to wire all the components into circuit before fitting the coil box.

● Preliminary Tests And Adjustments

WHEN this stage of the wiring has been completed fit the coil box and the tuning dial. When the connections have been made to the coil box mount the loud speaker to the chassis and join its output leads to the plate and screen of V3. After this has been done and the general wiring checked against the circuit diagram, plug the valves into their respective sockets, snap the grid clips on to V1 and V2, and plug the power cord into the mains. When the set warms up advancement of VC to the maximum position should permit the builder to hear that "aliveness" which indicates that the set is functioning properly.

If the grid of V2 is touched a hum should be heard in the loudspeaker. This should increase to a howl if the grid pip is touched after the clip has been removed.

If these tests indicate that the set is working, it can be aligned in accordance with the instructions given at the end of this article.

However, if either before or after alignment the receiver exhibits any tendency towards instability it will be necessary to disconnect the grid return of I.F.1 from the coil box side of R4 and join it to the junction of R4 and R5.

This five valve super-het is particularly interesting for it combines a direct coupled audio system with permeability tuning of the mixer and i.f. stages.

The high gain obtained from the iron cored coils ensures that the receiver is both sensitive and selective, and the direct coupled audio system provides high fidelity reproduction over a frequency range only governed by the capabilities of the loudspeaker used with the receiver.

Direct coupling, first introduced to the home builder by the Americans, Loftin and White, provided the technical sensation of 1930 but later fell into disrepute because neither valves nor resistors proved capable of standing up to the high voltages necessary for this type of amplifier. Better resistors and the use of indirectly heated valve types have overcome these difficulties. Today the direct coupled amplifier will give as satisfactory service as the conventional types and is both simpler to build and provides better tone quality with fewer parts.

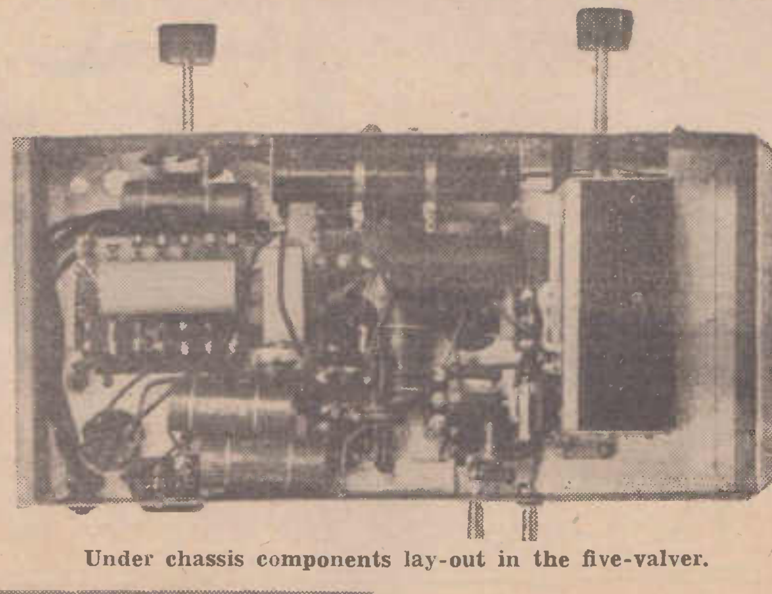
Pictures of the finished chassis show that it is conventional in lay-out. The top chassis view shows the coil box at the left-hand end of the chassis. Alongside it are the mixer tube and the first i.f. transformer. To the right of this transformer is the i.f. valve, V2, and between it and the second detector a.v.c-audio tube on the rear edge of the chassis, is the second i.f. transformer. The two valves at the right hand end of the chassis are the 6V6G output tube and the 5V4G rectifier.

The 6V6G is used as a triode and the 5V4G, an indirectly heated type rectifier, is employed because its heating cycle is approximately the same as the output and the other valves in the receiver so that no dangerously high voltages are applied to these latter tubes during the warm-up period.

● Voltage Distribution In D-C Audio Stage

ONLY two controls are provided, one for tuning and the other for volume. Referring to the circuit diagram, it will be seen that the r.f. portion of the receiver is conventional in design, AVC, developed from r.f. signal voltage fed to the a.v.c. diode of V3, through the small coupling condenser, C11, is fed to the i.f. valve V2 and the mixer tube V2.

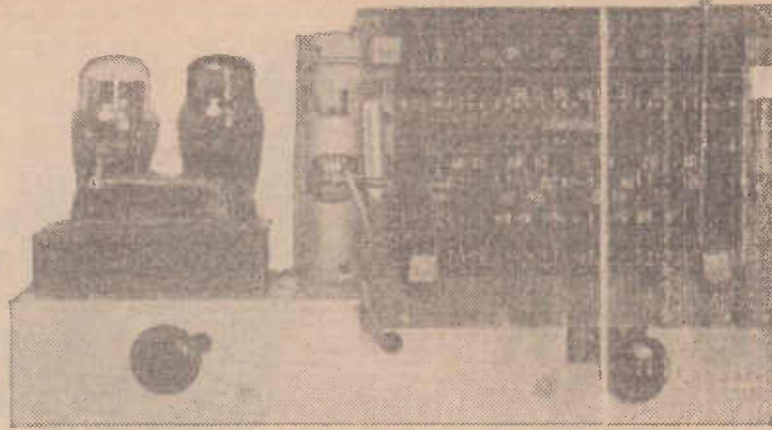
Power supply is derived from a standard 385 volt transformer, but as only a small voltage drop takes place across the filter choke CH, a potential of 400 to 420 volts is available at the positive side of E2. For V4 ground return for this potential is provided by means of the cathode resistor, R15, and will be in the vicinity of 150 volts, which means that the cathode is 150 volts above



Under chassis components lay-out in the five-valver.

ground instead of the normal 12½-15 volts for such a valve. However, the grid of V4, being coupled directly to the plate resistor supplying V3, is some 130 volts positive with regard to cathode, but this potential is bucked by the potential developed across resistor R15, with the result that the correct grid bias of 15 to 20 volts negative is obtained.

Although it is desirable that the values of the plate resistor, R14, and the cathode resistor, R15, be fairly close to the stated values, it will be found that the see-saw action (plate current drain for V3 and cathode current for V4) will result in establishment of the correct operating conditions even when the values of the two resistors are not exactly right.



Front view of the five valve direct coupled super het.

Alignment Problems Simplified

BOTH the coil box and the IF transformers are aligned in the factory and under normal circumstances need not be touched after assembly in the receiver.

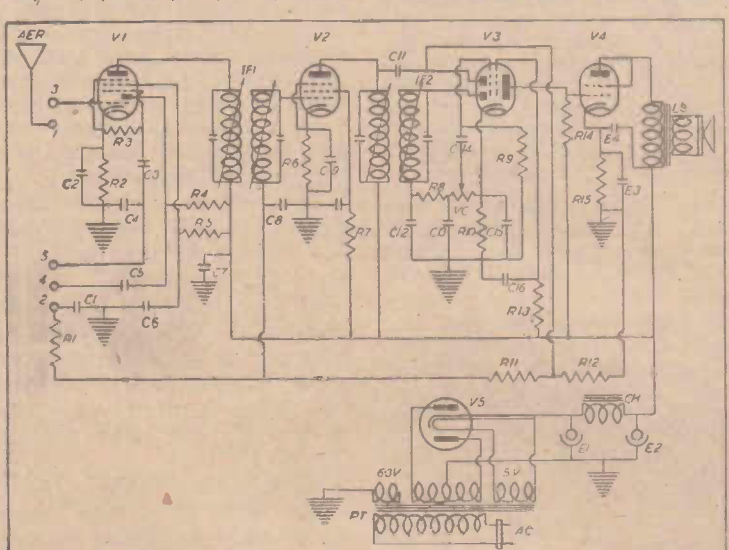
However, here is the procedure to be followed by those who have not access to a signal generator, yet want to get the maximum sensitivity from the finished set.

First check the dial pointer to see that rotation of the tuning knob brings the pointer to the stop lines at each end of the dial scale. Next tune the set to a known station at the high frequency end of the dial—say 3AK or 3XY and, if necessary, adjust the oscillator trimmer "A" to bring this station right on its correct setting on the station calibrated dial. Next adjust the aerial trimmer "B" for maximum signal Both these trimmers will be found on the rear of the coil box. Finally, adjust the slugs on IF2 and IF1 for a peak signal, at the same time reducing the volume control setting so that small changes in level can be more readily noted. Start by adjusting the diode trimmer on IF2 and move in turn to the plate trimmer on IF2 and the grid trimmer on IF1.

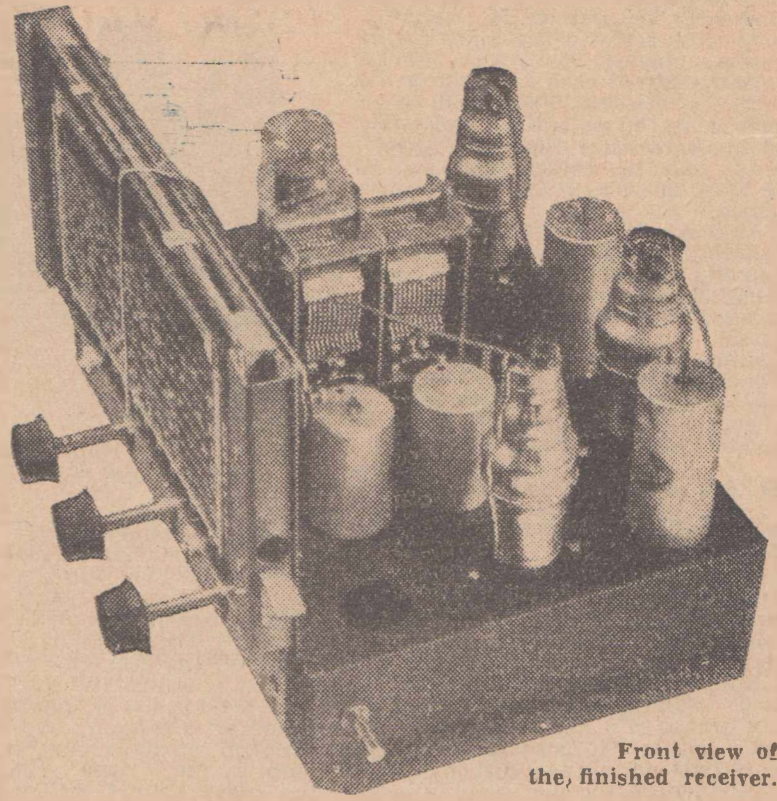
One point which is of special importance is the capacity of the condenser connected between oscillator plate and the No. 4 lug on the coil box. This condenser is listed in the four valve circuit as C3 and in the five valve circuit as C5 Its capacity is .00025 mfd plus or minus 2½ per cent. It is essential that this capacity tolerance is not exceeded or the oscillator will not track properly. Coil boxes which have the letter "A" in front of their serial numbers have the condneser built in, but those which carry only the serial numbers require external connection of the condenser.

SCHEMATIC & PARTS LIST FOR 5 VALVE SUPER

COIL KIT: Kingsley KFT1. Ferrotune Unit.
CH: Type 6/60 mA. filter choke.
C1, C14: .05 mfd. 400 volt tubular condensers.
C2, C6, C7, C8, C9, C10, C16: .1 mfd 400 volt tubular condensers.
C3, C11, C12, C13: .0001 mfd mica condensers.
E1, E2, E3: 8 mfd 500 volt electrolytic condensers.
E4: 16 mfd 500 volt electrolytic condensers.
IF1, IF2: Types KIF5, KIF6, 455KC. permeability tuned I.F. transformers.
L5. 8 inch permanent magnet dynamic loudspeaker matched to 6V6GT, valve operated as a triode.
PT: Power Transformer—385-0-385 v. at 80 mA.; 6.3 v. at 3 A., and 5v. at 2 A.
R1, R7: 100,000 ohms ½ w. carbon resistors.
R2, R6: 300 ohms 1w. wirewound resistors.
R3, R5, R8: 50,000 ohms ½w. carbon resistors.
R4: 20,000 ohms 1w. carbon resistor.
R9, R11, R12: 1 megohm ½w. carbon resistor.
R10: 2000 ohms 1w. carbon resistor.
R13: 1.5 megohm ½w. carbon resistor.
R14: 150,000 ohms 1w. carbon resistor.
R15: 5,000 ohms 10w. wirewound resistor.
VC: 1 megohm carbon potentiometer.
VALVES: One each 6J8G, 6K7G, 6B8G, 6V6GT, 5V4G.



FOUR VALVE BATTERY SUPER



Front view of the, finished receiver.

High Efficiency —
Low Battery Consumption —
Really Good Tone —
Good Audio Output —
Easy To Construct —
Reasonably Low In Cost

THIS is an economical 4-valve battery superheterodyne employing the popular series of Australian type 2-volt valves. The circuit may be used equally well either as a straight broadcast set or with a commercial type dual-wave bracket. First we will describe the set as a straight broadcast receiver and then show how the dual wave bracket may be incorporated.

The circuit line-up is quite usual, consisting as it does of a 1C7G type mixer valve with an I.F. channel of 455 k.c. The I.F. amplifier valve, V2, is a type 1M5G, whilst the 1K7G valve, V3, operates as diode detector, A.V.C. rectifier, and first audio amplifier. The output valve, V4, is a type 1L5G.

All the valves in the receiver are operated under economy conditions and the output valve has been very slightly over-biased to hold the "B" battery consumption down to about 12 milliamperes. At the same time adequate output is obtained from the 1L5G to operate a modern efficient type permagnetic speaker.

● Details of Chassis Layout

THE layout of the receiver can be clearly seen from the accompanying photographs, but for the uninitiated we will touch briefly on the salient features of the parts assembly. Ready drilled and finished chasses are available for this set, and it will be noticed that a common chassis is employed for both this and the five valve battery receiver described elsewhere in this handbook. The four valve set may first be built and later, if the builder feels so inclined, he may add the additional valve to give extra range to the receiver.

In this chassis the valve hole nearest the front right-hand corner of the chassis is left blank and the valve, V1, mounted in the second hole.

The gang condenser and dial occupy a central position, the aerial and oscillator coil being mounted between the valve and the gang condenser. The aerial coil is the one nearest the front edge of the chassis. In the back right-hand corner, the first I.F. transformer, I.F.1, is bolted in, whilst in line along the back of the chassis from this point are the valve sockets for V2, I.F.2, and the socket for V3.

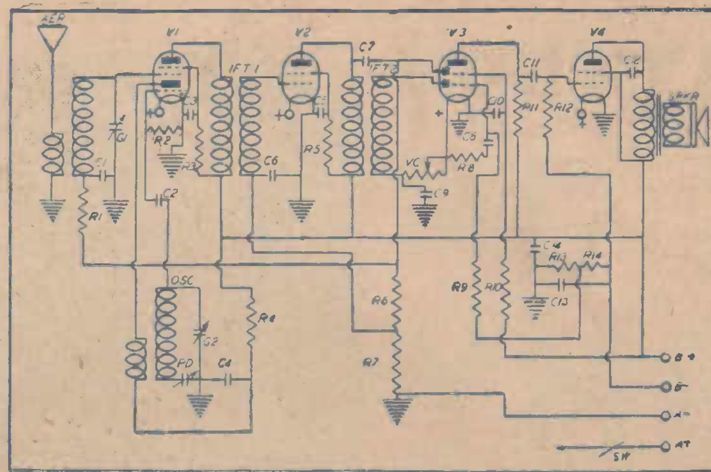
The V4 socket is placed in the space to the left of the gang condenser. The two speaker terminals are near this socket on the left-hand edge of the chassis and the aerial terminal is near the V1 socket on the right of the assembly. All of these terminals must be insulated from contact with the metal chassis with fibre washers. On the other hand, the earth terminal must make good contact with the chassis and it is mounted on the back wall of the chassis, near I.F.1. A hole, sleeved with a rubber grommett for the battery leads, is drilled on the left-hand wall of the chassis near the speaker terminals.

The volume control potentiometer, VC, is on the front wall of the chassis to the right of the main tuning control. The filament switch, SW, is to the left of this control. The only other component to be mounted at this stage is the padder condenser, PD. This is placed close to the third coil hole, near the socket for V2.

When mounting the parts, place solder lugs under the holding-down bolts to serve as anchor points for the tinned earth network.

PARTS LIST FOR FOUR VALVE BATTERY SUPER

CHASSIS: To suit layout and components (see text).
COIL KIT: Aerial and oscillator coils, iron cored, permeability tuned for 455 k.c. with padder.
C1, C3, C4, C5, C10: .1 mfd. tubular condensers.
C2, C7, C9: .0001 mfd. mica condensers.
C6: .05 mfd. tubular condenser.
C8, C11: .02 mfd. tubular condensers.
C12: .005 mfd. tubular condenser.
C13: 10 or 25 mfd. low voltage electrolytic condenser.
G1, G2: Two gang condenser with dial and trimmers to suit coils.
I.F1, I.F.2: Iron cored permeability tuned intermediate frequency transformer, 455 k.c.
PD: Padder condenser to suit coils.
R1, R11: 250,000 ohm ¼ or ½ watt resistors.
R2, R3, R4: 50,000 ohm ½ watt resistors.
R5: 75,000 ohm ½ watt resistor.



R6, R7, R10, R12: .5 megohm ¼ or ½ watt resistors.
R8: 1 megohm ¼ watt resistor.
R9: 100,000 ohm ¼ watt resistor.
R13: 125 ohm 25 m.a. wire-wound bias resistor.
R14: 375 ohm 25 m.a. wire-wound resistor.
SPEAKER: Permagnetic speaker to suit 1L5G.
SW: Single-pole single-throw rotary filament switch.
VALVES: V1, 1C7G; V2, 1M5G; V3, 1K7G; V4, 1L5G. With sockets to suit. Shields for V1, 2 and 3.
VC: Volume control potentiometer, .5 megohm.
SUNDRIES: Solder lugs, tinned copper wire, hook-up wire, four terminals, insulating washers, grid clips, nuts and bolts and knobs.

Point to Point Wiring

THE tinned wire earth network is the first thing to be wired in place. It serves as an earth return for by-pass condensers, resistors, and other components, and aids materially in keeping the wiring neat and the finished receiver stable in operation. Solder the tinned wire for the network to the lugs placed under the holding bolts of the assembled parts and join it to the earth terminal and to the moving plate wiper of the gang condenser.

A sketch of an 8-pin octal socket is shown with this article, and the wiring description will detail only the number of the socket lug to which connection must be made.

To the earth network join each of the No. 7 lugs of the four valve sockets. Join the No. 2 lugs of all sockets and wire them to one lug of the filament switch, SW.

Solder a lead to the aerial lug of the aerial coil and take this to the aerial terminal. Earth the E lug of the aerial coil to the earth network. The G lug of the aerial coil passes through a hole in the chassis up to the fixed plate lug of the front, or G1, section of the gang condenser, G1-G2. The .1 mfd tubular condenser, C1, connects from the AVC lug of the aerial coil to the earth network.

The G lug of the oscillator coil joins to one lug of the .0001 mfd. condenser, C2, and to the fixed plate lug of the G2 section of the gang condenser. The free end of C2 solders to the No. 5 lug of the V1 socket, as does one lead of the 50,000 ohm resistor, R2. Earth the other lead of this resistor and the moving plate contact of the padder condenser, PD. The other side of PD is wired to the padder lug of the oscillator coil. Join the No. 6 lug of the V1 socket to the OSC. P lug of the oscillator coil, and solder a lead from the P lug of I.F.1 to the No. 3 lug of the V1 socket. To the "B" positive lug of I.F.1 solder a lead from the corresponding lug on I.F.2 and one lead each of the 50,000 ohm resistors, R3 and R4, and the 75,000 ohm resistor, R5.

The unconnected end of R3 should be joined to the No. 4 lug of V1 socket, from which point the .1 mfd. tubular condenser, C3, is soldered to earth. The free end of R4 joins to the OSC. B positive lug of the oscillator coil and to one lug of the .1 mfd. tubular condenser, C4. The other side of C4 earths, whilst the remaining end of R5 solders to the No. 4 lug of the socket for V2. The .1 mfd. tubular condenser, C5, is wired from this same lug to earth.

A.V.C. Wiring Connections

THE plate lug of I.F.2 joins to the No. 3 lug of the V2 socket, and to this point also connects one lug of the .0001 mfd. condenser, C7. The unconnected lug of C7 has attached to it a lead from the No. 4 lug of the V3 socket, and one lead of the .5 megohm resistor, R6. The resistor, R7, solders from the free end of R6 to the earth network.

To the AVC lug of the aerial coil to which C1 is connected join one lead of the 250,000 ohm resistor, R1, and run a wire from the junction of R6 and C7 to the free end of this resistor.

The G or diode lug of I.F.2 connects to the No. 5 lug of V3, whilst to the F or AVC lug of this unit is soldered a flex lead and one lug of the .0001 mfd. condenser, C9. The free lug of C9 should be earthed and the flex lead run across the chassis to the outside lug of the volume control, i.e., that nearest to the main tuning control. The other outside lug of VC joins to the No. 2 lug on the V3 socket.

To the centre lug of VC attach one lead of the 100,000 ohm resistor, R9, and to the free end of R9 solder one lead of the .02 mfd. tubular coupling condenser, C8. Run a lead from the other side of this condenser to the No. 1 lug of the V3 socket.

A hole is drilled in the chassis near this lug and a short flex lead soldered to the No. 1 lug and passed through the hole. This lead terminates in the grid clip for the grid cap of the valve, V3. To the No. 1 lug of V3 socket connect one lead of the 1 megohm resistor, R8. To the No. 1 lug of V4 socket solder one lead of resistor, R14, and the negative lead of the 10 or 25 mfd. electrolytic condenser, C13. The positive lead of this condenser and one lead of resistor R13 are joined to the earth network whilst the free ends of R13, R14 and R8 join to one another.

To the "B" positive lug of I.F.2 solder a flex lead and one lead of the .5 megohm resistor, R10. The other end of R10 and one lead of the .1 mfd. tubular condenser, C10, join to the No. 6 lug of the V3 socket. Earth the remaining lead of C10 and wire the flex lead from I.F.2 to the No. 4 lug of V4 socket.

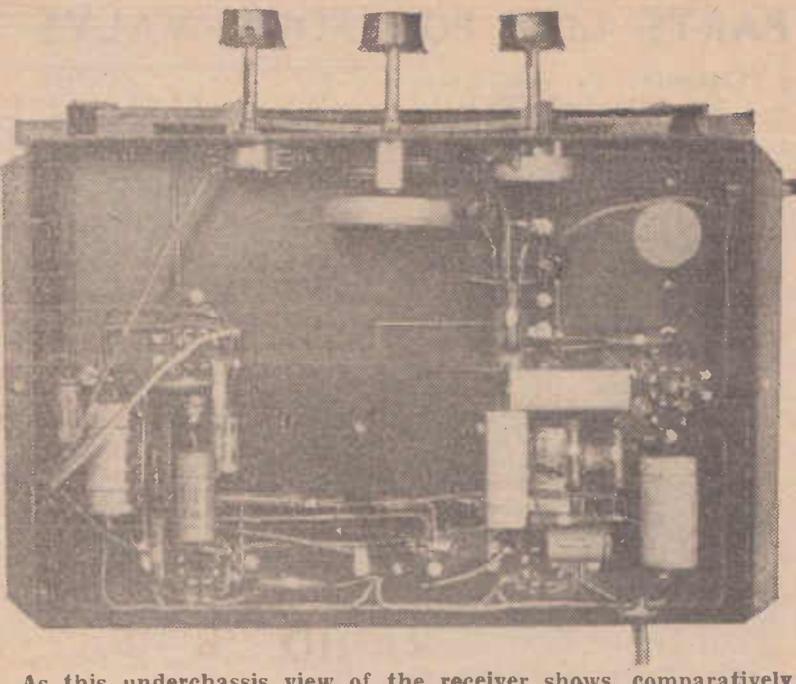
Join one lead each of the tubular 02 mfd. condenser, C11, and the 250,000 ohm resistor, R11, to the No. 3 lug of the C3 socket. Solder the free lead of C11 to the No. 5 lug of the V4 socket to which point also is attached one lead of the 1 megohm resistor, R12. The unconnected lead of R11 joins to the No. 4 lug of the V4 socket, whilst that of R12 joins to the No. 1 lug of the same socket.

Also wire one speaker terminal to the No. 4 lug. The other speaker lug joins to the No. 3 lug of the V4 socket. Connect the .005 mfd. condenser, C12, one lead to each of the speaker terminals.

Solder to the F or AVC lug of I.F.1 a flex lead from the junction of R6 and R7, and one lead of the .05 mfd. tubular condenser, C6. Earth the other side of C6, and wire the .5 mfd. tubular condenser, C14, from earth to the No. 4 lug of the V4 socket.

The lead coming from the top of the I.F.1 can terminate in the grid clip for the grid cap of the valve, V2. A short flex lead should be soldered to the fixed plate lug of G1 section of the gang condenser to terminate in a similar clip for the grid of V1.

Complete the wiring by taking four pieces of wiring flex about 3 ft. in length, and of different colors, for battery leads. Label them as follows:—"A" battery negative, "A" battery positive, "B" battery negative, and "B" battery positive. The four ends of these battery leads are then passed through the grommett hole in the chassis and connected thus:—"A" battery negative lead to the earth network; "A" battery positive lead to the vacant lug of the filament switch; "B" battery negative lead to the No. 1 lug of V4 socket; and "B" battery positive lead to No. 4 lug of the same socket.



As this underchassis view of the receiver shows, comparatively few parts are required to build the receiver. Careful placement of them permits efficient as well as neat looking wiring.

Dual-Wave Version

THOSE desirous of making a dual wave version of the receiver should obtain a dual wave bracket with oscillator coil suitable for use with the 1C6 battery convertor valve. The unit is mounted as shown in the accompanying photograph and the manufacturer's wiring details followed.

It will be necessary to rearrange the controls on the front of the chassis if the dual wave bracket is employed, but individual constructors can arrange this side of the job for themselves. When the bracket is used the aerial and oscillator coils and the padder condenser are not required.

The batteries required for the set are a two volt accumulator for the "A" battery and three 45 volt heavy or triple duty "B" batteries. The "B" batteries are connected in series, i.e., negative of one to positive of next. This leaves the positive of the first battery and the negative of the third for connection to the battery leads from the set.

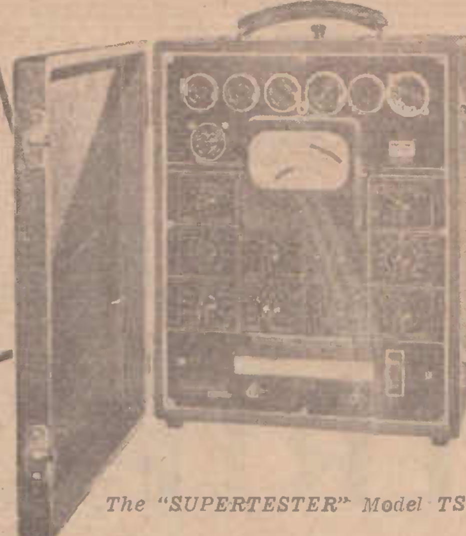
Before connecting the "B" batteries, however, connect the speaker leads, the aerial and earth wires and the "A" battery leads. Switch on the receiver filament switch and see if the valves light If so, the "B" battery leads then may be connected and the testing carried out.

If the valves fail to light in the initial test on no account attach the "B" battery leads until the fault has been found. Otherwise the valve filaments may be burnt out.

Turn the volume control full on —clockwise—and turn the main tuning dial until a signal is heard. Once it has been ascertained that the receiver is working correctly, have it aligned by a radio man with the aid of an oscillator or signal generator and output meter. This small expenditure will ensure maximum results from your receiver.

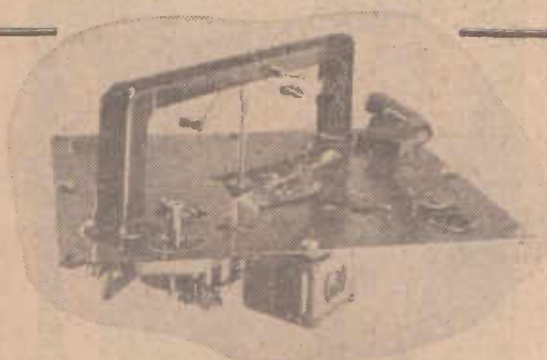
This receiver will provide reliable reception in almost any location, but should be provided with an efficient aerial and earth system if best results are to be expected. An overall length of 50 to 60 feet for the aerial wire will be suitable.

Here's your all-purpose tester the "UNIVERSITY SUPERTESTER"



The "SUPERTESTER" Model TST

Among the most modern and efficient valve and circuit testers on the market today is the "University Supertester" Model TST. This compact instrument combines all the functions of a multimeter, output meter, valve tester, paper *and mica condenser tester, a really* efficient electrolytic condenser, imped*ance and leakage tester — all in one case.. The "Supertester" is available in* two models, for A.C. operation only, or for universal operation from A.C. or 6-volt battery. Other models on application.



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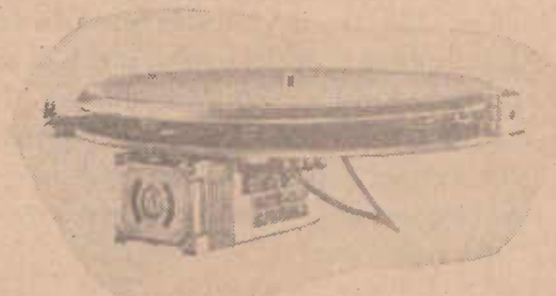
(3) IF STOPPED during a recording the "Collaro" returns pick-up to REST POSITION and STOPS MOTOR.

(4) A Sturdy constructed motor allows constant speed and does not slow down when *fresh records dropped.*

(5) Incorporates Needle Cups.



Collaro Motors

"COLLARO" A.C. 37 Gramo Motor
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"COLLARO" A.C. 37 Gramo Motor & Pick-Up

"COLLARO" A.C. 37 Record Changer
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MODEL F15. 13 watts output, A/C operated, output 500 ohms.

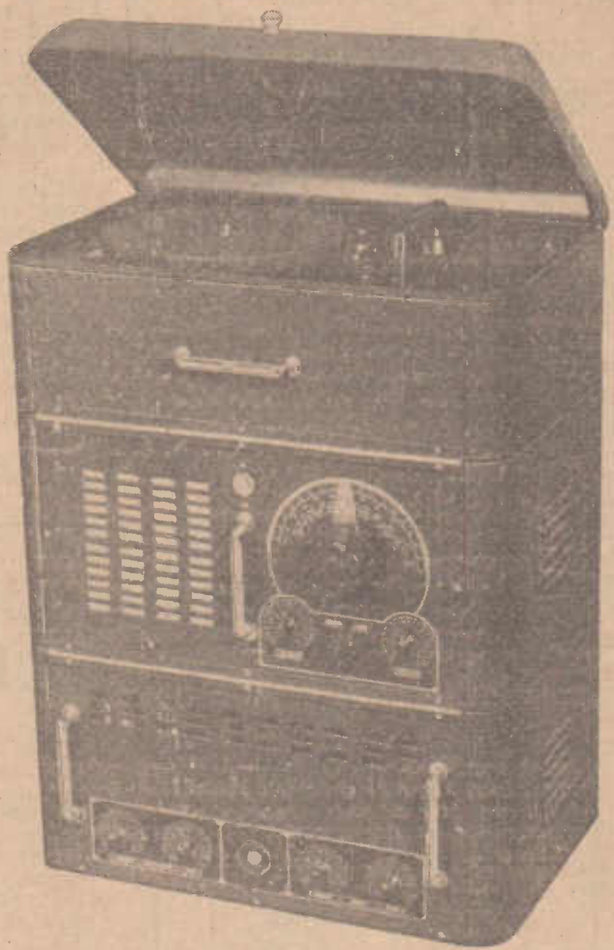
MODEL F15V. 13 watts output, 12 volt D/C and 240 volt A/C operated, output 500 ohms.

MODEL F30. 26 watts output, A/C operated, output 500 ohms.

MODEL F60. 60 watts output, A/C operated, output 500 ohms.

MODEL F120. 120 watts output, A/C operated, output 500 ohms.

MODEL F 3 0 0. 300 watts output, A/C operated, output 250 and 500 ohms.



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S.W. ADAPTORS AND CONVERTERS

Applications of Each Unit — Wiring Descriptions — Frequency Ranges — Special Applications — General Methods of Operation.

NO doubt there are many listeners possessing straight broadcast band receivers who would like to be able to receive short-wave stations. In this article we propose to deal with two simple units which will give those listeners short-wave reception on their standard receivers.

There are three types of broadcast band sets in general use: the superheterodyne, the tuned radio frequency, and the regenerative. Of the two units described here, the first—known as a converter—will be suitable for the superheterodyne and for the T.R.F. if the latter is sufficiently sensitive. If the T.R.F. set has two tuned radio frequency stages the converter will be satisfactory, but if only one radio frequency stage is included in the broadcast set the adaptor type unit should be used. The latter unit also is the only one suitable for the regenerative type of broadcast set.

Application of the Converter

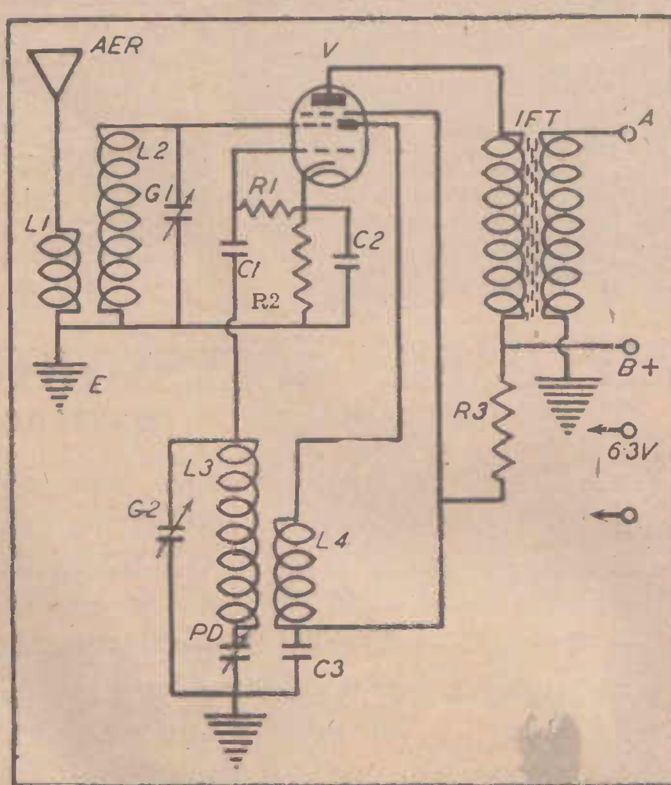
BRIEFLY, the operation of the converter is as follows: Signals are fed from the aerial to the grid of the mixer section of the converter valve via the coils, L1, L2. The secondary winding, L2, is tuned by one section of the gang condenser to the frequency of the incoming signal. The oscillator secondary coil, L3, is so proportioned and padded with the condenser, PD, that it at all times differs from the incoming signal by about 550 kilocycles—depending on the setting of the trimmers and the tuning of the intermediate frequency transformer, IFT. The two signals are "mixed" in the converter valve and the resultant "beat" fed through the windings of IFT to the aerial terminal of the broadcast set.

It is not possible at present to obtain commercially wound coils for units of this type, but the home builder will have no difficulty in winding them from the details given later in this article.

The tuning range of the coils we describe is from about 15 to 50 metres.

To make them, obtain two pieces of high quality ¾ in. diameter bakelite trolitul, or other high frequency insulating material tubing, 2 in. in length. On one piece of former drill two

PARTS LIST AND SCHEMATIC CIRCUIT OF CONVERTER UNIT



CHASSIS: To suit parts (see text).
COILS: L1, L2, L3, L4 (see text).
C1: .0001 mfd. mica condenser.
C2, C3: .1 mfd. tubular condensers.
G1, G2: Two-gang condenser with dial. To be fitted with trimmers.
IFT: Converter type intermediate frequency transformer (see text).
PD: Padder condenser, .005 mfd. mica condenser.
R1: 50,000 ohm ½ or ¼ watt resistor.
R2: 250 ohm 1 watt bias resistor.
R3: 15,000 ohm 1 watt resistor.
V: 6K8G converter valve.
SUNDRIES: Coil material (see text), solder, lugs, hook-up wire, nuts and bolts, valve socket, tinned wire and terminals.

small holes at one end to anchor the wire, and wind on 12 turns of 22 gauge enamel covered or tinned wire. Space the turns one diameter of the wire. This spacing is easily done by winding two strands of wire together and later removing one winding, leaving the required turns neatly spaced.

All ends of the windings for both sets of coils are finished off and held tightly by passing them through small holes drilled in the former. Leave about 5 in. of wire for connections at the start and finish of all windings. The winding just completed is the L2 winding. For L1 wind five turns of finer wire — say gauge 30 enamel or D.S.C. — in the space between the last five turns of the 12 turn winding, L2. The windings should be in the same direction. This completes the aerial coil. For the oscillator coil wind on 11 turns of the heavier gauge wire, again spacing it one diameter, for L3, and another five turns of the fine gauge wire between the last five turns of L3 for the feedback winding, L4.

Constructing the Converter Unit

THE parts for the converter should be mounted on a small metal chassis measuring about 8 inches square and some 2½ inches deep. The two-gang condenser and its associated dial occupy a central position on the chassis with the socket for the converter valve V mounted to the right of them. The intermediate frequency transformer, IFT, is mounted between the valve socket and the back edge of the chassis. Incidentally IFT is a special 550 K.C. transformer built specially for units of this kind.

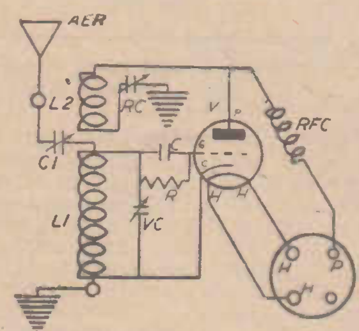
If this special I.F. is not available, it will be necessary to obtain a 455 K.C. unit and make some slight alterations to it. The trimmer should be removed from one section of the transformer and this winding moved as close to the other tuned winding as possible. It will be necessary also to remove turns from the tuned winding until a peak is obtained in the broadcast receiver. This will have to be a matter of trial and error.

On the rear wall of the chassis, near IFT, mount two terminals. One of these must be insulated from the metal chassis whilst the other mounts directly to it. Another insulated terminal, for the aerial wire, mounts on top of the chassis, in the front left-hand corner. In the centre of the rear wall of the chassis drill a large hole and fit this with a rubber grommett. This is to take the heater and "B" positive leads.

Mount the oscillator coil underneath and on the front wall of the chassis with a small metal bracket so that its leads come close to the valve socket. The aerial coil mounts below chassis also, but on the floor of the chassis so that its axis is at right angles to that of the oscillator coil and directly over the front or G1 section of the gang condenser, G1-G2.

A gang condenser with trimmers is specified, but if this is not available, separate small trimmers will be supplied to connect from the gang condenser's fixed plate lugs to its frame or earth.

ONE VALVE ADAPTOR AND PARTS LIST



CHASSIS: To suit parts (see text).
COILS: L1-L2 (see text).
C1: 3 plate midget variable condenser.
C: .00025 mfd. mica condenser.
R: 7 megohm resistor.
RC: 17 or 23 plate midget variable condenser.
RFC: Radio frequency choke.
VC: Single gang tuning condenser. Capacity, .000385 to .0005 mfd.
V: (See text).
SUNDRIES: Coil material, tinned copper wire, solder lugs, nuts and bolts, valve socket (see text), insulating washers and terminals.

The padder condenser mounts in the corner of the chassis near the oscillator coil. Begin the wiring by taking two pieces of flex about 3 ft. in length and twisting them together to form a pair. Pass one end of the pair through the hole in the rear wall of the chassis and solder one lead of each of the pair to the heater lugs of the valve socket.

Take a piece of fairly heavy gauge tinned copper wire and wire this to the terminal which mounts directly to the metal chassis. This is to be the earth terminal. The other end of the tinned wire joins to the earth wiper lug on the gang condenser and to one side of the padder condenser, PD. To this point also connect the start of the 12 turn winding of the aerial coil and the inner end of the five turn winding. The free 12 turn coil end connects to the fixed plate lug of the front section of the gang condenser and to a short flex lead which terminates in the grid cap for the valve, V. The unconnected lead of the five turn winding joins to the insulated aerial terminal.

Final Stages of The Wiring

TO the cathode lug of the valve socket solder one lead each of the resistor and condenser, R2 and C2. Solder the other ends of these parts to the tinned earth wire. The start of the 12 turn winding of the oscillator coil joins to one side of condenser, C1, and to the fixed plate lug of the rear section of the gang condenser. The free lug of C1 joins to the oscillator grid lug of the valve socket and to one lead of resistor, R1. The other end of R1 wires to the cathode lug of the socket.

The remaining lead of the 12 turn winding joins to the unconnected side of the condenser, PD. The outside lead of the five turn winding on the oscillator coil joins to the oscillator plate lug of the valve socket whilst the other end of this winding joins to the screen grid lug of the same socket. To this point also connect one lead each of resistor, R3, and condenser, C3. Earth the other end of C3. To the free lead of R3 solder a 3 ft. length of wiring flex for the "B" positive connection. To the plate lug of the valve socket solder a lead from the P plug of the I.F. transformer, IFT. The "B" positive lug of this component joins to R3 and to the "B" positive lead.

The E or A.V.C. lug on IFT connects to earth whilst the G lug of this unit is joined to the remaining insulated terminal on the rear wall of the chassis. This completes the wiring.

Using the Converter Unit

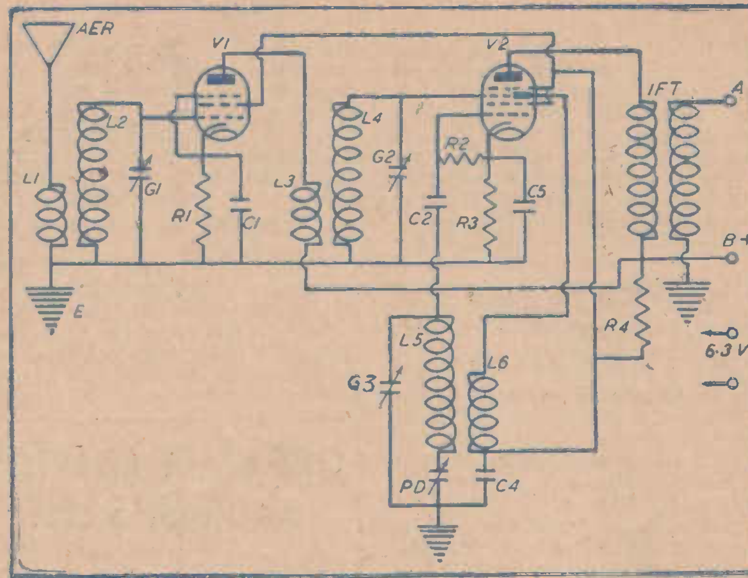
TO connect the unit to the broadcast receiving set the twisted pair must be joined to a 6.3 volt AC source and the "B" positive lead to positive 250 volts on the receiver. If you are not certain of these connections have a radio man locate the points and bring them out to a four-pin socket.

The leads from the converter are then wired to a 4-pin plug and the converter plugged in when required. The other connections required are a wire from the earth terminal of the converter to the earth terminal of the set and the connection of the insulated terminal which joins to IFT to the aerial terminal of the receiver. The aerial wire now connects to the aerial terminal of the converter.

To place the converter in operation, switch on the broadcast set and tune it to a point just above 3AR where no other station is received. With a screwdriver vary the converter trimmers on IFT until a loud rushing noise indicates that the unit is in tune with the set.

Next turn the dial of the converter slowly until a station is heard at the point where the condenser plates are nearly at the "full out" position. Make sure that the trimmer on the oscillator coil is nearly "full out," and then adjust the trimmer on the aerial coil for best results. Finally, re-adjust trimmer on IFT for best signal strength.

If possible have a radio service man align the converter for you. His low charge will be well repaid by the improved results.



Circuit of a two-valve short-wave converter using a radio frequency stage ahead of the mixer.

How to Use the Adaptor

IN the case of the adaptor, a plug or old valve base to be used as the base of the detector valve in the broadcast set should be obtained. The heater and "B" positive supply are obtained simply by removing the detector valve from the broadcast set and inserting the suitably wired plug of the adaptor. The valve from the existing set is used in the adaptor socket. The coil for the adaptor is similar to the aerial coil of the converter and should consist of 12 turns of 22 gauge enamel wire for coil L1 and 5 turns for L2. In this case, however, the 5 turns for L2 are wound close to the last turn of L1 and not interwound with it.

Build the unit on a small metal chassis and mount the main tuning condenser, VC, in the centre of it and on top of the chassis. To the right of VC mount the valve socket and near the socket, and directly below it, coil L1-L2. The reaction condenser, RC, mounts on the front wall of the chassis to the right of the main tuning condenser. The aerial condenser, C1, balances the front of the unit as it is mounted on the left of VC, but it must be insulated from the chassis. An insulated terminal for the aerial and an earth terminal mounted straight on to the chassis completes the preliminary assembly.

Begin the wiring by running a tinned lead from the earth terminal to the moving plates of VC and RC and to the cathode lug of the valve socket. Join the fixed plates of VC and C1 and to them wire the start of the 12-turn winding, L1. The end of this winding should be joined to earth or chassis. Solder the resistor R and condenser C to the fixed plate lug of VC and connect their free ends together and join them to the grid of the valve, V. The aerial terminal joins to the moving plates of C1. The outside lead of the 5-turn winding should be wired to the plate lug of the valve socket and to one side of the radio frequency choke, RFC. The latter component is usually mounted on a small metal bracket so that its lugs cannot make contact with the metal of the chassis.

The unconnected lug of RFC joins to the plate pin of the valve base which plugs into the existing set. To the heater connections of this plug run leads from the heater lugs of the valve socket. These leads, and the plate lead, should be long enough to allow the adaptor to be used fairly close to the broadcast set. The free end of the 5-turn winding wires to the fixed plate lug of the reaction condenser, RC. This completes the wiring.

Operating the Adaptor Unit

TO operate the adaptor, remove the detector valve from the broadcast set and insert the adaptor plug. Place the valve in the adaptor valve socket and join the earth terminal of the adaptor to the earth terminal of the set. Switch on the broadcast set and connect the aerial wire to the adaptor aerial terminal. Rotate RC towards the "full in" position until a dull "plop" is heard. Then tune the main condenser VC very slowly until a station whistle is heard. "Back off" RC until the station is heard at maximum strength without any sign of whistling. If it is not possible to make the valve oscillate, as denoted by the dull plop as RC is turned "full in," try reversing the leads of the 5-turn coil. If this does not rectify matters add one or two turns to the five turn coil.

The aerial coupling condenser, C1, is to remove "dead spots" over the tuning range where it is not possible to make the detector valve oscillate normally.

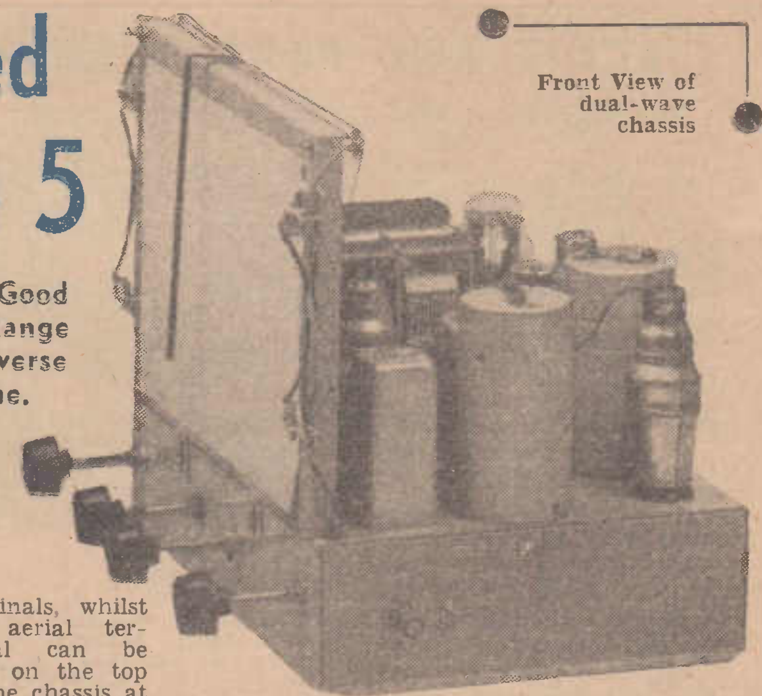
Usually it can be pre-set to give good results over the whole tuning range which is from about 15 to 50 metres with standard tuning condensers.

In the wiring descriptions given earlier it has been assumed that the detector valve is of the triode type. If it should happen to be a screen grid type an additional lead must be used to connect the screen grid lug of the adaptor valve socket to the corresponding lug on the plug which goes to the broadcast set.

This type of adaptor may be employed with battery receivers and the wiring will be the same except that in most cases there will be no cathode connection to the valve socket, and filament wiring will take the place of heater wiring detailed.

Both units can be relied upon to give reliable reception on the short wave bands once their operation and adjustments have been mastered.

A.C. Operated Dual-Wave 5


Front View of dual-wave chassis

Efficient Yet Simple To Build—Good A.V.C. System—Short Wave Range From 13 To 42 Metres — Inverse Feedback Ensures Good Tone.

THE design of this dual wave a.c. operated receiver represents the simplest practical form in which high efficiency can be combined with ease of construction. The use of modern coils and intermediate frequency transformers permits simple yet effective circuiting which provides adequate sensitivity for normal needs.

Assembling The Components

IN the original receiver four controls were used and these were located in line along the front of the chassis. Some types of dials do not lend themselves to this layout, in which case the gang condenser and its dial should be mounted higher up than usual and the volume control placed below the main tuning dial. To the right of the gang then would be placed the wave change switch or the dual wave bracket, whilst in a similar position to the left of the main tuning control would be the radio-pickup switch. Looking down on the receiver chassis we find that the socket for the valve, V1, and the aerial and oscillator broadcast coils are towards the front of the chassis to the right of the gang condenser.

Along the right hand edge of the set and along the back there are in turn IFI, the socket for the 6G8G valve, V2, the second I.F. transformer, the socket for the 6J7G valve, V3, and the output and rectifier valve sockets V4 and V5 for the 6V6G and 5Y3G respectively.

The power transformer is mounted at the left of the gang con-condenser, whilst the power choke CH is mounted below the chassis. Its place may be readily seen from the under-chassis view of the receiver. On the back of the set are the pickup and earth terminals, whilst the aerial terminal can be seen on the top of the chassis at the extreme right hand edge. The aerial terminal and one pickup terminal must be insulated from contact with the metal of the chassis. The broadcast band padder condenser, PD, is placed below chassis, but is adjusted from above through a hole in the chassis. The short wave padder, PDI, is fixed and requires no adjustment.

The speaker plug is located near the output valve socket on the rear wall of the chassis. Incidentally, when mounting the valve sockets place them so that their heater lugs are towards the walls of the chassis. A couple of solder lugs bolted on a small piece of bakelite should be mounted near the padder condenser, PD. This helps in the wiring by serving as a mounting for the screen resistors, R3, and the "B" positive bypass condenser, C14.

Point To Point Wiring

SO much for the preliminary assembly. Begin the wiring by running in a tinned wire earth network between the solder lugs under the sockets and other components, the earth terminal and the moving plate wipers of the gang condenser, G1-G2. To this earth network solder leads from one heater lug of each of the sockets for V1, V2, V3, and V4. Connect together the remaining heater lugs of these sockets and wire them to one lug of the 6.3 volt winding on the power transformer, PT. The other side of this winding joins to earth. Also wire to earth the cathode lugs of the sockets V1, V2, and V4. To the cathode and suppressor grid lugs of V3 connect one lead of the 2000 ohm resistor, R8, and the positive lead of the 10 or 25 mfd. electrolytic condenser, C10. Earth the other leads of these parts. Run a twisted pair from the 5 volt winding on PT to the heater lugs of the socket for V5. Do likewise with the outside high tension lugs of PT to the plate lugs of V5 socket. One lead of CH and the positive lead of the condenser E1, join to one heater lug of V5 socket whilst the other end of CH joins to the screen grid lug of V4 socket.

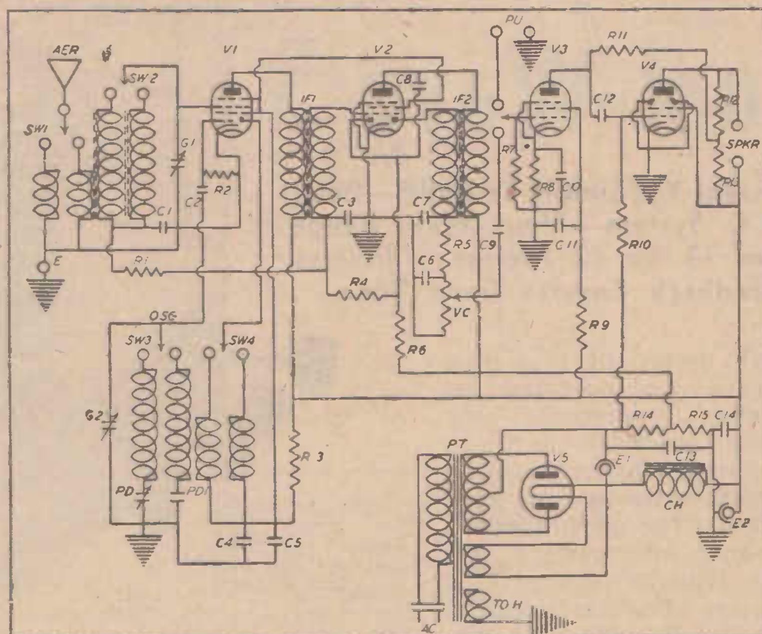
Connect together one lead each of the resistors R14 and 15. Earth the free end of R15 and the positive lead of the 10 or 25 mfd. electrolytic condenser, C13. The negative end of C13 and the unconnected side of R14 join to the centre tap of the high tension winding on PT. To this point also solder the negative end of E1.

I.F. Stage and A.V.C. Connections

WIRE the plate lead of IF1 to the plate lug of the socket for V1 and similarly connect the plate lead of IF2 to the plate of V2. The "B" positive lugs of IF1 and IF2 connect together and to one of the insulated solder lugs on the bakelite strip. To the other lug on this strip join the screen grid lugs of the sockets for V1 and V2 and one lead of the 12,500 ohm resistor R3.

The other end of the resistor, R3, joins to the lug on the strip to which IF1 and IF2 are con-

CIRCUIT AND PARTS LIST OF DUAL WAVE 5



CHASSIS:—To suit layout and components. (See text.)

COIL KIT:—455 K.C. aerial and oscillator coils for broadcast band. Iron cored. Short wave iron cored coils 13-42 metres with suitable padder condenser, PD1, or dual-wave type bracket with inbuilt trimmers, padders, ready wired.

C1, C5:—1 mfd. tubular condensers 400 volt working.

C2, C6, C7, C8:—.0001 mfd. mica condensers.

C3, C9, C12:—.05 mfd. tubular 200 volt working condensers.

C4:—8 mfd. 400 volt working electrolytic condenser.

C10, C13:—10 or 25 mfd. 40 volt electrolytic condensers.

C11, C14:—.5 mfd. tubular 400 volt condensers.

CH:—Power choke supplied with permagnetic speaker, D.C. Resistance, 520 ohms.

E1, E2:—8 mfd. 400 volt electrolytic condensers.

G1, G2:—Two gang condenser with dial to suit coils.

IF1, IF2: — Intermediate frequency transformers. Permeability tuned iron core type for 455 K.C.

PD:—Broadcast coil padder.

PT:—Power transformer, 80 milliampere, 265-0-265, a 5 and a 6.3 volt winding.

R1, R10, R11:—250,000 ohm ½ watt resistors.

R2, R5:—50,000 ohm ¼ or ½ watt resistors.

R3:—Two 25,000 ohm 1 watt resistors in parallel.

R4:—750,000 ohm ¼ or ½ watt resistor.

R6, R7:—1 megohm ¼ or ½ watt resistors.

R8:—2000 ohm 1 watt bias resistor.

R9:—1.5 megohm ½ watt resistor.

R12:—100,000 ohm ¼ or ½ watt resistor.

R13:—15,000 ohm ¼ or ½ watt resistor.

R14, R15:—180 ohm 100 m.a. wire wound resistor tapped at 45 ohms.

SW1 to SW6:—6 pole two way wave change switch.

SW:—Single pole double throw pick-up radio switch.

VC:—Volume control potentiometer .5 megohm.

VALVES:—One each 6K8G, 6G8G, 6J7G, 6V6G and 5Y3G.

SPEAKER: — Permagnetic type 10 or 12 inch speaker transformer to suit 6V6G. (Supplied with special filter choke.)

SUNDRIES:—Solder lugs, tinned copper wire, hook-up wire, nuts and bolts, terminals, insulating washers, five valve sockets and speaker socket, three valve shields, three grid clips, four trimmer condensers, four knobs and AC flex lead and plug.

nected whilst the .5 mfd. tubular condenser, C14, joins from this lug to the earth wire. From the lug on the strip to which the screen grid lugs of V1 and V2 were wired connect the 8 mfd. electrolytic C4 and the .1 mfd. tubular condenser C5 to earth. Take care that the negative of C4 is earthed to the chassis.

The grid lead of IF1 comes out the top of the can and terminates in the grid clip for V2. To the A.V.C. lug of IF1 join one lead of the .05 mfd. tubular condenser, C3, and one lead of the 1 megohm resistor, R4. To the free end of R4 solder one lead of R6 and a lead from one diode plate of the socket, V2. The .0001 mfd. condenser, C8, connects from this diode plate to the plate lug of the same socket. The remaining diode plate lug of V2 socket wires to the G or diode lug of IF2.

The A.V.C. or diode return lead of this component is soldered to one lead each of the 50,000 ohm resistor, R5, and the .0001 mfd. condenser, C7. To the other end of R5 solder one lead of the other .0001 mfd. condenser C6 and the inside insulated lead of a piece of metal braided or shielded wire.

When using the shielded wire cut back the metal braid about ¼in. from where the connection is to be made to prevent shorts.

Earth the free end of C6 and the outside metal braid to the earth network. Run the shielded lead across the chassis to the volume control, VC, earthing the outside metal braid at several points. Cut back the shielding as previously described and join the inside lead to the outside lug of VC which represents the full on position, i.e., fully clockwise. The other outside lug of VC joins to earth.

Solder one lead of the .1 mfd. tubular coupling condenser, C9, to the "radio" position lug of the radio - pickup switch. Another shielded wire is then run from the arm of VC to the free end of this condenser. Again earth the shielding braid in several places. Shielded wire also is required to run from the arm lug of the radio-pickup switch to the grid cap of V3. This lead passes up through the chassis near the **V3** socket. **(Continued on next page.)**

A similar piece of wire connects the insulated pickup terminal to the pickup lug on the radio-pick-up switch, SW. Earth the braids of the shielded leads and make sure that no short circuits can occur between the outer metal covering and the connections of the inner conductor.

The resistor, R7, solders from the inner conductor of the lead to the grid cap of V3 to earth. To the plate of the V3 socket connect one lead each of the 250,000 ohm resistor, R11, and .1 mfd. tubular coupling condenser, C12. The other side of C12 is wired to the grid lug of the socket, V4. From this point to the junction of R14 and CT of PT solder the resistor, R10.

To the screen grid lug of the socket for V3, solder one lead each of the 1.5 megohm resistor, R9, and the .5 mfd. tubular condenser, C11. Earth the free end of C11 and join the unconnected lead of R9 to the screen grid lug of the V4 socket. To this point also solder the positive lead of the electrolytic condenser, E2, one lead of the 15,000 ohm resistor, R13, and a lead from the junction of R3 and the "B" positive lugs of IF1 and IF2. Earth the negative side of E2.

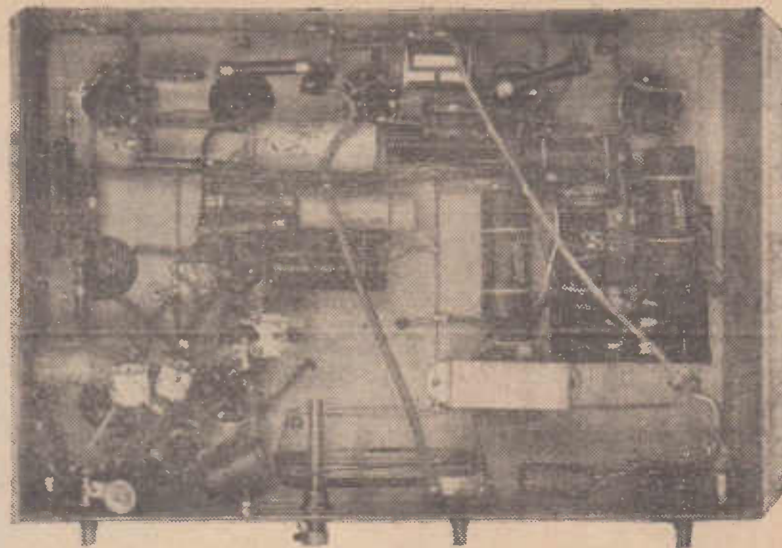
Connect one small pin of the speaker socket to the plate lug of the V4 socket and to this point also solder one lead of the 100,000 ohm resistor, R12. The free ends of the resistors, R11, R12, and R13, are wired to one another. The other small pin of the speaker socket is joined to the screen grid lug of the V4 socket.

Aerial and Mixer Circuits

THE coil and mixer circuit wiring has been purposely left until last. Mount the four trimmer condensers across the secondary winding of each coil. On the aerial coils the trimmer will connect from the G. lug to the A.V.C. or E. lug, whilst on the oscillator coils they will connect from the G lug to the padder lug.

Here is the wiring description for separate coils. Connect together the earth ends of the primary or aerial windings of the broadcast and S.W. coils and earth them. Run a lead from the aerial terminal to the arm contact of one section of the 6 pole switch. Set the switch in the broadcast position and wire the broadcast aerial coil contact to the lug with which the arm makes contact.

The short wave aerial coil connection joins to the other lug of this section of the switch. Solder a short flex lead to the fixed plate lug of the G1 section of the gang condenser and terminate this in the grid cap for the grid of the mixer valve, V1. To the same fixed plate lug of the G1 section of the gang solder a lead from the arm contact of another section of the 6 pole wave change switch. This switch being left in the same position, we can easily pick out the lug to which the G connection of the broadcast aerial coil must be wired. The other lug on this section of the switch joins to the G connection of the S.W. aerial coil.



Under chassis view of the receiver.

Connect together the E or A.V.C. lugs of the broadcast and S.W. aerial coil and to them solder one lead of the .1 mfd. tubular condenser, C1. Earth the other lead of this condenser.

To the junction of C1 and the two coils solder one lead of the 250,000 ohm resistor, R1. A lead from the free end of this resistor is then connected to the junction of C3 and IF1. The free end of the resistor, R6, connects to the junction or tap of R14 and R15.

To the oscillator grid lug of the V1 socket solder one lead each of the 50,000 ohm resistor, R2, and the .0001 mfd. condenser, C2. Earth the free end of R2. To the other side of C2 join the fixed plate lug of the G2 section of the gang condenser and a lead from another arm of the 6 pole wave change switch. To the broadcast lug of this same section of the switch join the oscillator grid lug of the broadcast oscillator coil. The E or padder connection of this coil joins to the fixed plate lug of the broadcast variable padder condenser, PD. The short wave oscillator coils, G, contact wires to the vacant S.W. lug on the wave change switch. That makes three complete sections of the switch wired up.

The fixed padder condenser, PD1, the value of which must suit the particular short wave coils used, is then connected from the padder end of the short wave coil to earth. The arm of the fourth section of the 6 pole wave change switch connects to the oscillator plate lug of the V1 socket.

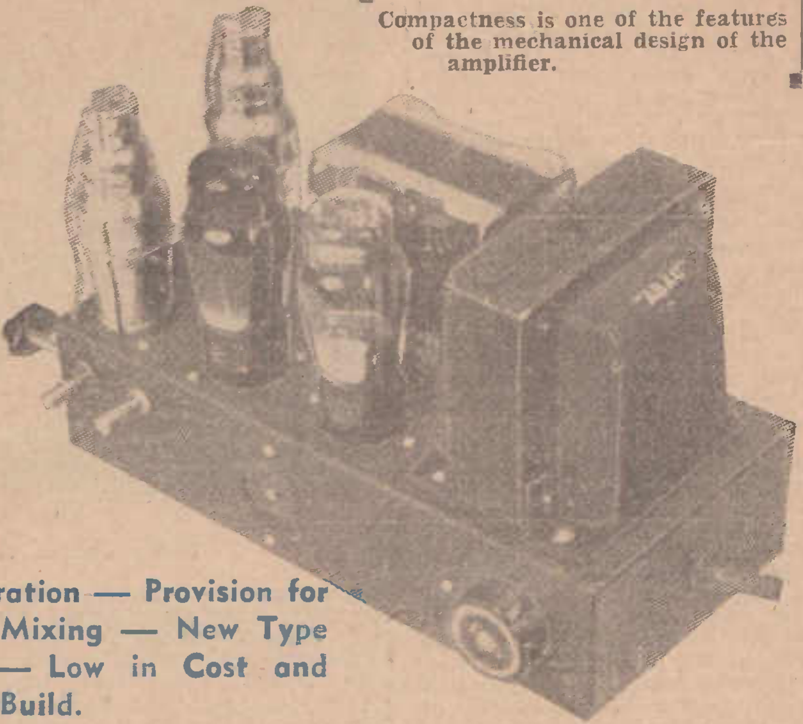
The Broadcast lug of this section of the switch wires to the Osc. plate lug of the broadcast oscillator coil whilst the free lug of the same section solders to the Osc. plate lug of the corresponding short wave coil. The Osc. "B" positive lead of both the broadcast and short wave oscillator coils connect together and wire to the junction of R3 and the screens of V1 and V2.

The wiring is completed with the connection of the A.C. power lead to its correct tappings on the power transformer, PT.

Testing and Alignment

PLACE the valves in their correct socket and fit the valves shields to them. Attach the speaker and aerial and earth wires and plug the mains lead into a power point. Switch on and see that all valves light. Touch the grid cap of the valve V3 with a finger and a loud buzz will prove that the audio stages are working normally. Turn the volume control to full on and tune over the band. It should be possible to receive some kind of a signal although it will probably be very faint and not in its correct dial position. Once having proved that the receiver is working to have a radio serviceman align it by means of a signal generator and output meter.

4½ WATT HIGH FIDELITY AMPLIFIER



Compactness is one of the features of the mechanical design of the amplifier.

Designed for Portable Operation — Provision for Microphone and Pick-up Mixing — New Type Inverse Feedback System — Low in Cost and Simple to Build.

THIS compact single-ended amplifier has been designed to suit the needs of small dance bands, electric guitarists, and others requiring a low output amplifier for announcements and the playing of recorded music in small halls, cafes, and similar locations.

It has a rated output of 4.5 watts and may be built into a portable carrying case either with built-in speaker or for use with a wired speaker installation.

A preamplifier stage has been included so that sufficient gain is available for contact or other type microphones. One of the latest inverse feedback systems developed by the A.W. Valve Co. is incorporated in the amplifier, and the 'feedback control is brought out to the control panel so that adjustments can be made to suit differing localities or the ear of the user.

The chassis measures only 11 inches by 5 inches by 2½ inches deep. With the addition of terminals the width increases to around six inches. Even so, the complete amplifier, together with an 8-inch permagnetic speaker could be built into a carrying case measuring about 16 inches by 12 inches by 6 inches.

An interesting feature of the amplifier is that it is fitted with a tap changing arrangement which carries one ampere fuses. With this fitting the amplifier can be readily adapted for use on 200 to 250 volt A.C. mains, simply, quickly and without removing the chassis from the case. Six taps are provided, and the fuses will protect the rectifier and transformer should a short occur in the power supply of the amplifier.

The chassis, power transformer, and choke, together with the tap changing fuse holder are available to those wishing to build this handy amplifier.

Details Of The Circuit

FOUR valves are used in the circuit arrangement. The first, a type 6J7G, is wired as a preamplifier for a microphone. A totally or continuously earthed microphone plug is required for the connection to the amplifier otherwise a loud hum will spoil results. The second valve, another type 6J7G, serves as driver for the 6V6G. The pickup is connected to the grid of V2 through its own volume control potentiometer, VC2.

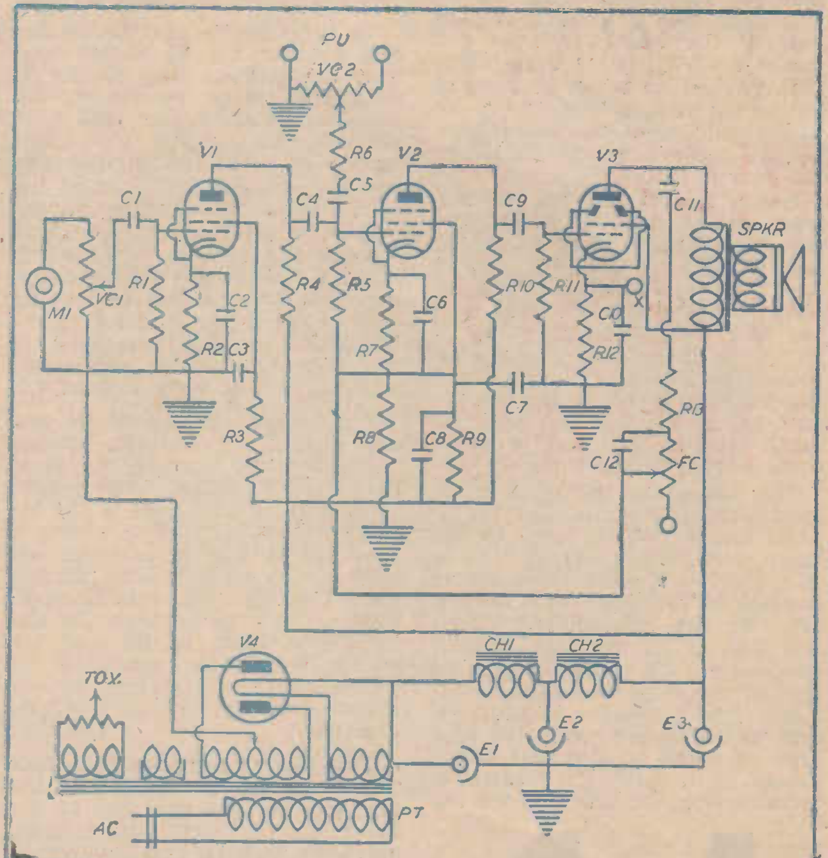
A simple mixing arrangement prevents the pickup volume control from affecting the microphone gain when a mix between the two is required. The output valve is a type 6V6G and the feed back is arranged from the plate of this valve through C11, R13, and the feedback control FC. to the cathode of the driver 6J7G, V2.

In many cases where a type 6J7G is used as a high gain microphone preamplifier a bad hum is developed. No amount of decoupling seems to overcome this trouble, which is caused by a leakage between heater and cathode of the 6J7G itself. It can be prevented, however, by making the heater of the 6J7G positive in respect to cathode. This has been done in this circuit by returning the centre-tap of the 6.3 volt winding supplying V1 and V2 to the cathode of the 6V6G valve V3. This places the heater of V1 and V2 12.5 volts above earth and will overcome the hum problem.

Chassis Layout And Assembly

AS may be seen from the photographs of the original chassis the power transformer, PT, is mounted at one end of the assembly, with the tap changing fuse holder directly below it. In each corner at the opposite end of the chassis are mounted the sockets

PARTS LIST AND SCHEMATIC DIAGRAM



CHASSIS:—to suit layout and components. (See text).

CH1, CH2:—Filter chokes. CH1 type TZ57 (200 ohms) CH2 supplied with Permagnetic Speaker (520 ohms).

C1, C3, C4, C5, C7, C9: — .05 mfd. tubular condensers 400 volt working.

C2, C6, C10:—25 mfd. 25 volt tubular electrolytic condensers.

C8:—.01 mfd. tubular condenser.

C11:—.5 mfd. tubular condenser. 400 volt.

C12: — .005 mfd. tubular or mica condenser. 400 volt.

FC: — .5 megohm potentiometer.

MI:—Microphone inlet socket.

PT:—Power Transformer. 265 volts a side with a 5 volt and two 6.3 volt windings and special taps for use with ABAC tap changing fuse holder.

PU:—Pickup terminals.

R1, R5:—1 megohm ½ watt resistors.

R2:—1300 ohm bias resistor. 1 watt.

R3:—1.5 megohm 1 watt resistor.

R4:—250,000 ohm ½ watt resistor.

R6, R11:—.5 megohm ½ watt resistors.

R7:—3200 ohm bias resistor 1 watt.

R8:—1000 ohm bias resistor. .1 watt.

R9:—3 megohm ½ watt resistor.

R10:—10,000 ohm ½ watt resistor.

R12: — 232 ohm wire wound bias resistor. 50 m.a.

R13:—15,000 ohm ½ watt resistor.

SPEAKER: — Permagnetic type to suit 6V6G.

VALVES: — V1 and V2 type 6J7G, V3 a 6V6G and V4 a 5Y3G.

VC1, VC2:—.5 megohm potentiometers.

SUNDRIES:—Nuts and bolts, solder lugs, tinned copper wire, hook-up wire, two valve shields, 4 octal sockets, a four pin speaker socket, a centre tap resistor a rubber grommet and three control knobs.

for the valves V1 and V2. Between V2 and the power transformer are the sockets for V3 and the rectifier valve, V4. The speaker output socket and the pick-up terminals are placed on the same side wall of the chassis as the tap changing fuse holder.

On the short-end wall of the chassis near the V1 and V2 sockets are the three potentiometers VC1, VC2, and FC. FC is nearest V2, and VC1 is directly below the V1 socket. The mike inlet socket is mounted on the other side wall of the chassis below V1 socket. A shield cover is provided to bolt in place to prevent hum from pickup the wiring of the V1 and V2 sockets and the potentiometer wiring. A corner must be clipped out of this shield to allow the heater and other wires to pass through. The A.C. Power flex passed through a grommett-fitted hole below PT on the remaining short-end wall of the amplifier. Mount all sockets so that their heater lugs are towards the outside walls of the chassis.

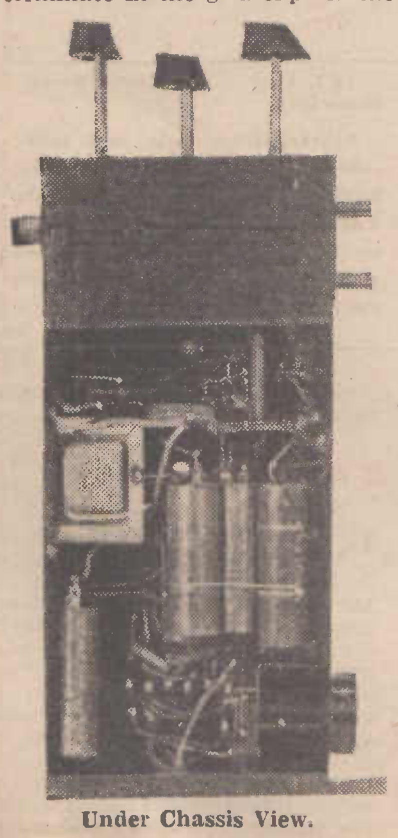
Two chokes are employed in the filter system. The smaller of these is supplied with the permagnetic type speaker with which the amplifier is to be used. The other large choke is mounted on top of the chassis between PT and the V1 socket. The small choke can be seen mounted below chassis on the side wall directly below the larger choke.

Point To Point Wiring

BEGIN the wiring by joining together one heater lug of V1 to the corresponding lug on V2. Do likewise with the remaining heater lugs of these sockets tucking the wiring well into the corner formed by the wall and floor of the chassis. This applies to all heater wiring which should preferably be loosely twisted together, where it passes from one socket to the other, and to the power transformer, PT. Connect the heater lugs of V1 and V2 to one 6.3 volt winding on PT and across this winding solder the centre tap resistor, CT. The remaining 6.3 volt winding on PT is joined with a similar twisted pair to the heater lugs of the socket for V3. Carry out similar wiring from the 5-volt winding of PT to the heater lugs of the V4 socket, and from the outer high voltage secondary lugs on PT to the P lugs on V4.

Earth the centre lug of the high voltage winding on PT and one side of the 6.3 volt PT winding which connects V3 heater lugs. It is advisable to run a piece of heavy gauge tinned copper wire from the centre tap of PT to one of the pickup terminals, soldering it to lugs placed under the holding bolts of the chokes and the mike inlet socket. All earth returns then can be easily made to this tinned wire.

The outside lug of VC1 farthest from VC2, and the outside lug of VC2, nearest VC1, connect to earth. The other outside lug of VC1 wires to the insulated centre contact of the mike inlet socket, M1. To the arm of VC1 solder one lead of the .05 mfd. tubular condenser, C1. The remaining lead of this condenser goes to one lead of the 1 megohm resistor, R1, and to the inside conductor of a piece of metal braided wire which passes up through the chassis to terminate in the grid clip for the grid of V1. Earth the outside metal braid making certain that it does not short at any point. Also earth the free lead of R1.



Under Chassis View.

To the cathode and suppressor grid lugs of the V1 socket connect the positive lead of the 25 mfd. electrolytic condenser, C2, and one lead of the 1300 ohm resistor, R2. Earth the other leaders of these two components. Use the number 6 or vacant lug of V1 as a "B" positive anchor point and to it solder one lead each of the 1.5 megohm resistor, R3, and the 250,000 ohm resistor, R4. The unconnected lead of R3 goes to the screen grid lug of the V1 socket as does one lead of the .05 mfd. tubular condenser, C3. Earth the other side of C3.

The remaining lead of R4 and one lead of the .05 mfd. tubular condenser, C4, join to the plate lug of the V1 socket. The vacant outside lug of VC2 joins to the insulated pickup terminal whilst to the arm of VC2 is soldered one lead of the .5 megohm resistor, R6. The .05 mfd. tubular condenser, C5, joins between the unconnected leads of R6 and C4, whilst the inner conductor of another piece of shielded wire is attached to the junction of C4 and C5.

This lead passes through a hole in the chassis to terminate in the grid clip for the grid cap of the valve V2, the metal braid being cut back at each end to prevent shorting and then being soldered to earth or chassis.

To the cathode and suppressor grid lugs of V2 socket connect the positive lead of the 25 mfd. electrolytic condenser, C6, and one lead of the 3200 ohm resistor, R7. Connect together the free ends of R7 and C6, one lead of the 1000 ohm resistor, R8, the centre arm lug of the potentiometer, FC, and one lead of the 1 megohm resistor, R5. The other end of R5 goes to the junction of C4 and C5, whilst that of R8 is earthed. Use the number 6 lug of V2 socket for supporting one lead each of the 3 megohm resistor, R9, the 10,000 ohm resistor, R10, and the .01 mfd. tubular condenser, C8. The unconnected leads of R9 and C8 together with one lead of the .05 mfd. tubular, C7, join to the screen grid lug of the V2 socket. The free lead of R10 and one lead of the .05 mfd. tubular condenser, C9, are next soldered to the plate lug of the V2 socket.

Earth the other side of C7 and wire together the junction points of R3, R4 and R9, R10. Also connect these resistors to a lead from the screen grid lug of the V3 socket.

Final Wiring Connections

THE remaining lead of C9 must connect to the grid lug of this socket to which point also is soldered one lead of the .5 megohm resistor, R11. Earth the other side of R11. To the plate lug of the V3 socket join one small pin lug of the speaker socket and one lead of the .5 mfd. tubular condenser, C11. One lead of the 15,000 ohm resistor, R13, solders to the remaining lug of C11 whilst the other side of the resistor, R13, connects to one lug of the .005 mfd. condenser, C12, and to one lead from the outside lug of FC nearest to the pickup terminals.

The unconnected lug of C12 and the arm of FC are wired together and to the junction of R7 and R8. The other small pin lug of the speaker socket connects to the screen grid lug of V3 socket. To this screen grid lug also solder the positive lead of the 8 mfd. tubular condenser, E3, and lead from one end of the small choke, CH2.

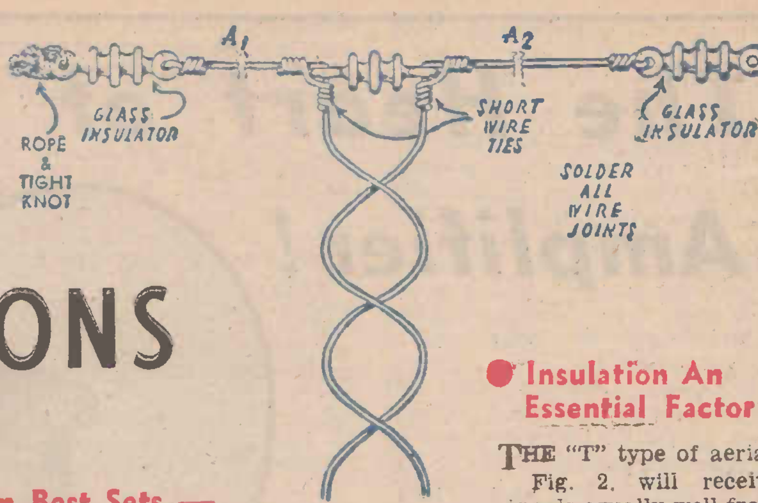
The other lead of this choke joins to one lug of the large choke and to the positive lead of the 8 mfd. electrolytic condenser, E2. The remaining large choke lug connects to one heater lug of the V4 socket and to the positive lead of the other 8 mfd. condenser, E1.

Earth the negative leads of E1, E2, E3, the 25 mfd. electrolytic condenser, C10, and one end of the 232 ohm resistor, R12. The remaining leads of C10 and R12 go to the cathode lug of the V4 socket to which point a lead must be connected from the centre tap of the resistor, CT, connected across the 6.3 volt winding on PT. Next wire the A. B. and 1, 2 and 3 lugs of PT to corresponding lugs on the tap changing fuse holder. The wiring is completed with the connection of the AC power flex to the remaining lugs on the fuse holder.

Fit valve shields to V1 and V2 and place them in their correct sockets. Plug into their respective sockets the valves V3 and V4 and the speaker plug. Connect up pickup and microphone leads and the amplifier is ready for testing.

It will be found to be an excellent performer and capable of providing high quality reproduction over a wide band of musical frequencies.

AERIALS AND THEIR APPLICATIONS



Doublet aerial construction. Lengths A1 and A2 are of the same dimensions.

Outdoor Aerials Improve Even Best Sets — Value As Electrical Noise Reducers — Aerial Directivity — "L," "T," and Doublet Types — Tuned Aerials For Short Wave

THERE is an old radio adage which says "A radio receiver is only as good as its aerial system." This axiom has fallen into disregard in late years due to the fact that modern high sensitivity receivers will function remarkably well on short lengths of wire installed round picture rails, skirting boards or other fixtures. Nevertheless, many a listener would be agreeably surprised with the improvement in results from the modern receiver if an efficient aerial system was installed.

In addition to increases in their signal strength from distant stations noise from electrical appliances would be considerably reduced and all stations would be heard with far greater clarity due to the improved signal to noise ratio.

An efficient aerial system must be well insulated, erected as high as practicable, be clear of surrounding earthed objects such as houses, trees, sheds, electric and 'phone posts and wires.

There are three main types of outdoor receiving aerials in use today, these are the Inverted L, the T and the Doublet. Each has something to commend it for special application in individual locations, but the directivity of the three types is quite different.

By "directivity" we mean the ability of the aerial system to receive signals better from one direction than from another. Probably the simplest and best of the types mentioned above for general use is the inverted "L" shown in Fig. 1. In suburban sites it is usually necessary only to erect one pole of from 30 to 40 feet in height and attach the lead-in end of the aerial to a gable or chimney. With this arrangement the aerials will receive best those stations in the direction to which the lead-in end is pointing. This will be even more noticeable if the lead-in end of the flat top portion is slightly higher than the free end.

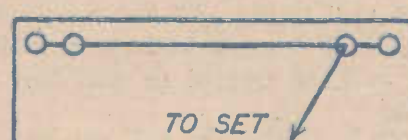


Fig. 1

Insulation An Essential Factor

THE "T" type of aerial, Fig. 2. will receive signals equally well from either end, but is not very sensitive to signals from stations at right angles to its length. On the other hand, unlike the "T" type, the Doublet receives best from stations at right angles to its length. The greatest advantage of the doublet aerial system is the fact that it may be cut to specific lengths and roughly tuned to the frequency of the band on which listening is intended. Another advantage of the doublet is that it aids in reducing electrical and car ignition interference on short waves. The tuned type of doublet may be tuned fairly accurately to the frequency of individual stations.

So much for the theoretical side of the aerial system. The insulation of the aerial and lead-in wire is very important if optimum results are to be obtained. At least two insulators, spaced 12 inches apart, should be inserted between the aerial wire proper and its supporting ropes or wires. If guy wires are employed on the masts these should be broken in one or two places with efficient "strain" insulators. The aerial itself should not run closer than 15 feet to a building, wall, or roof, and should be at least 20 feet

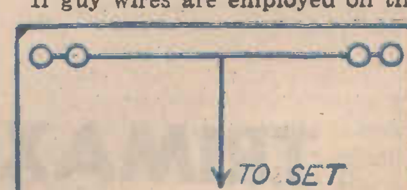


Fig. 2

from growing trees, iron roofs and similar objects which absorb aerial energy.

It should be borne in mind that the effective height of an aerial is the distance from the aerial wire to the nearest earthed object in the vicinity. For aerial wire use, ordinary hard - drawn copper wire will do, or better still one of the stranded, bare or enamelled wires sold for this purpose. In the long run an enamelled or other covered wire will prove slightly more efficient than the bare wires, as the covering prevents corrosion, especially where the wire is exposed to soot-laden or sea air.

One simple way of erecting an "L" type aerial has been given. One point remains to be mentioned, and that is the advantage of using a single length of wire when constructing this form of aerial. One free end of the aerial wire is attached to its insulators and halyard, and the length of the flat top section of the wire decided upon. The remaining length of wire, which will become the lead-in, is passed through an insulator and firmly bound at this point with wire.

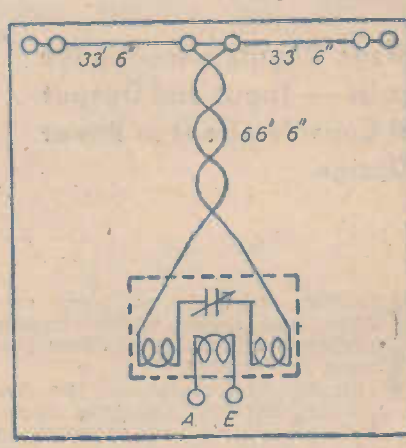
The "T" Type Aerial

THE "T" type aerial, Fig. 2, is really two Inverted "L" types placed back to back, but having a common lead-in. In this case the lead-in wire must be wound around the main aerial wire at the centre point and well soldered in place. By taping the point or giving it a coat of shellac insulating varnish, or both, a good corrosion-free joint will be obtained.

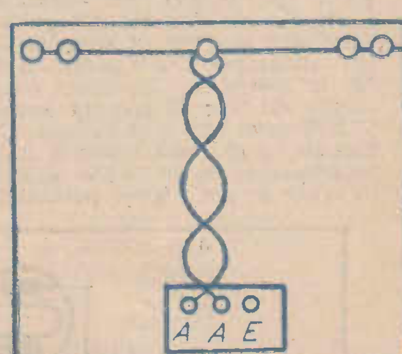
A word on the installation of the lead-in to the receiver. In any of these aerial installations the lead-in must be well insulated where it enters the radio shack or house. It is essential also to keep it clear of spoutings, iron roofs and similar earthed objects and to ensure that it is held firmly so that it cannot sway about in the wind. Suitable lead-in insulators to pass through wall or window sills are available but always drill the hole for the lead-in tube or insulator with a slope to the outside so that rain water will not run into the house.

Doublets Cut Down Interference

BEFORE the war there were many commercial types of tuned and semi-tuned doublet aerials on sale. These will no doubt become available again soon. For broadcast band operation there is no necessity for the flat-top sections of the doublet aerial to be cut to specific lengths. Make each section as long as possible and identical in length. On the broadcast band the main advantage of the doublet is its reduction of man-made static and electrical interference.



Tuned doublet aerial.



Connection of doublet to the receiver.

In the doublet aerial the flat-top portions are divided by an insulator, and one wire of the twin lead-in is soldered to each flat top section. These sections, being high up and out of the area of interference, pick up good, "clean" signals, and the lead-in, being twisted or transposed, picks up the noise signals out of step or out of phase in each lead-in wire. The noise signals thus cancel out and the radio signal free from most of the interference passes along the lead-in wires to the receiver.

Here are the details of a tuned doublet, which will prove very efficient on the short-wave bands. Each flat top section should measure 33 feet 3 in. in length. In this case the two sections should be separated by a distance of 15 inches. The lead-in wire, which may be ordinary twin-twisted lighting flex, should be 66 feet 6 in. in length. To tune this doublet obtain a piece of 1 in. insulating former, and upon it wind two coils of 15 turns each, and spaced 3-16th inch from one another. In this space wind 12 turns of wire. Wire of gauge 26 D.C.C. should be used. The coils are all wound in the same direction. Join one feeder line to the outside lead of the first 15 turn winding, and the other feeder line to the outside lead of the second 15 turn winding. One of each at the two inner 15 turn windings joins to one lug of a .0005 mfd. variable condenser. One lead of the 12 turn coupling coil joins to the aerial terminal of the receiver and the other joins to earth.

Where an ordinary doublet aerial is employed without a terminating device as just described the receiver's input circuit must be changed in the following manner:

Provide another insulated terminal in addition to the aerial terminal and disconnect from earth or chassis the earthed end of the aerial winding on the aerial coil. This lead then should connect to the additional insulated terminal. The leads from the twisted lead-in then connect one to each of the insulated terminals and the earth remains connected to the earth terminal.

POWER SUPPLY AND FILTER CIRCUITS

Types of Rectifiers—Voltage Regulation—Choke and Condenser Filter Circuits — Input and Output Voltage Tables — General Considerations in Power Pack Design.

TO the average set builder the arrangement of a suitable power supply for his amplifier or radio receiver seems a simple thing. All that he has to do is to walk into a radio shop and order a power transformer of similar voltage and current rating to that specified in the article dealing with the radio unit which he proposes to build. But there is more to it than that and in the following article it is proposed to deal with the broad aspects of power supply design in a manner which will permit Mr-Average-Radio-Set-Builder to determine the requirements of the power unit which will meet HIS particular requirements.

First let it be realised that the power unit consists of three major units—the power transformer, the rectifier and the filter unit. In designing our power supply unit we must first deal with the middle one of these three components, for upon it will rest much of our future design. Rectifiers may be divided into three major classes. They are those which handle heavy currents at low voltages, those which handle medium currents at high voltages, and those which handle medium currents at medium voltages.

In the first class are the low voltage battery charging rectifiers which deliver currents of from 2 to 10 amperes at potentials ranging from 20 to 50 volts. They do not really come into the present discussion, which is confined to rectifiers likely to be used for power supply to radio receivers and amplifiers.

Three Standard Types of Rectifiers

FOR the former we normally need a rectifier capable of delivering a current of from 60 to 100 milliamperes at a potential of 250 to 350 volts. Rectifiers such as the old type 80 and the newer 5Y3GT meet this requirement, although in extreme cases it may be necessary to go to the 6X5GT in order to get higher potentials — but lower currents — than those provided by the preceding two tubes. For high powered amplifiers and extremely large radio receivers rectifiers such as the 5R4GY must be used.

These three rectifiers more or less cover the whole range of present-day receiver and amplifier requirements, a pleasant change from earlier days of rectifier design when all kinds of valve, cuprous oxide, and electrolytic rectifiers competed for the consideration of the radio designer.

Accepting that these three rectifiers will cover the complete range of current and voltage requirements of the average set or amplifier designer, we next come to their application.

In the past it was an accepted fact that where good regulation — steadiness of voltage output despite large variations in current drain — was required, the only rectifier valves which could be used were of the mercury vapor type. Today, better valve design and increased knowledge of filter design makes it possible to use the generally cheaper and more stable type of high vacuum-hot cathode rectifier.

Besides possessing nearly all the good voltage-regulation characteristics of the mercury vapor type rectifier the new high vacuum type possesses, as always, an interference-free characteristic which eliminates the necessity for shielding in order to prevent high frequency "hash" getting into the r.f. or i.f. stages of a sensitive receiver.

This more or less confines our consideration of suitable rectifiers to the high vacuum types and for practical purposes to the three types already mentioned.

Correctly Rated Transformers

BEFORE we consider the question of hum filtration, itself an important thing in any reasonably high fidelity audio sys-

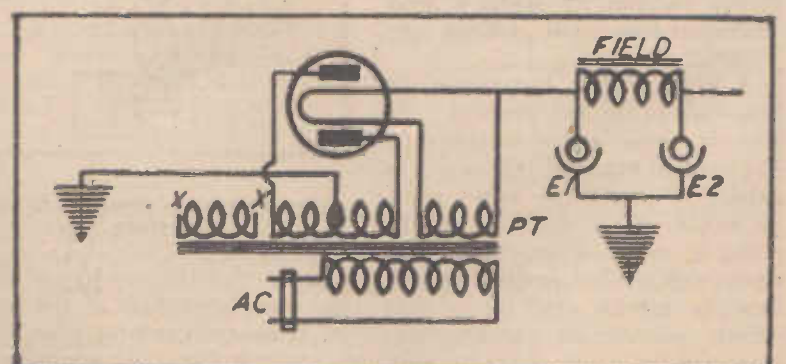


Fig. 2. — A standard type power supply unit in which the field winding of the loud speaker is used as a filter choke.

tem whether it be part of a public address system, gramophone amplifier or radio receiver, we must be sure that our rectifier can handle both the current and the voltage required by the unit which it is to power.

Either current or voltage overloads will materially shorten the life of a rectifier, or may even cause it to break down immediately it is placed into service. The manufacturer's figure for maximum current and voltage to be drawn under working conditions should never be exceeded.

Having decided upon the rectifier required, the next task is to select the power transformer with which it is to be used. Not only must this power transformer deliver a plate to plate voltage not higher than the specified rating for the rectifier, but it must be provided with the filament windings capable of meeting the demands of both the rectifier filament and the filaments or heaters of the receiver or amplifier valves.

Any given transformer will always deliver more voltage from each winding when no load is applied than it will when the rated load is drawn. For this reason a transformer which is rated to deliver 385 volts on each side of its centre tap might show an a.c. output of more than 400 volts on no load. Incidentally, this discrepancy between no load and full load output will increase in direct proportion to the regulation quality of the transformer. The worse the regulation the greater the difference between the no load and full load voltage.

Rectifier valves, too, have a regulation characteristic due to their internal resistance. Modern rectifiers of the high vacuum type have quite good regulation. In the accompanying tables it will be seen how this varies (a.c. plate voltage input to d.c. output) in accordance with the various current drains.

Choke and Condenser Input

TWO sets of figures are given. One is for a "choke input" filter and the other is for a "condenser input" filter. Study of the voltage output figures for the various current drains will show that for choke input the input voltage must range from 50% higher at low current drains to 25% higher at high current drains than the transformer voltage needed in order to get the same voltage output as is obtainable from condenser input.

RECTIFIER CHARACTERISTICS

5R4GY

A.C. Volts (R.M.S.) Per Plate.	LOAD CURRENT mA. 75	150	200	250
Choke Input.	D.C. VOLTS AT INPUT TO FILTER			
300	220	190	180	170
500	400	370	360	350
700	580	540	520	510
	Filter choke Inductance 10 Henries min.			
Condenser Input				
300	320	260	230	200
500	600	520	480	450
700	860	780	740	705
	Input filter condenser 4 Mfd minimum.			

5Y3GT

A.C. Volts (R.M.S.) per Plate.	LOAD CURRENT mA. 40	60	80	100	120
Choke Input	D.C. VOLTS AT INPUT TO FILTER				
220	170	160	155	145	140
250	195	187	180	170	165
300	240	232	225	220	215
350	285	275	272	265	250
400	330	320	310	305	295
450	370	360	352	345	340
500	415	405	400	390	385
	Filter choke Inductance 5 Henries min				
Condenser Input.					
220	245	225	205	190	175
250	285	265	245	230	215
300	355	335	315	295	280
350	420	400	375	360	340
	Input filter condenser 4 Mfd. minimum.				

6X5GT

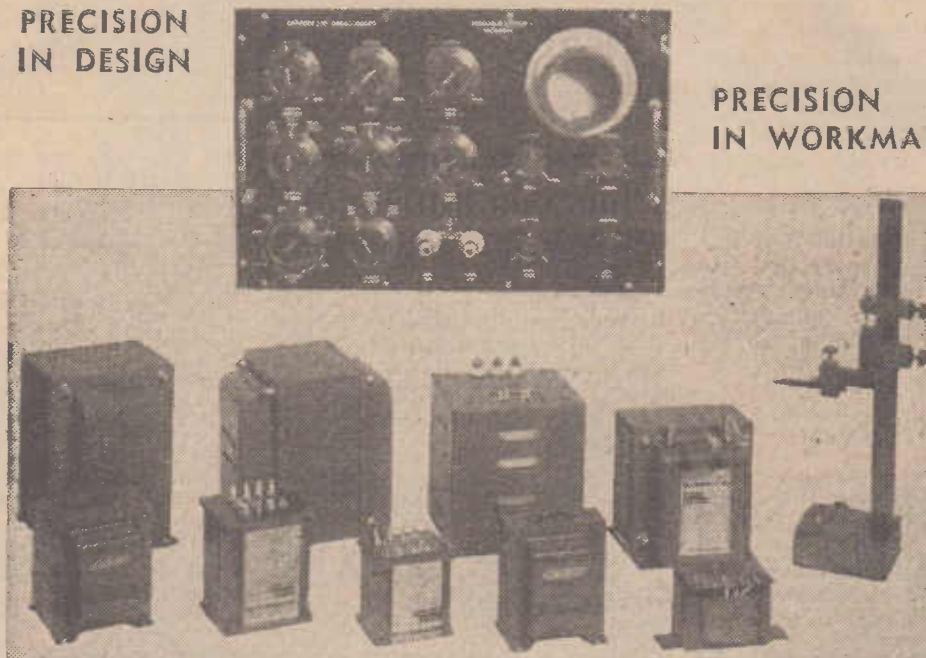
A.C. Volts (R.M.S.) per Plate.	LOAD CURRENT mA. 30	50	70
Choke Input.	D.C. VOLTS AT INPUT TO FILTER		
200	168	162	160
250	212	207	205
300	255	250	248
350	300	295	292
400	345	340	335
450	390	385	380
	Filter choke Inductance 8 Henries min.		
Condenser Input			
200	235	215	200
250	305	285	270
300	375	352	335
325	420	387	370
	Input filter condenser 4 Mfd.		

RED LINE

TRANSFORMERS & CHOKES

PRECISION
IN DESIGN

PRECISION
IN WORKMANSHIP



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A choke input filter is one in which the d.c. output from the rectifier is fed straight into the filter choke which is not by-passed to ground by the electrolytic condenser used on the input side of the condenser input filter.

All this seems a waste of power and voltage, but there are circumstances which call for the use of the choke input filter which is characterised by an extremely good regulation. Certain types of audio amplifier, including the types A1, A2 and B amplifiers, depend for their distortion-free operation on a plate supply voltage which will not vary under widely changing load conditions. Again, in communications types of short wave receivers it is essential that frequency drift, contributed to largely by fluctuating supply voltages, shall be eliminated. Here again choke input supply systems help.

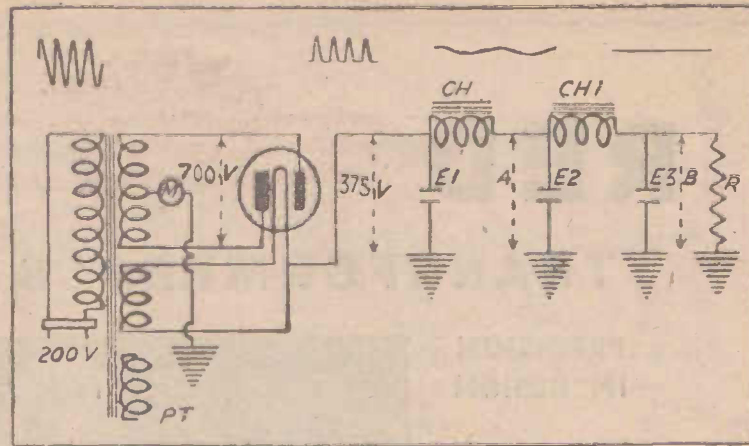

Fig. 1. — Basic circuit of power supply unit with two section filter. Removal of the condenser E1 will convert the filter system to "Choke Input."

Filtering The Power Supply

HAVING dealt with the power transformer and the rectifier system let us go on to the problem of filtration. Although the purpose of any valve power rectifier is to change alternating current into direct current the rectified current is not pure direct current as it possesses a "ripple" characteristic which chiefly manifests itself at a frequency equal to twice the frequency of the a.c. supply. To "flatten out" this ripple and provide a substantially direct current a filter system consisting of inductance and capacity is used.

In Fig. 1 is a standard two-section filter circuit in which the inductive portion consists of a 20-30 henry choke coil, CH, and a 50-60 henry choke coil or the field winding of an electro-dynamic type loud speaker, CH1. The capacitive part of the filter consists of three electrolytic condensers E1, E2 and E3. E1 should have a capacity of 16 mfd. and E2, E3 a capacity of 8 mfd. each.

Voltage for the output stage of the amplifier or receiver is drawn from the point "A" and for the other stages of the unit from the point "B." The resistor, R, is intended to simulate the load current drawn from the rectifier and power transformer and is not usually included in the circuit.

As shown, this filter circuit is a condenser input type but can be changed over to choke input by eliminating the condenser E1. If this is done it is desirable to increase the capacity of E2 from 8 to 16 mfd.

At the top of the diagram is shown the successive changes through which the alternating current passes as it travels from the secondary of the transformer to the output of each filter section. At the left the high voltage alternating current, at a potential of 350 volts per plate is fed to the rectifier and changed into "ripply" direct current at a potential of 375 volts to the input of the filter. After passing through CH, a low resistance choke which will not greatly reduce the potential, the latter is tapped off at the point "A" and fed through a suitable voltage dropping resistor to the plate of the final stage valve in the amplifier or receiver.

Note that, as indicated by the wavy line at the top of the diagram, there is still a proportion of "ripple" in the output voltage. This does not matter for the final stage valve for it is not likely to be amplified sufficiently to be heard in the loudspeaker. For the preceding stages, however, first class filtration is needed and this is effected in the second section of the filter. The resistance of CH1 should also be high enough to reduce the approximately 370 volts to the 260 required for normal mixer, i.f. and pre-amplifier stages.

Simple Filter Circuits

THE foregoing circuit, the constants of which have to be adjusted to suit individual requirements—that is the power transformer rating, the type of rectifier valve, and the d.c. resistance and current carrying capacities of the choke coils all are inter-related with the current and voltage requirements of the valves with which they are to be used—gives an idea of condenser-input operation of a filter system.

If choke output is to be used then the plate to plate output voltage of the power transformer will have to be increased from 700 to 950 (475 volts on each side of the centre tap) to get an equivalent d.c. voltage at the input to the filter.

Choke input filters and even the double section condenser or choke input types are not normally used except on large amplifiers and receivers. For most uses the simple single circuit condenser-input type of filter shown in Fig. 2 will suffice. This may consist of a pair of electrolytic condensers, E1, E2, each of which may have a capacity of from 8 to 16 mfd. and either the field winding of an electrodynamic speaker, or if the more modern P.M. type is to be used, a small but highly efficient choke.

In the latter case only a low voltage power transformer, delivering about 265 volts on each side of the centre tap will be required and besides costing less initially than a high voltage unit the lower operating voltage will mean increased life for electrolytics and the rectifier valve.

ROLA 8K: For consoles and table model receivers. Lighter and more compact than standard 8 in. speakers, the 8K does not dissipate heat owing to elimination of the field coil by the use of an Anisotropic Alnico magnet.

ROLA 3C: Australia's smallest loud speaker. Admirably suited for use in small portables and compact communication systems. A triumph in speaker design achieved by the use of Anisotropic Alnico.

ROLA 5C: A 5 in. 12-oz. speaker ideally suited for A/C and AC-DC midget receivers, and also finds useful application in vibrator and battery operated sets.

ROLA 6H: This 6 in. speaker is expressly designed for larger and better quality mantel receivers. Used with a chilase choke (Rola 6/60) it replaces electrodynamic speakers in A/C operated receivers.

Limited supplies of ROLA speakers are now reaching the trade, but do not be disappointed if the speaker you want is not immediately available.

ROLA LOUD SPEAKERS with ANISOTROPIC ALNICO

ROLA CO. (AUST.) PTY. LTD., THE BOULEVARD, RICHMOND, VIC.

5 VALVE VIBRATOR SUPER HET.

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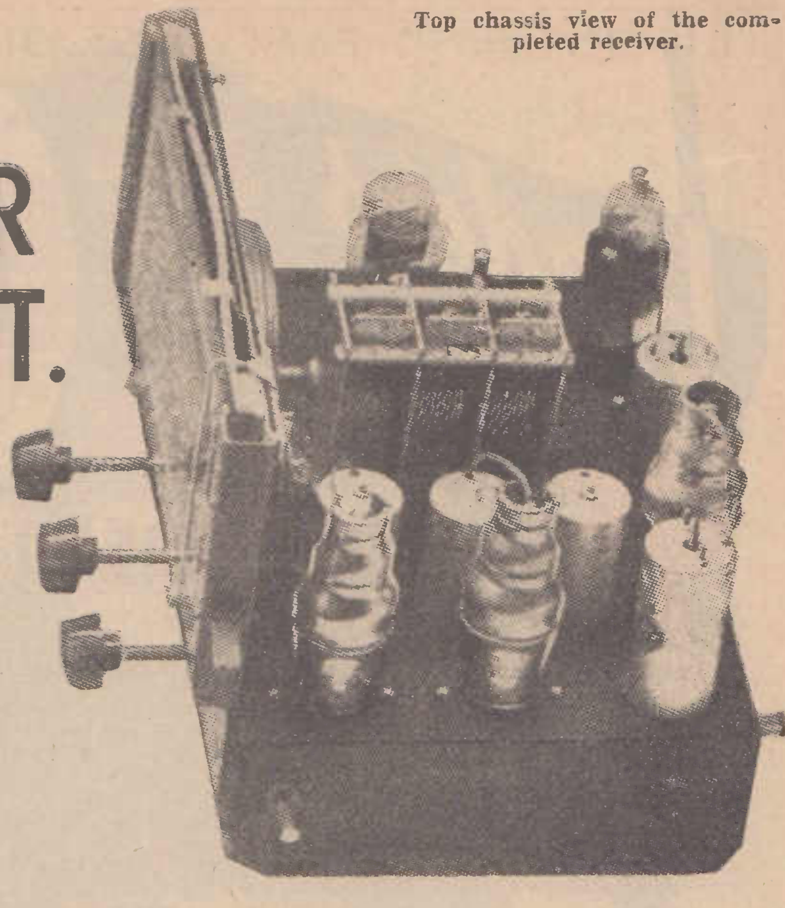


Top chassis view of the completed receiver.

THOUGH vibrator operated receivers are becoming increasingly popular with radio set users who are remote from sources of alternating current electric supply there is still a large group which prefers to stick to the straight battery operated set. This is because of the difficulties attending the frequent recharging of the "A" battery for the vibrator set, for this battery needs recharging about every three weeks, whilst the "A" battery of a straight set will run for two months or so on each charge.

This five valve battery receiver is highly sensitive and employs iron-cored permeability tuned type coils and I.F. transformers throughout. Its "B" battery consumption of about 16 milliamps. is not unduly heavy for a set of this type, whilst the quality of reproduction from a modern permagnetic speaker compares favorably with that of standard A.C. sets.

The first of the five valves in the line-up is a type 1M5G as a tuned radio frequency amplifier, the second, a 1C7G, is a mixer and local oscillator. The second 1M5G serves as I.F. amplifier in a 455 k.c. channel. The valve V3 is a type 1K7G used as diode detector, A.V.C. rectifier, and first stage audio amplifier. The output valve is a type 1L5G. Automatic bias is incorporated in the circuit design. The receiver is designed to operate from a 2 volt Accumulator as "A" battery and 135 volts of high tension provided by three 45 volt triple capacity "B" battery units connected in series.

Chassis Layout Details

READY punched chassis are available for this receiver, the layout of which is as follows:

The gang condenser and dial are mounted centrally on the chassis with the three coils in line to the right of the gang. The aerial coil is nearest the front of the chassis and the oscillator coil at the back.

Starting from the front right hand side of the chassis and working along the back to the left hand side, we find in order, the valves V1 and V2, the first I.F. transformer IF1, the valve V3, IF2, the valve V4 and, in the space on the left of the gang condenser, the output valve, V5. The aerial terminal is near the V1 socket, the earth terminal on the back wall of the chassis, and the speaker terminals on the left hand side of the assembly. The aerial and both speaker terminals must be insulated from the chassis.

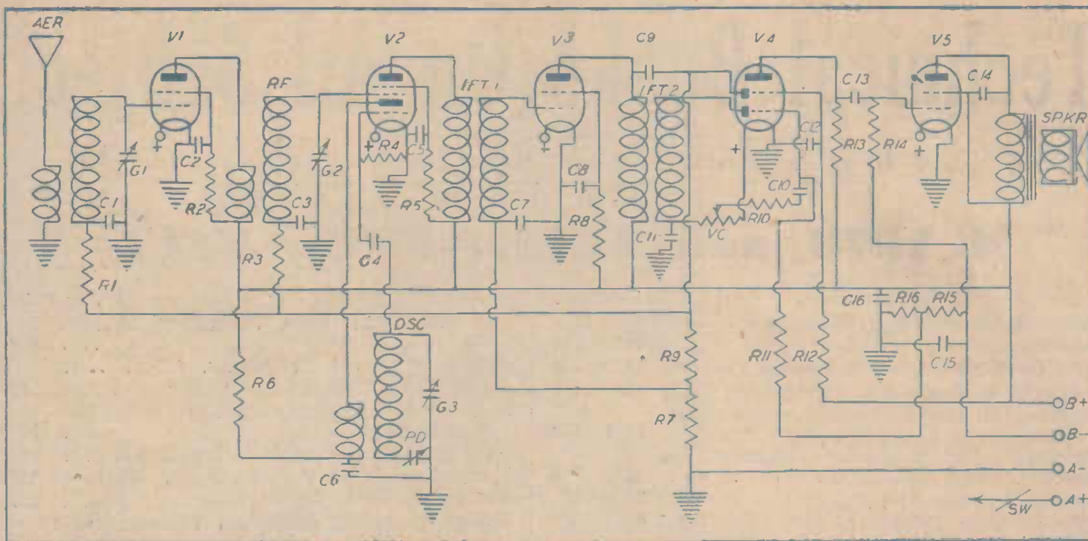
Looking at the front of the set the centre knob is the main tuning control, the knob on the left is the filament switch, and that on the right the volume control. Below the chassis the padder condenser, PD, is bolted down near the oscillator coil. When assembling the parts place tinned solder lugs under all holding down bolts.

Point To Point Wiring

BEGIN the wiring by joining up these lugs with lengths of tinned copper wire laid down on the chassis floor and soldered to the earth terminal, the moving plate wiper of the gang condenser, the moving plate lug of the padder condenser and the number 7 lug of each of the five valve sockets. With wiring flex connect up the number 2 lugs of all five sockets and wire them to one lug of the filament switch SW.

Join the aerial terminal to the aerial lug of the aerial coil and earth the E lug of this coil to the earth network of tinned wire. The G lug of the aerial coil joins to the fixed plate lug of the front, or G1, section of the gang condenser. The G lugs of the R.F. and oscillator coils join respec-

CIRCUIT AND PARTS LIST OF VIBRATOR "5"



CHASSIS: To suit layout and components.

COIL KIT: Consisting of permeability tuned iron cored type aerial, radio frequency, and oscillator coils for 455 k.c. (with padder).

C1, C2, C3, C5, C6, C8, C12: 1 mfd. tubular condensers.

C4, C9, C11: .0001 mfd. mica condensers.

C10, C13: .02 mfd. tubular condensers.

C7: .05 mfd. tubular condenser.

C14: .005 mfd. tubular condenser.

C15 10 or 25 mfd. low voltage electrolytic condenser.

G1, G2, G3: Three gang condenser with dial and trimmers to suit coils.

IF1, IF2: 455 K.C. intermediate frequency transformers. Permeability tuned iron core.

R1, R3, R13: 250,000 ohm ¼ or ½ watt resistors.

R2, R8: 75,000 ohm ½ watt resistors.

R4, R5, R6: 50,000 ohm ½ watt resistors.

R7, R9, R12: ½ megohm ½ watt resistors.

R10: 10,000 ohm ¼ watt resistor.

R11, R14: 1 megohm ¼ watt resistors.

R15: 200 ohm 25 M.A. type wire wound bias resistor.

R16: 150 ohm ditto.

SW: Single pole single throw rotary battery switch.

VC: 500,000 ohm volume control potentiometer.

VALVES: V1 and V3, 1M5G; V2, type 1C7G; V4, 1K7G; V5, a 1L5G. All with sockets to suit. Valve shields for V1, 2, 3 and 4.

SPEAKER: Permagnetic speaker with transformer to suit 1L5G.

SUNDRIES: Tinned copper wire, solder lugs, nuts and bolts, grid clips, 4 terminals, insulating washers, rubber grommet and wiring flex.

tively to the fixed plate lugs of the G2 and G3 sections of the gang condenser. Leads attached to the fixed plate lugs of section G1 and G2 of this condenser terminate in the grid clips for the valves V1 and V2. The lead coming out of the top of IF1 is connected similarly for the grid of V3.

To the E. or A.V.C. lugs of the aerial coil attach one lead each of the resistor R1 and the condenser C1. One lead each of R3 and C3 solder to the E or A.V.C. lug of the R.F. coil. Earth the free ends of C1 and C3. Solder the condenser C4 from the number 5 lug of the V2 socket to the G lug of the oscillator coil. The padder lug of this coil joins to the fixed plate lug of the padder condenser. The resistor R4 is connected from the number 5 lug of V2 to earth.

The number 6 lug on the V2 socket connects to the Osc. P or lug of the oscillator coil whilst to the Osc. "B" positive lug of the oscillator coil is connected one lead each of the resistor R6 and the condenser C6. Earth the other end of C6 and solder that of R6 to the "B" positive lug of IF1. To this point also attach leads from the "B" positive lugs of the R.F. coil and IF2.

One lead of both R2 and C2 connect to the number 4 lug of the V1 socket. Earth the free lead of C2 and solder that of R2 to the "B" positive lug of the R.F. coil. The plate lug of this coil wires to the number 3 lug of the V1 socket. The corresponding lug on the V2 socket goes to the P lug of IF1.

Next, connect the resistor R5 from the "B" positive lug of IF1 to the number 4 lug of V2. Condenser C5 is connected between the number 4 lug of V2 and earth. One lead each of C8 and R8 wire to the number 4 lug of V3. The free end of R8 goes to "B" positive lug of IF2 and the free end of C8 goes to earth.

AVC And Audio Connections

THE number 3 lug on the V3 socket connects to the P lug of IF2 and to one side of the condenser C9. The free end of C9 and one lead of R9 join to the number 4 lug of the V4 socket. R7 solders from the unconnected side of R9 to earth. The junction of R9 and R7 is wired to the E. or A.V.C. lug of IF1 from which point condenser C7 goes to earth. The free lead of the resistor R1 is attached to the junction of R9 and C9 by a piece of wiring flex.

The G or Diode lug of IF2 is joined to the number 5 lug of the V4 socket, whilst the A.V.C. or diode return lug of IF2 is connected to one lug of C11 and to the lug of the volume control VC nearest to the main tuning control. Earth the free end of C11 and join the other outside lug of VC to the number 2 lug of the

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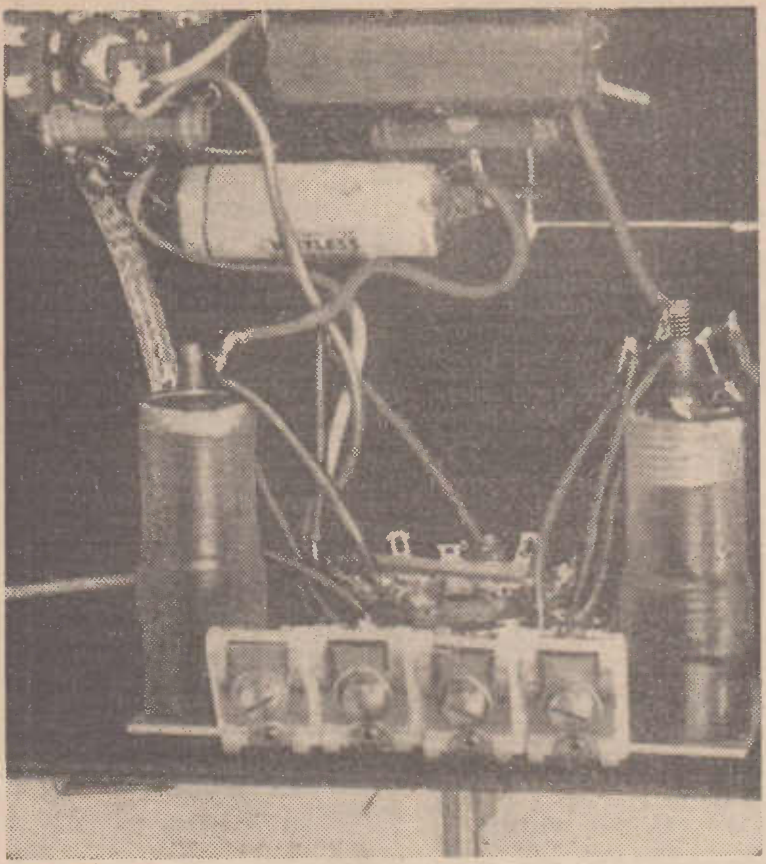


View of commercial dual-wave coil unit showing the way in which it is wired into circuit.

V4 socket. To the arm lug of VC solder one lead of the resistor R10.

Connect one lead of C10 to the remaining lead of R10 and run a lead from the unconnected lead of C10 to the number one lug of the V4 socket. A short lead passes up through the chassis from this lug and terminates in the grid clip for the cap of the valve V4.

To the number 1 lug of the socket V5 solder one lead of R15 and the negative lead of C15. Wire one lead of R16 to the free end of R15 and earth the positive lead of C15 and the unconnected lead of the resistor R16. The resistor R11 connects from the junction of R15 and R16 to the number 1 lug of V4. Attach one lead each of R13 and C13 to the number 3 lug of the V4 socket. The free end of C13 goes to one lead of R14 and to the number 5 lug of V5, whilst the remaining lead of R13 connects to the number 4 lug of the V5 socket and to one speaker terminal. To this terminal join a flex lead from the "B" positive lug of IF2, one lead of C14 and C16 and a piece of flex about 3 feet in length for the "B" positive battery lead. All battery leads pass through a grommet fitted hole near the speaker terminals.

The unconnected lead of C16 earths, whilst that of C14 connects to the remaining speaker terminal and to the number 3 lug of the V5 socket. To lug number 6 of V4 socket solder one lead of R12 and one lead of the condenser C12. Earth the other end of C12, and join the remaining lead of R12 to the number 4 lug on the V5 socket.

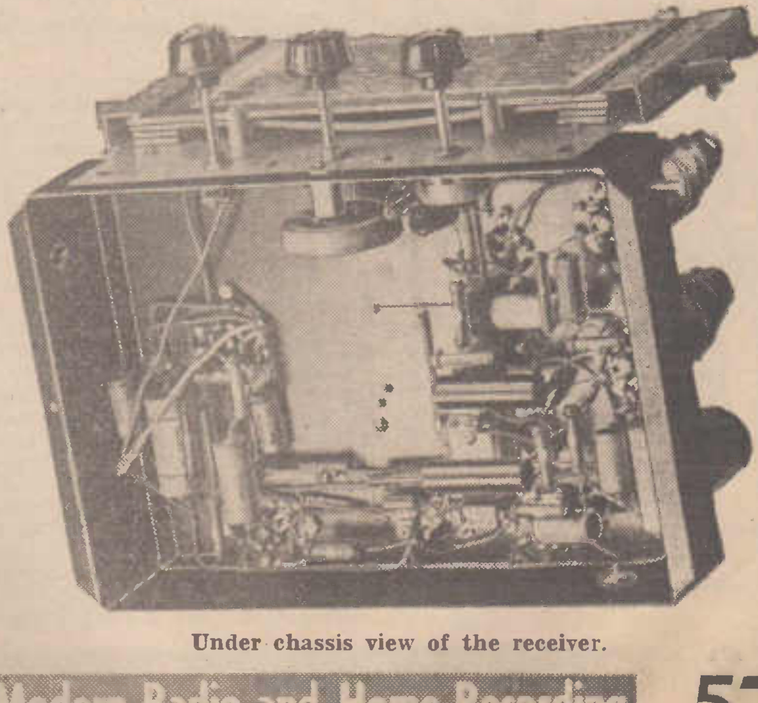
A lead from the junction of R15 and C15 runs to the remaining lead of R14 to which point also connects the "B" negative battery lead. The "A" negative battery lead solders to the earth network, whilst the "A" positive battery lead is attached to the vacant lug of the filament switch, SW. This completes the wiring of the receiver.

● Checkover And Initial Tests

CHECK all wiring over carefully, attach the "A" battery leads to a 2 volt accumulator and switch on. If the valves light everything is o.k. to connect the speaker leads, the aerial and earth wires and to join up the "B" battery leads.

Switch on once more and tune over the band to see if any station is receivable. If so, this proves the receiver is working correctly and it may then be lined up and installed in its operating position.

A receiver of this type will be eminently suitable for the DX fan who is not lucky enough to have A.C. power available. In a good location and with an efficient aerial system the receiver should be capable of receiving overseas broadcast band stations.



Under chassis view of the receiver.

FOUR SIMPLE CRYSTAL CIRCUITS

Full Coil Winding Information — Hints on Crystal Detectors and Aerials — Need for Low Loss Circuits — Selectivity and Range.

PRACTICALLY every radio set builder starts off with a crystal receiver, for despite the limitations of range and volume which are inherent in this type of radio set the low cost and the ease with which such sets can be constructed makes them appeal to all who are starting out in home set building.

A crystal receiver consists of three fundamental parts. The first is the tuning or resonating circuit which selects the station to which it is desired to listen. This consists of an inductance or coil used in conjunction with a variable condenser. Upon the design and efficiency of the coil depends the selectivity and sensitivity of the set.

The second part of the receiver is the detector, which usually consists of a piece of Galena or Silicon held in a suitable mounting with a fine wire, or "catswhisker" as it is commonly known, resting on one of its surfaces. The function of the detector, which allows current to flow in one direction much more readily than in the other, is to change the alternating currents fed to it through the aerial and tuning circuits into uni-directional currents which will operate the headphones. The phones themselves constitute the third part of the set.

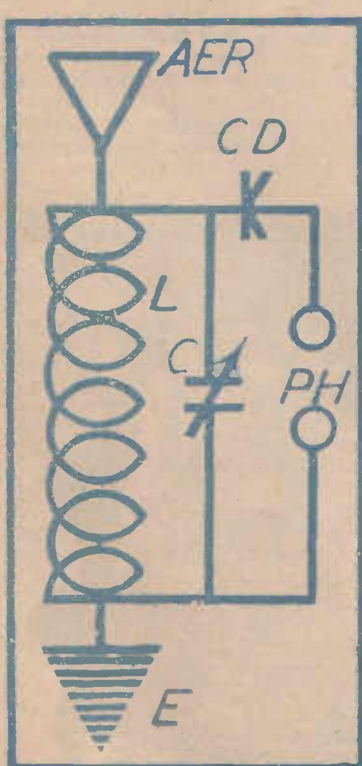


Fig. 1

Circuit Losses Must Be Low

THERE is no amplification in a crystal circuit. The detector can only rectify the energy fed to it from the aerial and tuning circuits. It can therefore be easily understood that losses must be reduced to a minimum if best results are to be obtained.

The aerial itself constitutes the first link in the receiving chain and should be erected as high as is possible. It must be well insulated and the lead-in kept clear of spoutings, trees and other earthed objects if best results are to be expected.

Generally, the longer the aerial the greater will be the energy pick-up of the system, but as the lengths of the aerial and earth wire affect the selectivity of the tuning circuits it is important in places close to powerful transmitting stations to keep the aerial size down to reasonable limits.

In the inner suburban area a limit of about 50 feet is desirable, but at greater distances from the transmitting stations lengths of 75 to 100 feet may be employed to advantage.

Constructional Details

IT will be noticed that each of the sets employs a variable condenser to tune the receiver to the frequency or wavelength of the station to which it is desired to listen. Most intending constructors of a crystal set will have little trouble securing a .0005 mfd. variable condenser together with a suitable knob or dial to control it. The coils have been designed to make use of this capacity condenser. The modern tuning condenser has a capacity of about .000375 mfd., and if one of these units is employed it will be necessary to add a few turns to the windings otherwise it may not be possible to cover the whole of the broadcast band.

The circuits of four crystal receivers are shown. The first one, Fig. 1, is very simple, but broadly tuned and would not be suitable for any but remote country locations well away from powerful stations. However, it is suggested that the junior experimenter makes up the simple set first and observes the differing results from the various receivers as they are built later on.

No specific details of placement of parts or their mounting positions, will be given as these will depend on the whims of individual builders. Some may wish to make a permanent job in existing cabinets, whilst others will, no doubt, adopt the very simple "bread-board" layout. Whichever system is employed, keep the parts reasonably close together in order that short efficient wiring will result. The crystal detector selected may be either of the catswhisker type or one of the semi-fixed type if one is available. The catswhisker type is slightly more sensitive, but the latter is a little more reliable as it will hold its setting for longer periods.

Coil Winding Data

THE first step in the construction of any of the receivers is the winding of the coil. A piece of round former 2¾ inches in diameter is required. This may be of cardboard, bakelite, dry wood, or any other insulating material. At this stage it may be as well to point out that the intending experimenter can if he so desires, make a coil which will be suitable for the four sets here described. In doing this he can try out the various hook-ups and pick the best for his location.

A quite simple coil can be made for the circuits of Figs. 1 and 2 by winding 50 turns of 26-gauge D.C.C. wire on the former mentioned above. The smaller or primary winding for Fig. 2 consists of 15 turns of the same wire wound in the same direction as the 50-turn coil but spaced ⅛ of an inch from it.

If the experimenter desires to make the coil which will serve all four sets, here are the details.

The coil consists of a total of 50 turns, but tappings are made at detailed points as the winding proceeds. The simplest way to make the tappings is to place a small piece of match stick under the required turn when the coil

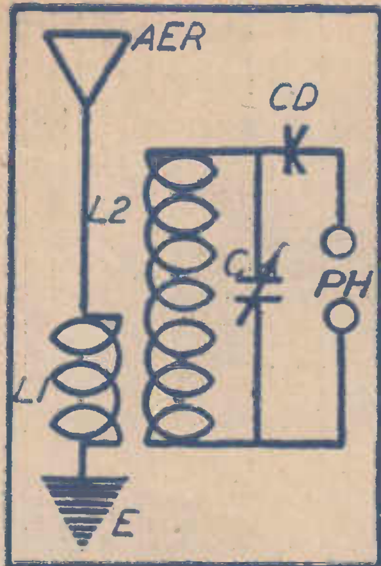


Fig. 2

is being wound. This lifts the wire clear of the other turns, and later it may be cleaned with sandpaper and a lead soldered to it.

Start winding from one end of the former and wind on 17 turns, then make a tapping as described. Continue the winding and make similar tappings at the 23rd, 27th and 34th turns, and finish at the 50th turn. It is best to leave quite long leads at the start and finish of the coils as these leads can be directly connected to other points in the circuit without the need for any joins.

Wind a primary of 15 turns ⅛ of an inch from the 50th turn, and in the same direction as the main winding. This coil will serve for circuits of Figs. 1, 2 and 3. If the circuit of Fig. 4 is to be used the former will need to be much longer, as a second 50 turn coil must be wound one inch from the end of the first 50 turn winding.

Final Wiring Connections

BEFORE starting to wire the receivers it will be necessary to mount on your panel or baseboard the tuning condenser, four terminals — one each for the aerial and earth and two for the headphone connections. The crystal detector also must be placed in a readily accessible position. A small metal bracket attached to the side of the coil former will hold it firmly in place. If desired all connections may be held under the lock nuts of the terminals of the various parts, but it is really good experience to start off right in radio set construction and to obtain a small soldering iron and some resin cored solder.

Solder lugs should be clamped under all components, and the leads soldered direct to them. This ensures low resistance connections and best results from your sets. In the case of the circuit shown in Fig 1, connect the start of the 50 turn coil to the aerial terminal, the fixed plates of the .0005 mfd. tuning condenser and to the crystal cup connection of the crystal detector. The free end of the 50 turn coil then joins to the earth terminal and to one headphone terminal. The remaining headphone terminal joins to the unconnected side of the crystal detector.

To wire up the circuit of Fig. 2 connect the start of the 50 turn winding to the fixed plates of the

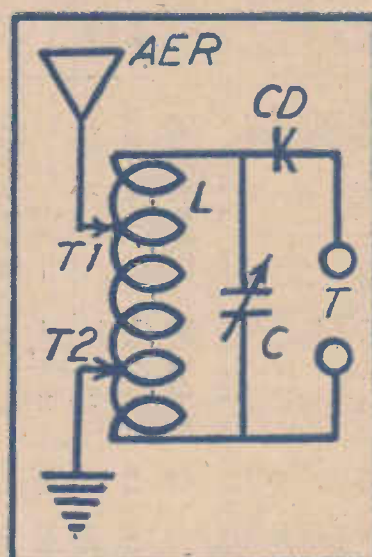


Fig. 3

tuning condenser and the cup connection of the crystal detector, the end of the same winding to one headphone terminal and the remaining headphone terminal to the unconnected side of the crystal detector. The aerial terminal then is joined to the outside end of the 15 turn coil and the free end of this coil is joined to the earth terminal. In the case of the circuit of Fig. 3 the wiring is the same as for Fig. 2 except that the aerial and earth terminals are connected to the 17th and 34th turn taps respectively instead of to the 15 turn coil, which is disregarded if using the combination coil.

The circuit shown in Fig. 4 is slightly more complicated. It calls for the use of condensers of .0005 mfd. capacity instead of the single one used in the other circuits. In addition, a three-point tapping switch is employed to vary the position of the aerial connection between three taps on the first 50 turn winding. If desired three separate aerial terminals may be used in place of this switch, but the switch is to be preferred as the tapping may be changed at will from the front panel to give best results on individual stations.

To wire this receiver connect the start of the tapped 50 turn coil to the fixed plate lug of the first variable tuning condenser, VC1. The moving plate lug of this condenser joins to the end of the tapped 50 turn coil. The aerial terminal joints to the arm of the three-point tapping switch whilst the three tapping lugs of this switch join to the 17th, 23rd and 27th taps on the coil. The 34th turn tap joins to the end of the other 50 turn untapped winding, to the earth terminal, to the moving plate lug of the variable condenser, VC2, and to one phone terminal.

The other phone terminal joins to the catswhisker side of the crystal detector, CD, the other side of which wires to the start of the 50 turn untapped winding and to the fixed plate lug of VC2.

The small .001 mfd. fixed condenser connects directly across the phone terminals.

This completes the wiring of the receiver. To test the sets it is only necessary to connect the aerial earth and phone leads to their respective terminals to set the catswhisker lightly upon the surface of the crystal and to rotate the plates of the tuning condenser until a station is heard.

If, at first, you get no results try another spot on the crystal until a sensitive one is found.

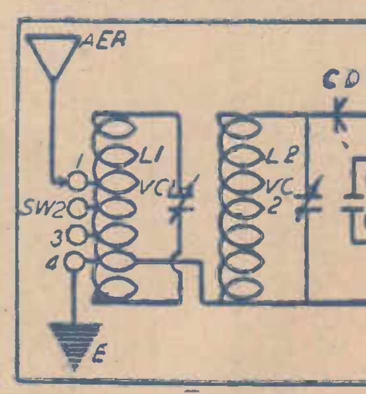


Fig. 4

Once a station has been located it is a simple matter to find the most sensitive spots on the crystal and to locate other stations on the dial.

VALVE CHARACTERISTICS

*One valuable **outcome** of war-time restrictions on radio valve manufacture was the **elimination** of many of the obsolete types, and this trend has **been** carried on until today we have a reasonable minimum of basic valve types capable of carrying out **all** the tasks expected of them. Operation characteristics of all these will be found in the tables below.*

1.4 VOLT VALVES

Type.	Purpose.	Filament Volts.	Filament Amps.	Plate Volts.	Plate mA.	Grid Volts.	Screen Volts.	Screen mA.	Plate Impedance.	Trans Conductance.	Load Resistance.	Power Output.
1A7GT	Converter	1.4	.05	90	0.6	0	45	0.7	.6 Meg	250 uMhos	Osc. plate 90 v. at 1.2 mA. Grid resistor .2 Meg. Osc. grid current .035 mA. Screen supply from B+ through 65,000 ohms.	
1H5GT	2nd Det. Diode Triode	1.4	.05	90	0.15	0	—	—	.24 Meg	275 uMhos	——	——
1P5GT	R.F.-I.F. Amplifier	1.4	.05	90	2.3	0	90	0.7	.8 Meg	750 uMhos	——	——
1Q5GT	Power Amplifier	1.4	1.0	90	9.5	4.5	90	1.3	.075 Meg	2200 uMhos	8.000 ohms.	270 mW
1R5	Converter	1.4	.05	90	1.6	0	67½	3.2	.6 Meg	300 uMhos	Osc. plate & screen tied tog. Grid resistor .1 Meg. Osc. grid current .25 mA.	
1S5	2nd Det. Diode Pentode	1.4	.05	67½	1.6	0	67½	0.4	.6 Meg	625 uMhos	See Resistance Coupling Tables on Page 65.	
1T4	R.F.-I.F. Amplifier	1.4	.05	90	3.5	0	67½	1.4	.5 Meg	900 uMhos		
3S4	Power Amplifier	*1.4	.1	90	7.4	7.0	67½	1.4	.1 Meg	1575 uMhos	8.000 ohms.	270 mW.
3V4	Power Amplifier	*1.4	.1	90	9.5	4.5	90	2.1	.1 Meg	2150 uMhos	10,000 ohms.	270 mW.

* FILAMENTS IN PARALLEL FOR 1.4 VOLT OPERATION

2 VOLT VALVES

Type.	Purpose.	Filament Volts.	Filament Amps.	Plate Volts.	Plate mA.	Grid Volts.	Screen Volts.	Screen mA.	Plate Impedance.	Trans Conductance.	Load Resistance.	Power Output.
1C7G	Converter	2.0	.12	135	1.3	3.0	67½	2.5	.6 Meg	300 uMhos	Osc. plate fed from B+ through 20,000 ohms. Osc. plate current 3.1 mA. Osc. Grid resistor .05 Meg. grid current .2mA.	
1H4G	Triode	2.0	.06	135	3.0	9.0	—	—	.01 Meg	900 uMhos	——	——
1J6G	Class "B" Twin Triode	2.0	.24	135	1.2	4.5	—	—			Used with triode connected 1K7G as driver will deliver 1.6 W. with bias of 4½ volts. Transformer ratio 2.2 : 1. 10,000 output load.	
1K5G	R.F.-A.F./Pentode	2.0	.12	135	1.25	0	45	0.48	1.75 Meg	820 uMhos	See Resistance Coupling Tables on Page 65.	
1K7G	2nd Det. Diode Pentode	2.0	.12	135	0.9	0	45	0.35	2.0 Meg	620 uMhos	See Resistance Coupling Tables on Page 65.	
1L5G	Power Amplifier	2.0	.24	135	6.0	4.5	135	1.5	.15 Meg	2150 uMhos	15,000 ohms.	350 mW.
1M5G	R.F.-I.F. Amplifier	2.0	.12	135	1.25	0	45	0.5	1.56 Meg	78(uMhos	——	——

6.3 VOLT VALVES

Type.	Purpose.	Filament Volts.	Filament Amps.	Plate Volts.	Plate mA.	Grid Volts.	Screen Volts.	Screen mA.	Plate Impedance.	Trans Conductance.	Load Resistance.	Power Output.
6A8G	Converter	6.3	.3	250	3.4	3	100	2.7	.36 Meg	550 uMhos	Osc. plate from 250 v. through 20,000 ohms. Grid resistor 50,000 ohms. Osc. grid current .4mA.	
6B6G	2nd Det. Diode Triode	6.3	.3	250	0.9	2	—	—	.091 Meg	1100 uMhos	See Resistance Coupling Tables on Page 65.	
6G8G	2nd Det. Diode Pentode	6.3	.3	250	6.5	3	100	1.5	.85 Meg	1100 uMhos	See Resistance Coupling Tables on Page 65.	
6J7G	R.F.-A.F. Pentode	6.3	.3	250	2.0	3	100	0.5	1.0 Meg	1225 uMhos	See Resistance Coupling Tables on Page 65.	
6J8G	Converter	6.3	.3	250	1.3	3	100	2.9	4.0 Meg	290 uMhos	Triode plate from 250 v. through 20,000 ohms. Grid resistor 50,000 ohms. Osc. Grid current .4m A.	
6U7G	R.F.-I.F. Amplifier	6.3	.3	250	8.2	3	100	2.0	.8 Meg	325 uMhos	——	——
6V6GT	Power Amplifier	6.3	.45	250	45.0	12½	250	4.5	.052 Meg	4100 uMhos	5,000 ohms.	4.5 W.

6.3 VOLT VALVES (Single-Ended Types)

6SA7GT	Converter	6.3	.3	250	3.5	2	100	8.5	1.0 Meg	450 uMhos	Special coil needed. Grid resistor 20,000 ohms. Grid current .5 mA.
6SF7GT	2nd Det. Diode Pentode	6.3	.3	250	12.4	1	100	3.3	.7 Meg	2050 uMhos	See Resistance Coupling Tables on Page 65.
6SJ7GT	R.F.-A.F. Amplifier	6.3	.3	250	3.0	3	100	0.8	1.0 Meg	1650 uMhos	See Resistance Coupling Tables on Page 65.
6SK7GT	R.F.-I.F Amplifier	6.3	.3	250	9.2	3	100	2.6	.8 Meg	2000 uMhos	
6SQ7GT	2nd Det. Diode Triode	6.3	.3	250	0.9	2	—	—	.091 Meg	1100 uMhos	See Resistance Coupling Tables on Page 65.

6.3 VOLT VALVES (Special Types)

1603	Non microphonic pentode	6.3	.3	250	2.0	3	100	0.5	.9 Meg	1225 uMhos	See Resistance Coupling Tables on Page 65.
6SN7GT	Twin Triode	6.3	.6	250	9.0	8	—	—	7700 Ohms	2600 uMhos	See Resistance Coupling Tables on Page 65.
807	Power Amplifier	6.3	.9	400	240	25	300	10.0	6000 Ohms	3200 uMhos	With fixed bias two valves in Class AB2 will deliver 55 watts with 78 volts grid to grid input. A driving power of 200 mW. is required. The load resistance under this condition is 3200 ohms. Current ratings given are for maximum signal conditions.

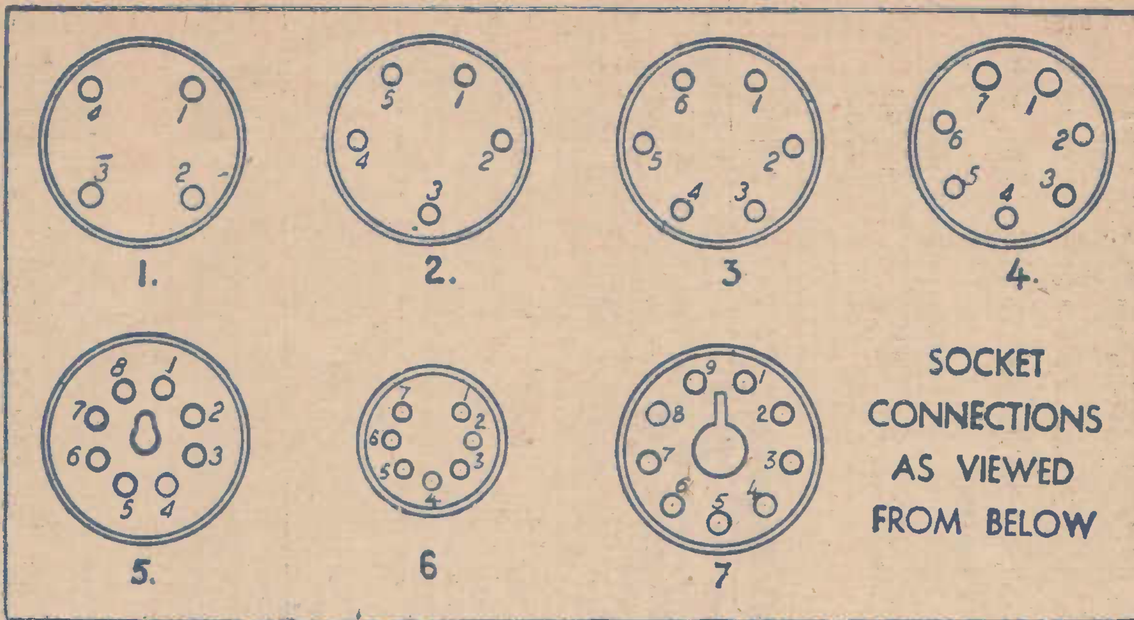
6.3 VOLT VALVES (Continental Types)

Type	Purpose	Filament Volts	Filament Amps.	Plate Volts	Plate mA.	Grid Volts	Screen Volts	Screen mA.	Plate Impedance	Transcon-ductance	Load Impedance	Power Output
EA50	Television Diode	6.3	0.15	—	--	Max. diode voltage 50. Max. diode current 5mA. Max. heater cathode volts 50. Heater Cathode resistance 20,000 ohms. Diode/Cathode capacity 2.1 uuFd.						
EBF2G EBF35	Diode Pentode I.F. & A.F. Amplifier	6.3	0.2	250	3	2	100	1.6	1.3 Meg.	1,800	Screen voltage from B+ through 95.00	
ECH35	Mixer	6.3	0.3	250	3	2	Osc. plate 250 v. at 3.3 mA. through 45,000 ohms. Osc. grid resistance 50,000 ohms. Osc. grid current 0.2 mA. Screen voltage 100v. at 3 mA. from potentiometer connected across 250 v., and having bleed current of 3.0 mA. Transconductance 650 uMhos. Plate impedance 1.3 meg.					
EF50	VHF Amplifier	6.3	0.3	250	10	2	250	3.0	1.0 Meg.	6,500	Plate and screen Current and voltage ratings are for each pentode	
EFF50	VHF Twin Amplifier	6.3	0.56	250	10	2	200	1.5	0.6 Meg.	11,000		
EK2G EK32	Mixer	6.3	0.2	250	1.0	2	50	0.8	Osc. plate 200 v. at 2.5 mA. Osc. grid resistance 50,000 ohms. Osc. grid current 0.3 mA. Transconductance 350 uMhos. Plate impedance 2.0 Meg.			
EL5G EL35	Power Amplifier	6.3	1.35	250	72	14	275	7.0	0.22 Meg.	8,500	3500 ohms	8.8W.
EL3NG							PUSH-PULL OPERATION: Plate volts 250. Screen volts 275. Max. plate current (two valves) 130mA. Max screen current (two valves) 10 mA. Load resistance 4500 ohms plate to plate. Power output 19.5 W. Cathode resistance (two valves) 120 ohms.					
EL33A	Power Amplifier	6.3	0.9	250	36	6	250	4.0	0.05 Meg.	9,000	7000	4.5W.
							PUSH-PULL OPERATION: Plate and screen voltages 250. Max. signal plate current (two valves) 57 mA. Max. signal screen current (two valves) 9.2 mA. Load resistance 10,000 ohms plate to plate. Power output 8.2 watts. Cathode resistance 140 ohms per valve.					

RECTIFIERS

Type	Filament Volts	Filament Amps.	Max. A.C. Plate Volts (R.M.S.) Choke Input	Condenser Input	Max. D.C. Output Choke Input Volts	Choke Input mA.	Condenser Input Volts	Condenser Input mA.	Regulation % Choke	Cond.
5R4GY	5	2	1900	1800	750	175	950	150	8	11.5
5Y3GT	5	2	500	350	380	125	340	125	6.1	13.9
6X5GT	6.3	.6	900	650	380	70	370	70	1.3	8.5

NOTE.—The maximum d.c. output voltages are those measured under the stated load conditions at the input to the filter. In all cases of condenser input the input capacity has a minimum of 4 mfd. Following are the minimum inductance values (under d.c. load) of the chokes: 5R4GY, 10 H.; 6X5GT, 8 H.; 5Y3GT, 5 H. Regulation percentage is expressed as the percentage change in output voltage from half to full load



VALVE SOCKET CONNECTIONS

All socket connections are as viewed from the underside of the sockets. The bases are numbered to agree with the diagrams above.

1.4 VOLT VALVES

Type	Base	1	2	3	4	5	6	7	8	Cap
1A7GT	5	BS	Fil. +	Plate	Grd. 3, 5	Grid 1	Grid 2	Fil. —	—	Grid 3
1D8GT	5	—	Fil. +	Pen. Pl.	Screen	Pen. Gr.	Tri. Pl.	Fil. —	Diode Pl.	Tri. Gr.
1H5GT	5	BS	Fil. +	Tri. Pl.	—	Diode Plate	—	Fil. —	—	Tri. Gr.
1P5GT	5	BS	Fil. +	Plate	Screen	—	—	Fil. —	—	Grid
1Q5GT	5	—	Fil. +	Plate	Screen	Grid	—	Fil. —	—	—
1R5	8	Fil. —	Plate	Grd. 2, 4	Grid 1	Fil. —	Grid 3	Fil. +	—	—
1S5	8	Fil. —	—	Diode	Screen	Plate	Grid	Fil. +	—	—
1T4	8	Fil. —	Plate	Screen	—	Fil. —	Grid	Fil. +	—	—
3S4	8	Fil. — (ser.)	Plate	Grid	Screen	Fil. — (par.)	Plate	Fil. +	—	—
3V4	8	Fil. — (ser.)	Plate	Grid	Screen	Fil. — (par.)	Plate	Fil. +	—	—

2 VOLT VALVES

Type	Base	1	2	3	4	5	6	7	8	Cap.
1A4P	1	Fil. +	Plate	Screen	Fil. —	—	—	—	—	Grid
1C4	1	Fil. +	Plate	Screen	Fil. —	—	—	—	—	Grid
1C6	3	Fil. +	Plate	Osc. Pl.	Os. Grd.	Screen	Fil. —	—	—	Grid
1C7GT	5	—	Fil. +	Plate	Gr. 3, 5	Grid 1	Grid 2	Fil. —	—	Grid 4
1D4	2	Fil. +	Plate	Grid	Screen	Fil.	—	—	—	—
1D5GP	5	—	Fil. +	Plate	Screen	—	—	Fil. —	—	Grid
1H4G	5	—	Fil. +	Plate	—	Grid	—	Fil. —	—	—
1H6G	5	—	Fil. +	Plate	AVC Diode	Det. Diode	Grid	Fil. —	—	—
1J6G	5	—	Fil. +	Plate 2	Grid 2	Grid 1	Plate 1	Fil. —	—	—
1K5G	5	—	Fil. +	Plate	Screen	—	—	Fil. —	—	Grid
1K6	3	Fil. +	Plate	Screen	AVC Diode	Det. Diode	Fil.	—	—	Grid

Type	Base	1	2	3	4	5	6	7	8	Cap.
1K7G	5	—	Fil. +	Plate	AVC Diode	Det. Diode	Screen	Fil. —	—	Grid
1L5G	5	—	Fil. +	Plate	Screen	Grid	—	Fil. —	—	—
1M5G	5	—	Fil. +	Plate	Screen	—	—	Fil. —	—	—
19	3	Fil.	Plate 2	Grid 2	Grid 1	Plate 1	Fil.	—	—	—
30	1	Fil.	Plate	Grid	Fil.	—	—	—	—	—

6.3 VOLT VALVES

AMERICAN SERIES

Type	Base	1	2	3	4	5	6	7	8	Cap.
6A7	4	Htr.	Plate	Gr. 3, 5	Grid 2	Grid 1	Cath.	Htr.	—	Grid 4
6A8G	5	—	Htr.	Plate	Gr. 3, 5	Grid 1	Grid 2	Htr.	Cath.	Grid 4
6B6G	5	—	Htr.	Tri. Pl.	Diode 2	Diode 1	—	Htr.	Cath.	Grid
6B7	4	Htr.	Plate	Screen	Diode 2	Diode 1	Cath.	Htr.	—	Grid
6B8G	5	—	Htr.	Plate	Diode 2	Diode 1	Screen	Htr.	Cath.	Grid
6C6	3	Htr.	Plate	Screen	Sup.	Cath.	Htr.	—	—	Grid
6D6	3	Htr.	Plate	Screen	Sup.	Cath.	Htr.	—	—	Grid
6F6G	5	—	Htr.	Plate	Screen	Grid	—	Htr.	Cath.	—
6G8G	5	—	Htr.	Plate	Diode 2	Diode 1	Screen	Htr.	Cath.	Grid
6H6GT	5	—	Htr.	Plate 2	Cath. 2	Plate 1	—	Htr.	Cath. 1	—
6J7G	5	—	Htr.	Plate	Screen	Sup.	—	Htr.	Cath.	Grid
6J8G	5	—	Htr.	Hep Pl.	Gr. 2, 4	Tri. Gr. and Grid 3	Tri. Pl.	Htr.	Cath.	Grid 1
6K8G	5	—	Htr.	Hex. Pl.	Gr. 2, 4	Tri. Gr. and Grid 1	Tri. Pl.	Htr.	Cath.	Grid 3
6SA7GT	5	—	Htr.	Plate	Gr 2. 4	Grid 1	Cath. & Grid 5	Htr.	Grid 3	—
6SF7GT	5	—	Pn. Gr.	Cath.	Screen	Diode	Pen. Pl.	Htr.	Htr.	—
6SJ7GT	5	BS	Htr.	Sup.	Grid	Cath.	Screen	Htr.	Plate	—
6SK7GT	5	Fil. —	Fil. —	Pen. Pl.	Grids 3, 5	Pen Gr.	Tri. Pl.	Fil.	Grid	—
6SN7GT	5	Grid 2	Plate 2	Cath. 2	Grid 1	Plate 1	Cath. 1	Htr.	Htr.	—
6SQ7GT	5	BS	Tri. Gd.	Cath.	Diode 2	Diode 1	Tri. Pl.	Htr.	Htr.	—
6U7G	5	—	Htr.	Plate	Screen	Sup.	—	Htr.	Cath.	Grid
6V6GT	5	—	Htr.	Plate	Screen	Grid	—	Htr.	Cath.	—
42	3	Htr.	Plate	Screen	Grid	Cath.	Htr.	—	—	—
75	3	Htr.	Tri. Pl.	Diode 2	Diode 1	Cath.	Htr.	—	—	Grid
807	2	Htr.	Screen	Grid	Cath.	Htr.	—	—	—	Plate
1603	3	Htr.	Plate	Screen	Sup.	Cath.	Htr.	—	—	Grid

CONTINENTAL SERIES

Type	Base	1	2	3	4	5	6	7	8	Cap.
EBF2G	5	H	M	P	Grid 2	Det. Dio.	AVC Dio.	Cath.	H	Grid 1
EBF35	5	H	M	P	Grid 2	Det. Dio.	AVC Dio.	Cath.	H	Grid 1
ECH35	5	M	H	P	Grids 2, 4	Tri. Plate	Tri. Grid	H	Cath.	Grid 1
EF50	8	H	SG	P	Supp.	Shield	Cath.	Grid 1	Shield	H to Pin 9
EFF50	8	H	P1	SG1	Grid 1	Cath.	Grid 2	SG2	P2	H to Pin 9
EK2G	5	M	H	P	Grids 3, 5	Grid 1	Grid 2	H	Cath.	Grid 4
EK32	5	M	H	P	Grids 3, 5	Grid 1	Grid 2	H	Cath.	Grid 4
EL5G	5	—	H	P	Grid 2	Grid 1		H	Cath.	—
EL35	5	—	H	P	Grid 2	Grid 1	—	H	Cath.	—
EL3NG	5	—	H	P	Grid 2	Grid 1	—	H	Cath.	—
EL33A	5	—	H	P	Grid 2	Grid 1	—	H	Cath.	Cap.

RECTIFIERS

Type	Base	1	2	3	4	5	6	7	8	—
5R4GY	5	—	Fil.	—	Plate 2	—	Plate 1	—	Fil.	—
5V4G	5	—	Htr.	—	Plate 2	—	Plate 1	—	Htr.	—
5Y3GT	5	—	Fil.	—	Plate 2	—	Plate 1	—	Fil.	—
6X5GT	5	—	Htr.	—	Plate 2	—	Plate 1	Htr.	Cath.	—
80	1	Fil.	Plate 2	Plate 1	Fil.	—	—	—	—	—
83V		Fil.	Plate 2	Plate 1	Fil.	—	—	—	—	—

VHF CONVERTERS

Permeability Tuning on 90 Megacycles — Special Valve Types Needed — Lay-out and Construction Pointers — Co-axial Tuning Described.

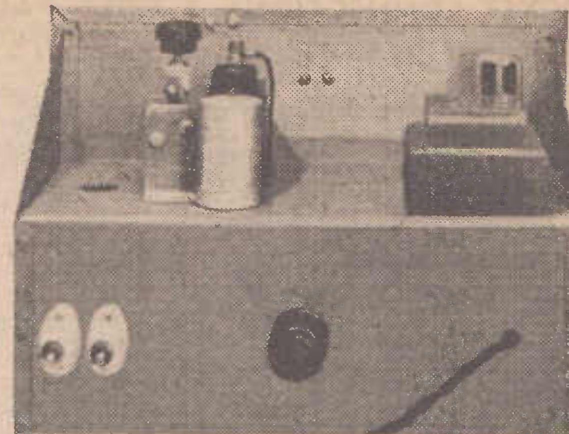
THIS very high frequency converter unit is intended for operation on 6, 10 or 20 metres and makes use of valves specially designed for working on frequencies of the order of 60 to 90 megacycles.

Though in its present form the unit is intended for operation on the amateur bands, it is possible without great trouble to extend its frequency range to take in the FM broadcasts which are being conducted experimentally on 91 megacycles.

Both the r.f. and the mixer stages are permeability-tuned, the r.f. valve being connected, tuned anode fashion, to the pentode grid of the mixer tube. The Ferrotuned coils, L2 and L3, are gang tuned, and a separate control is used to peak the aerial coil, L1, which is inherently broad in its tuning. Output from the mixer tube is fed into an i.f. transformer tuned to a frequency in the region of 10.5 megacycles and feeding into the aerial circuit of a standard dual wave or short wave receiver tuned to the same frequency. The converter is self powered.

The r.f. valve suggested for this converter is a 6AK5. Other valves which may be used, listed in their order of suitability, are the 6AG5, RL7 or EF50. The mixer valve is one of the new Philips ECH35's, which are particularly fine performers on the Very High Frequencies.

Construction of receivers for use on the Very High Frequencies involves careful planning of the layout and the use of small components. Lead lengths must be reduced to the minimum and all by-pass and coupling condensers must be of the high quality mica type. Insulation materials must be carefully selected for use in the r.f. circuits and quartz, special r.f. type bakelites, or polystyrene should be used. All circuit components should be of midget dimensions.



Rear view of the converter chassis

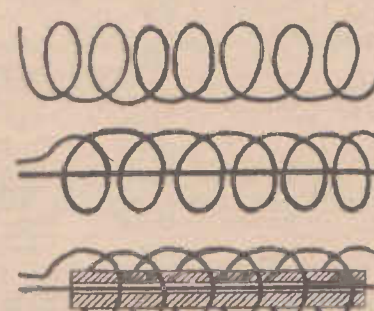


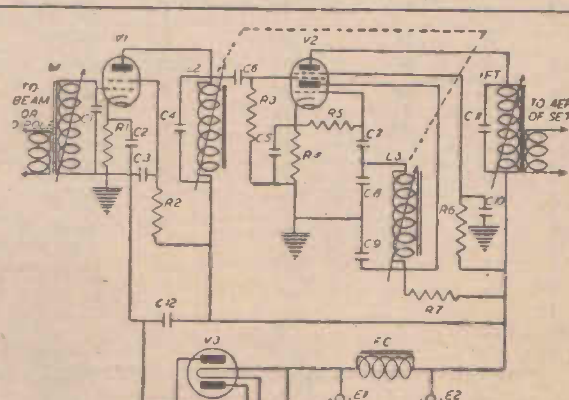
Fig. 1. The principle of co-axial tuning.

An interesting new development in Very High Frequency tuning is what is known as "Co-axial Tuning." The inductances used at these frequencies are so small that the length of the coil-connecting leads plays an important part in determining the frequency range over which a given coil may be tuned. In Fig. 1 is shown the method used to overcome this difficulty at frequencies in the 100 megacycles region.

The top diagram shows a conventional coil in which the two ends are a "fixed" part of the tuned circuit. The lower diagram illustrates the co-axial form of tuning, in which one of the leads is taken back through the coil and is tuned by a slotted iron slug which also tunes the coil itself. By this means tuning of the whole of the effective inductance is obtained, for the coil is so mounted that the length of its other lead is infinitesimal.

Parts List and Circuit Diagram

C1, C4, C8, C9: Band setting condensers built into L1, L2 and L3.
C2, C3, C5, C10, C12: .01 mfd mica condensers.
C6: 50 micro-microfarad mica condenser.
C7: 100 mmfd, mica condenser.
E1, E2: 8 mfd. 500 v. electrolytic condensers.
FC: Type 6/60 mA filter choke.
IFT: Permeability tuned I.F. transformer 10.5 m/cs. condenser C11 built into it.
L1, L2, L3, L4: Ferrotune coils covering 50, 30, or 15 megacycle bands.
PT: Power transformer—285v. at 60 mA.; 6.3v. at 3 A. and 5v. at 2 A.
R1, R4: 250 ohms 1w. carbon resistors.
R2, R3: 100,000 ohms 1w. carbon resistors.
R5, R6: 50,000 ohms 1w. carbon resistors.
R7: 10,000 ohms 1w. carbon resistors.
VALVES: One each 6AK5, ECH35, 5Y3G.



Permeability-Tuned

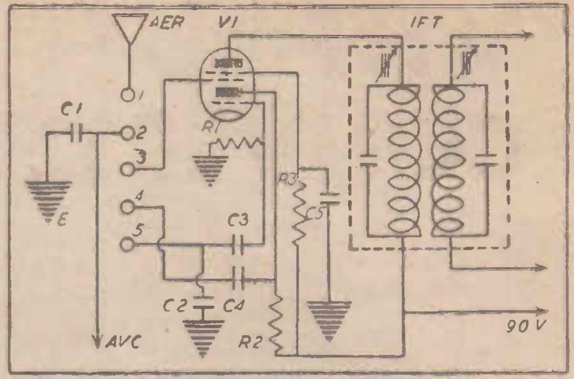
BATTERY SUPERS

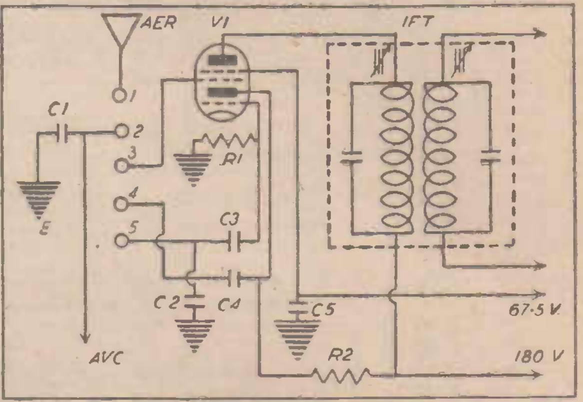
Brief Details for inclusion of P.M. Tuning on Standard Battery operated Super-heterodynes using either 1.4 or 2 volt valves.

ONCE the general principles of the connection of a Ferrotune coil box are understood, permeability tuning can be applied to the mixer stage of any standard battery operated superheterodyne and will provide in this type of receiver all the advantages which it confers in the A.C. receiver. The two circuits shown at the right are basic mixer circuits showing the correct values of plate, screen and control grid resistors for each type of battery valve. For best results from the P.M. tuned battery super-het it is desirable also to employ permeability tuned I.F transformers.

PARTS LIST

1A7 Type Valve.
COIL KIT: Ferrotune KFTI.
C1: Same capacity as AVC by-pass used in i.f. stage.
C2: 250 mmfd mica.
C3: 100 mmfd mica.
C4: .01 mfd mica.
C5: .1 mfd paper.
IFT: Kingsley type KIF5.
R1: 200,000 ohms ½ watt carbon.
R2: 50,000 ohms ½ watt carbon.
R3: 70,000 ohms ½ watt carbon.
VALVE: 1A7GT.
1C7G Type Valve.
As for 1C7G type tube but R2 becomes 20,000 ohms and R3 is deleted.





At the top is the circuit used with the 1A7GT. The lower circuit is the one used with the 1C7G.

RESISTANCE COUPLED AMPLIFIER TABLES

The tables below set out the resistor and condenser values for various types of valves. The supply voltage is that at the filter output and the grid resistor is that for the following valve.

Supply	180 Volts									300 Volts								
6G8G, 6B6G, 6SF7GT: Plate Resistor . . .	0.1 Megohm			0.25 Megohm			0.5 Megohm			0.1 Megohm			0.25 Megohm			0.5 Megohm		
Grid Resistor . . .	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2
Screen Resistor . .	0.44	0.5	0.6	1.18	1.2	1.5	2.6	2.8	3	0.5	0.55	0.6	1.2	1.2	1.5	2.7	2.9	3.4
Cathode Resistor .	1000	1200	1200	1900	2100	2200	3300	3300	3500	950	1100	900	1500	1600	1800	2400	2500	2800
Screen Condenser	0.08	0.08	0.07	0.05	0.06	0.05	0.04	0.04	0.04	0.09	0.09	0.08	0.06	0.06	0.08	0.05	0.05	0.05
Cathode Condenser	4.4	4.4	4	2.7	3.2	3	2.1	2	2.2	4.6	5	4.8	3.2	3.5	4	2.5	2.3	2.8
Coupling Condenser	0.02	0.15	0.008	0.01	0.007	0.003	0.005	0.003	0.002	0.025	0.015	0.009	0.015	0.008	0.004	0.006	0.003	0.0025
Output Voltage . .	30	52	53	39	55	53	47	55	53	60	89	86	70	100	95	80	120	90
Voltage Gain . . .	30	41	46	55	69	83	81	115	116	36	47	54	64	79	100	96	150	145
6SN7GT: Plate Resistor . .	0.05 Megohm			0.1 Megohm			0.25 Megohm			0.05 Megohm			0.1 Megohm			0.25 Megohm		
Grid Resistor . . .	0.05	0.1	0.25	0.1	0.25	0.5	0.25	0.5	1	0.05	0.1	0.25	0.2	0.25	0.5	0.25	0.5	1
Cathode Resistor .	1190	1490	1740	2330	2830	3230	5560	7000	8110	1020	1270	1500	1900	2400	2700	4590	5770	6950
Cathode Condenser	3.27	2.86	2.06	2.19	1.35	1.15	0.81	0.62	0.5	3.56	2.96	2.15	2.31	1.42	1.2	0.87	0.64	0.54
Coupling Condenser	0.06	0.032	0.0115	0.038	0.012	0.006	0.013	0.007	0.004	0.06	0.034	0.012	0.035	0.0125	0.0065	0.013	0.0075	0.004
Output Voltage . .	24	30	36	26	34	38	28	36	40	41	51	66	43	56	64	46	57	64
Voltage Gain . . .	13	13	13	14	14	14	14	14	14	13	14	14	14	14	14	14	14	14
6J7G, 1603: Plate Resistor . .	0.1 Megohm			0.25 Megohm			0.5 Megohm			0.1 Megohm			0.25 Megohm			0.5 Megohm		
Grid Resistor . . .	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2
Screen Resistor . .	0.44	0.5	0.5	1.1	1.18	1.4	2.45	2.9	2.7	0.44	0.5	0.53	1.18	1.18	1.45	2.45	2.9	2.95
Cathode Resistor .	1000	750	800	1200	1600	2000	2600	3100	3500	500	450	600	1100	1200	1300	1700	2200	2300
Screen Condenser	0.05	0.05	0.05	0.04	0.04	0.04	0.03	0.025	0.02	0.07	0.07	0.06	0.04	0.04	0.05	0.04	0.04	0.04
Cathode Condenser	6.5	6.7	6.7	5.2	4.3	3.8	3.2	2.5	2.8	8.5	8.3	8	5.5	5.4	5.8	4.2	4.1	4
Coupling Condenser	0.02	0.01	0.006	0.008	0.005	0.0035	0.005	0.0025	0.0015	0.02	0.01	0.006	0.008	0.005	0.005	0.005	0.003	0.0025
Output Voltage . .	42	52	59	41	60	60	45	56	60	55	81	96	81	104	110	75	97	100
Voltage Gain . . .	51	69	83	93	118	140	135	165	165	61	82	94	104	140	185	161	350	240
6SJ7: Plate Resistor . .	0.1 Megohm			0.25 Megohm			0.5 Megohm			0.1 Megohm			0.25 Megohm			0.5 Megohm		
Grid Resistor . . .	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2
Screen Resistor . .	0.29	0.31	0.37	0.83	0.94	0.04	1.85	2.2	2.4	0.35	0.37	0.47	0.89	1.10	1.18	2.0	2.2	2.5
Cathode Resistor .	760	800	860	1050	1060	1180	2000	2180	2410	500	530	590	850	860	910	1300	1410	1530
Screen Condenser	0.10	0.09	0.09	0.06	0.06	0.07	0.05	0.04	0.035	0.10	0.09	0.09	0.07	0.06	0.06	0.06	0.05	0.04
Cathode Condenser	9.1	8	7.8	6.8	6.6	6.1	4.0	3.8	3.6	11.6	10.9	9.9	8.5	7.4	6.9	6	5.8	5.2
Coupling Condenser	0.019	0.015	0.007	0.001	0.004	0.003	0.003	0.002	0.0015	0.019	0.016	0.007	0.011	0.004	0.003	0.004	0.002	0.0015
Output Voltage . .	49	60	62	38	47	54	37	44	54	72	96	101	79	88	98	64	79	89
Voltage Gain . . .	55	82	91	109	131	161	151	192	208	67	98	104	139	167	185	200	238	263
6SQ7GT: Plate Resistor . . .	0.1 Megohm			0.25 Megohm			0.5 Megohm			0.1 Megohm			0.25 Megohm			0.5 Megohm		
Grid Resistor . . .	0.1	0.25	0.5	0.25	0.5	1	0.5	1	2	0.1	0.25	0.5	0.25	5	1	0.5	1	2
Cathode Resistor .	2600	2900	3000	4300	4800	5300	7000	8000	8800	1900	2200	2300	3300	3900	4200	5300	6100	7000
Cathode Condenser	3.3	2.9	2.7	2.1	1.8	1.5	1.3	1.1	0.9	4	3.5	3	2.7	2	1.8	1.6	1.3	1.2
Coupling Condenser	0.025	0.015	0.007	0.015	0.007	0.004	0.007	0.004	0.002	0.03	0.015	0.007	0.015	0.007	0.004	0.007	0.004	0.002
Output Voltage . .	16	22	23	21	28	33	25	33	38	31	41	45	42	51	60	47	62	67
Voltage Gain . . .	29	36	37	43	50	53	52	57	58	31	39	42	48	53	56	58	60	63

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