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features—

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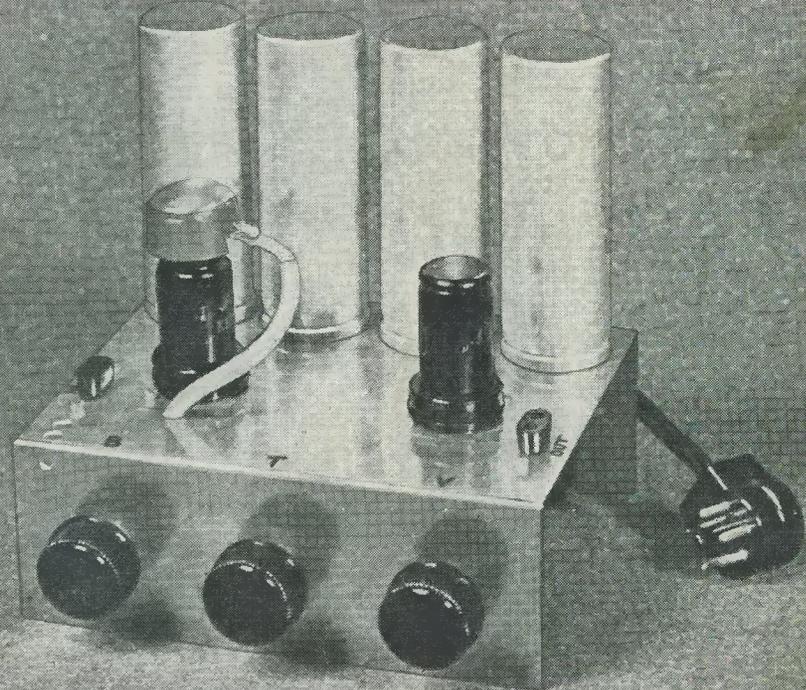
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The

# RADIO CONSTRUCTOR

for the Radio and Television Enthusiast

Vol. 6  
Number 6  
FEBRUARY  
1953



### IN THIS ISSUE...

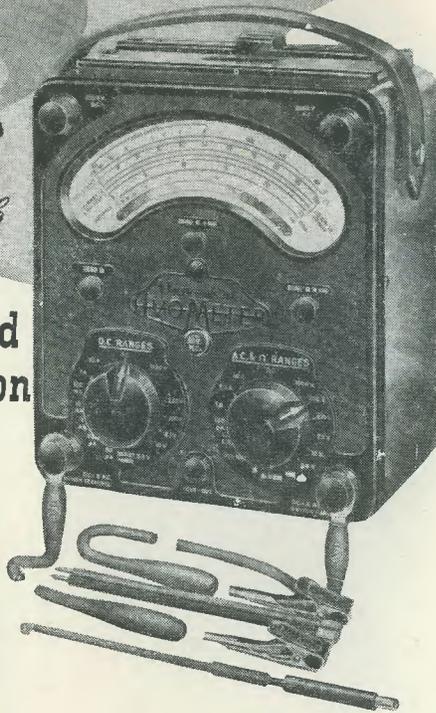
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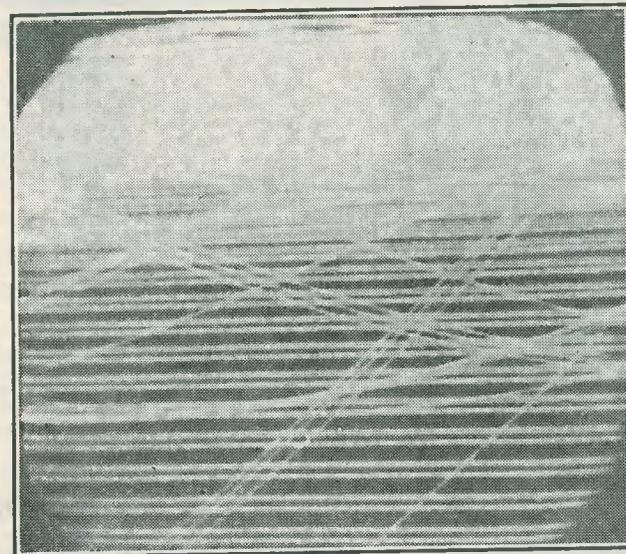
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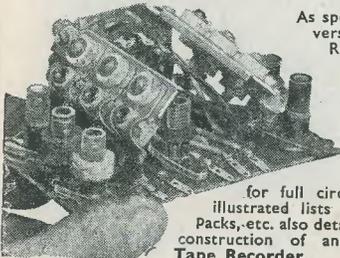
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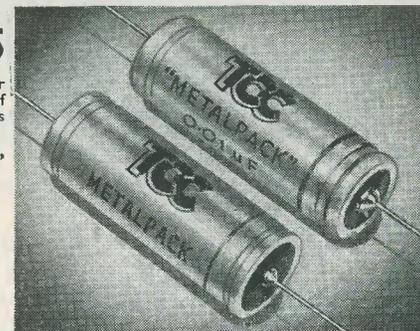
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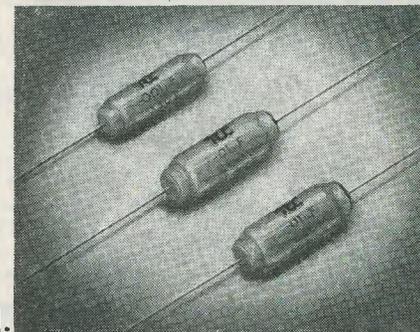
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.001	350	200	1/2 in.	.2 in.	CP110N
.002	350	200	1/2 in.	.22 in.	CP111N
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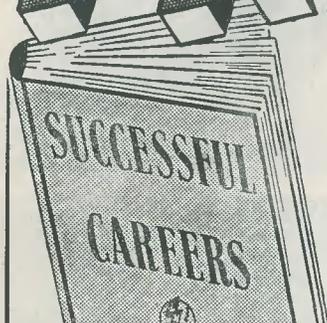
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The

# Radio Constructor

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## NOTICES

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THE EDITOR invites original contributions on construction of radio subjects. All material used will be paid for. Articles should be typewritten, and photographs should be clear and sharp. Diagrams need not be large or perfectly drawn, as our draughtsmen will redraw in most cases, but relevant information should be included. All Mss must be accompanied by a

stamped addressed envelope for reply or return. Each item must bear the sender's name and address.

TRADE NEWS. Manufacturers, publishers, etc., are invited to submit samples or information of new products for review in this section.

ALL CORRESPONDENCE should be addressed to Radio Constructor, 57, Maida Vale, Paddington, London, W.9. Telephone CUN. 6518.

A Companion Journal to THE RADIO AMATEUR

# Suggested Circuits for the Experimenter

The circuits presented in this series have been designed by G. A. FRENCH specially for the enthusiast who needs only a circuit and the essential relevant data.

## NO. 26 AN AUTOMATIC SCRATCH SUPPRESSOR

An undesirable adjunct of gramophone reproduction is given by the existence of needle scratch. Although needle scratch need not be too troublesome with new or modern pressings, it can still be sufficiently bad to mar enjoyment when older or worn records are being played. Even with new records, however, a scratch filter of some type is often considered to be of advantage.

When loud passages are being played from a record, needle scratch usually ceases to be objectionable, as its level is then relatively lower than that of the reproduced sound. Conversely, when quiet passages are being played, the scratch level becomes relatively high and correspondingly more unpleasant.

A filter capable of reducing scratch from noisier records is liable to cause unwanted attenuation of the higher frequencies. This is especially true in the case of amplifiers (or the amplifier portions of broadcast receivers connected to external pick-ups) which use simple top-cut tone controls. When such amplifiers are used, it is impossible to remove scratch without destroying much of the top brilliance of the recording.

### The Circuit

An answer to this problem is suggested in this month's circuit. In this circuit the amount of higher audio frequency (scratch) attenuation is made variable, and is so controlled as to be inversely proportional to the volume level of the middle and lower frequency section of the recorded sound. Thus, scratch is kept below the objectionable point at all volumes; attenuation (and possible loss of top) occurring at the lower volume levels only.

Variable attenuation is achieved by means of a variable-mu valve which is connected to give negative feedback at the higher audio

frequencies. A portion of the voltage appearing across the output transformer secondary is applied to the grid of this valve; its anode being coupled to the grid of the output valve. Filters, passing the higher frequencies only, are fitted in both the grid and anode circuits of the variable-mu valve, the connections to the output transformer secondary being such that the feedback applied to the output valve is negative. The amount of feedback and, correspondingly, the amount of high frequency attenuation, can then be controlled by varying the bias of the variable-mu valve.

A further source of AF is taken from the primary of the output transformer. This is fed, via a filter passing the middle and lower frequencies, to a diode. The diode develops a negative voltage proportional to the volume level; and this voltage is used to control the variable-mu feedback valve.

In the circuit shown here, V1 is the output valve already fitted in the amplifier (a single-ended amplifier is assumed), V2 is the variable-mu valve, and V3 the diode. The filters in the grid and anode circuits of V2 are provided by C6 and R3, and C2 and R1 respectively. The amount of feedback is controlled by the potentiometer R6, which can be a panel control if desired. In some cases most of the useful control exerted by this component will be found to be cramped at its earthy end; in which case it would be advisable to use a lower value component and to fit a fixed resistor of the requisite value between its top end and the output transformer secondary.

The components R8 and C7 form the filter in the input circuit to the diode V3. Rectification is carried out here in normal fashion, the rectified voltage appearing across R9. This potentiometer also varies the control exerted on the variable-mu valve. It should be set to

## COMPONENT VALUES

### Resistors

R1	Output valve grid leak. (Already fitted).
R2	1.5 k $\Omega$
R3	500 k $\Omega$
R4	100 k $\Omega$
R5	150 k $\Omega$
R6	250 k $\Omega$
R7	4 M $\Omega$
R8	100 k $\Omega$
R9	1 M $\Omega$

### Valves

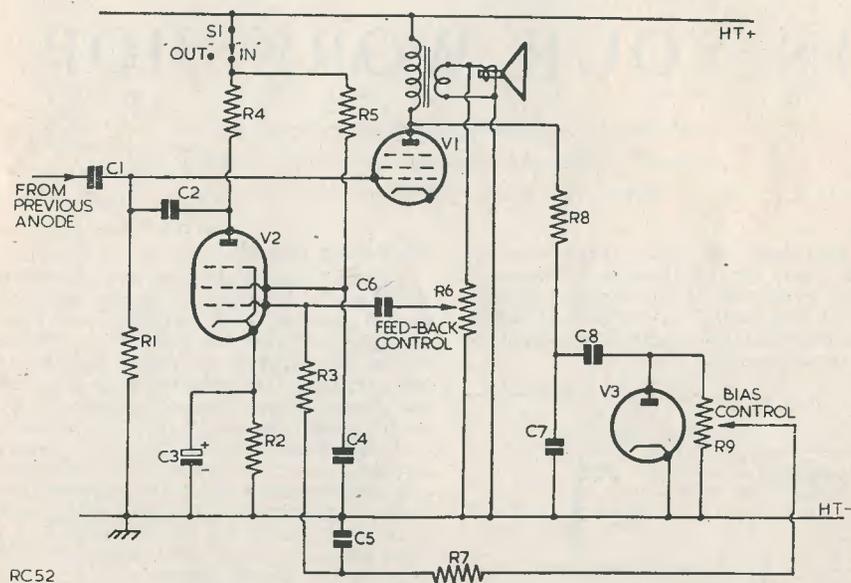
V1	Output Pentode (Already fitted)
V2	Variable-mu pentode
V3	Diode

### Capacitors

C1	Coupling capacitor (Already fitted)
C2	100 pF
C3	25 $\mu$ F; 25 W.V.
C4	0.1 $\mu$ F
C5	0.1 $\mu$ F
C6	100 pF
C7	0.005 $\mu$ F
C8	0.001 $\mu$ F

### Switches

S1	S.P.S.T.: "In-Out" switch
----	---------------------------



the position in which the scratch suppression level follows the reproduced sound level most closely. R9 can be a pre-set component.

The rectified voltage from R9 is applied, via R7 and C5 (which give a time delay of approximately half a second) and R3, to the grid of V2.

The potentiometers R6 and R9 should be capable of maintaining sufficient control over the circuit to meet most practical instances. If, however, V2 gives too much amplification, it may be found that scratch suppression cuts in rather too sharply at low volume levels. This effect can be cleared by running the anode and screen-grid of this valve from a lower-

voltage HT point. Alternatively, the value of C6 could be reduced.

The scratch suppressor is switched in and out of circuit by S1.

### Precautions

Owing to phase shifts in the output transformer it is possible for the circuit to become self-oscillatory at a high or supersonic frequency when the bias on V2 is low. This effect may be cleared by using a better quality output transformer than that already fitted or, if this does not meet the case, by connecting a capacitor of some 50 pF between the anode of

V2 and chassis. Long or badly-positioned grid and anode leads may also cause instability. The best layout would consist of mounting V2 close to V1, and of keeping the associated wiring short. The leads from the output transformer secondary to R6, and from R6 to C6, need not be kept excessively short, however.

A disadvantage with this particular circuit lies in the fact that it is applied to the amplifier after the volume and tone controls. It should still be found, nevertheless, that after it has once been set up for average volume levels the circuit should cope quite adequately in normal

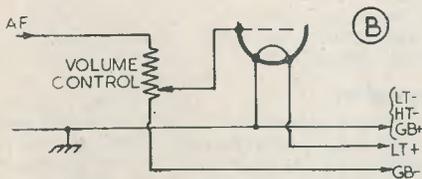
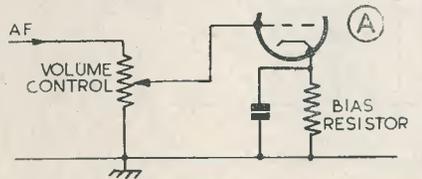
use. When, occasionally, unusually high or low volume settings are used, the difference may be taken up by adjusting R6.

It will be readily seen, of course, that this circuit need not be applied at the output valve at all; but could be connected instead to any stage, within reason, in the amplifier. The output stage has the advantages, however, of possessing a transformer which can be utilised to give a feedback voltage of the correct phase, and of offering a sufficiently large AF voltage to obtain adequate control of the variable- $\mu$  feedback valve.

## IN YOUR WORKSHOP

In which J.R.D. discusses Problems and Points of Interest connected with the Workshop side of our hobby based on Letters from Readers and his own experience.

An important little device which does not always receive the full attention it deserves is the volume control. I should like, therefore, to devote this month's article to a consideration of this component, and to the circuits in which it may be used.



RC53

Fig 1 Typical AF volume control circuits as applied to (A) mains valves and (B) battery valves

### AF Volume Controls

Volume Controls are met most frequently these days in AF circuits. Almost inevitably, in such instances, one finds that a source of AF is applied between the ends of the volume control track, whilst the slider taps off the amount of AF that is desired to be passed on to the next stage. One end of the track is earthy, with the result that the following cathode is usually already connected (normally through a capacitor) to this point. The slider can then be connected to the following grid. Typical arrangements for mains and battery circuits are given in Fig. 1. It may be seen, in these diagrams, that grid bias is applied to the valve via the volume control.

The ratio of rotation to resistance change (i.e. resistance change between either end of the track and the slider), given by an AF volume control is of some importance. As the properties of the ear are such that it compares volume levels logarithmically, it follows (roughly speaking) that the best type of AF volume control would be one where the resistance changes varied logarithmically according to the degree of rotation. The ear would then receive the impression that equal amounts of rotation of the volume control produced equal changes in volume level. A potentiometer possessing a straight line characteristic (i.e. with resistance varying at the same rate as its rotation) would not therefore be really suitable as an AF volume control.

The above is something of an over-simplification, although it is near enough to the truth to underline the desirability of using an AF volume control which has a logarithmic or "tapered" track. Many constructors who have used straight line characteristic surplus potentiometers as volume controls will have noted that the first thirty degrees or so of rotation from the minimum volume end causes a large amount of change in volume level; whereas the rate of change of volume over the remainder of the track becomes increasingly smaller until, at the maximum volume end, an adjustment of twenty degrees or so causes hardly any audible difference in volume at all.

own design. Both types are equally suitable for most home-constructed equipment. If the constructor wishes to make certain that he is obtaining a potentiometer of the correct type, it is best to buy a component made by a reliable firm, and which is sold definitely as a "volume control," or whose track characteristic is defined.

### Noise

AF volume controls are components which are liable to wear somewhat with the passage of time. The usual symptom of wear is given by the fact that the volume control becomes noisy. The fault is normally a mechanical one

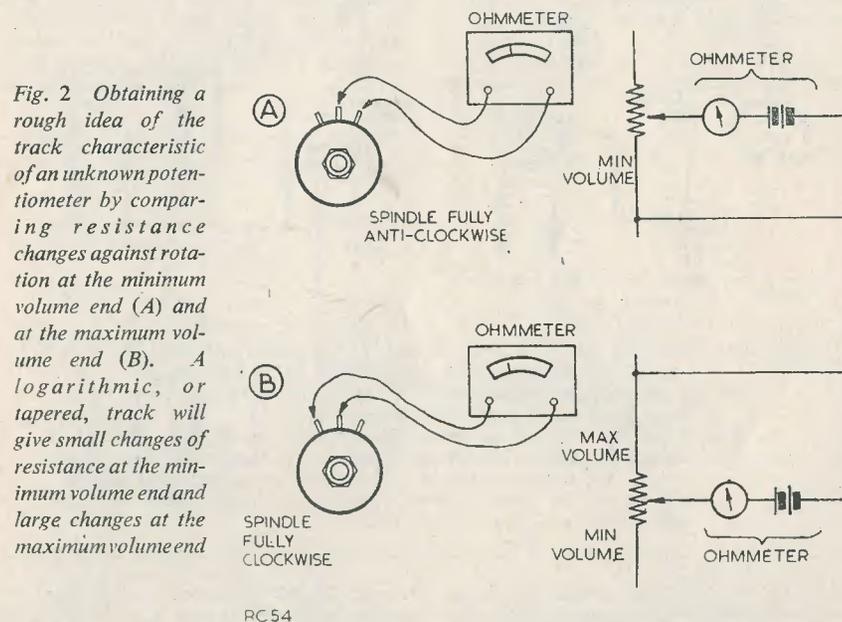


Fig. 2 Obtaining a rough idea of the track characteristic of an unknown potentiometer by comparing resistance changes against rotation at the minimum volume end (A) and at the maximum volume end (B). A logarithmic, or tapered, track will give small changes of resistance at the minimum volume end and large changes at the maximum volume end

RC54

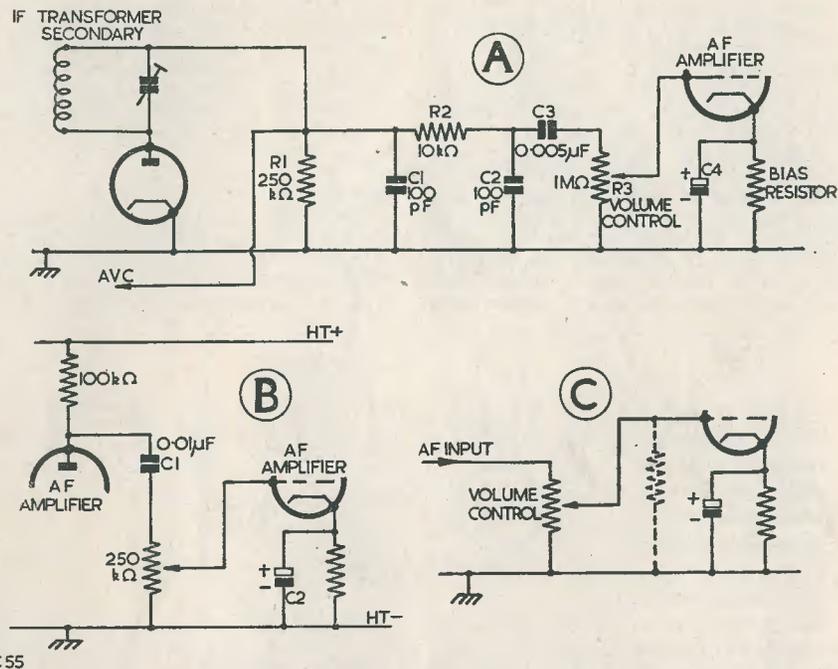
A fairly useful check of the type of track employed in an unknown potentiometer may be made with the aid of an ohmmeter. If the potentiometer has a logarithmic or tapered track the meter, when connected between the bottom end of the track (see Fig. 2 (A)) and the slider, will register only small changes in resistance per degree of rotation from the minimum volume end; whilst, when connected between the top end and the slider (Fig. 2 (B)) it will indicate large changes in resistance.

Manufacturers do not necessarily fit logarithmic tracks to their AF volume controls. Instead, they may use tapered tracks of their

and infers a badly worn track or poor contact between the slider and the track.

The only cure for a worn-out volume control is replacement. "Doctoring" the track with a pencil is extremely bad practice because the "repair" is short-lived and the value of the component is altered.

Noise in a volume control need not, however, necessarily be caused by wear of the track. This is particularly true if it is found that rotating a volume control causes a "rushing" noise in the speaker, whilst no difficulty is experienced in obtaining a reliable volume setting at any point.



- Fig. 3(A) A typical second detector circuit. If C3 should become leaky it is possible for R3 to generate noise whilst being adjusted.
- (B) If the coupling capacitor C1 in this circuit were to become leaky, noise might result in the same manner as in (A).
- (C) When the valve whose grid is shown here is in an early stage of a sensitive amplifier, the volume control may cause noise even when no DC is developed across it. A cure can sometimes be found for this trouble by connecting an extra fixed resistor (shown here in dotted line) between grid and chassis.

A fault of this sort often points, when the volume control itself is above suspicion, to the fact that an unwanted DC voltage has formed across the track. In the circuit of Fig. 3 (A), AVC voltage is built up across the diode load R1, this being isolated from the volume control R3 by C3. If, now, C3 becomes leaky, some of the AVC voltage would appear across R3 as well. When this component is rotated, therefore, it would cause a change in the grid bias applied to the following valve. This change in grid bias might easily cause a "rushing" noise as the volume control was turned. A similar effect would be given if the coupling capacitor were not connected to a diode load but to a previous AF anode as in Fig. 3 (B). A slight "leakiness" of the capacitor would then cause part of the HT

voltage to be developed across the volume control, with similar results. The DC voltage formed across the potentiometer in the last two examples need only be small to cause noise.

A further example of this effect is obtained when the volume control is connected, in the conventional circuit of Fig. 3 (C), to an early grid of a sensitive amplifier. In this case, even though no DC voltage is present across the volume control, slight irregularities in contact efficiency may cause the grid to be continually but momentarily disconnected from chassis potential as the control is turned. Once again, a "rushing" noise could be formed as a result. If the volume control itself is in good order, a trouble of this nature may usually be cured by connecting a high-value resistor (say, three or four times the value of the potentiometer)

permanently between the grid of the valve and chassis. This resistor would then ensure that the grid always remained at chassis potential.

Volume controls fitted to systems where noise cannot be tolerated (e.g. broadcasting studios, large cinema sound installations, etc.) do not usually use a resistive track at all. Instead, the slider contact point travels over a series of small metal studs, fixed resistors being connected between the studs.

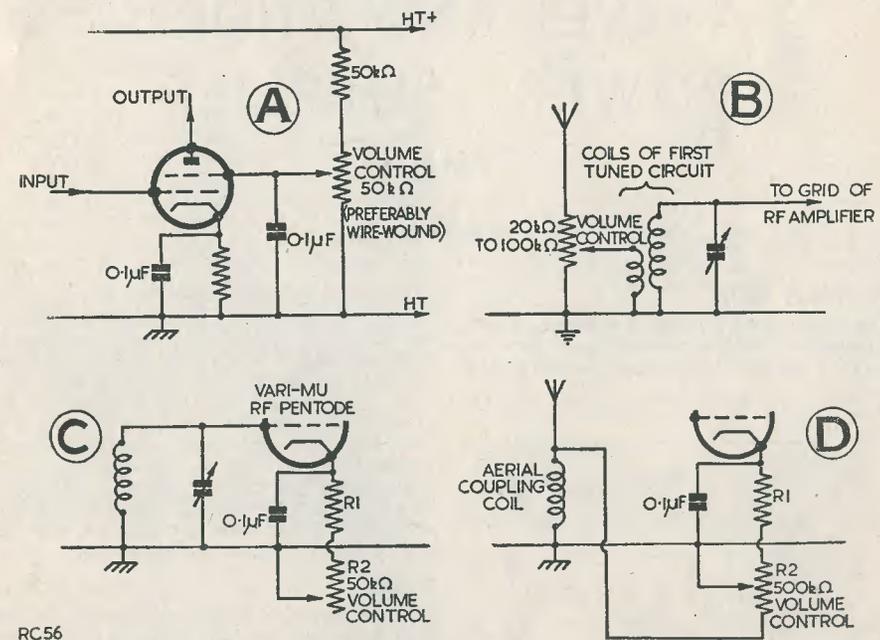
#### RF Volume Controls

There is usually little point in attempting to obtain any form of equal volume-change-for-rotation impression from an RF volume control which is fitted to a receiver. This is because the effect of such a control usually varies considerably according to the strength of the received signal. Straight line characteristic components are quite suitable, therefore, for use as RF volume controls.

A very loose approximation to an equal volume-change-for-rotation effect might conceivably be given by the slightly old-fashioned circuit of Fig. 4 (A). This circuit was quite popular in the days of the screen-grid RF amplifier; and it could be applied, successfully enough, to a modern pentode. It functions by varying the voltage on the screen-grid. Even nowadays it still has its uses; especially in battery receivers which require an RF volume control, presuming that the extra HT current taken by the potentiometer can be accepted.

For the purpose of the record, it is worth while including the circuit of Fig. 4 (B), which one meets occasionally in some publications. Although this arrangement will obviously function (after a fashion) it cannot be recommended.

Fig. 4 (C) shows the circuit which is most popular these days. This varies the grid bias



- Fig. 4 (A) An old-fashioned type of RF volume control applied, in this diagram, to a screen-grid valve.
- (B) A form of RF volume control which is mentioned occasionally but which is of little practical use.
- (C) The usual form of RF volume control. The value of R1 should be that of the normal bias resistor for the valve.
- (D) A variation of (C) which is especially useful for TRF receivers.

of the controlled RF valve by varying the amount of cathode resistance in circuit. The resistor R1 is included to ensure that the cathode bias cannot be reduced to too low a value. The volume control may, of course, be connected in the cathode circuits of more than one valve.

The circuit of Fig. 4 (C) is met most frequently in communications receivers, where it is used in conjunction with an AF volume control, and in three-valve straight receivers of the midget class. In the latter case it is often found, however, that the control does not provide sufficient attenuation, even in the minimum volume position, to cut out powerful local stations. The arrangement of Fig. 4 (D) is then resorted to. In this circuit the volume control, on travelling towards the lower volume

end, commences to damp out the aerial-earth system. At the minimum volume end itself, the aerial is short-circuited to chassis.

The component values given in Fig. 4 are typical only.

### The Megabuck

I wonder if it was a radio enthusiast versed in Megacycles and Megohms who introduced the term Megabuck. This term (so I read the other day) is used quite frequently in American financial circles. A Megabuck is equal to a million dollars. I presume that it is also equal to a kilogrand.

For myself, I shall continue to use, for all my financial transactions, the Monopound. This is known, in London financial circles, as the Mononicker.

## VALVES AND THEIR POWER SUPPLIES

### Part 3

By F. L. BAYLISS A.M.I.E.T.

#### Early Battery Valves

The writer does not know whether or not any original "bright emitters" are now in use — but knowing the surprises in odd nooks

and corners of this country, he would not be shocked if there were. Although, too, he did not have an opportunity, unfortunately, to handle circuits in which these valves were used, he heard the results, and very good they were.

In fact, looking back upon battery valve introductions, there does not, to him, seem to have been the improvement that some advertisements would have us believe.

However, two-volt types are still very popular and, despite the introduction of successively different and more efficient varieties, even the old LF and HL valves are still in use.

#### Simpler

Power supplies for two-volt valve circuits are hardly complex. No longer is there a need for control of the filament current by a rheostat. Nor, often, is a grid bias battery necessary.

HT positive for two-volt valves is usually 120V, but may be 90V.

Where grid bias is entirely automatic, the bias is obtained by connecting HT- to a resistor, the other end of the resistor to chassis.

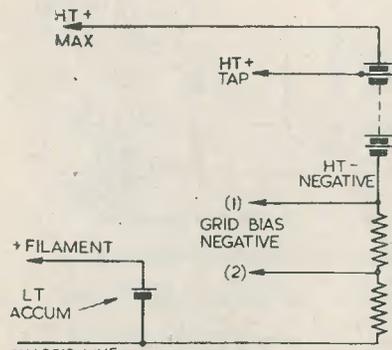


FIG. 5

RC63

and thus causing a voltage drop, negative at the battery end, across the resistor as the current flows through it to chassis. More than one resistor may be included to give various tapping points. Such an arrangement is shown in Fig. 5. The filament cell is usually a 2V accumulator.

Where a bias battery is used, the positive terminal of the battery is connected to chassis (HT-), the negative bias leads being plugged into their respective sockets on the battery.

The valveholders for 2V valves are of the British four, five and seven pin types, and are shown in Fig. 7.

Pins 3 and 4 of the 4-pin and 5-pin types are always the filament connections. When valves with these bases have a metal coating, this is connected in the valve to the negative side of the filament. Care should always be taken to connect the accumulator leads to the valve pins of correct polarity.

With 7-pin bases, pins 4 and 5 are always the filament pins, but here the metal coating is usually connected to pin 1, which is reserved as a chassis connection.

#### Top Cap Connections

Before leaving the subject of 2V battery valves, and although it hasn't strictly anything to do with power supplies, it may be as well, perhaps, to mention top cap connectors.

When testing a receiver, it is often convenient to tap the moistened finger on to the top cap, to cause a click or howl.

Top caps, however, are a very mixed bag — some are grids, some anodes. Usually, the small caps on British octal base valves are grids, but the larger caps are sometimes anode, sometimes grid. It therefore behoves one to be wary when testing thus, and to check the valve connections beforehand. (*Far better not to resort to it at all, particularly with AC/DC receivers! An AF or RF oscillator is safer.—Ed.*)

#### LT Accumulators

Although the 2V lead acid accumulator of the two thick-plate kind is most usually used, there are other and equally suitable types.

In the lead and acid group, the Varley types, having thin plates between which is packed an absorbent material, are among the very best, and have the advantage of being unspillable. Another type, sometimes obtainable as ex-WD surplus, has a long filler cap, of patent design, projecting downwards into an abnormally large case top to give, also, an unspillable effect. A third kind is the familiar jelly acid accumulator, sometimes used in portables; these, too, are unspillable.

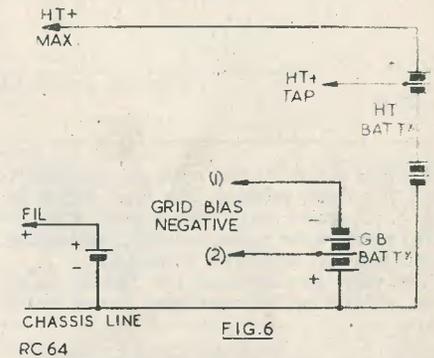


FIG. 6

RC 64

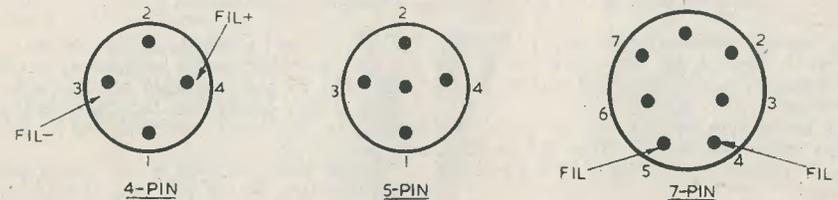


FIG. 7

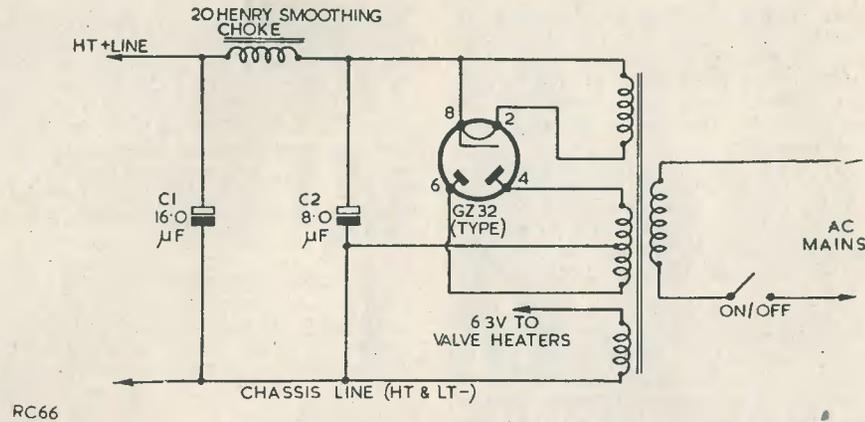
BRITISH BASES

RC 65

Alkali accumulators, familiar under the name of "Nife," are quite different. The potential of these is 2.5V, but they may be used wherever a lead acid cell has been employed. When getting such cells charged, it may be as well to point out that the electrolyte is potassium hydrate, and that the cell should not be topped up, in the usual manner, with water, nor have sulphuric acid added to the solution.

#### AC Mains Valves

Modern AC mains valves employed in receivers in current use are largely of the 6.3V heater type, and have international octal bases.



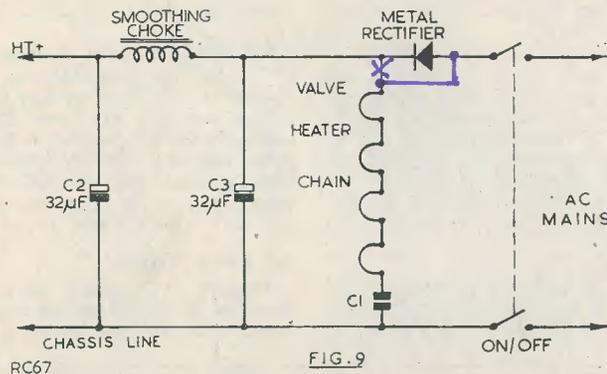
RC66

Perhaps the safest and most popular power pack for these valves is the type shown in Fig. 8. A mains transformer is used, together with a full-wave valve rectifier, smoothing choke and two electrolytic capacitors.

The valve rectifier is of the 5Z4 or GZ32 type, with the cathode connected to one heater pin.

and this trait becomes more marked as the rated output increases.

When using this circuit, the valve maker's recommendations in respect of the value of the reservoir capacitors  $C_1$  and  $C_2$ , and the minimum series resistance should be adhered to.  $C_1$  plus  $C_2$  should not exceed the specified value, e.g. for a total recommended value of



RC67

FIG. 9

The receiver valve heaters are supplied by one secondary winding of the transformer; the receiver on-off switch is inserted into the mains side of the latter component.

The advantages of this type of circuit are (a) the mains are isolated from the receiver, and (b) full-wave rectification is made easily possible.

On the other hand, such a power pack tends to be expensive, on account of the transformer,

$32 \mu\text{F}$ ,  $C_1$  and  $C_2$  may each be  $16 \mu\text{F}$ .

The minimum series resistance is usually provided by the resistance of the choke. If there is any doubt that the choke meets the need, an additional resistor should be inserted in series with it.

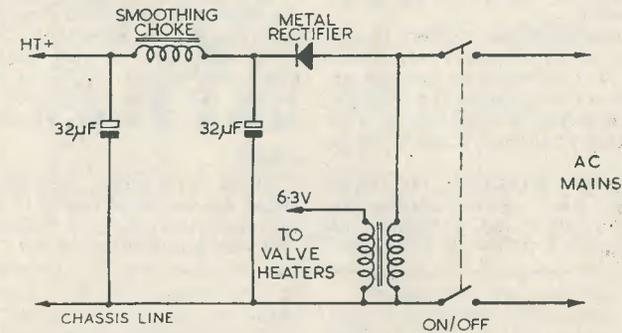
A less expensive type of AC power pack is shown in Fig. 9. In this case, the AC supply is taken direct from the mains. A metal rectifier gives half-wave rectification, whilst

smoothing is performed by the choke and capacitors  $C_2$  and  $C_3$ .

Greater values of  $C_2$  and  $C_3$  are now permissible — and, indeed, necessary, as the ripple is now half the frequency of a full-wave circuit — and a total capacitance of  $200 \mu\text{F}$  is quite often used in such a circuit. The makers of the rectifier usually specify suitable values for the capacitance, and their recommendations should be followed.

The circuit of Fig. 10 is similar to that of Fig. 9 except that the valve heater current is provided by a heater transformer, the receiver valve heaters being wired in parallel.

This is a highly convenient type of power pack as, with a heater transformer with a secondary of 0-12V tapped at 2V, 4V, and 6.3V, it may be used to supply a wide variety of valves. Its use as a test gear universal power pack will immediately suggest itself.



RC 68

FIG. 10

The valve heaters, wired in series, also take their supply direct from the mains via the capacitor  $C_1$ . The voltage ratings of the heaters is immaterial, and that of individual valves may differ. It is essential, however, that all valves in the chain have a similar current rating, i.e. all 0.2A or all 0.3A, etc.

The capacitor  $C_1$  should have a working voltage rating of treble the mains supply voltage, e.g. 750V for 250V mains, and its value is calculated to the formula

$$C_{\mu\text{F}} = \frac{I_h \times 10^6}{2\pi f \sqrt{E_s^2 - E_h^2}}$$

where  $I_h$  = valve heater current (the current of one valve only, 0.2A, 0.3A, etc.)

$f$  = mains frequency

$E_s$  = mains voltage

$E_h$  = total voltage across all valves

in series, i.e. the voltage across the chain.

$C_1$  must be a paper capacitor.

It is better, though not essential, to use a two-pole on-off switch with this circuit, and perhaps wise to insert a 500 mA fuse in each mains lead.

If undue hum is experienced, it is permissible to insert an  $0.1 \mu\text{F}$  tubular paper capacitor between the mains side of the rectifier and the chassis.

The current rating of the transformer should adequately cover the total current of all valves to be served.

The remarks in respect of fuses, on-off switch, reservoir capacitors, and modulation hum capacitor given for Fig. 9 also apply to Fig. 10.

A convenient choke for both circuits is one rated at between 3 and 10 Henrys, having a DC resistance not exceeding  $100 \Omega$ , and a current carrying capacity to the user's requirements.

#### Metal Rectifiers

There are many types of metal rectifier suitable for Figs. 9 and 10. Where only 60 to 100mA are required from the pack, a selenium rectifier will fill the bill admirably. These are in plentiful supply as ex-WD components, and cost only a few shillings each.

The popular Westinghouse copper oxide types, HT46 to HT48, giving outputs from 120 to 30 mA respectively, are also obtainable at reasonable prices, whilst the Westinghouse 14A series (14A.86, 180 mA; 14A.100, 200 mA, etc.) although not perhaps cheap, cater adequately for the heavier current ratings of power amplifiers and television receivers, and may also occasionally be picked up on the surplus market.

[continued on page 289]

# A RADIO TUNER UNIT FOR MAGNETIC RECORDERS

By L. F. SINFIELD A.M.I.P.R.E.

Those who have built or purchased a magnetic recorder frequently require to record programmes direct from radio, such recordings to be of high quality.

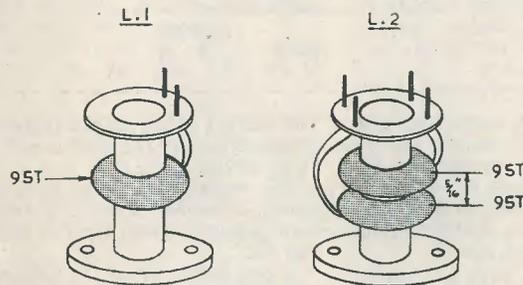
Use of the domestic radio receiver is not desirable because (a) the frequency response is limited, and (b) it is awkward to connect up electrically for direct use, and if the recorder microphone is employed in conjunction with the receiver speaker additional acoustic losses result.

A special tuner unit is desirable, but this is invariably bulky. Also, power supplies are normally required, with the possibility of introduction of hum.

end a phone jack was fitted so that the whole unit simply plugged into the crystal mike socket. Aerial and earth sockets are fitted at the outer end, whilst on the side is the tuning control. A hole allows entry for trimming the wave-trap. The normal aerial consists of about twelve feet of flex as a "throw-out" aerial. No earth is required for operation, but one can be fitted if so desired.

## Circuit

As in the London area the Home Service could still be heard faintly in the background on other stations, the wave-trap L1/C is used with the aerial in socket A1. This trap may



Tuner unit coils. The dust cores are screwed into the centre of the tuned windings, and then sealed

RC81

The tuner unit described was designed for working into the crystal microphone socket of the magnetic recorder described by the writer in the September, October, and December issues of this magazine. However, it will work into the mike socket of any recorder provided the input impedance is 1 MΩ or higher. The tuner uses a germanium diode detector, but must not be compared with normal crystal sets working into headphones, as it is the high output impedance which is the secret of the efficiency of the unit. High "Q" coils are employed, and the detector and load are so chosen that the loading on the tuned circuit is reduced to a minimum, so giving good sensitivity and selectivity.

In the writer's unit the whole circuit was fitted into a metal case 3" × 2½" × 1½". At one

or may not be required, depending on the location. It may be that another station is the offender, in which case the trap should be tuned to this other signal.

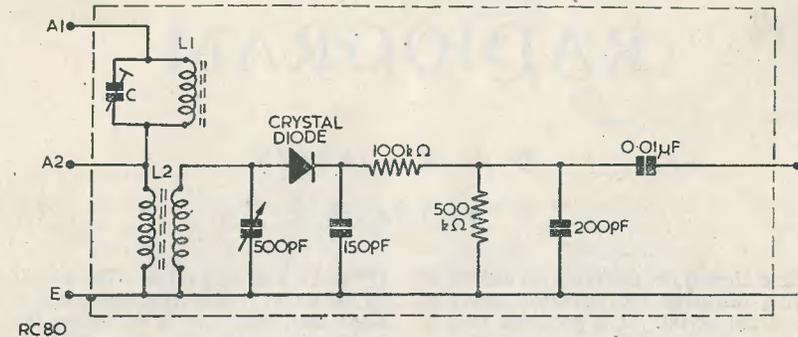
L1 consists of 95 turns of litz wire wound by hand in a bunch on an Aladdin former. The dust core is sealed in the centre of the winding, and the tuning carried out by trimmer C.

Should it be required to receive the station to which the trap is tuned, it may be desirable to transfer the aerial wire to socket A2, as the trap may reduce the signal strength too much if socket A1 is used.

L2 consists of a coupling winding of 65 turns and a tuned winding of 95 turns, both of litz wire and wound as before. The centres of the windings are 1/16" apart, and the spread of the

windings brings the outer turns in close contact (see sketch). Tuning is by a 500 pF variable, which can be of the solid dielectric type to save space.

It may not, however, be possible to obtain reception of a particular foreign station free from break-through from neighbouring stations.



Circuit diagram of tuner unit for use with magnetic recorders.

The crystal must be a germanium diode of the type which has a very high reverse resistance. There are currently on the market many uncodded germanium diodes of various makes, but these are almost all of low reverse resistance and are completely unsuitable. Suitable types are GEX55, Brimar GD4, GEC45, 1N34, BTH CG1, and Westinghouse WG7A, B or C. The forward resistance of these units is very low, being of the order of a few hundred ohms. The reverse resistance should be greater than 200,000 ohms, the higher the better. An indication of the resistance may be obtained with a normal multimeter, set to the ohms range and using the *interanl* batteries. Do not test with an additional voltage supply or with a "megger," as an input voltage of about 50 is the normal maximum rating. Ensure also that on test the peak current is well below 50 mA on the test equipment. This is applicable to the forward test, as an applied voltage of 50 (without limiting resistors) would produce a current exceeding the rating of the diode.

The crystal is followed by a simple RF filter network, load resistor and a blocking condenser, until finally the filtered audio is fed to the output plug.

The sensitivity and selectivity obtainable is quite adequate for normal use, and the quality leaves nothing to be desired. On test with the simple "throw-out" aerial, the Home, Light, and Third programmes are easily selected. In the evenings, Luxembourg and a few other foreign stations can be heard, and some CW at the high frequency end of the band. The British stations are, of course, well above these and can still be selected interference free.

The circuit is not recommended for use with headphones directly across the output, and is strictly for use into an amplifier.

## Optional Modification

The following modification is entirely optional, and its effect will depend upon conditions and the location.

It consists of tuning the coupling winding of the main tuning coil by a 140 pF fixed condenser. This tunes it to the Light programme, and increases the output by at least 6 db.

The effect on other British stations is negligible, but foreign stations at the high frequency end of the band are reduced, so that interference is reduced considerably in areas of weak Light programme reception.

## VALVES AND THEIR POWER SUPPLIES

*continued from page 287*

It is essential that metal rectifiers should be connected correctly and, so far as their own products are concerned, Messrs. Westinghouse will be glad to be of assistance to the constructor.

Metal rectifiers are robust, trouble-free, and when used correctly will last a lifetime. They are, therefore, a real investment and on that account amply repay care taken in the design of the associated power pack and the choice of high grade smoothing components of ample voltage rating.

# A 10-VALVE RADIOGRAM

By J. R. DAVIES

## PART THREE

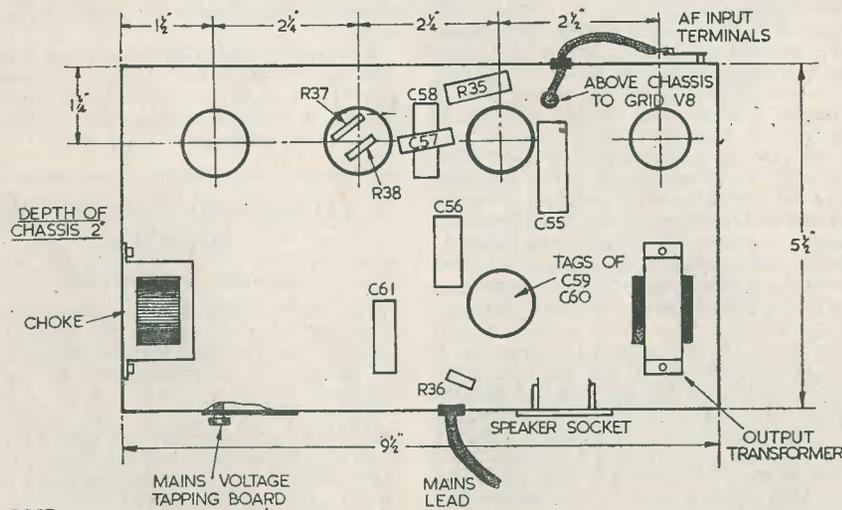
We have already, in the first two articles of this series, discussed the technical aspect of the radiogram circuit. It is proposed now to carry on to the layout and method of construction used by the writer.

### The Power Unit and Amplifier

We shall commence first of all with the power unit and amplifier chassis. As was stated in the first article in this series, the particular amplifier circuit used here need not necessarily be employed, since the radio chassis can be connected to any high-fidelity amplifier so long as the latter can supply the necessary

HT and LT needed for it. The amplifier used by the writer is a fairly simple piece of equipment and, although it compares favourably with commercial radiogram AF circuits, it obviously could not deliver the same power at the same quality as would be given by a more ambitious job with push-pull output.

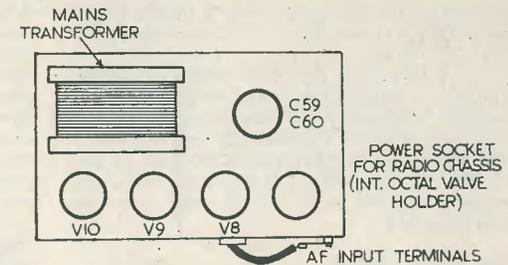
Fig. 5 shows the under-chassis layout and external dimensions of the amplifier, illustrating also the positions of the more important components. It will be realised, of course, that the measurements given in the diagram need not be followed exactly if the constructor has components on hand which are different in size from those employed by the writer.



RC57

Fig. 5. The layout below the amplifier and power unit chassis.

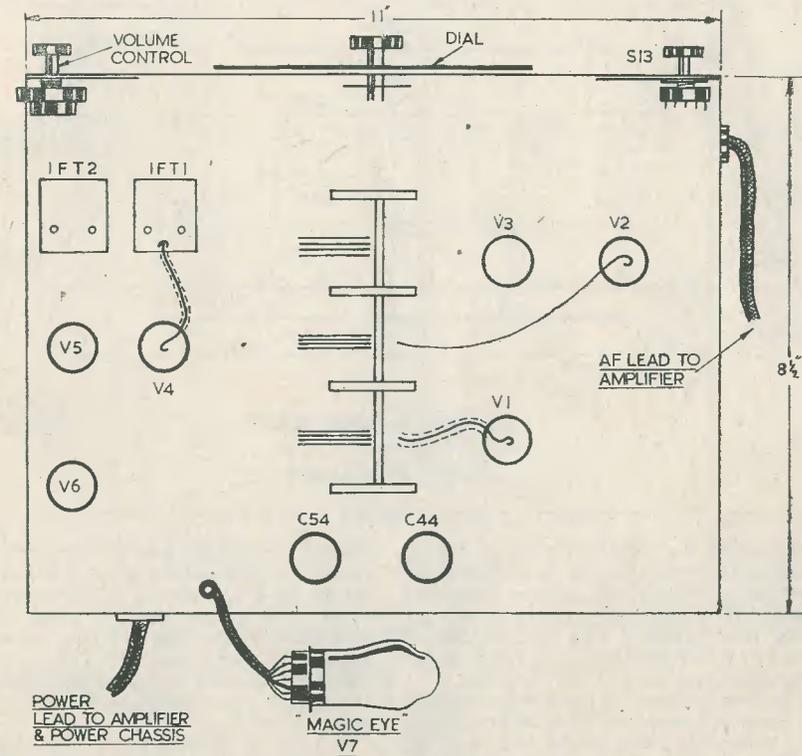
Fig. 6 The top of the amplifier chassis



RC58

Care should be taken to see that the heater leads are tightly twisted together, and that they are laid close to the underside of the chassis. Reference to Fig. 1 of the first article

in this series will reveal that the power inter-connecting leads between the radio chassis and the amplifier are numbered 1 to 7. These references could apply to the appropriate pin



RC59

Fig. 7. Top view of the radio chassis.

number of the octal valve holder on the amplifier which accommodates the power plug from the radio chassis.

Fig. 6 shows the top of the amplifier chassis. The rather large mains transformer shown is a Premier component (Cat. No. SP 250A). Although slightly overloaded, this particular transformer seems to cope quite well in this circuit. It is important to note that the 6.3 volt winding of the mains transformer must be centre-tapped.

**The Radio Chassis**

The radio chassis is, of course, much more complicated and needs far more attention to detail than does the amplifier and power unit.

itor employed. It will be seen that the volume control and bass tone control switch are mounted above the chassis on small brackets, these being made flush to the front of the chassis. The connection to the bass control switch from the cathode follower is taken along the top of the chassis via screened cable. The output from the bass control circuit is then passed through the chassis to the treble control below it.

A general under-chassis view is shown in Fig. 9. Wearite "P" coils were employed in the writer's model. The oscillator coil trimmers are mounted direct to the coil tags and are not shown in Fig. 9. It will be seen that two screens are fitted underneath the

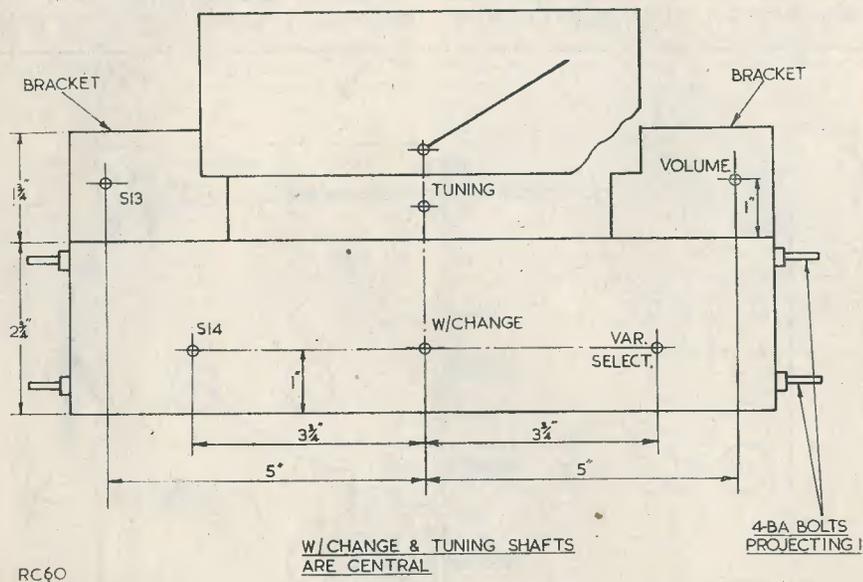


Fig. 8. Front layout.

A top view of the chassis is given in Fig. 7. Although it is again possible to state that the dimensions given for the chassis need not necessarily be followed by constructors, it may prove a little helpful to take note of them in this case as the components used by the writer in the radio chassis are of standard size.

Fig. 8 gives a view of the front of the receiver, again giving dimensions. The dial employed by the writer was a J.B. model and its height from the top of the chassis depends upon the dimensions of the particular three-gang capac-

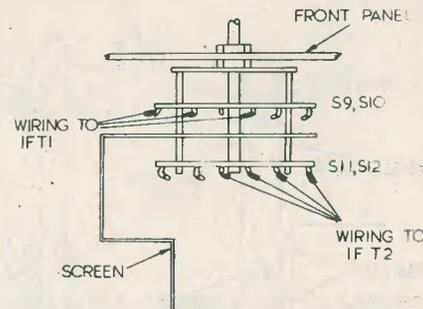
chassis, a small one around the treble control circuits and a more complicated one spreading across the entire chassis. This second screen is used to isolate the RF stage from the frequency-changer and to screen the wiring of the two IF stages from each other. It is also used for mounting various components, and it steadies the wave-change switch supports which pass through it.

It may be noted further that this screen approaches very closely to the variable selectivity switch contacts, the connections to which

are spaced on either side of the end of the screen. However, unless some care is taken at this point, it may be found that IF instability will be experienced due to capacitive feedback, the stray capacitances occurring either in the switch itself or in the wiring immediately adjacent to it. For this reason, an alternative scheme is illustrated in Fig. 10, this improved layout providing variable selectivity with no risk at all of capacitive feedback.

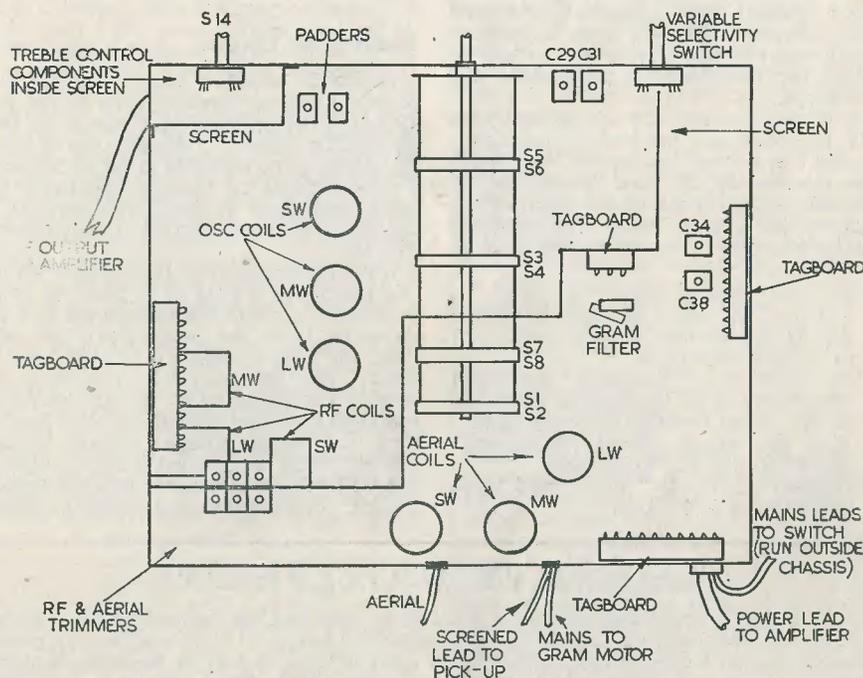
**IF Alignment**

Another question encountered in the variable selectivity circuits concerns the procedure of aligning the IF transformers. It will be seen from the circuit diagram that, in the "Sharp" position of the selectivity switch, an external trimmer is connected across one of the windings of each transformer; whilst, in the "Staggered" position, another trimmer is connected across the other winding, the first being taken out of circuit.



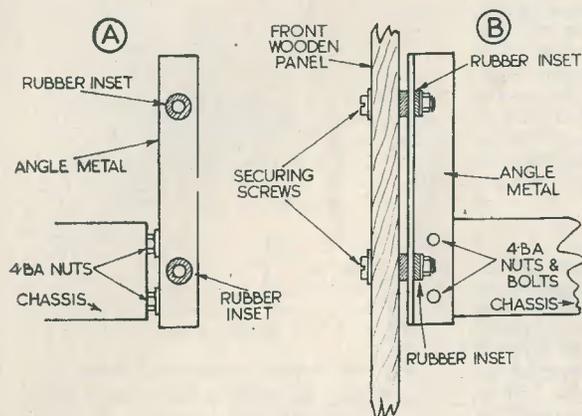
RC61

Fig. 10 An alternative scheme for screening the variable selectivity wiring, using a double-wafer switch



RC60

Fig. 9. General layout below the chassis.



RC62

Fig. 11 Showing how the two 4-BA bolts projecting from either side of the front of the chassis are used for fixing a length of angle metal which holds the chassis to the front panel. (A) and (B) give different views, (B) also illustrating the fixture to the panel itself.

To align the IF transformers it is first of all necessary to discover experimentally to what frequencies each tuned circuit has to be set to obtain a good bandwidth (flat, with no peaks) when staggered for the "Staggered" selectivity switch position. This will have to be done with the aid of a signal generator and AVC-reading meter, or with a wobulator and oscilloscope.

Let us presume that with one particular set of IF transformers it has been found experimentally that a good "staggered" bandwidth is given when the IF tuned circuits are set alternately above or below the intermediate frequency (465 kc/s) by 3 kc/s. The procedure of alignment can then be carried out as follows:—

- (i) Set the variable selectivity switch to "Sharp" and adjust the secondary of the first IF transformer and the primary of the second to 465 kc/s.
- (ii) Set the switch to "Staggered" and adjust the primary of the first and the secondary of the second transformer to 468 kc/s.
- (iii) With the switch still at "Staggered," adjust C31 and C34 to 462 kc/s.
- (iv) Return the switch to "Sharp" and adjust C29 and C38 to 465 kc/s.

- (v) Repeat the above processes, taking care to ensure that, on the "Sharp" position, the IF transformers are carefully "peaked" to 465 kc/s.

#### Mounting the Chassis

It will be apparent from the appropriate diagrams that the threaded parts of two long 4BA bolts project from either side of the front of the radio chassis. These are used to enable the chassis to be mounted to the underside of a wooden panel, as would be required in the usual radiogram cabinet. The method of carrying out this mounting is illustrated in Fig. 11.

It must be emphasised that, despite the fact that the chassis is fixed to its panel by rubber mountings, acoustic feedback caused by back-radiation from the loudspeaker impinging upon the tuning capacitor is still liable to occur. The best way of overcoming this trouble is to primarily mount the speaker (or speakers) in the finished cabinet some distance from the radio chassis. Should acoustic feedback then be apparent it may usually be cleared by fixing an acoustic screen (plywood, felt, etc.) between the speaker and the chassis.

### "MAGNA-VIEW" REPRINTS

The English Electric Company have asked us to state that the demand for their booklet based on the "Magna-View" design has been extremely heavy. They would be very grateful if readers desiring a copy of this booklet would apply at once, so that an adequate number of reprints can be made available. Make sure of your copy NOW. The booklet is free of charge, and applications should be made to The English Electric Co., Television Dept., Queens House, Kingsway, London, W.C.2.

# RADIO MISCELLANY

CENTRE TAP talks about

## TV COSTS—THE AMATEUR MARKET—DEATH RAYS

Following my comments on TV servicing last month, the question of how much is a reasonable amount for the average viewer to allow for maintenance of his receiver again arises. This question has been debated at length many times, but no satisfactory figure has been arrived at, as experiences of commercial TVs, even of the same model, varies so widely. One owner might find servicing and replacements costs him over twenty pounds in the first year, while another user of an identical model does not have occasion to dip in his pocket at all until the set is well into its third year.

Obviously, a CRT failure is going to cost the owner anything from £14 to £28 according to its size, and the valves, of which eighteen or nineteen per set would be a fair average, apart from occasional failures must eventually lose their emission. Disregarding component failures which are impossible to forecast, and allowing for cost of valve replacements and a new tube, we arrive at a figure in the region of £40 as a minimum maintenance cost over a period of four years.

Thus we have a minimum of ten pounds per annum, and to this minimum must be added the cost of depreciation. A set that costs £75 today will not be worth much in four years time. The depreciation might well be the heaviest charge in the cost-sheet. Together they are likely to average out at roughly ten shillings per week. That is a minimum cost. A few unlucky breakdowns might easily enlarge it by another third.

When one first gets down to the hard economics of viewing it is rather frightening—especially when one thinks of some of the programmes which cost one a further £2 a year. Having faced up to these facts, the rental of hired TVs (12/6 per week and upwards) is not unreasonable, and if the wretched thing proves troublesome you can at least get it replaced.

Whichever way you approach it, TV is an expensive business. Every home constructor I have met has admitted it cost him a lot more to build than he first anticipated. In fact, it usually tots up to somewhere near the cost of a commercial model, but whatever little one saves in that respect, it does show a big saving in upkeep and the depreciation is more than halved. Of course, you also get a lot more fun for your money. The joys of our hobby consist of very much more than getting one's listening or viewing a bit cheaper, although I would be last to deny the pleasurable thrill to be got from picking up a real snip on the junk market.

#### What They Say

Thinking of bargains reminds me of a remark I overheard recently at a local club. One member confided to his pal, "I've given up looking round the well-known junk shops. All the best stuff they had is sold. Nowadays you are far more likely to find the real bargains in some of those little odd places."

The same evening another member told me, "You find all these quality-merchants finish up the same way. They start off as music-lovers and work themselves into such a pitch listening for distortion that they don't even hear the music."

Whilst I am on the subject of quotes, and despite my opinion of some of the programmes, I simply must add this one, "I'll tell you what. I have built over a dozen sets of various sorts but I hardly ever spent any time listening to them. Now I have built one TV, I have wasted more time looking-in than I have spent listening to all the other receivers combined."

To cap it all, after the meeting the Secretary told me of one of the new members who apparently was intent on becoming an Old Timer in double quick time. He sent for a bumper parcel of parts so that he would have a well-lined junk-box like all the other chaps!

### Revival

It is good to see Mullard Ltd. once again taking a more direct interest in the amateur constructional market. A quarter of a century ago, when home-built receivers were enjoying their heyday and the Mullard Master Three was a household byword, a large percentage of their valves were retailed direct to the home-constructor. Post-War, that percentage has fallen to a low figure, and helped by the enormous number of valves which flooded the ex-W.D. market, direct-to-constructor sales sank to their lowest level ever.

Supplies of the popular types are now disappearing from the surplus market, but perhaps it may be a little thoughtless of me to rub this in—particularly as many readers may have recently had to endure the bitter experience of having to pay 35s. or more for the replacement of a type they originally picked up at roughly a tenth of that price!

The recent Mullard booklet *The Amateur's Guide to Valve Selection* is a welcome sign that the more progressive radio manufacturers are conscious that there is a lively amateur market, even though we may not be able to absorb as many of their products in a year as they deliver for a single Government contract. What is important, however, is the goodwill entailed. Dealers always carry stocks of valves that amateurs specifically demand, and from the shelves they also pass to the Servicing Department. A customer, too, more readily accepts a replacement of a make which he knows to be consistently used by those who buy individual valves from choice. The purchaser of a new receiver is favourably influenced if he feels he is getting the "best sort" of valves of a make that he might reasonably expect to easily obtain spares. This factor, at least, is more important to-day than ever before. War-time experiences, when one might have waited for months for a replacement, still loom prominent in recent memory.

### Wider Range of Appeal

The Mullard booklet provides much of interest to amateurs and includes seven circuits. The identification of types, operating conditions, dimensions and base connections cover over thirty of the more popular mains and battery types. The valves with primarily TV applications are, rather surprisingly, dealt with more sketchily, despite the very evident enthusiasm for TV construction.

Personally, I was disappointed at the omission of the more specialised types, such as UHF valves, voltage stabilisers, etc. With these included, this booklet might well fulfil the need for a much-wanted handy reference. Without further expansion the booklet will chiefly appeal to constructors whose main interest

lies in modern broadcast receivers and gramophones. With the other widely used types included, it would become a "must" for every reader.

### Stirring Story

Also to hand this month is a copy of *The Electric Tool User*. This journal, No. 6 of a series, is published by the makers of the well-known Wolf electric drills and soldering irons. While it is primarily intended for industrial users, a couple of pages are devoted to a variety of jobs satisfactorily performed by an amateur user of a familiar friend, the Wolf Cub. These uses included cleaning, polishing and circular sawing, as well as its more conventional role of taking the hard work out of drilling. Not content with this range of uses, the writer turns his Cub to further work. With the aid of a meat skewer, he uses it as a paint mixer and stirrer!

### On the Beam

One of the Sunday papers this week front-pages an old time favourite—a mysterious Death Ray. This time it is the Russians who have developed it. Back in 1938 it used to be the Germans.

Whosoever's turn it happens to be, the inventors are invariably secretive, but clever news-hounds soon get on the trail. With the 1938 scare it was because some careless operator had allowed the mystery beam to project in the wrong direction. As the result, all the cars on a certain stretch of road "konked out" with ignition trouble and the secret was out.

This time, "eye-witnesses" come forward with accounts of inexplicable forest fires. For good measure they also throw in a story of the mysterious deaths of no less than thirty-four people in a ten-mile "security zone" around Braunsberg. Aircraft, too, have been seen to disintegrate in flames. Nor are these alarming reports in any way vague. They even tell us where these Death Ray projectors are made—the Zeiss works at Jena. And the number already delivered—140.

When I was quite a lad a British inventor built a Death Ray machine which was, after a lot of newspaper prompting, actually tested by the War Office. They turned it down flat, and no doubt gullible readers of "scientific" fiction were astounded that neither side during the War swatted invading aircraft with invisible destruction.

Even those who have made only a superficial study of the problems of transmitting power by radio know that not one, but dozens of inventions and improvements are needed before such a feat could be accomplished. No doubt, like me, they'll be thrilled to see the inventor toast a piece of bread at a 100 yards, let alone burn up aircraft.

# QUERY CORNER

## A "Radio Constructor" Service for Readers

### Extra IF Stage

*I would like to increase the sensitivity of my Basic Superhet receiver by adding another IF stage. If you consider that this is a practical proposition, would you suggest a circuit for the extra stage?* (J. G. Davis, London)

In principle, we do not like the idea of adding extra valves to receivers which have already been carefully designed. One of the main reasons for this dislike is the ease with which some other stage in the set can be overloaded as a result of such an addition. It is not always appreciated that the addition of a valve to a receiver may not always increase its sensitivity, but it can frequently increase the background noise and probably also cause instability. However, one of the features of the Basic Superhet, which was described in our Data Booklet No. 1, is that additions can be readily made once the maximum efficiency has been achieved with the basic circuit. So the writer, asking the forgiveness of designer "Centre Tap," will describe an additional IF stage for this admirable receiver.

The additional valve is fitted after the first IF stage, and in keeping with the range of valves employed in the original set a 6K7 is used. Bearing in mind an earlier comment on the possibility of instability, it is essential that a certain amount of thought is given to problems of accommodating the extra stage. Ideally, the IF valves and transformers should be positioned in a straight line so that the transformers and associated components act as screening between the valves. This straight line construction cannot, of course, be adopted if a receiver is being modified, and in this case the extra valve should be mounted beside the second detector, V3 on the original circuit diagram of the receiver. Should the chassis be too small to allow for the additional components, they may be mounted on a metal outrider beside the second detector. Wherever the second IF stage is housed, the valvholder and extra components should be screened from the remainder of the circuit.

Turning now to the circuit diagram Fig. 1, it will be seen that the stages on either side of the second IF have been included. This is because to obtain optimum results minor modifications have to be made to the receiver as it stands. The first of these modifications is the inclusion of an IF gain control in the cathode circuit of the first IF valve. This manual control enables the operator to reduce the gain on local stations, and so avoid overloading the subsequent stages. Another refinement concerns the AVC circuit. Full AVC is not applied to the second IF stage because it is very possible that the signal voltage plus the full AVC voltage on a local station will exceed the working grid base of the valve. If this should occur there is a possibility of trouble from cross modulation and distortion. The AVC voltage for the additional stage is therefore taken from a tap on the diode anode load. The only other modifications in this part of the circuit are to the values of the anode load and cathode bias resistor for the first AF amplifier; these are shown on the diagram.

The circuit of the additional stage is quite conventional, the valve operating under fixed screen voltage conditions. The extra IF transformer should preferably be of the same type as that used in the original stage. If a glass unmetallised valve is to be employed, the use of a screening can is essential.

Before leaving this subject, it is only fair to state the disadvantages of adding a second stage of IF amplification, which will naturally improve both the sensitivity and selectivity of the set. The first disadvantage is the increase in the noise level which will become apparent on weak stations. This noise is largely generated by the frequency changer valve, and therefore becomes more troublesome as the IF and AF gain of the receiver is increased. A second disadvantage is that any second channel interference will be more noticeable. This interference is caused because the selectivity of the RF side of the receiver is insufficient to reject signals operating on frequencies which are spaced at double the

intermediate frequency from the signal to which the set is tuned. Both these disadvantages can be overcome by improving the RF sensitivity and selectivity of the receiver, which means the addition of an RF stage or a pre-selector such as described in the booklet on the Basic Superhet.

This appears to be a very good example of the case where one improvement leads to another, so at this point we had better pass on to the next query.

### Coil Alignment

*I have made a simple SW superhet using plug-in coils, but I find it difficult to set the trimmers across each section of the two gang tuning condenser to give optimum results on all bands. Is there any way of overcoming this difficulty?* (W. King, Leeds)

It is possible to obtain optimum tracking on all wave ranges when using plug-in coils by providing each set of coils with their own trimmers. A standard plug-in SW coil is easily adapted to accommodate a trimmer by cutting a piece of paxolin to fit the top of the former. The paxolin is held in position by using two 6BA bolts and drilling and tapping two holes in the top lip of the former. There is plenty of space on the paxolin to fix a 25pF trimmer, which is then connected by two straight rigid wires across the tuned winding on the coil. Both the RF and local oscillator coils should be modified in this manner, and if trimmers are already connected across the

tuning gang they should be removed. After each set of coils has been aligned, the trimmers should preferably be locked with a blob of wax to prevent any further movement which may otherwise occur whilst the coils are being plugged in or out of the sockets.

The paxolin top plate provides a conveniently flat surface on which to place marks to distinguish the oscillator coils from the RF coils, and also to carry the wave range indication of each set of coils.

### Valve Bias

*Some superhet radio receivers have valves in the frequency changer or IF stages whose only source of bias is from the AVC line. Thus, presumably, if the set is operated without a signal these valves work without bias. Is there any disadvantage in this mode of operation?* (B. Littlewood, Leicester)

In some of the cheaper receivers the valves are, as our correspondent points out, operated so that their only source of bias is from the AVC rectifier. This arrangement has the advantage that several bias resistors and shunt capacitors are saved, and thus the set can be sold at a lower price. There is a disadvantage, however, and this concerns the sensitivity of the set. On a very weak signal there is little or no negative bias on the valves in question, so they probably pass a small amount of control grid current. This current damps the tuned circuit with which the valves are associated and this in turn reduces the overall amplification. As soon as a stronger signal is tuned in, the negative bias from the AVC line increases and the operation is normal. The overall effect of this no-bias operation is that the sensitivity of the receiver on weak signals is lower than it would be if the FC or IF valves were worked with a standing negative bias. Thus, from a purely technical point of view the use of the normal biasing arrangement is much to be preferred.

### THE ANNUAL EXHIBITION OF THE TELEVISION SOCIETY

will be held on January 23rd and 24th, 1953, at 155, Charing Cross Road, W.C.2. by the kind invitation of The Edison Swan Electric Company Limited. The Exhibition will be open as follows: January 23rd. 6-9.30 p.m. Members and friends. January 24th. 10.30 a.m. to 6.0 p.m. Members. Public admission by invitation card.

All exhibits are closely related to Television Engineering or Production or to the Production of Television Programmes. Tickets of admission may be had from Society members and Patron Members or from G. T. Clack, Lecture Secretary, 43 Mandeville House, Worsopp Drive, London, S.W.4.

## Query Corner

### RULES

- (1) A nominal fee of 2/6 will be made for each query.
- (2) Queries on any subject relating to technical radio or electrical matters will be accepted, though it will not be possible to provide complete circuit diagrams, for the more complex receivers, transmitters and the like.
- (3) Complete circuits of equipment may be submitted to us before construction is commenced. This will ensure that component values are correct and that the circuit is theoretically sound.
- (4) All queries will receive critical scrutiny and replies will be as comprehensive as possible.
- (5) Correspondence to be addressed to "Query Corner," Radio Constructor 57 Maida Vale, Paddington, London, W.9.
- (6) A selection of those queries with a more general interest will be reproduced in these pages each month.

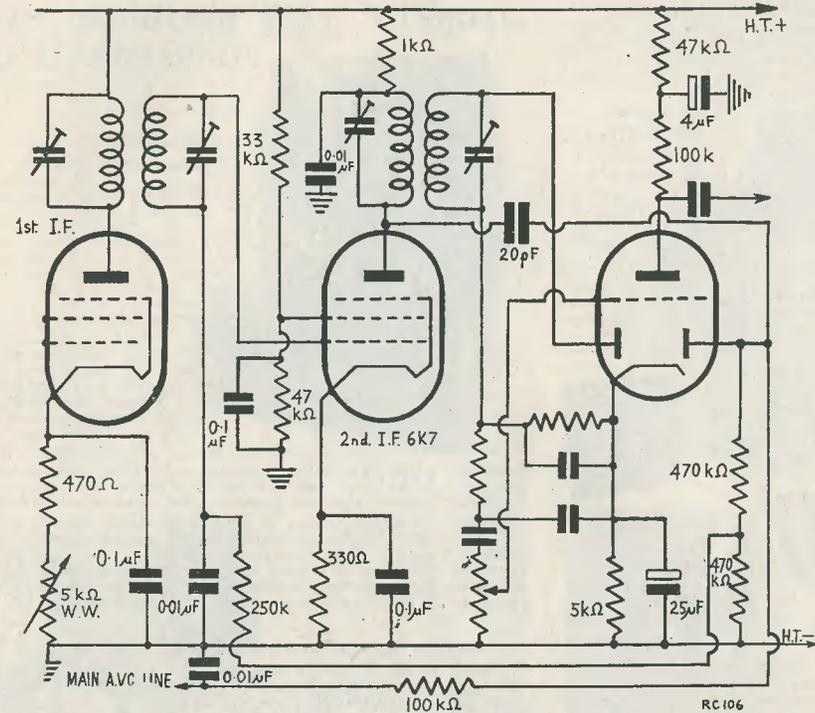


Fig. 1. Showing the addition of a 2nd IF stage to the Basic Superhet. All unspecified components remain unchanged in value to that given in the original design

## These Miniatures can be of great assistance to the Amateur

### Brimar 6BR7—Low Noise A.F. Pentode

Interest in magnetic tape recording is growing fast, and with it the requirement for a valve to operate quietly at high gain and low input level under adverse conditions of vibration, shock etc. The 6BR7 was designed to do all this and is finding great favour among constructors of film sound reproducing equipment and magnetic tape recorders. Used in the first stage, it will give a gain of 100 times with a noise level on its own grid of less than 20 μVolts, which is well below the normal signal levels encountered.

### Brimar Germanium Diodes—GD3 and GD4

Although not strictly miniature valves, these small components are used as one-way devices. The GD3 is intended for general detector work and has a forward resistance of less than 350 ohms at +1 volt and a reverse resistance

of more than 50,000 ohms at -10 volts. The working voltage is limited to 25 volts.

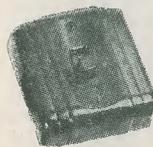
The GD4 is a higher grade diode and is intended for noise suppression etc., where its high reverse resistance of 0.25 MΩ at -10 volts is necessary, and its operating voltage is extended to 50 volts. Both diodes are approximately the size of a ½-watt resistor and are wire ended.

Efficient in operation, Germanium crystals have helped the crystal receiver to return to popularity and, because the cats-whisker is permanently adjusted for optimum results, high sensitivity is assured.

Further information on the types mentioned above may be obtained on application to Messrs. Standard Telephones and Cables Limited, Publicity Department, Foots Cray, Sidcup, Kent, who will be pleased to send a Broadsheet containing characteristics of their valves to any interested readers.

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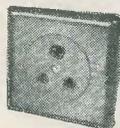
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3/.036 3 core flat ... ..	2/-
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7/.029 Twin with earth ...	1/11
7/.036 Twin flat ... ..	2/9
7/.036 Twin with earth ...	3/3
7/.064 Twin flat ... ..	4/9

**LEAD COVERED CABLES, 250 v. CLASS**

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3/.036 3 core ... ..	3/8 yard
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These are P.V.C. or rubber insulated, laid flat then braided with cotton and compounded:

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10 core ... ..	2/6 yard
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Cabinet only, £4, 17/6  
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**Tape Deck.** Fitted with 3 motors giving fast rewind/forward run and no friction. High fidelity record/playback giving approximately 1 hour playing from standard 1,200ft tape. Tape, 35/- per reel.

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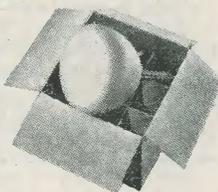
**Instruction Booklet.** Shows in close detail exactly how to assemble and operate the recorder, is free with kit or available separately at 5/- (credited if you buy kit or complete recorder).

**Price £35.** Complete kit of parts, including 6 B.V.A. valves, loudspeaker and cabinet (state whether portable or table model required), or £11, 14/6 deposit and 12 monthly payments of £2/6/3. Carriage, insurance 10/- extra.

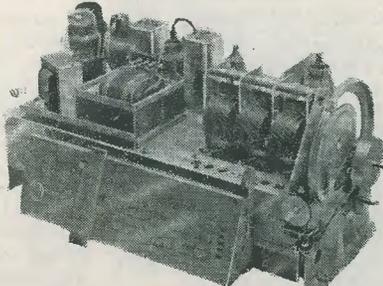
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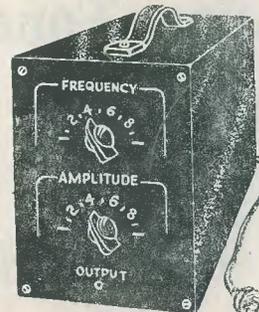
Although this generator can be built and used by any beginner it is at the same time a most useful instrument for the more advanced worker.

It can be tuned to the vision channel and will produce a pattern on the face of the C.R. tube. Alternatively if tuned to the sound channel it will produce an audible signal in the loudspeaker.

Thus its owner will become independent of B.B.C. transmissions and can fault-find or test at any time. It operates entirely from A.C. mains and is quite suitable for use with superhet or straight receivers.

A complete kit of parts (in fact everything except the cabinet) with full constructional and operational data will be supplied for 29/6, plus 2/6 post and insurance, alternative data is available separately, price 2/6 (credited if you buy the kit later).

**NOTE.** Cabinets as per the illustrated prototype now available at 17/6 each.



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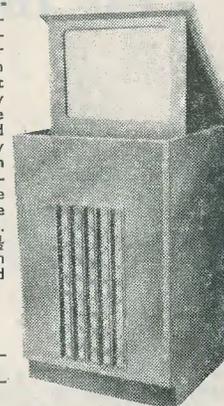
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We can supply the 21 valves, C.R. Tube and all the parts for £20/10/-. H.P. terms are available, deposit being £6/17/6, balance 12 monthly payments of £1/9/9 each. Carriage and packing 10/- extra.

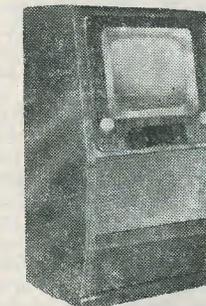
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# Two Interesting Tone Control Circuits

By W. E. THOMPSON, A.M.I.P.R.E.

There are many applications for tone control circuits in audio amplifiers, pre-amplifiers, etc., and in the past there has been a multiplicity of such circuits published which claim advantages of some sort. The author makes no such claims for the two circuits to be described, except to say that they have been found in practice to produce pleasing results over a long period, and may be of some use to readers. The basic circuits have appeared elsewhere, and references to their sources are given so that further information on them can be read if desired.

The first circuit is intended for inclusion in an audio amplifier stage, and was described by E. J. James, B.Sc., in the February 1949 issue of *Wireless World*. It gives variable bass and treble cut and lift, and component values can be chosen to suit the constructor's particular taste in frequency response. James shows that the basic bass lift circuit, Fig. 1(a), can be made to give controllable lift by means of the variable resistor across C1, as in Fig. 1(b). Similarly, the basic bass cut circuit of Fig. 2(a) is modified for variable cut as in Fig. 2(b). Turning now to the treble circuits, Fig. 3(a) shows the basic top lift circuit, and this is made controllable by the variable resistor in series with C3 as shown in Fig. 3(b). In Fig. 4(a) the basic top cut circuit is shown, and again control of response is by the variable resistor in series with C4, as in Fig. 4(b).

The bass control circuits of Figs. 1 and 2 can be combined as in Fig. 5 to give both lift and cut, the potentiometer R3 then performing the functions of the variable resistors seen in Figs. 1(b) and 2(b). By adopting the same expedient in Figs. 3 and 4, the circuit of Fig. 6 is evolved for providing top lift and cut. In this case, potentiometer R4

takes the place of the variable resistors in Figs. 3(b) and 4(b).

A further simplification is achieved by combining Figs. 5 and 6 to produce the basic circuit for variable bass and treble lift and cut shown in Fig. 7. It will be seen that resistors R1 and R2 of Fig. 6 have now vanished, their functions being taken over by R1, R2 and R3 of Fig. 7. Having regard for the wide and efficient range of control this circuit gives, it is delightfully simple and uses a minimum of components. Due to the insertion loss, however, it is necessary in most cases to precede the network with a low-gain A.F. stage to compensate for the overall attenuation of this form of inter-stage coupling.

This circuit was applied to a pre-war commercial superhet receiver soon after James' article appeared in *Wireless World*; it has given excellent results, and is still in use. The reproduction of this old receiver now compares very favourably with modern sets; it uses an 8-inch energized moving coil speaker whose frequency response is nothing to write home about, but no alterations to either the speaker or cabinet have been made to try to improve matters, since the tone control circuit adequately eliminates such shortcomings. At full bass lift it was found that hum from the full-wave mains rectifier became apparent, and an increase of capacity of H.T. smoothing capacitors was necessary to remove remaining ripple. Later, a check with an audio-frequency oscillator revealed that the set now has a fairly good response down to 40 c/s with the tone control set to full bass lift, whilst at full top lift there is still a measurable signal on an oscilloscope around 16 kc/s.

The receiver had the usual triode-hexode frequency changer, variable-mu R.F. pentode

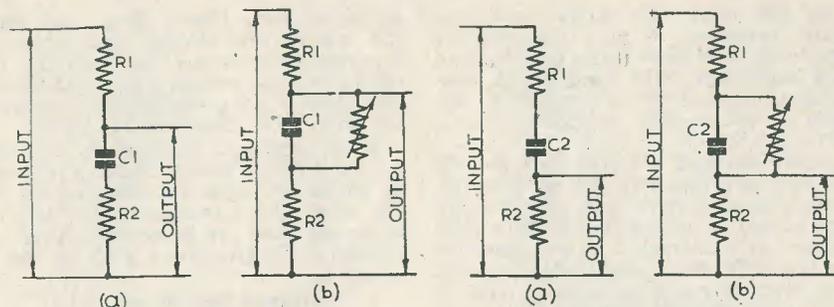


FIG. 1  
FIXED & VARIABLE BASS  
LIFT CIRCUIT

FIG. 2  
FIXED & VARIABLE BASS  
CUT CIRCUIT

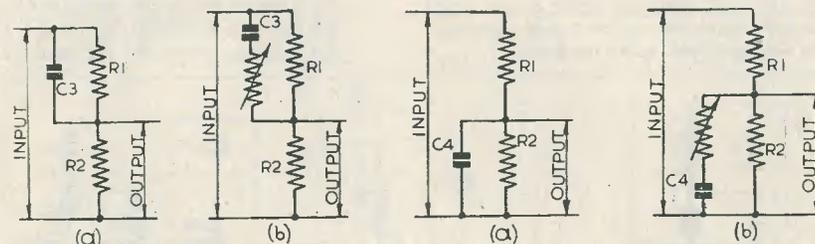


FIG. 3  
FIXED & VARIABLE  
TOP LIFT CIRCUIT

FIG. 4  
FIXED & VARIABLE  
TOP CUT CIRCUIT

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as I.F. amplifier, and D.D.-pentode output stage. The output valve circuit was modified so that after signal rectification the audio was fed into a low-gain stage using a 6J5 triode. The tone control circuit formed the coupling between this additional stage and the grid of the pentode output section of the D.D.-pentode. This latter valve was retained even though it has a 4-volt heater, and other valves preceding it were changed for 6.3-volt types, namely, 6K8-G and EF39. Additional turns were provided on the 4-volt heater winding on the mains transformer for supplying the three 6.3-volt valves. The diagram of Fig. 8 shows the final form taken by the modified circuit. The component values shown in the parts list are those which were found, partly by calculation and partly by experiment, to give the best overall response and range of control for the particular set and its conditions of use.

Some remarks concerning certain features

of this circuit may be of use. The R.F. filter formed by R5, C6 and C7 was added to the original circuit to remove residual R.F. from the rectified signal, these small components being mounted within the cam of the second I.F. transformer to screen them, and the lead from the junction of R5-C7 to the volume control R6 was run in screened wire. C8 was mounted close to R6, the lead from C8 to the grid of V3 also being in screened wire. R7 was mounted directly on the valve-holder of V3. The parasitic stopper R11 was mounted directly on the grid clip of V4, the "hot" side of R11 being connected to R4 in screened wire. It was found that R11 removed the last trace of the characteristic "pentode shriek" on high notes, and that the inclusion of this resistor eliminated the need for the usual series-connected resistor and capacitor across the primary of the output transformer. The large value of C5 ensures adequate low-frequency response

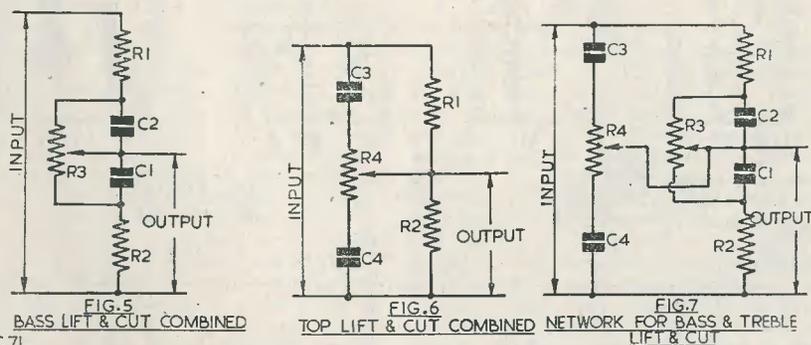
and for best results this should be a non-inductive capacitor. A mica capacitor for C8 was found to be better than a non-inductive tubular paper type. The signal diode load-cum-volume control R6 is returned to the cathode of V4 in order to secure a 6-volt delay for A.V.C.

A metal shrouded 6J5 was used for V3, since screening is thus automatically obtained. If a glass envelope type such as 6J5-G/GT or L63 is used, it may be found that a valve screening can is desirable. It is not essential that a Pen.4DD valve is used for V4, provided that if some other type of output pentode is used it has high-slope characteristics. For instance, an EL33 might be used, but as this type does not contain signal diodes, V3 would have to be made a D.D.-triode. This, in turn, might involve some alterations to values of R8, R9 and R10 to achieve the same relative gain, depending on the triode characteristics of the particular valve used for V3.

secrets of Mrs. Dale's Diary, and making full use of floor-shaking bass when their favourite boogy-woogy band lets rip. And talking of bass, perhaps it is as well to stress that there is no one-note thump about it—it's lovely stuff, clean and uncoloured.

If the response produced by the stated values of C1-C4 does not quite suit your ear or the sundry china nick-nacks on the shelf, the values can be changed so that your ideas of reproduction can be better satisfied. The following will give you a guide to the procedure:—

- To increase bass lift, reduce C1.
- To increase bass cut, reduce C2.
- To decrease bass lift, increase C1.
- To decrease bass cut, increase C2.
- To increase treble lift, increase C3.
- To increase treble cut, increase C4.
- To decrease treble lift, decrease C3.
- To decrease treble cut, decrease C4.



When this circuit was built up in practical form, the author so arranged the controls R3 and R4 that when viewed from the front of the cabinet, the treble control R4 was on the right and the bass control R3 on the left. To comply with a personal "fad" that the direction of rotation gives indication of the function performed, these components were wired so that turning R3 anti-clockwise (leftwards) produces a rising bass response, and turning R4 clockwise (rightwards) gives a rising treble response. The effect of this is that the knobs are turned outwards to extend frequency response in either direction, and inwards to contract the response. It has been noticed that even XYL's (i.e., those attached to other OM's as distinct from my one and only!) readily catch on to this scheme of things, even to the extent of turning up the treble to hear more distinctly the latest

It will most likely be found that some careful and patient realignment of I.F. transformer response will also pay dividends. Aim at securing a flat-top and steep-sloped skirt to the response curve, even if this entails sacrificing some gain. Of course, an oscilloscope and wobulator simplifies such a procedure enormously, but a reasonably close estimation of the response can be drawn out in graph form by plotting the readings of an output meter while the signal generator is gradually tuned each side of the resonant I.F. frequency. For this test, the signal generator should be connected to the signal grid of the frequency-changer stage, so that the overall response of both I.F. transformers is plotted.

In Fig. 9 is shown in diagram form the location and wiring of the tone control components, as viewed from underneath the

## Parts List for Fig. 8

R1	100 kΩ ½w.	C4	0.02 μF. 350V paper, non-ind.
R2	10 kΩ ½w.	C5	0.5 μF. 350V paper, non-ind.
R3	1.0 MΩ carbon pot.	C6	100 pF. silver mica.
R4	100 kΩ carbon pot.	C7	100 pF. silver mica.
R5	100 kΩ ½w.	C8	0.01 μF. 350V mica.
R6	500 kΩ carbon pot. (log. law).	C9	8.0 μF. 350V electrolytic.
R7	1.0 MΩ ½w.	C10	25 μF. 12V electrolytic.
R8	22 kΩ ½w.	C11	50 μF. 25V electrolytic.
R9	27 kΩ ½w.	C12	100 pF. silver mica.
R10	1.0 kΩ ½w.	V3	6J5 valve.
R11	10 kΩ ½w.	V4	Pen.4DD valve (Mullard).
R12	200 Ω ½w.	T1	Output transformer to match speaker voice coil to 7,000 ohms anode load. (48 : 1 for 3-ohm speaker).
R13	1.0 MΩ ½w.		
R14	1.0 MΩ ½w.		
C1	0.005 μF. 350V mica.		
C2	0.005 μF. 350V mica.		
C3	0.003 μF. 350V mica.		
			Valveholders, 1 International octal, 1 British 7-pin.

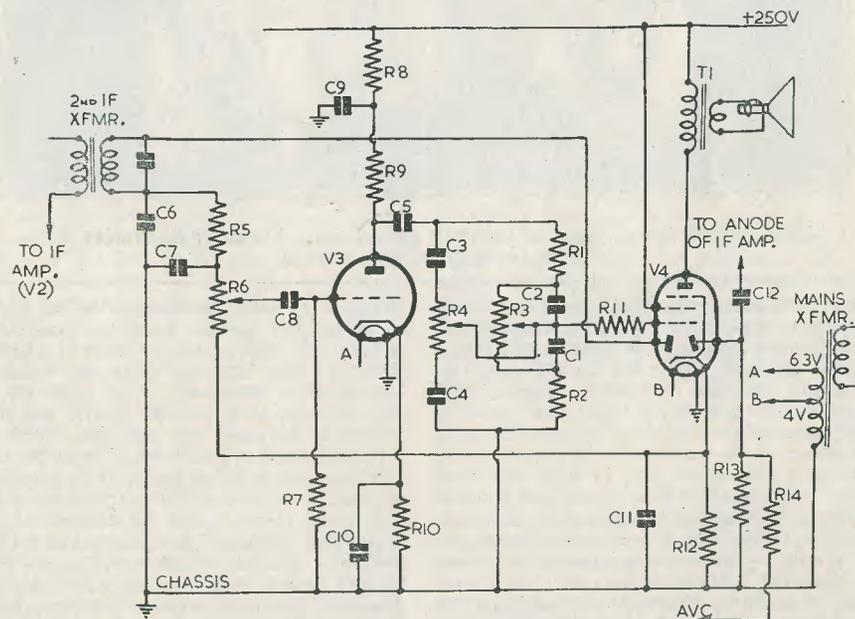


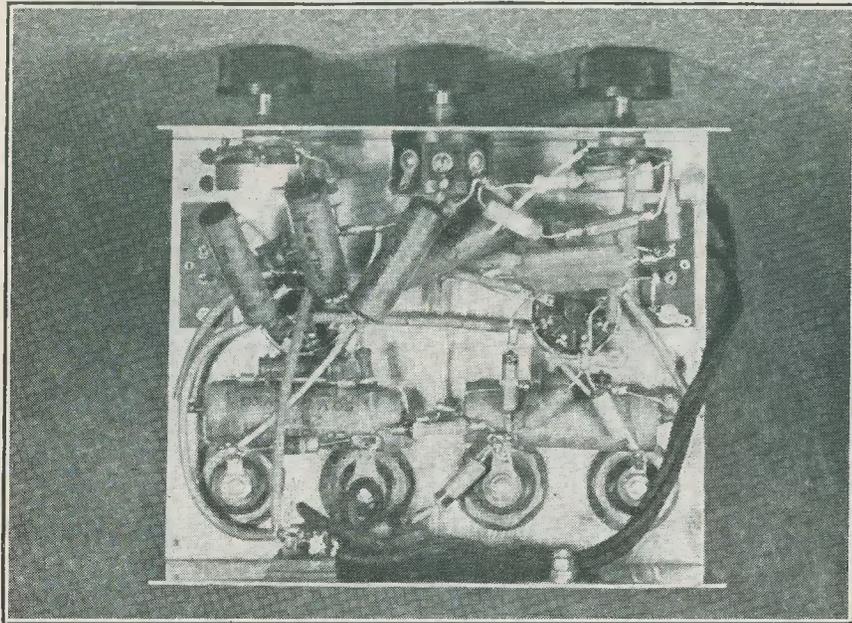
FIG. 8  
SIGNAL-RECTIFICATION & OUTPUT STAGES OF CONVENTIONAL SUPERHET MODIFIED TO INCLUDE VARIABLE TONE CONTROL STAGE

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chassis. The components can be neatly grouped around the two potentiometers, and wiring kept quite short.

The second circuit to be considered is of American origin, and was developed by J. Carlisle Hoadley of the Navy Air Test

Center, Maryland, U.S.A. An article appeared in the November 1950 issue of *Radio and Television News*. The main feature of this circuit is that it provides automatic correction for the Fletcher-Munson effect, and a brief note on this aspect is perhaps required.



Under chassis view of Hoadley type tone control unit. The cover illustration shows the arrangement above chassis.

It is well-known that the human ear is less sensitive to the low and high audio frequencies. If all frequencies are to be heard at the same relative loudness, those at the extremes of the audio spectrum have to be a good deal louder than those in the mid-band. Due to this feature of the ear, if the frequencies being heard are now reduced in loudness, there will be a noticeable loss of high and low notes. This tailing-off of highs and lows is known as the Fletcher-Munson effect, and tone control circuits are a convenient expedient for producing some compensation to off-set this peculiarity of the human ear. If, under these conditions, controls are adjusted to lift the bass and treble, the overall relative loudness will be increased; the result so far as the ear is concerned is that the music, although quieter, still sounds natural because the lows and highs are still audible. Conversely, if the volume control is turned up so that the loudness is greater, the ear notices that bass and treble become predominant; adjustment of tone controls to reduce the highs and lows will restore the overall loudness level to conform to natural responses of the ear.

This very short description is an attempt to explain in as few words as possible the reason why one invariably finds it necessary to adjust tone controls when the volume is increased or decreased. One must try, for this purpose, to appreciate clearly the subtle difference between the note or chord that is played loudly or softly by the instrumentalist, and the note or chord that is being reproduced at loud or quiet level by the loudspeaker.

If some means could be devised whereby the ear did not notice such changes of extreme-frequency loudness when reproduction sound level is altered, the "naturalness" would be preserved no matter whether the reproduction were quiet or loud. Ideally, turning down the volume control should lift the highs and lows to compensate exactly for the ear's changes of sensitivity at all settings of the control; similarly, it should cut the highs and lows to give exact compensation at all high-volume settings. Hoadley's circuit is a bold attempt to achieve this condition, and he has succeeded in attaining a fairly close approach to the ideal. It is a two-stage pre-amplifier in which both stages are fed by corrective feedback networks, the first

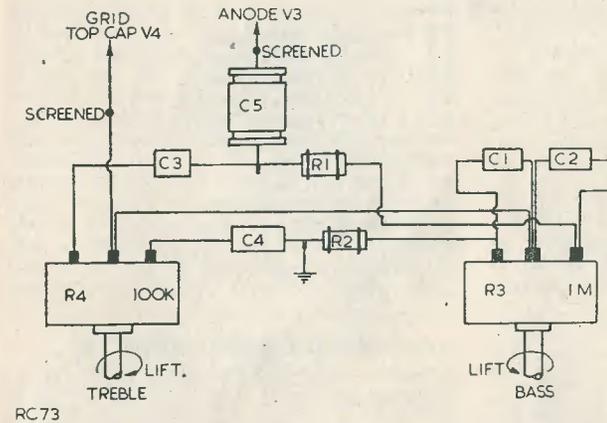


Fig. 9. Layout and wiring of tone control components, under chassis view.

stage having some measure of adjustment so that tone control can be effected, and the second having its correction so arranged that the volume control, which forms part of the network, gives automatic compensation for Fletcher-Munson effect. The circuit of the unit is given in Fig. 10. The network C1, R1, C2, R2, R3 and R4 provides feedback from anode to grid of the 6J7, and gives bass compensation, the degree of lift being adjustable by R1. A small treble lift is effected by the network C3, R3, R4 and R5, the latter being a variable resistor for adjusting the amount of treble boost. In actual operation, R1 and R2 are adjusted so that at normal listening level the reproduction suits one's taste for overall response; the controls are then left in position and loudness level correction is performed by the volume control automatically.

The amplified output from V1 is further amplified by V2, and the network C9, R9, R11 and R12 provide feedback from anode to grid of the 6SJ7. It will be seen that R11 controls not only volume, but the degree of feedback from anode to grid of V2 at the same time. At maximum volume when the grid of V2 is at the top end of R11, the amount of feedback is very small due to the high resistance of R11 being in series with the feedback loop; consequently there is very little bass compensation. When R11 is turned down to minimum volume, however, only a small part of R11 remains in the feedback loop, so there is large feedback to V2 grid, and the bass frequencies will be consider-

ably amplified. Treble compensation operates similarly from the network C8, R10, R11 and R12.

This pre-amplifier can be driven from a radio tuner unit, microphone or gram. pick-up. With the two latter forms of input, however, a further stage of pre-amplification will probably be necessary if mike or pick-up output is low, as is usual with high-quality components. The photographs on the cover and accompanying this article show a specimen of the two-stage compensating pre-amplifier of Fig. 10 which was made up rather hastily by the present author in order to assess its utility. One's reaction, to this unit was at first rather difficult to define; it seemed that the circuit was something of a wash-out because it did not appear to do anything, and it took some careful and critical listening to realise that the effect one was expecting just was not there! Many years of listening to conventional reproducing equipment trains the ear to "hear" low notes because they are expected to be there, and more often than not are falsely heard because the ear produces its own interpretation of them from harmonics and beat-notes. One's hearing, therefore, has to educate itself to the fact that the pre-amplifier is causing the *fundamentals* to be reproduced, and it takes a little time to get accustomed to this. Once the phenomenon is recognised, one realizes that no matter where the volume control is set the reproduction sounds natural, and it is a fact that this appreciation of naturalness is difficult to acquire simply because it is, well—just natural!

## Parts List

R1	500 k $\Omega$ carbon pot.
R2	100 k $\Omega$ $\frac{1}{2}$ w.
R3	510 k $\Omega$ $\frac{1}{2}$ w.
R4	47 k $\Omega$ $\frac{1}{2}$ w.
R5	10 k $\Omega$ carbon pot.
R6	4.7 k $\Omega$ $\frac{1}{2}$ w.
R7	510 k $\Omega$ $\frac{1}{2}$ w.
R8	100 k $\Omega$ $\frac{1}{2}$ w.
R9	91 k $\Omega$ $\frac{1}{2}$ w.
R10	47 k $\Omega$ $\frac{1}{2}$ w.
R11	500 k $\Omega$ carbon pot. (log law).
R12	47 k $\Omega$ $\frac{1}{2}$ w.
R13	4.7 k $\Omega$ $\frac{1}{2}$ w.
R14	680 k $\Omega$ $\frac{1}{2}$ w.
R15	91 k $\Omega$ $\frac{1}{2}$ w.
R16	62 k $\Omega$ $\frac{1}{2}$ w.
R17	39 k $\Omega$ $\frac{1}{2}$ w.
C1	0.1 $\mu$ F 350V paper.

C2	0.02 $\mu$ F 350V paper.
C3	0.02 $\mu$ F 350V paper.
C4	25 $\mu$ F 12V electrolytic.
C5	16 $\mu$ F 350V electrolytic.
C6	16 $\mu$ F 350V electrolytic.
C7	0.1 $\mu$ F 350V paper.
C8	0.001 $\mu$ F mica.
C9	0.003 $\mu$ F mica.
C10	25 $\mu$ F 12V electrolytic.
C11	16 $\mu$ F 350V electrolytic.
C12	16 $\mu$ F 350V electrolytic.
C13	0.25 $\mu$ F 350V paper.

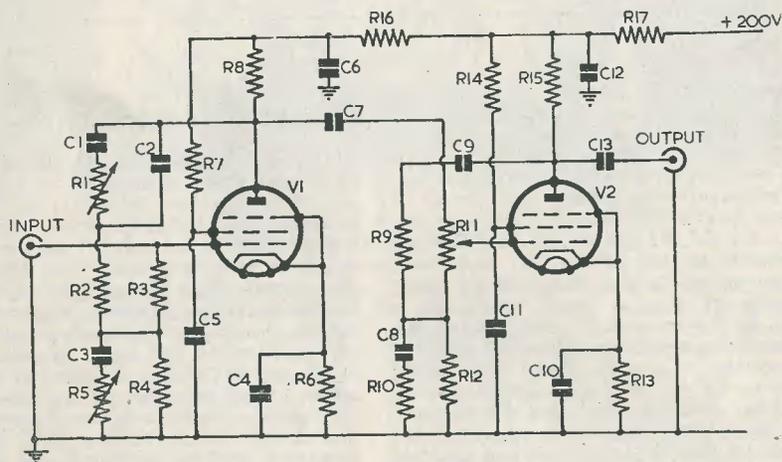
V1 6J7.

V2 6SJ7.

Valveholders, 2 International octal.

Co-axial chassis-sockets, plugs, cables, etc.

Screened cap for V1.



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Fig. 10. Circuit of self-compensation pre-amplifier with tone control.

Used in conjunction with a hi-fi audio amplifier and good loudspeaker, the quality of reproduction resulting from the automatic compensation at all volume levels knocks all your long-cherished ideas of tone controls into some other world.

If it is desired to adjust component values to give a slightly different frequency response, increasing C2 will shift the bass lift so that it begins at lower frequencies; decreasing C2 will raise the turnover frequency and give

greater overall bass lift. Little else will be necessary due to the automatic compensation effected by the second feedback network.

In the construction of the unit, the usual precautions should be adopted, remembering that the stages are working at high gain at the low-level end of the reproducing system. Short wiring, especially at grids and anodes, is essential, and ground loops should be avoided. It is a good scheme to run a thick wire as a bus-bar along the length of the

chassis, making all earth-returns to this bar rather than the chassis, and earth-connect bus-bar and chassis at one point only, preferably at the output socket, in order to reduce the possibility of hum pick-up. The valves specified are metal shielded, so screening cans are unnecessary. The heater feeds should be run in twisted pair, and the wires dressed to lay close down to the chassis and runs arranged so that they avoid grid and anode circuits. To prevent hum induction, use a separate lead for the H.T. negative return (so that it is not common with the heater earth return) and if possible use a

separate heater winding for the valve heaters. This winding can have an earthed centre-tap, or if a tap is not provided the centre-point earth can be obtained by means of a hum-dinger. Grid wiring should be in screened wire. Input and output leads are best made with co-axial cable, using co-axial plugs and sockets for inter-unit connections. Chassis-screens, or screening boxes for some components were not necessary in units made by the present author, but if obstinate cases of hum are encountered their use could possibly effect a cure.

## BOOK REVIEW

### RADIO ENGINEERS' SERVICING MANUAL.

Edited by E. Molloy and W. F. Poole, Assoc. Brit. I.R.E. 750 pages, 588 illustrations. Price 42s. Published by George Newnes Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

This book should have a great appeal to service engineers. Compiled by fourteen authorities associated with leading manufacturers, it contains a substantial amount of useful information. The preliminary chapters outline the attributes desirable in a service engineer, a survey of the types and design of modern receivers, describe modern valves and the testing of them, give details of routine servicing, and the alignment of receivers. Other chapters deal with some installation requirements of both domestic and car radio sets, and the suppression of electrical interference. A chapter is devoted to communications receivers.

The major portion of the book contains service data and circuit diagrams of some 500 modern receivers (including one well-known make of communications receivers) produced by 32 manufacturers. Full details of circuits are given, all component values being shown. A general description of each set, with points of special interest, details of modifications in certain models, valves used, test voltages and alignment data is given for most of the receivers listed. In many instances a sketch of the chassis layout assists identification of component locations.

An endeavour has been made to give all the essential information required on a set at a single opening of the pages, and so avoids having frequently to turn over in the quest for some detail.

An appendix includes some pages of useful data and radio circuit formulae. There is a short general index, and the additional index to each model reviewed is a useful adjunct.

### TELEVISION ENGINEERS' SERVICING MANUAL.

Edited by E. Molloy and W. F. Poole, Assoc. Brit. I.R.E. 654 pages, 425 illustrations. Price 42s. Published by George Newnes Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

This is a companion volume to that reviewed above, compiled by sixteen authorities. Here again, the preliminary chapters deal with general topics. Various types of receiver are surveyed and some features of circuitry are described. Some notes on installation of receivers and aerials are given, and types of aerial and feeders are discussed, also the effect of geographical position on reception. Servicing equipment is briefly touched upon; a few notes on typical faults encountered are given. A short description of single side-band working appears in the final introductory chapter.

About 120 models, made by 29 manufacturers, are described in the main body of the book. The amount of information given is, without a doubt, quite remarkable and exceptional. Such treatment seems rarely found elsewhere; in a great many cases a large number

of pages is devoted to one model. Full circuit diagrams with component values, detailed circuit descriptions, dismantling, adjustment and alignment procedure, test voltages, details of modifications met with in different runs of the same model, fault analysis, and many other aids are presented.

The general index also contains references to models reviewed in the book.

Both of these books are well produced: they are unique insofar that they collect a vast amount of material into the compass of two volumes of handy size.

Whilst suggesting them to service engineers in particular, it is felt that these books will also be very attractive to radio men in general for the technical information they make available, perhaps for the first time in collective form. It is to be hoped that further editions will be forthcoming later in order that the data shall be kept up to date.

Although the initial outlay on these books might seem heavy at first sight, an examination of their contents leaves no doubt that they are fine value. Your reviewer has no hesitation in highly commending them.

## The Editor Invites

articles from readers, of a nature suitable for inclusion in this magazine. Articles submitted for publication should preferably be typewritten, but ordinary writing is acceptable if clearly legible. In any case, double spacing should be used, to allow room for any necessary corrections. Drawings need not be elaborately finished, as they will usually be redrawn by our draughtsmen, but details should be clear. Photographs should preferably be large (half-plate) but in any case the focus must be good. Much useful advice to prospective writers is given in our "Hints for Article Writers" which will be sent free on request.

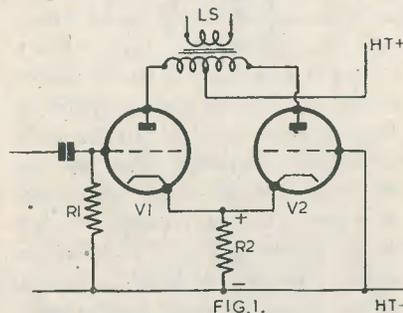
# 8-10 WATT AC or AC/DC AMPLIFIER

By K. R. PIPER

Recently, a design for a 4-watt amplifier was given. It is intended now to elaborate slightly on this to give 8 to 10 watts output.

To achieve this greater output, we use a push-pull output stage and phase split in the output stage. Fig. 1 gives a basic circuit, and perhaps a little explanation will help to show just how the system works.

When a positive voltage is fed to V1's grid, the current through the valve increases, causing a rise in the voltage between its cathode and HT-. Now V2 is held normally so that its grid is negative to its cathode by a certain amount, namely the voltage across R2, and any increase in this voltage makes the grid of V2 more negative with respect to its cathode, so that its current drops; conversely, when a negative signal causes V1 to lower its current, the associated drop in voltage across R2 causes the current in V2 to rise. In other words, push-pull working is the result.



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FIG. 1.

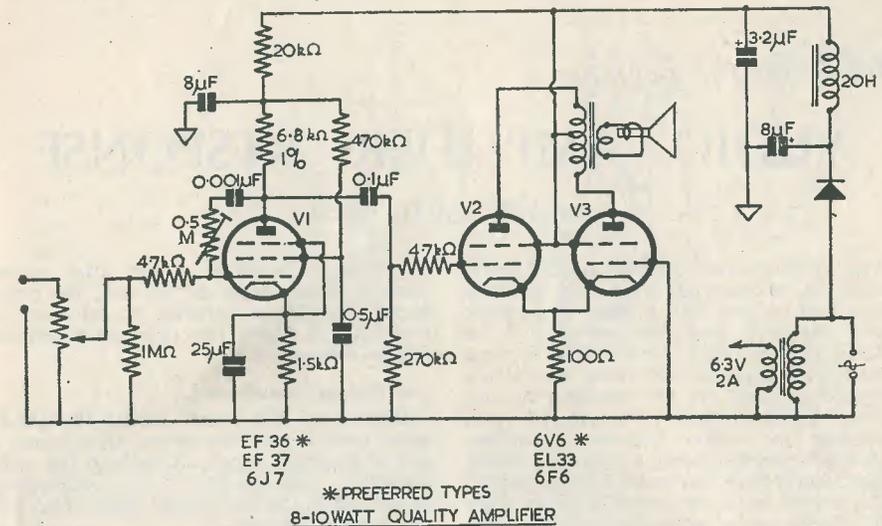
Now it will be seen that each valve must work on the straight part of its curve, that is in class "A"; this limits our maximum power output but, as class "A" operation of a valve gives the least distorted output, it suits our

purpose to use this simple system, especially as no more drive is needed than if only one valve was to be used in the output stage. Incidentally, this class of operation is known as class "AB"; class "A" truly applies to single-ended stages.

Figure 2 gives the complete circuit of the amplifier, and a check-up will show that it is identical (except for one extra valve, of course) to that shown in the 4-watt Amplifier, with one difference—the bias resistor on the output stage is only half the value of that shown previously, and it is not by-passed. Obviously, if it were by-passed with a condenser the bias on V2 and V3 would remain constant and V3 would do no work at all. The reason for the bias resistance being halved is that the two valves draw twice as much current through it, and so produce the same voltage at its ends.

The setting-up procedure is the same as for the 4-watt amplifier, and needs no further comment.

It will be noticed that no tone control is fitted. There are, however, several ways of fitting tone control for those who like an extra knob to twiddle—I don't, but here they are. Firstly, a potentiometer and series condenser can be fitted across the input, or from the grid of V1 to chassis; I do not recommend either of these. Next, a potentiometer and series condenser may be placed across the load of V1; this gives fair results. Finally, the same arrangement can be connected across the output transformer as in Fig. 3. This is the best, but needs a ganged potentiometer, and can generally be ruled out on that score. It may be possible to obtain the desired control by using a single RC network from anode to anode (Fig. 3b) but I'll not bet on it. If you do try this method use a very good condenser of very high working voltage, as the anode-to-anode voltage rises very high on peaks; 1,500V wkg. would not be a pessimistic rating.



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\* PREFERRED TYPES  
8-10 WATT QUALITY AMPLIFIER

Again, alternative valve types are given; all will work well, but the output pair must be of the same type. Note that the heater transformer must be capable of giving at least 2 Amps.

The rectifier should be able to pass 100mA. There are some excellent ex-WD types for this job which cost only a few shillings. A conventional power pack may be preferred and details will be given in a later article of suitable power packs.

### Universal Operation

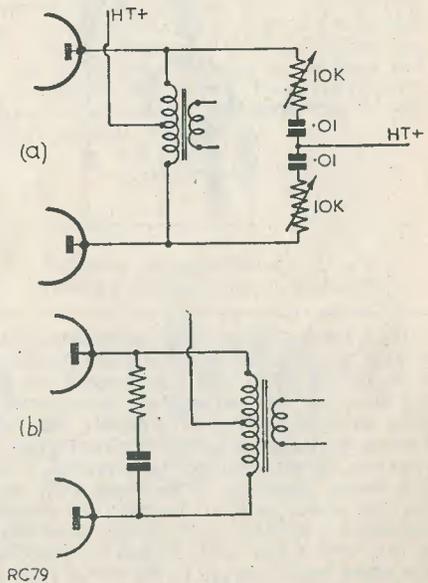
Again DC operation is possible, simply by doing away with the transformer, and placing the heaters in series and adding a suitable dropper resistor. Remember to use valves of suitable current rating

i.e. 0.2 Amp = EF36/37 and CL33's  
0.3 Amp = 6J7 and 25L6's

### Practical Quality Amplifier

The series resistor will be, for 230 volts,  
870Ω for 0.2A valves  
560Ω for 0.3A valves  
As before, a Brimistor is desirable in the heater line. For 25L6's, alter the bias resistor to 150Ω.

Incidentally, it may prove worthwhile to adjust the bias resistor slightly when working on voltages other than 230V.



RC79

Fig. 3

Mainly for the Beginner

## AUDIO AMPLIFIER RESPONSE

By H. E. SMITH G6UH

The whole question of high fidelity reproduction is of such a wide and complex nature that to deal with it from every angle would require a complete volume of the "Radio Constructor." As the aim in these series for the Beginner is to make each article complete in itself, we are touching on one or two problems only in connection with improving the audio frequency response. High quality reproduction is not just a matter of installing a large loudspeaker on a gigantic baffle, driven by a pair of KT66's in push-pull. There are a great number of details to attend to in the circuit, even in the power supply itself, before one can expect anything like good results.

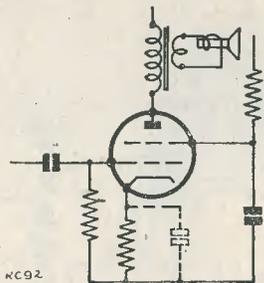


Fig. 1 Simple negative feedback (Cathode bypass capacitor omitted)

First, then, a few words on the power supply. If, due to insufficient filtering and smoothing, a slight 100 cycle ripple is present on the HT line, this will perhaps not be noticeable with an average type of amplifier, but will become quite objectionable when the frequency response of the amplifier is improved. The first thing, therefore, is to make quite sure that the power supply is properly filtered and smoothed. Another point often overlooked is that with Class AB2, B, and C amplifiers the power supply should be capable of delivering approximately twice the current which is normally required under "no signal"

conditions. Therefore, if the total current drain is of the order of 120 mA, the power supply should be capable of delivering at least 250 mA if good bass response and overall fidelity is expected.

### The Output Transformer

Often given less than a second thought by many constructors, the output transformer is one of the most important items in the audio amplifier. One can never obtain satisfactory results unless the transformer conforms to the following conditions:—

(a) It must provide an accurate match between anode impedance and speech coil impedance, i.e., its ratio and inductance must be correct. (This especially applies if a triode valve is used as the output stage, but is not quite so important if a pentode or tetrode is used).

(b) It must have a low leakage inductance. (Most of the multi-ratio output transformers obtainable from reputable manufacturers fulfil this condition). A high leakage inductance results in a loss of the high frequencies.

(c) The inductance of the primary should not be so low that the lower frequencies predominate, or so high that these frequencies are attenuated.

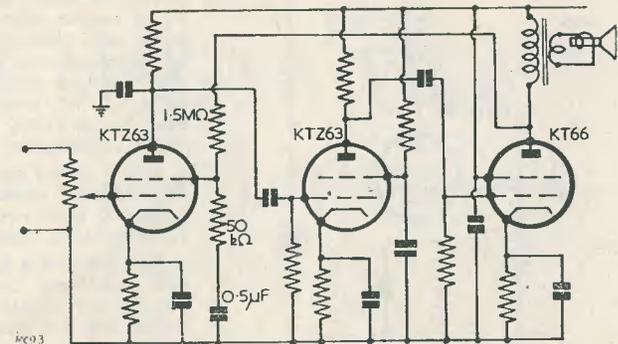
Some good average values for primary inductance, when pentodes or tetrodes are used in the output stage, are as follows:—

Anode load resistance	Primary inductance for 2db down at 50 cycles
7000 ohms	31.0 Henries
8000 "	33.0 "
9000 "	37.0 "
10,000 "	42.0 "
and for triode valves:—	
1000 "	4.0 Henries
1500 "	6.0 "
2000 "	8.5 "
3000 "	12.5 "
5000 "	21.0 "

The ratio of the output transformer can be determined from this simple equation:—

$$\text{Ratio} = \sqrt{\frac{\text{Rated load resistance of valve}}{\text{Speech coil impedance at 400 cycles.}}}$$

Fig. 2 Typical three stage amplifier with feedback from output to input.



Both the rated load resistance of the valve and the speech coil impedance at 400 cycles can be obtained from the manufacturers of these items. When contemplating output transformers, a good quotation to bear in mind is one taken from the *Radio Designers Handbook* by F. Langford Smith. We quote, "A transformer merely 'reflects' on to its primary circuit a load imposed on the secondary, and does not (apart from its own losses) impose a load on the primary circuit unless a load is applied to the secondary. It is the turns ratio between primary and secondary, not the number of turns on the primary which governs the reflected impedance. For example, a transformer with 3000 turns on the primary and 1000 turns on the secondary would have a ratio of 3:1. If the number of turns on the primary were increased to 6000 and the turns ratio maintained

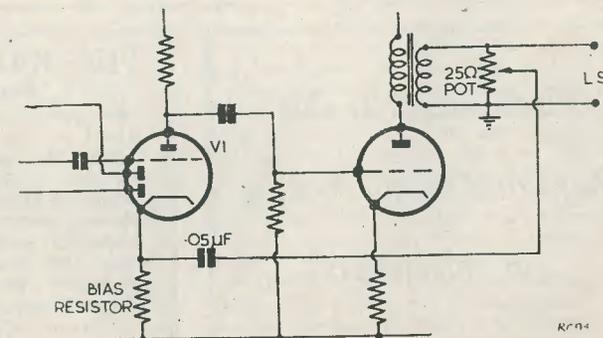
at 3:1, the secondary would have 2000 turns and the reflected impedance of the secondary load would be *as before*, provided the secondary load remained constant." So you see it is not the number of turns which matter, but the ratio of the primary and secondary turns.

### Harmonic distortion and Negative feedback

Having arrived at a satisfactory design for our output transformer, we have satisfactorily matched the output stage to the loudspeaker, but distortion will still be present in the output. This is harmonic distortion, generated in the valves preceding the output stage and in the output stage itself. The total of these harmonics which can be tolerated in a high quality amplifier is as follows:—

2nd Harmonic, 4%  
3rd Harmonic, 2%

Fig. 3 Negative feedback from the speech coil circuit. V1 is a typical double-triode (or may be any type of valve).



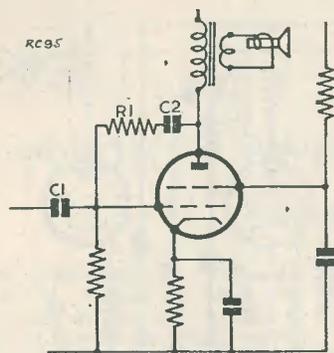


Fig. 4 Negative feedback from anode to grid of output valve.  $C_1$  should be at least  $0.5 \mu F$ ;  $C_2$ ,  $0.01 \mu F$  and  $R_1$ , 50 to 500  $k\Omega$ , according to the percentage of feedback required.

Many commercial receivers contain as much as 15% and 7% respectively. The generally accepted method of reducing this distortion is to incorporate "negative feedback" into the amplifier. Negative feedback is the process of feeding back a portion of the output voltage into the input circuit, out of phase with the input voltage (the voltage fed back is not always 180 degrees out of phase with the input, but is never wholly in phase).

This operation causes:—

- A reduction in harmonic distortion.
- A reduction in phase distortion.
- A reduction in sensitivity.
- A reduction in noise.
- An increase in stability.
- An increase in frequency response.

Thus we achieve in one operation not only a reduction of the unwanted harmonics,

but an increase in the overall response. There is, of course, also a reduction in gain. In most cases this may be compensated for by an increase in the gain control setting, especially when a pentode precedes the output valve. If the amplifier uses only triodes, it may be necessary to add another stage of audio amplification to offset the loss of gain.

Fig. 1 shows one of the simplest methods of obtaining negative feedback. All that is necessary is to remove the by-pass capacitor from the bias resistor of the output valve.

Fig. 2 shows a typical three stage amplifier with feedback taken to the input stage. Almost any amplifier may be modified to this circuit and it is most effective.

An alternative arrangement is given in Fig. 3. The feedback voltage is taken from the speech coil, and the variable resistor allows the percentage of feedback to be adjusted to suit the individual ear. This may be incorporated in almost any commercial Broadcast receiver and a great improvement will result in the overall response.

Fig. 4 shows a method of applying feedback to the output valve alone. This applies a larger percentage of feedback than Fig. 1, but does not, of course, take into account any distortion present in the valves preceding the output stage.

Never try to effect an improvement in low frequency response by fitting capacitors from anode to earth or across the primary of the output transformer. This attenuates the high frequencies only and causes an overall loss of fidelity.

It must be appreciated that we have only just touched on the subject of Negative feedback in this article, but it is hoped that it may assist the reader in understanding the subject a little more clearly and to appreciate how important a matter it is when high fidelity reproduction is required.

Please mention this  
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### THE RADIO AMATEUR FOR JANUARY

Amongst the interesting articles contained in this issue are: Radio Telescopes, Radiation Patterns of Model Aerials, Modulating a Simple Rig, Design of Mains Transformers, and the winning entry in the Radio Amateur Technical Award—A Double Superhet. Also the usual supporting features Broadcast Bands Review, On the Higher Frequencies, and Amateur Bands Commentary.

# "THE MAGNA-VIEW"

The Radio Constructor's 16 inch Televisor

## PART 12

Your writer was fortunate to receive an invitation to the luncheon which preceded the opening of the R.S.G.B. Amateur Radio Exhibition, and to hear some most excellent speeches, from speakers who know the radio amateurs' outlook so well. Sir Ian Fraser opened the Exhibition and from his memory drew references to the initiative once shown by the amateurs during the days of scanty equipment and little knowledge. How true this is! If only the amateur today would grow his own 'trees' instead of seizing the acorns that fall from the professional laboratory.

Mr. Charles Orr-Ewing made a most amusing and instructive speech; his asides to the radio industry were very pointed, as indeed was his reference to Lisle St. The constructor has always known that this little centre of radio was incomplete within itself, and that to construct any piece of apparatus a great many new components were always necessary. Is there any analogous difference between the amateur who is introduced to radio by the surplus, or cheap market, and the factory which secures free samples from the Radio Industry? A most recent survey of the number of home-built TV receivers by a contemporary of ours has shown this figure to be as high as 300,000. Not many of these sets could possibly have been made without the purchase of a great number of new components. Yet today, little effort is made by the manufacturers to assess and value this huge market.

For nearly two years, this magazine has tried to persuade the B.B.C. to transmit Test Card 'C' for a short spell in the evenings.

Surely a number, the magnitude of 300,000 is worth some consideration. It would be interesting to know how many 'custard tarts' described by Phillip Harbin have been made. Yet the presence of the Navy, Army and Royal Air Force at the various exhibitions shows that Whitehall is thoroughly aware

that in the event of a national emergency the ranks of the ardent amateurs must largely provide the future radar operators who would be needed. Even Parliament cannot train a conscript into a useful wireless mechanic in eighteen-months.

Once again, the amateurs have opened up a new band, on two metres. It will be interesting to see how long a period elapses before the authorities seize it. This has had a precedent on practically every wave-band in use today.

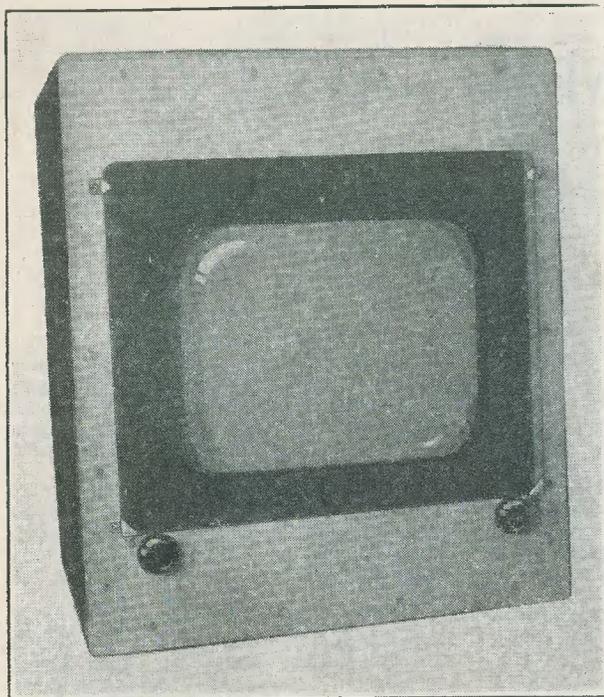
One highly gratifying movement between professionals and amateurs is the forthcoming Television Society's transmitter to be opened next year in Surrey. This will transmit on 427 Mc/s. (The *Radio Constructor* will in due course publish a converter as a front-end for existing TV receivers). Why not more of this collaboration, and less complaining about Lisle St.?

Today the Radio Industry is feeling the benefits of this introduction, but regrettably is not fully supporting the amateur or the retailer in presenting his products for inspection at the shows designed for this purpose.

A shrewd gentleman this Mr. Orr-Ewing. In passing thanks to all the patient and long-enduring ladies often 'divorced' from their gentlemen for the "many hours spent in the shack," he certainly produced food for thought. Yes, gentlemen, quite a reflection!!

After a most enjoyable lunch, to the show. A few interesting items were on view and quite a collection of short wave gear. Some QRT, others working models. Of these, perhaps the most adventurous was the amateur TV station. The transmitted pictures were quite good, and we have invited this society to further their cause, if they so desire, in the pages of the '*Radio Constructor*.'

Naturally your writer's main interest at the Royal Hotel was the 'Magnaview.' This was on the English Electric Co's stand, and we spent a considerable time during the four



*This version of the "Magna-View" consists of a table cabinet containing the tube, timebases and power supply, thus providing a standard output on which the constructor may rely for trying out various types of vision strips. This constructor also has his sound arrangements in unit form so that experiments may also be carried out there in a convenient manner.*

days of the Exhibition answering queries regarding our TV.

Undoubtedly the most repeated question was "How much does it cost to build?" Quite frankly, this is one we have avoided. In the first place, it is quite impossible to know from day to day just what the purchase tax is likely to be on any component, and this is clearly seen if one recalls waking up the other day to discover that loudspeakers were taxed to the extent of 66 per cent.

Cathode ray tubes of the Magna-View size carry about £8 in tax, which is absolutely ridiculous, so you see what we mean. Nevertheless, it is possible to produce some of the several versions suggested for this set very reasonably. The best course to take would be the construction of the timebase with suitable power-pack, and for the latter with its economical requirements we did provide several alternatives.

With this arrangement a quasi-installment plan could be carried out. As shown, a 9" or 12" tube would establish the circuitry and linearity of raster. An existing vision/sound strip to provide tube modulation and

sound and at once the constructor has a 'Magnaview' in embryo. Thus as he recovers from the first financial depletion, the five channel vision/sound strip could follow, and the real joy, the large screen tube.

Despite the very bad weather that was endured throughout the Exhibition, a great many visitors appeared from far-off places. As might be expected, a great many were wondering if the five-channel super-het would bring TV to their homes. This is always a difficult poser. It must be realised that pure geographical disposition is not always an indication of expected results. It may surprise some readers to hear that we know of a technician living within stone-throwing distance of Alexandra Palace who has found it necessary to employ an aerial of the type normally used for fringe reception. Conversely, we all know of the many recorded successes that would almost suggest Dx results.

As stated in the issue dealing with the 'Magna-View' receiver, this set is sensitive to about 20 microvolts, which, given average conditions, is about eighty miles.

However, a considerable increase can still be effected by direct coupling between the oscillator and mixer grids. A 2pF condenser is satisfactory, and ensures greater injection than the present method of inductive coupling. Rest assured, no TRF receiver is ever likely to be as efficient as a well designed super-het.

It must be emphasised, and this crops up regularly, that we know of no valves as yet to replace the 6U4G, and the 6CD6G. The fly-back voltages in this circuit would almost certainly cause the collapse of substitutes.

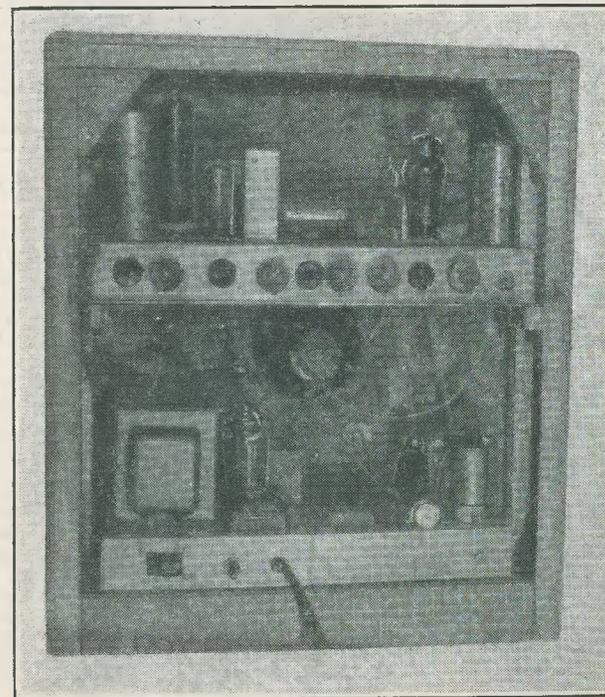
Your writer has on many occasions pointed out that the HT voltage must not be raised beyond 250V, and we thoroughly dislike the idea of resistors to drop the voltage on existing power packs which deliver high voltage. Resistors are prone, when subjected to much dissipation of energy, to become direct-path vehicles, and once again we do urge you to take the article in the June issue seriously.

Some interest has been aroused by the mention that a radio-tuner for the 'Magna-View' will be available soon. A little advance information is that it will occupy a small

cabinet by Messrs. Ashdown, which will conform to the structural design of the main TV cabinet. When in position on top, the general appearance suggests one large elegant cabinet, with master-switch to select either radio or TV. This will commence next month.

Many queries, of course, have now been answered both by post and in the pages of the 'Radio Constructor.' We realise this new technique may be a little confusing, and it is obviously more satisfying for you to be sure. All we ask is, if in doubt, write! Several constructors are producing their own versions as expected, and the photographs shown depict one such successful example. Based on the Pye strip, well known to you all, this is a jolly good effort. We have actually seen this one in operation in the London area, and here again the reader who made it experienced no difficulties at all. The modulation, seen on the English Electric tube in this case, was very good indeed. Readers who missed both the National Radio Show, and the R.S.G.B. Exhibition may be interested to know that the 'Magna View' will be seen at the Television Society's Exhibition in January.

*This back view of the table cabinet shows the arrangement of the timebase (above) and power supply chassis (below). The layout of the timebase is slightly different to that which has been described previously, in order that the pre-set controls may, in this case, be more conveniently arranged, a long the rear side of the chassis. It will be noted that the tube has been dust-proofed in the recommended manner — before this was done, whilst in the testing stage, it was found necessary to clean the tube face every three days!*



Is it really necessary to entirely shroud the tube? The design as given in the "Radio Constructor" aroused some considerable interest because of its originality. In point of fact, many hours were spent in arriving at the finalised layout given. Many factors were taken into account, viz one that would fit the cabinet, be easy to instal, be easy to remove, possess a very high safety factor (particularly in the case of metal-backed tubes), but above all a design that would obviate that infuriating and frequent necessity to clean the tube screen.

Some of the CRT's described in this journal have static screens, which may very well be described as magnets, in so far as their attraction of dirt is concerned. A simple experiment demonstrating this action most of our readers have probably carried out at parties.

The trick referred to is to stand on end a threepenny piece and to lay across the top of this, at right angles, an ordinary matchstick. The trick is to remove the matchstick without touching it or the coin, or handling either in any way. The guests are astonished when you simply take a comb, pass it two or three times through your hair (if any) whereupon bringing the comb near to the match will cause the latter to jump up in the air towards the comb.

Resuming technicalities, it will be seen what is likely to happen with the tube screen made similarly electro-static by some 12kV. (It is not believed that any reader's hair will develop this voltage !).

## LITERATURE RECEIVED

**Watts Radio (Weybridge) Ltd.** Have favoured us with a copy of their 1953 Catalogue. This is a well printed booklet of 24 pages literally crammed with items ranging from valve top caps to tape decks. Available from 8 Baker Street, Weybridge, Surrey.

**Mullard Ltd.** *The Amateur's Guide to Valve Selection* is the title of a book which should be of interest to most of our readers. It contains essential technical data on all Mullard valves and tubes currently being used by professional designers and which are recommended for use by the radio amateur. The conditions under which these valves should be operated in order to achieve optimum performance is indicated, and a section is included which gives full details of a number of circuits for battery and mains driven receivers and amplifiers. This book can be obtained from radio dealers at 1s 6d per copy. A. T. Sallis. List No. 9 is a duplicated catalogue containing details of over 400 items of ex-Govt. radio and electrical equipment cur-

Taking the design in all its aspects it must be said that there is everything to gain, and nothing to lose, by employing our design. (NOTE: At any parties you may be attending, you are advised not to use the tube in order to demonstrate the party trick described above—Ed.).

### Note on the 'Magna-View' Vision and Sound Receiver

A most unexpected point has arisen in connection with the 5-channel vision/sound strip line-up. A constructor reported complete failure to secure synchronisation. Fortunately, this reader was geographically accessible and we were able to render first aid. Primary examination showed everything to be perfectly normal electrically. However, the clue to this fault was soon discovered due to the tremendous output of the sound against rather weak CRT modulation.

Readers may already have guessed the fault. The 'Magna View' receiver is designed for single sideband; thus, if this receiver is aligned for the lower and not the upper sideband, the obvious effect will be that the sound channel will be at its loudest signal level, but the sync separator will be unable to perform its natural function of clipping off the picture section of the transmitted signal. (See Television Waveforms, *TV Fault-Finding*).

Readers should analyse the above carefully; the symptoms which will effectively rescue anyone from this error are loss of sync, weak picture and sound stronger than normal.

rently available. We found several items listed which we had been unable to trace elsewhere, so were really pleased to receive this list. The price is 6d post free, and the address is 93 North Road, Brighton, Sussex.

**Multicore Solders Ltd.** *Considerations of Soldering Technique in Radio and Television Assembly* has been produced in response to requests for a transcription of a Paper delivered to the Australian Institute of Radio Engineers in Sydney. The Paper was first recorded on tape by the Managing Director of Multicore Solders Ltd., Richard Arbib, and was then flown to Sydney. The brochure contains a wealth of information on the subject of soldering, and we can recommend it to all those who are pestered with dry joints! Copies are available free of charge on receipt of a stamped, self addressed envelope, which should be sent to Multicore Solders Ltd., Advertising Dept., Multicore Works, Maylands Avenue, Hemel Hempstead, Herts.

# A LIGHT PROGRAMME "BOOSTER"

With particular reference to the "CONSTANT COMPANION" Receiver

By J. R. DAVIES

Although most of the people who built the Constant Companion receiver (described in the *Radio Constructor* for May to September, 1951 inclusive) obtained satisfactory results, a few readers who live in outlying districts have had difficulty in receiving the BBC Light Programme transmissions on 1500 metres at adequate strength. In order, therefore, to assist these readers to obtain the best from their sets, this short article describes a Light Programme "booster" which may be easily added to their existing receivers. As is explained at the end of the article, the unit may be used to improve reception of the Light Programme with most other types of receiver as well.

The "booster" consists, mainly, of an RF pentode, whose anode is coupled aperiodically to the aerial input of the receiver, and a two-way switch which enables either an aperiodic or a tuned circuit to be connected to its grid. The pentode obtains its HT and LT supplies from the receiver. Fig. 1 shows the circuit.

It will be seen from this circuit that the two-way switch may be set either to "Normal" or to "Boost." When it is set to "Normal," the pentode acts as an aperiodic amplifier, its grid circuit being completed by the resistor R1 and its anode circuit by the choke L3. Under these conditions the pentode gives little amplification. At the same time, however, it offers the advantage of removing the aerial loading from the receiver tuned circuits, thereby ensuring, in some instances, smoother operation of the "progressive" reaction circuits. With the switch in the "Normal" position, the receiver may be operated in the usual manner both on medium and on long waves.

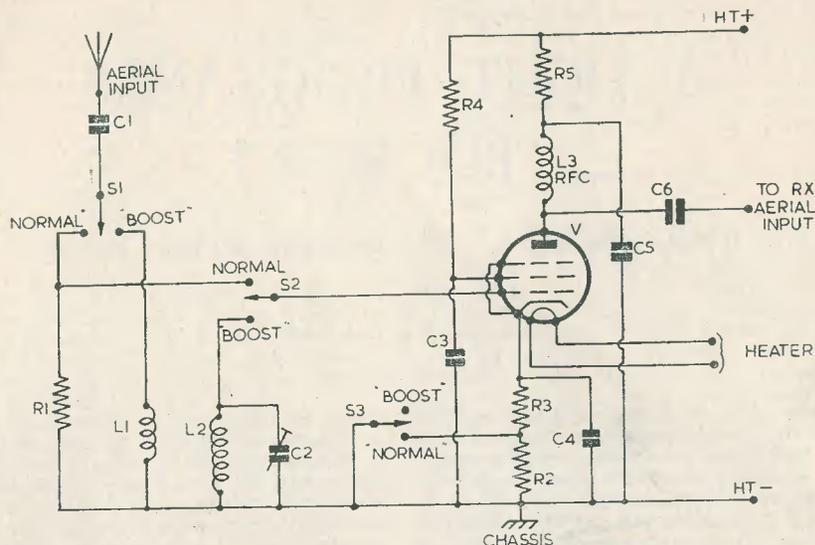
When the switch is set to "Boost," the aperiodic circuit connected to the grid of the pentode is removed; it being replaced by the tuned circuit L2/C2. This tuned

circuit is pre-set to 1500 metres, and allows the booster to offer a large amount of gain at this wavelength. It may be noticed that the section S3 of the switch introduces an additional resistor, R2, into the cathode circuit of the pentode. The purpose of this resistor, together with its value, will be discussed later.

### Supplies

The process of feeding the necessary supplies to the booster is shown schematically in Fig. 2 (A). HT is obtained by tapping from any convenient HT positive point in the receiver, such as pin 4 of V2. Any of the chassis tags on the receiver may be used for the HT negative connection. The HT negative connection will also give, of course, a link between the two chassis. The heater supply is obtained by breaking, at V3 valveholder, the lead joining the heaters of V2 and V3, the heater of the booster pentode being inserted in series. There is no necessity to alter the value of the line cord.

In order to prevent the necessity of having the booster permanently wired to the receiver, some form of plug and socket connection will be required. The best method of doing this consists of fitting a socket to the back of the receiver and allowing the booster to plug into this. Fig. 2 (B) shows the arrangement, and numbers also the pins which could, perhaps, be employed if an octal valveholder were used as the socket. There may be times when the booster is not required at all; using this system, its plug can be removed from the socket and a dummy plug fitted in its place. The dummy plug would not only "cover" the live contacts but would also ensure that the heater circuit between V2 and V3 in the receiver was once more completed.



RC 86

Fig. 1

Resistors

- R1 25 kΩ
- R2 see text
- R3 500 Ω
- R4 100 kΩ
- R5 10 kΩ

Coils

- L1, L2 PA1 Coil (Wearite)
- L3 All-wave Choke

Valves  
V EF39 or VR53

Capacitors

- C1 100 pF
- C2 see text
- C3, 4, 5 0.05 μF
- C6 100 pF

Switches

- S1, 2, 3 3-pole, 2-way, "Normal-Boost" switch

Practical Details

Little difficulty should be experienced with the practical layout of the booster. Most of the predictable troubles will be caused by unwanted inductive coupling between the booster coil and that in the receiver, and by possible capacitive coupling between the aerial input to the booster and the aerial lead from the booster to the receiver. The unwanted inductive coupling may be reduced by standing the booster on the left hand side of the receiver, this being the side further away from the coils. The capacitive coupling can be minimised by keeping the two aerial leads well away from each other.

A lay-out for the booster is given in Fig. 3. It will be seen that the PA1 coil is mounted with its axis horizontal, this being done to reduce further any possible coupling it may have with the coil in the receiver; and also

to minimise coupling with the anode choke L3. The chassis itself is very simple in design, all components relative to the grid being mounted above and all anode components below. A small vertical screen is fitted to the right of the chassis (looking at the front) in order to partly screen the grid components from the receiver. The output terminal, to which the receiver aerial lead is connected, is fitted at the right hand side of the chassis, whilst the aerial input terminal for the booster itself is at the left (also looking at the front).

Coils

A capacitance of between 200 and 275 pF will be needed to tune the PA1 coil to 1500 metres. This capacitance is shown as C2 in Fig. 1. It may consist either of a fixed capacitor with a trimmer in parallel, or of a padding-type capacitor which covers this range.

The anode choke may consist of any small, but reliable, all-wave choke.

Setting-up

When the booster unit has been built, it will be necessary to set it up. Before starting, however, a 2,000 ohm resistor should be temporarily fitted in the R2 position.

To commence the setting-up procedure, the booster should primarily be connected up to the receiver, the latter switched on, and the whole equipment allowed to warm up. The booster should next be switched to "Normal" and the receiver reaction capacitor (C7 in the receiver circuit) set to its optimum position.

The receiver should then be tuned accurately to 1500 metres on the long wave band. Should

Should such a condition be found it may be remedied by adding or subtracting fixed capacitance; or, if a padding-type trimmer whose minimum capacitance is still too high has been used, by connecting a fixed capacitor, in series.

Once the tuned circuit in the booster has been trimmed up accurately, the optimum value of R2 can be experimentally determined. The point to aim at here is to discover the minimum value for this resistor which does not allow instability to occur. If care has been taken with the construction of the booster unit it will, in many cases, be found possible to omit the resistor altogether; thus allowing maximum gain to be obtained in the "Boost" position.

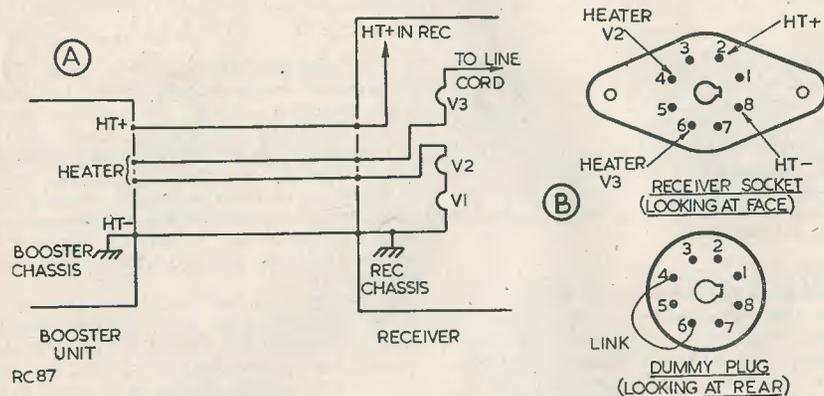


Fig. 2

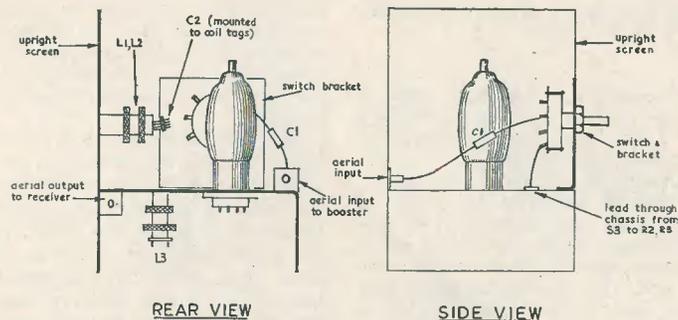
it be possible to hear the Light Programme transmitter, even if only faintly, this process will, of course, be quite simple. When the Light Programme is too weak to be heard at all, however, an approximate setting will have to be made. This setting can be corrected later as the booster is trimmed up.

The booster switch should now be put to the "Boost" position. Even with the tuned circuit trimmer (C2) badly off-set, an increase in programme strength should be at once apparent. The trimmer should then be adjusted until maximum strength is obtained. Care should be taken to see that the optimum point is not outside the range of the trimmer: i.e. that its minimum capacitance is not too high or its maximum capacitance is too low.

Mains Modulation

Owing to the nature of the aperiodic coupling existing when the booster is set to "Normal," it is possible that mains modulation may occur when large aerials are used. The Constant Companion was intended mainly to work with short aerials whose capacitance to earth is low; and the circuit of the booster unit was designed also with this end in view. If mains modulation should occur with a short aerial, it will be possible to clear it in almost every instance by reversing the mains plug.

If a large aerial is being used, however, and mains modulation occurs, reversing the mains plug may not always effect a cure. In this case, an additional all-wave choke should be



A LIGHT PROGRAMME BOOSTER  
FOR THE CONSTANT COMPANION

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Fig. 3

connected in parallel with R1, it being mounted by the side of the PA1 coil and with its axis similarly horizontal. If the additional choke is of the same manufacture and type as that already connected in the anode circuit, their resonant frequencies will be similar. The resistor R1 should, nevertheless, damp the grid choke sufficiently to prevent any trouble occurring on this score.

#### Conclusion

In conclusion the writer would like to point out that, although intended primarily for use with the Constant Companion, the booster unit described here may be coupled to almost any other receiver which has difficulty in receiving the Light Programme adequately.

It may, alternatively, be used to boost Third Programme transmissions, the only change then necessary being the substitution of L2/C2 by a PA2 coil and the requisite value of trimmer. The heater supply to the booster can, of course, be obtained from any source of 6.3 volts, or from any series heater supply of 0.2 amps. Series heater supplies of 0.15 or 0.3 Amps would necessitate the use of, say, a 12K7 or 6K7 (or their equivalents) respectively.

It should also be noted that the chassis of the booster unit is at mains potential as is, of course, the chassis of the Constant Companion receiver itself, and that the usual precautions against shocks, etc., must therefore be observed.

your readers help me? The size is approximately 18" x 10" x 9" deep.—  
T. W. HANNEN, 2 Crescent Road, Bournemouth, Hants.

#### THANKS

Dear Sir,

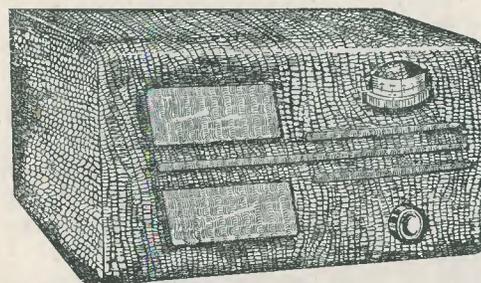
Please can you insert in "Mailbag" at some future date, at your convenience, a word of thanks to all your readers who have kindly come to my assistance with regard to the Type 21 ex-Army transmitter.

I have had numerous offers of, and also many copies of, data concerning this unit. Some letters I shall be answering personally, but owing to the fairly large number of letters received this is impossible in each and every case.—

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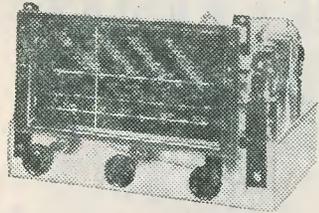


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(Continued on page 327)

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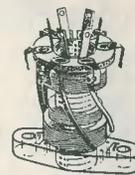
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Continued on page 328)

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