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and incorporating

ALL-WAVE ALL-WORLD DX NEWS

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THIS month's front cover continues our series of photographs taken in the modern factory of the Rola Company, situate on the Boulevarde, Richmond, alongside Melbourne's famous Yarra River. Many highly-skilled girls assist in the production of Rola Loudspeakers.

CONTENTS.

EDITORIAL

I read in the "Newspaper News" that broadcasting station 2UE decided to increase their advertising rates (their first rise since 1940) as from April 1st. They advertised this fact, then found that it was impossible to get a printer to print the new rate cards, so they had to postpone the increase until May 3rd.

That is not a joke.

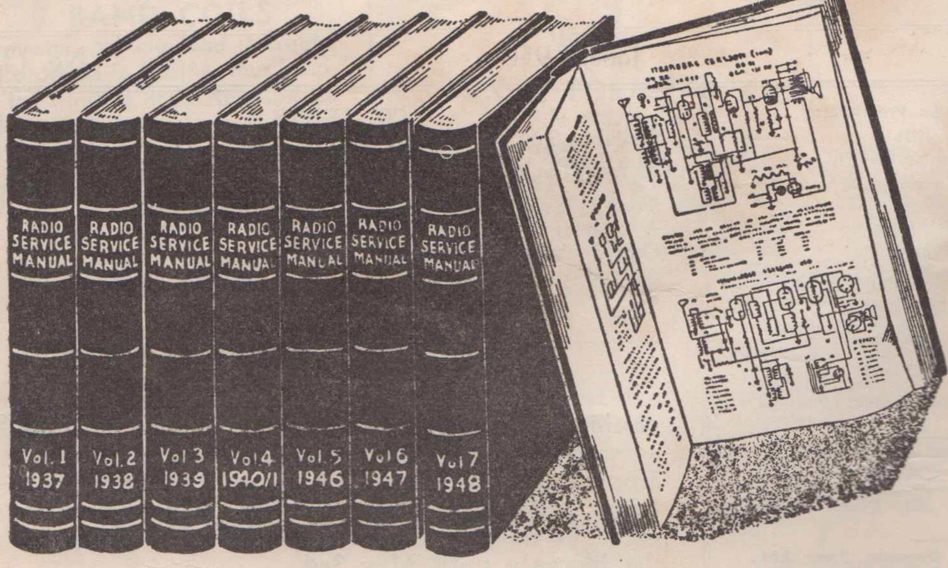
It is a fair summary of the printing game as I have found it for some time past. To get any printing done at all seems to call for more than mere love or money. To get a printer to tie himself up to a regular monthly periodical seems to be tougher than winning the lottery.

All of which is the start of the alibi for the late arrival of this issue. After much battling, quite by accident, I came across a printer fellow who was civil to me. It took some time to recover from the shock, but now he is on the job, and it looks as though it will be possible to have a June issue out on time, if we skip the April and May issues! A sad state of affairs, but the prospects are much brighter.

For years past the printing job and its economics have been like the sticky stuff on the fly-paper, holding back any possibility of turning out the sort of periodical I know you would appreciate; so let's all join in wishing the new printer lots of luck.

Yours faithfully,
A. G. HULL.

Just Out!



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Reliable Tuning Unit

Air testing a chassis using one of the latest Aegis tuning units brought home to us the amazing performance which can be obtained with the modern home-built chassis. Up till then we had not fully realized the value of a pre-fabricated r.f. end.

GOOD things abound in these modern times, so that we do not always appreciate them. A few years ago there was a demand for kits of coils for powerful all-wave receivers, but those on the market left much to be desired when it came to general performance.

Recently we had occasion to come across a set built up to use the recently-released Aegis all-wave tuning unit. A certain amount has been heard about this unit, but not nearly as much as it deserves. It makes simple the task of building up an all-wave chassis of outstanding performance. The particular chassis which we tested gave the most brilliant results. Perhaps a few of the best of the American communications receivers might match it, but we doubt if any Australian factory-built set is in the same class.

The Aegis unit, which is the basis of this receiver, is an expensive item. But what isn't these days? Plates for my camera cost 7½d. each now, as against less than 2d. before the war!

The unit is not just a set of coils, either, as it is really a complete r.f. amplifier ready to place on the chassis. It has its own sub-panel assembly, valve

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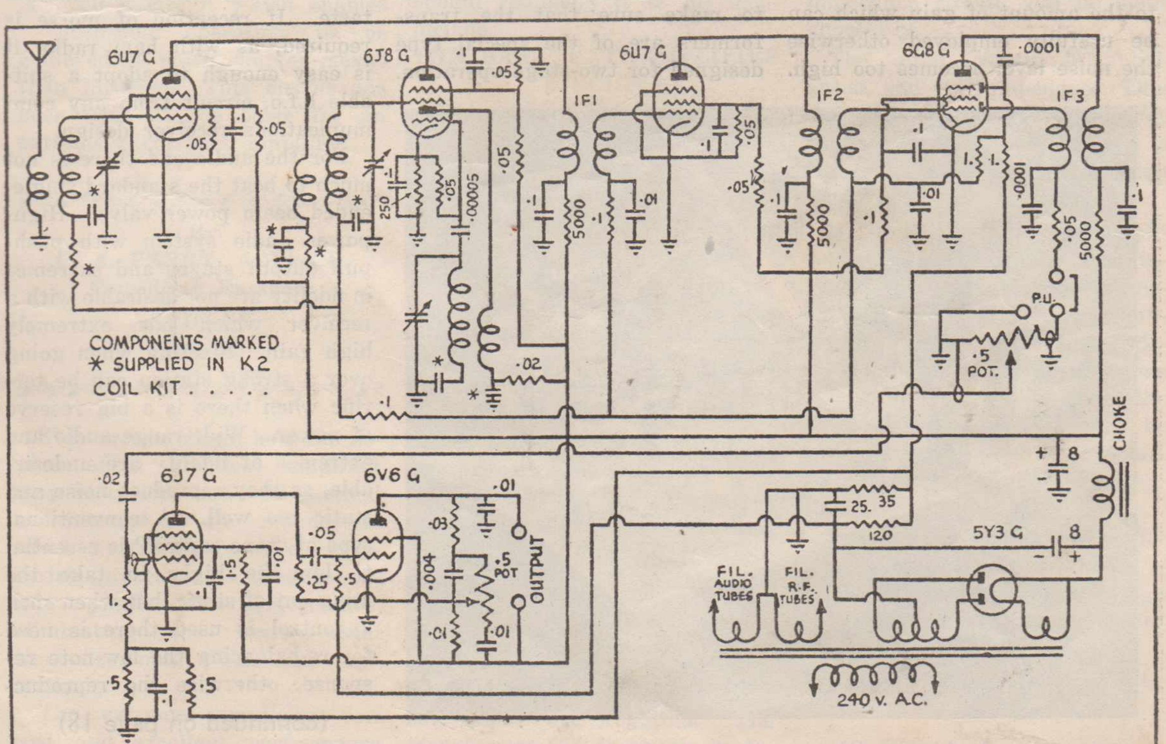

ALL-WAVE SET
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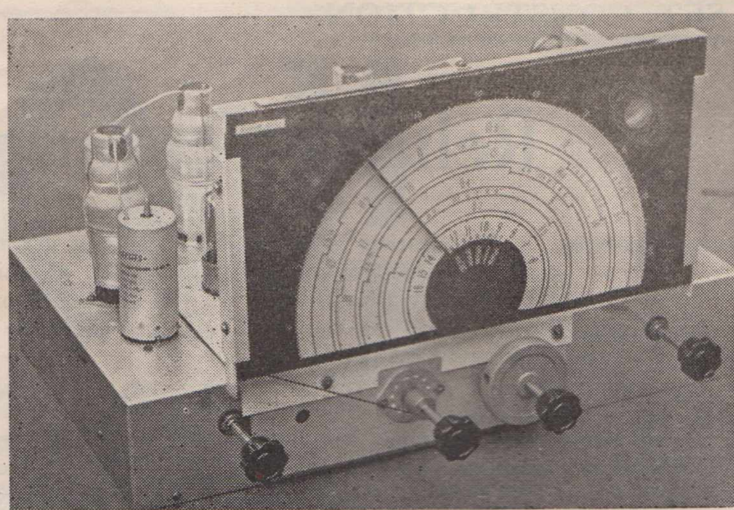
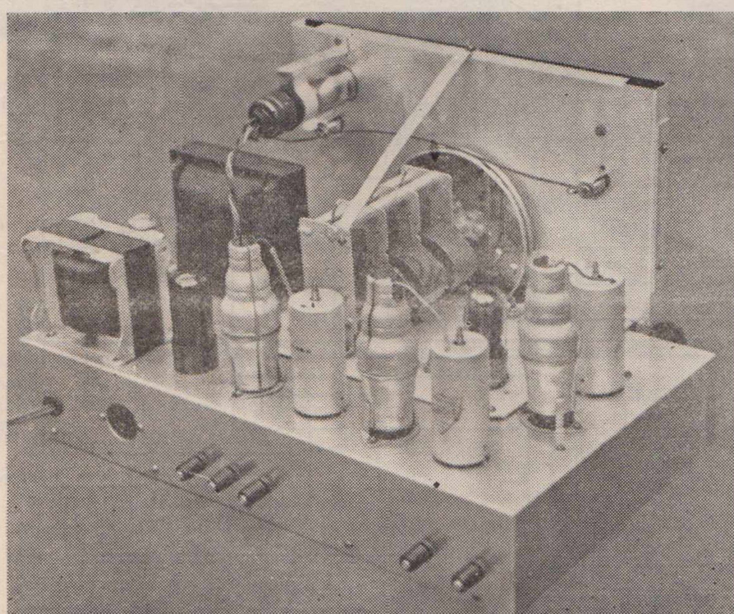


sockets, three-gang tuning condenser, dial, etc., and is ready-wired with its own resistors, bypass condensers, padders, trimmers, and so on. It makes the construction of a powerful multi-band receiver an easier job than building a straight broadcast receiver. The finished set is a receiver with performance better than anything you can buy for less than about a hundred pounds, so it is hardly fitting to make an issue of the price of the tuning unit.

The Circuit.

The wiring of the unit finalizes the circuit which is to be used for the r.f. end of the set, but there is plenty of scope for individual taste in the rest of it.

First point to decide is whether to use one or two intermediate stages. One stage can give ample gain, as there is a limit to the amount of gain which can be usefully employed otherwise the noise level becomes too high. But if a single stage of i.f. is designed for optimum results in both gain and selectivity, then there is often a slight shortage of selectivity when it comes to the finer points of separating DX stations. Extreme selectivity calls for two stages of i.f. amplification, but it is most important to make sure that the transformers are of the special type designed for two-stage operation. The aim is to get extreme selectivity, but not too much gain, as would be obtained if two stages were employed with standard types of intermediate transformers.



There are several arrangements of detection with a.v.c. which can be used, according to taste. If reception of morse is required, as with ham radio, it is easy enough to adopt a suitable b.f.o. circuit from any communications receiver design.

For the audio end there is not much to beat the standard single-ended beam power valve. High-power audio system with push-pull output stages and extremes in fidelity are not desirable with a receiver which has extremely high gain. Blasting when going over a strong station can be terrific when there is a big reserve of power. Wide-range audio and extremes of fidelity are undesirable, as they reproduce noise and static too well. A conventional type of "tone control" is essential to lop the highs to take the sting out of static, but when such a control is used there is need for re-balancing the low-note response, otherwise the reproduc-

(continued on page 18)

The Parry Cathamplifier

The original Parry cathamplifier was first featured in the "Radio and Electrical Weekly," and has aroused widespread interest. This circuit represents a substantial improvement in amplifier technique and "Australasian Radio World" is happy to be able to present this feature article.

By special arrangement with the designer, "Radio World" has obtained the design procedure and data relating to the prototype 15 watt amplifier.

Of particular interest to experimenters and technicians the article shows how an amplifier of required performance may be designed on paper and constructed to substantially verify expectations.

This unique development permits an amplifier to be constructed with only a few components, yet will give less than .5% distortion at 15 watts output for only a fraction of a volt input.

THE author has recently developed a circuit which enables push-pull operation to be achieved by much simpler means than hitherto. This circuit has been used as the basis for an extremely compact amplifier.

By
C. A. PARRY, A.M.I.R.E.
Consulting Engineer
SYDNEY
N.S.W.

This article shows how the design of a practical amplifier may be carried out. Of particular interest is the manner in which a straight-forward engineering procedure is used to obtain predictable performance, eliminating the more usual time-consuming "cut and try" methods.

The extreme simplicity, low cost and excellent performance of this remarkable amplifier should commend it to all technicians.

THE BASIC CATHAMPLIFIER CIRCUIT

The basic circuit used to obtain push-pull operation is shown in Fig. 1a. Figs. 1b. and 1c. show varations of this. Fig. 1b. does not require a centre-tapped transformer, and Fig. 1c. permits both A.C. and D.C. balancing of the output valves.

A transformer "T" is placed in the cathode circuit of the output valves as shown. The circulating (A.C.) current of the valves produces a voltage across the primary, the magnitude being adjusted by "R." By means of the transformer a voltage in correct phase can be fed into the grid of valve 2, so obtaining push-pull operation.

The circuit has a number of advantages as far as push-pull operation is concerned. Very few parts are required. The transformer "T" is simple in design, and, because it is in a low impedance circuit, can be small physically.

The input circuit is unbalanced, and high impedance. Thus the push-pull stage can be fed by a high-gain pentode and a high-gain amplifier of compact construction is possible.

If feedback from the output stages is contemplated, the influence of the cathode transformer is relatively small, simplifying design. Also, since adequate sensitivity with only one extra stage becomes feasible, the feedback voltage need only be applied over two stages, ensuring much greater inherent stability.

The balance adjustment "R" is only small in value, hence a stable wire-wound resistor may be used, and great stability of adjustment assured.

When balanced it may be shown that,

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CATHAMPLIFIER
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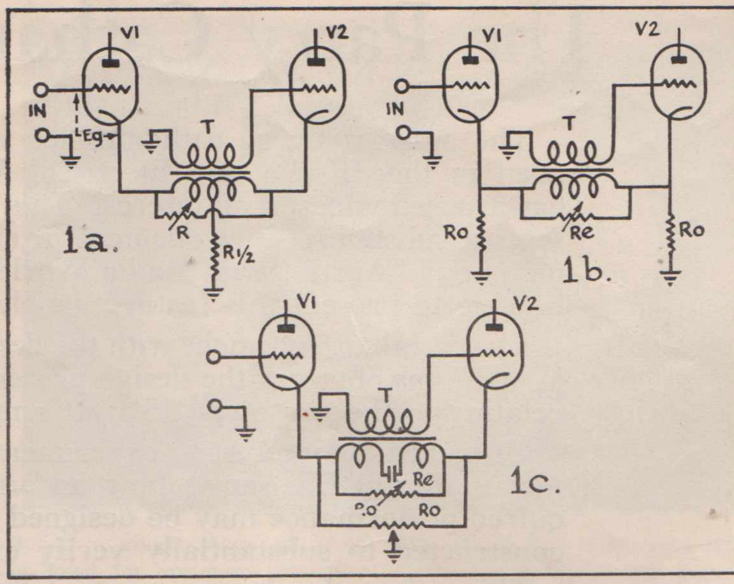

$R = 1/G\ (T - \frac{1}{2})$.

Where G= the change in cathode current for a given change in grid voltage

T= the ratio secondary to whole primary of the cathode transformer.

Other formulae may be developed for distortion, sensitivity and so on.

Balance is easily adjusted, either by observing equality of grid voltages or by obtaining minimum A.C. voltage from the centre tap of the primary of the cathode transformer, to earth.

The choice of the transformation ratio "T" is an arbitrary one, but should never be less than 1. The value selected by the author for the initial design was 3.3.

INITIAL CONSIDERATIONS

If advantage is to be taken of this circuit, to develop a compact and simple amplifier, at what point should we start? Using popular trend as a guide, it seems that for a first design, a 15 watt unit is reasonable.

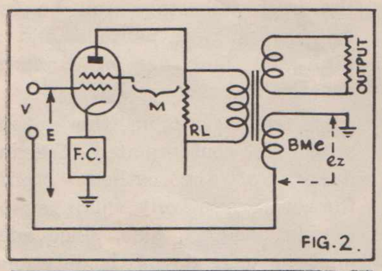

FIG. 2.

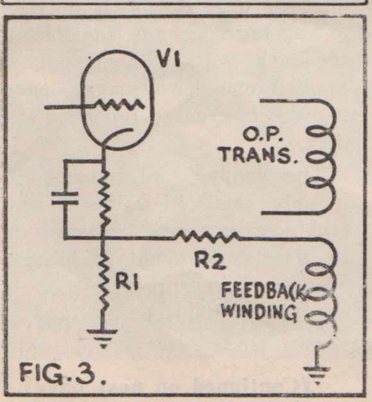

FIG. 3.

If this output can be obtained for less than .5 volt input, then the amplifier might be regarded as a basic amplifier unit. The ideal requirement of such a basic unit can be readily stated.

(a) Size—small, simple, compact.

(b) Response from 30 to 15,000 cycles plus or minus 1 decibel.

(c) Adequate speaker damping.

(d) Low harmonic distortion (less than 2.5%).

(e) For 15 watts output, less than .5 volt input.

(f) Good inherent stability.

(g) Low noise.

There may be some who will maintain that bass and treble boost should be included by adaptation of the feedback circuit. Such arrangements complicate the design, and quite often reduce the speaker damping or introduce instability, and cause more trouble than they cure. They represent bad engineering method. The basic amplifier should be regarded as an integral part of the speaker system. The whole unit—amplifier plus speaker—may well be regarded as the electro-acoustic transducer. The characteristics of the amplifier must help to overcome and supplement the shortcomings of the speaker system. If correction units are required, as undoubtedly they will be, then they should be placed between the input circuit and the basic amplifier.

Attention to this important principle would eliminate a great deal of the controversial discussion of amplifier "quality."

VALVE SELECTION

In order to take full advantage of the possibilities of the circuit, careful valve selection is necessary. If sufficiently sensitive valves can be used, feedback may be applied over, perhaps, only two stages, yet the resulting sensitivity may still be adequate.

A combination of EL35's for the output, driven by a resistance-coupled 6AU6G stage is an interesting suggestion, and after some preliminary calculations, was used for a trial design.

Using the manufacturer's curves it is possible to tabulate expected operating conditions. Thus we obtain table No. 1:—

The figures obtained from this table may now be used to proceed with the design of the feedback circuit and predict the overall performance.

DESIGN PROCEDURE

The circuit on Fig. 1b. will be used for the output circuit. Taking the constants already shown, the value of the balancing resistor "R" calculated at a low signal level is 67 ohms. Although the value required foı balance varies with different signal levels slightly, a 100 ohm potentiometer will suffice. We get an anticipated distortion (without overall feedback) of about 6.8%. The full output should be obtained with a grid to earth A.C. voltage (output valves) of only 15 volts R.M.S.

TABLE No. 1

Output Valves.	
Volts anode to cathode (max. sig.) (less drop in transformer)	=295
Volts screen to cathode (max. sig.)	=295
Bias (no sig.)	=17.5 v.
Valve current (x2) (no sig.)	=130 mA.
„ „ (max. sig.)	=150 mA.
Bias resistor (per valve)	=135 ohms.
Bias at max. sig.	=20 volts
H.T. supply at max. sig.	=315 volts
Transconductance (low sig.)	=8.5 mA/V
„ (med. sig.)	=6 mA/V
„ (large sig.)	=5.4 mA/V
Amplification factor	=191
A.C. plate resistance (per valve)	=22,500 ohms
Recommended load (per valve)	=2250 ohms
Watts output	=20 watts
(Due to slightly higher supply voltage this will be somewhat greater than 20 watts).	
Probable distortion for 20 watts (primary)	=4%
Output for transformer efficency of 75%	=15 watts
Grid drive for full output	=18 volts peak
Driver Valve	
Anode load resistance	=200,000 ohms
Anode current	=1 mA
Cathode current	=1.4 mA
Bias	=.75 volts
Anode volts	=100 volts
Screen volts	=40 volts
Transconductance	=2.5 mA/V
Bias resistor (for self bias)	=535 ohms
Following grid resistor	=.5 megohms
Effective A.C. plate load	=143,000 ohms
Screen dropping resistor	=675,000 ohms

Of the several feedback circuits which may be used, the most suitable for an amplifier of this type is to couple from the output transformer via a low impedance winding back to the cathode of the driver stage. The basic-equivalent of this (referred to the output valves) is indicated in Fig. 2.

There are generally two points at which the design may start. Either a given sensitivity may be considered, or a given effective valve impedance. This latter will be the basis for the design herein.

The magnitude of the valve impedance to be obtained is quite arbitrary. Good damping on the speaker (low output impedance and damping factor*) means low sensitivity. Too great damping, on the other hand, serves no useful purpose. A value of damping factor between .1 and .4 seems generally satisfactory. A figure of 1/7 is usually used by the author in initial designs. Allowing for some effect of the output transformer, and possible discrepancies between calculated and obtained results, the final figure so achieved is usually quite O.K. This value was used in the design of the prototype amplifier.

Thus from the valve constants we are able to obtain a value for the required feedback factor B=.425, referred to one output valve. When considering the transformation ratio referred to the whole primary, this figure is of course halved.

In Fig. 2 it is possible to show that

$$V=E\ (1 + BM/F).$$

Where M= nominal amplification

F= gain reduction factor.

This means that the feedback

(Continued on next page).

CATHAMPLIFIER

(Continued)

will reduce the gain by the value (1+BM/F) and thus the influence on sensitivity of the feedback constants may be determined. Also the amount by which distortion is reduced may be calculated.

Measurement of the ratio, Gain without feedback/gain with feedback, is a quite powerful method of determining that the amplifier is operating in accordance with expectations, and using the data mentioned, a value for this amplifier of 14 to 15 dB. was calculated. This is a comparatively low figure for a high-quality amplifier. However, as the estimated distortion with this feedback was quite low, no change to the constants so far determined was made. With a low value for the ratio referred to, the feedback loop is relatively easy to design and this reduces the possibility of inherent instablity; a factor which often is hard to eliminate and ruins an otherwise perfect piece of equipment.

* Damping Factor = Effective Valve impedance/Load impedance.

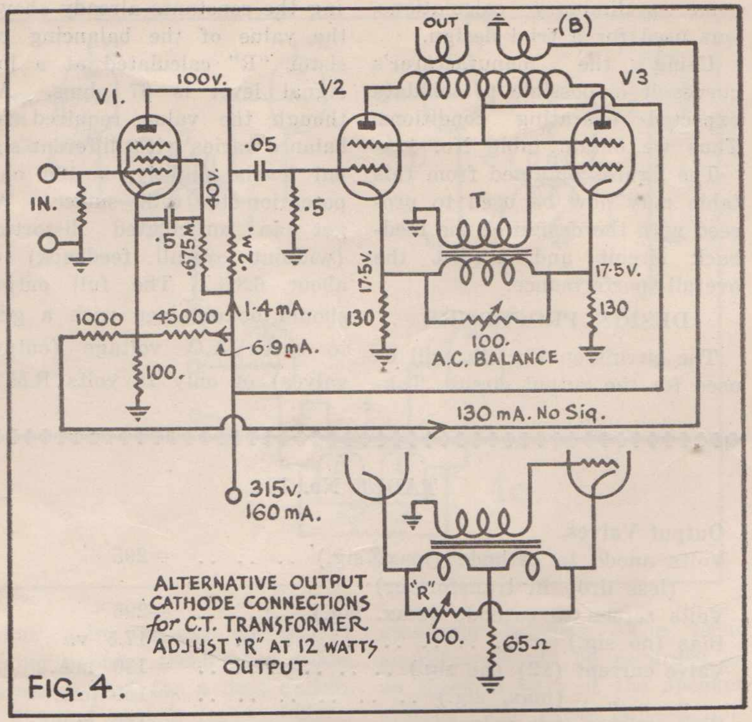

FIG. 4.

Once the essential behaviour of the equivalent circuit has been investigated the overall feedback circuit initially suggested may be examined. The arrangement of this is shown in Fig. 3. The choice of values for R1 and R2 is more or less arbitrary, but attention to small details permits considerable overall simplification. It will be readily appreciated that, if the gain of valve 1 is large, a large transformation ratio for the feedback winding could result. For instance, in this particular case it would not be unreal to calculate less than one turn for the feedback winding. A suitable ratio R1/R2 therefore considerably simplifies the output transformer design. Too large a value for R1 however would reduce the effective amplification of valve 1.

If R1 is carefully chosen the possibility of bias being obtained by additional bleed current is opened. The idealised arrangement is shown on the full circuit of Fig. 4. With the constants shown (the process by means of which the actual values were originally determined is beyond the scope of the present article) the effective cathode impedance of valve 1 is only 90 ohms. This value results in a

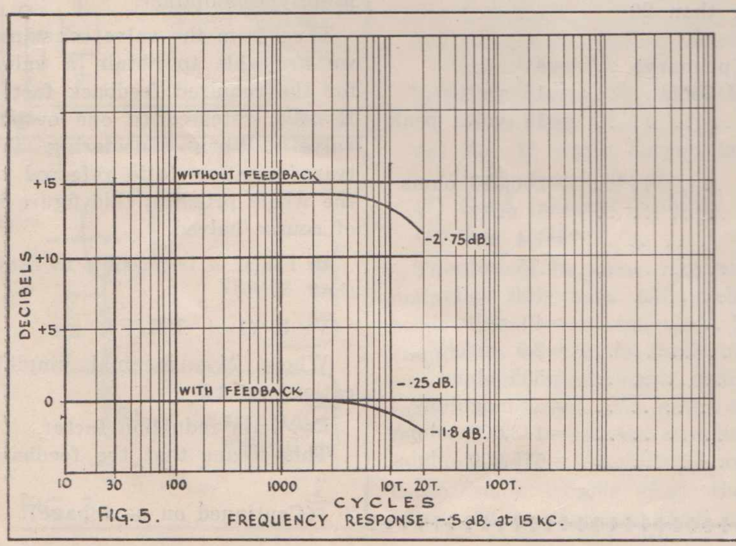

FIG. 5. FREQUENCY RESPONSE —·5 dB. at 15 KC.

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calculated gain of 290 for the 6AU6G stage.

Once this figure is obtained the transformation ratio for the feedback winding on the output transformer may be obtained.

Bb= B.Ra/Ga.

Where Bb=effective feedback factor expressed practically by the ratio, feedback turns/whole primary turns and referred to the output transformer.

B=feedback factor obtained from the equivalent circuit of Fig. 2.

Ra = ratio $(R_1 + R_2)/R1$ in Fig. 3.

Ga = gain of valve 1.

Using the constants determined so far Bb. = .008.

At full output the gain reduction by means of the overall feedback works out to a value of 5.4, and this enables the sensitivity to be obtained. The input to the grid of the driven output valve must be 15 volts, the gain reduction is 5.4, and the gain of valve 1 is 290, thus the input required is .28 volts. This

TABLE No. 2

(High tension supply 310 volts).

Voltages, etc.

Item	Estimated	Measured
6AU6G		
Plate volts	100	116
Screen volts	40	40
Bias volts	.75	.85+
Gain	290	296
EL35 Valves		
Bias no sig.	17.5	17.5
Cathode current no sig.	130	134
Output impedance (at 1000 cycles and referred to the 15 ohm winding)	2.14	2.3
Gain at maximum sig.	1	1
Ratio, Gain without feedback/Gain with feedback	14-15 dB.	14.5 dB.
Input volts for full output	.28 v	.24 v

is quite good sensitivity and means that the constants need not be changed until at least an experimental verification is obtained. If the experimental figure is reasonably close to this there would be no need to go to the trouble of further changes.

PERFORMANCE

It will be realised that all the component values for the full circuit of Fig. 4 have now been determined, and the anticipated performance figures of the complete amplifier have been calculated. The details in table 2 give measured data.

FREQUENCY RESPONSE

Fig. 5 shows the frequency response with and without feedback. The absence of appreciable loss without feedback, at low frequencies, means that full output may be expected.

LINEARITY

Linearity is shown in Fig. 6. The gradual departure from linearity is a desirable feature. The amplifier is essentially linear to 15 watts. The departure from linearity above this is to be expected despite the use of an efficient output transformer.

MODIFICATION

Slight modification to the circuit might permit slightly greater output. It is interesting to note that at the point at

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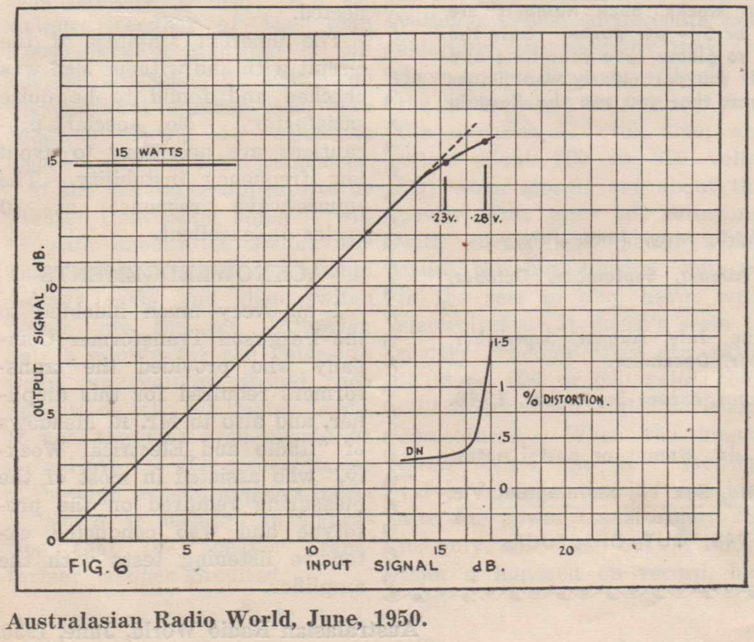

FIG. 6

CATHAMPLIFIER
(Continued)

which the output is beginning to have noticeable distortion, the output voltage is .28, the figure at which it was estimated full output should occur.

DISTORTION

On Fig. 6 is also plotted distortion at 500 cycles. At 15 watts the figure is excellent. Again it is interesting to note that at .28 volts input the distortion is 1.4%. This is close to the design figure. From the curves of Fig. 6, it would appear that the design figures are substantially correct, but that the output transformer is more efficient than that permitted in the initial design (so obtaining higher output in the load for the same power in the primary), but that, as expected, a slight degree of non-linearity near full output has occurred. A measurement of distortion at 60 cycles was attempted, and although less than 1% was obtained at 15 watts output, the distortion in the oscillator could not reliably be obtained, and so no definite value at this frequency can be quoted.

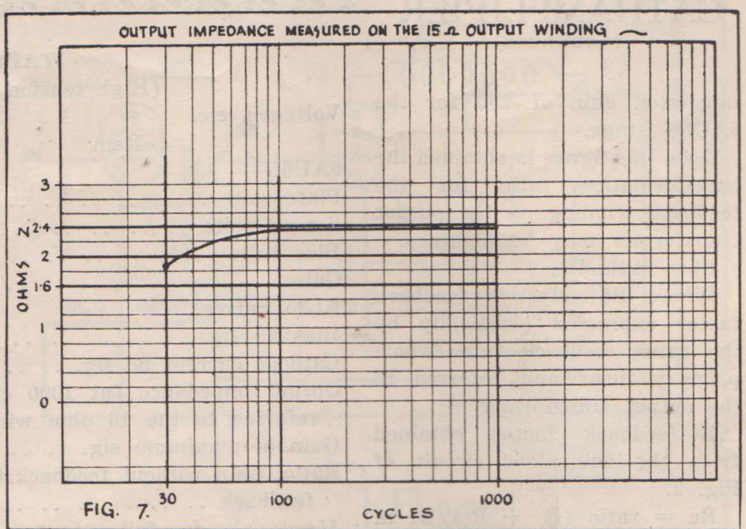

FIG. 7.

OUTPUT IMPEDANCE

Fig. 7 shows the absolute value of output impedance over the low frequency portion of the spectrum. This is measured on the 15 ohm load winding. As might be expected there is a drop at low frequency where the transformer inductance becomes effective.

STABILITY

A variation of plus or minus 35 volts on the H.T. supply varied the output at 1000 cycles by less than .1 bB. This degree of stability is of course to be expected.

The inherent stability of the circuit with and without load was checked and found to be quite satisfactory. No special precautions are necessary to avoid low frequency instability. The square-wave response at 30 cycles is excellent.

ACKNOWLEDGEMENTS

I am very much indebted to the Ferguson Transformer Company who provided the transformers required for this amplifier, and also to Mr. R. Meadows of "Radio and Electrical Weekly," who assisted in most of the measuring required on the prototype and who conducted extensive listening tests with the amplifier.

RESISTOR TROUBLES

From a practical radio serviceman comes this little article about resistor troubles and other causes of break-downs in receivers. It contains one or two hints which you should not miss.

FINDING the trouble in a broken down radio set is usually easy enough, but every now and then the repair man runs across a set which causes sleepless nights.

Such troubles as open-circuited speaker transformer windings are immediately evident when the routine voltage check is started. In fact, the first thing done after a chassis is upside down on the test bench should be to put the multi-meter across from the plate of the output valve to earth. Without switching on the set the first check should be with the meter set to read maximum ohms. If a resistance reading of less than 5,000 ohms is indicated it will not be advisable to switch on the set, but further resistance checking should be made to locate a broken down condenser.

If the resistance appears to be greater than 5,000 ohms it will be safe enough to switch the multi-meter over to the maximum voltage scale and then switch power into the set. Allowing half a minute for the valves to warm up, voltage should then appear on the voltmeter scale. If not, the test prod should be moved over to the screen to see if the high tension appears there. If so, it is usually an indication that the speaker transformer is open-circuited.

You may wonder why so much stress is laid on the speaker transformer, but checking over records for the past twelve months has revealed that open-circuited speaker transformers have accounted for more break-downs than any other cause in this particular area. Maybe it is the effect of the sea air, or humidity, but that is how it is down here. In passing, tribute might be paid to the Rola "Iso-core" transformers which seem to stand up far better than the old open types.

Next on the list of prevailing causes of break-down is the electrolytic condenser. Line voltages appear to fluctuate considerably, but normally they are down rather than up. Checks of the mains seem to indicate that the so-called 240 volt lines are often about 200 to 220 volts. But when storms are about the power often goes off, returning with surges and peaks which cause the high-tension voltages in the sets to play havoc with electrolytics. It doesn't seem to matter whether they are rated to stand 525 or 600 volts, they still break down under such circumstances. When the break-down occurs the poor rectifier valve takes a terrific beating, also the power transformer. Yet in only one case out of more than a hundred on record, has the power transformer actually burnt out. In quite a few cases the wax has run a little, but the transformer has remained serviceable. The thought does occur, however, that it wouldn't be a bad idea for set manufacturers to put a note in their instruction books to the effect that any set which does not operate should be immediately switched off, and not again operated until a serviceman has checked it over.

Glancing over my list of jobs done, the next outstanding cause of troubles seems to be grid-leak type resistors. No note was made as to which particular brand of resistors showed the greatest weakness, but the impression I gained was that all resistors with a rating of less than one watt should be declared black. In some of the best-known brands of receivers I have come across half-watt resistors being used for plate and screen feeds. Theory can be used to prove that the current through the resistors is so small that their power dissipation rating is not exceeded. But this is surely one of the cases where practice and theory fail to meet. In actual practice the half-watt resistors are a source of considerable trouble.

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RESISTORS
(Continued)

Unlike such simple troubles as broken-down condensers and open-circuited speaker transformers, resistor faults can be quite difficult to trace.

Take, for example, the case of the screen feed resistor for a 6G8G. In some cases the resistor will increase in value to 10 megohms or more, instead of the normal 1 megohm. On the average multi-meter the difference in resistance will not be readily noticed at the extreme end of the ohm-meter scale. Voltage checking on the screen of the valve is impossible with ordinary volt-meters of an internal resistance of 1,000 ohms per volt. Yet the performance of the receiver will be greatly affected by the low screen voltage. In a set recently repaired, the high resistance in the screen circuit cut back the overall gain of the set so that its performance was very weak. After considerable checking it seemed that a "dud" 6G8G was indicated. But testing the valve proved it O.K., and this was confirmed when the valve was replaced with a new one. Before starting to tear out my hair I remembered an old resolution I made some time ago to always suspect half-watt resistors; replaced the screen feed resistor and, presto!

But resistors can have many types of faults.

In another set the trouble was simply general noisiness. It was not so pronounced as to be immediately evident, yet with quite a good aerial there still remained a fair amount of background hiss on strong stations. The owner was unhappy. Tests with the signal generator showed that the sensitivity was O.K., but with too much noise. All valves were replaced, all circuits re-aligned, yet the trouble persisted. Finally the cause was discovered, but only by the tiresome method of substitution. Screen feed was again the trouble. This time the resistor was a one-watt type feeding the intermediate frequency amplifier. This resistor had not changed its actual resistance value, yet had become noisy. Usually a faulty resistor of this type can be detected because of its changed resistance, but not always, as proved in this case.

Sets which fade up and down, and those particularly irritating beggars which will play well in your shop but not in the customer's home, are often victims of resistors. Probably in the majority of cases a tubular condenser or a dud valve is the cause. But never overlook the possibility of resistor trouble, especially if the underside bristles with little half-watt resistors.

Just pull them out one by one and replace them with 1-watt types. They only cost a few pence each and may save you hours of worry.

Why do receiver manufacturers want to use half-watt resistors? Is it that they can save twopence on the cost of each set? Surely it must be poor economy in the long run. There may be some excuse in the case of baby battery portables which are cramped for room, but I can't imagine anything in their favour in a real radio set.

Testing Small Motors

Although the average ham is familiar with the procedure in locating shorts, open circuit and other faults associated with electrical apparatus, he is often at a loss when it is found necessary to locate a fault in an electric motor.

IT is not proposed to go into details on the servicing of all types of electric motors but merely to give a few hints on the way to go about locating the usual faults in the small commutator type commonly met with.

It is a wise plan to first make sure the trouble really is due to the motor and not to outside causes such as would result in overloading. Having satisfied

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yourself on this point, the next thing is to check up for purely mechanical faults—worn bearings, loose end plates or bearing mountings, either of which can be responsible for throwing the armature out of alignment. This would ultimately result in the armature binding or rubbing against the poles of the field magnets; the finer this adjustment—that is, the smaller this space—the more easily will this occur. Not only so, but as the commutator will also be thrown out of alignment, sparking at the brush contacts will also occur with the result that the copper segments of the commutator will become badly pitted or burnt causing the commutator to gradually lose its perfectly circular shape.

In carrying out this examination you may find that the trouble is due to nothing more than lack of lubrication or some easily remedied trouble, such as a loose bolt in the end plate or bearing mounting, or even dirt. Carbon particles which have accumulated from brush wear mixed with oil that has become dry form a gummy mixture which can be responsible for clogging up oil holes and bearings besides forming a coating between the commutator and brushes. These troubles can be

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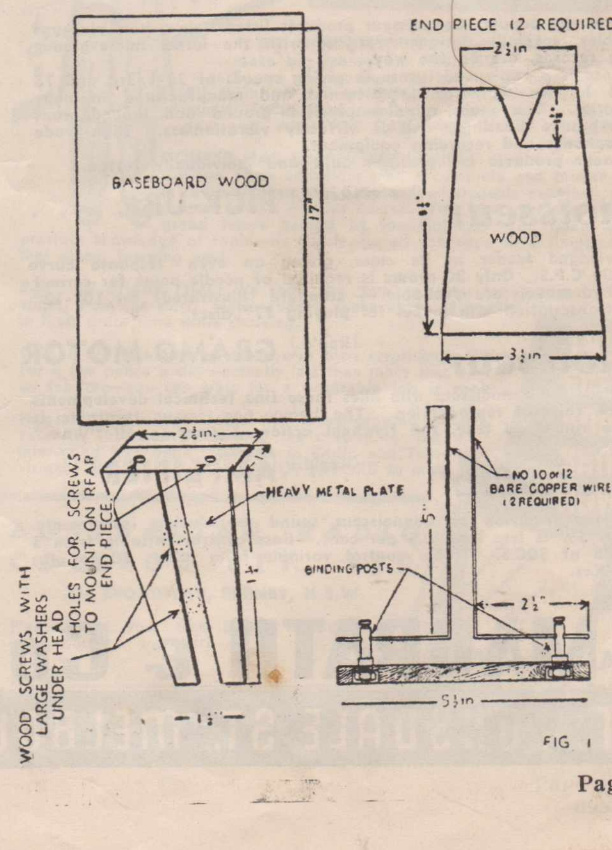


FIG 1

MOTORS
(Continued)

easily remedied and dirt removed by taking apart and cleaning with petrol an drad, or better still, carbon tetrachloride.

Next examine the brushes. If these are worn too short or the spring tension is insufficient, sparking and loss of power will occur. Sometimes a slight pressure on one or other of the brushes whilst the motor is running will reveal this in which case the brush should be replaced. If there appears to be still plenty of room for wear, the tension of the spring behind the brush should be increased. Where the spring tension cannot be altered it will generally be found that the brush has worn too short for the spring to be effective even though there may still appear to be plenty of carbon brush left for many hours of running.

If the trouble is still evident and you cannot see any other obvious cause, such as broken connections, etc., you can get down to the business of continuity testing. To do this properly you will first have to remove the armature taking note of whether the field coils and armature are series or parallel connected. You will generally find that series connection is used on most low powered motors—that is, field coils and armature windings are all connected in series via the brushes and commutator. The field coils can be tested first as this is a simple procedure. Each coil should be tested separately with a good ohmmeter or volt-

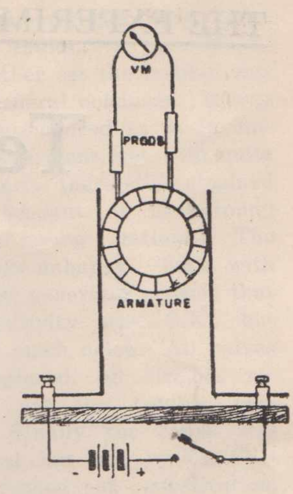
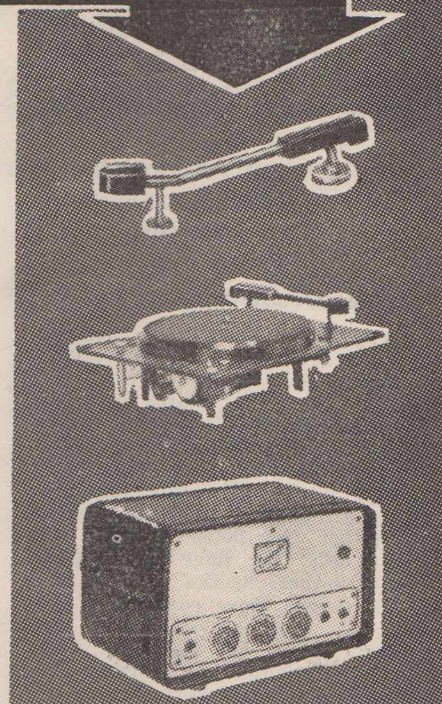


FIG 2

meter and battery in the usual way to ascertain that there is no open circuit in either. The



MOTORS

(Continued)

same test should be made between winding and core to make sure there is no leakage in this direction. Shorts in the winding itself are a little more difficult to locate especially if the motor is the low voltage type, as the ordinary D.C. resistance is lower. By passing a current through each winding the inductive effect can be noted in various ways. One simple method is to pass the same voltage through each winding in turn as would normally be the case when the motor is running. A piece of steel held near the pole piece will give a general idea of whether the coil is short circuiting. If it is, naturally there will be no magnetising effect. If one pole piece shows considerably less magnetism than the other, it is obvious that a partial short at least is occurring in that particular coil and it will have to be re-wound. Another method is to connect a voltmeter in series with the coil small battery taking note of the reading. This will only create a weak field but if a piece of steel is passed through the magnetic field a deflection of the meter will occur. If one coil shows considerably less deflection than the other (there are usually only two in low-powered motors) this coil is faulty. A dead short will result in no alternation to the meter reading at all.

There are other ways, of course, and the ham who is used to inductance trouble shooting should have no difficulty in making such tests.

ARMATURE TESTING

This is not quite such a simple procedure as some form of apparatus other than the meter is required for this purpose if the check is to be reliable. The usual way is to use an electromagnet known as a "growler." This consists of a laminated core open at one end with a winding supplied with A.C. The armature is placed across the gap completing the magnetic circuit when the current is switched on. Thus a voltage is induced into the armature windings. The voltage so induced can then be measured across the commutator sections of each winding. The points at which the contact with the commutator and voltmeter are made must be fixed in a similar manner as would normally be the case with the commutator brushes. Thus, as the armature is turned in the gap, each winding will be brought in series with the meter in turn. No reading on any particular winding indicates an open circuit or short. A low reading compared to the other windings indicates a high resistance or partial short. This apparatus makes a loud hum when in use —hence its name.

Another method of armature testing and one which is more likely to appeal to the reader requires a suitable mounting frame as shown in fig. 1. Here we have a wooden baseboard

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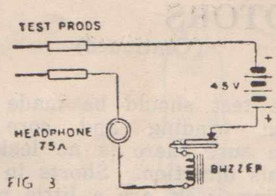
MOTORS
(Continued)

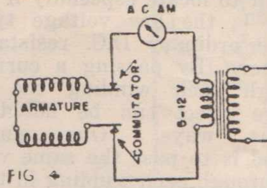
with two vertical end pieces, one movable to accommodate different sizes of armature. There is also a metal piece fastened to the rear end piece. This latter is moved to the proper position to accommodate the armature under test. By tightening the wood screws down on the wooden base, the metal piece shown is held in that position. Another assembly required is that holding two copper wires of about No. 10 size. These wires are held on the base in such a position that they fall between the commutator segments. Since the distance between wires is adjustable at the binding posts they will accommodate commutators of different diameters.

The commutator is first cleaned with very fine sandpaper. Then set the armature in the frame so that the two vertical wires contact opposite sides of the commutator (just as the brushes originally did).

Now test as in Fig. 2 across two adjacent segments, slightly rotate the armature, and so on, testing each pair of adjacent segments. Only slight variations in voltage may be expected, otherwise defective windings are indicated. If a test shows no reading (1) those two segments are shorted, (2) wires to commutator are not properly soldered, or (3) two or more loops of the winding are open. Further checking with an ohmmeter will establish which, if any, windings are open, in which case the armature must be rewound. (An excess piece of solder may sometimes cause a short between bars).

Should both armature and fields come through these tests, then we must suspect the commutator itself. Carbon or dirt between bars may be cleaned with sandpaper. The commutator may be "out of round" or the bars may be badly worn or discoloured. The solution is to cut it down on a lathe. Since this procedure requires precision, it may be better to turn it over to an experienced man, especially if you are not completely equipped for it. The mica (separators) should be properly undercut, so that they do not rise between the commutator bars and lift the brushes off the segments.



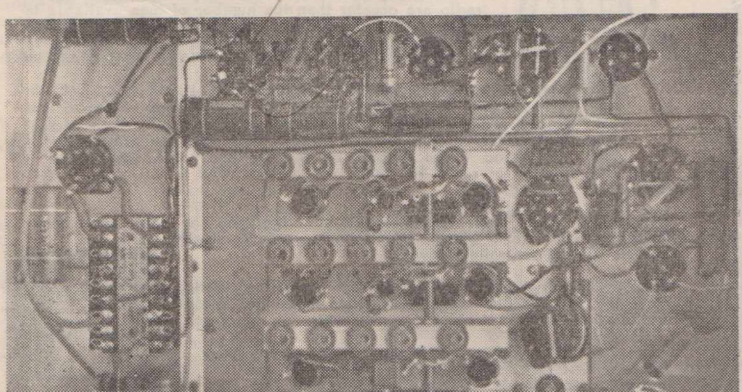


On small motors this can best be done with a safety razor blade.

The motor may now be reassembled, making sure that the armature is free to revolve. If it overheats or does not run properly there is an intermittent short in the armature. What usually occurs is that the motor runs normally for a few minutes until it gets warmed up, then suddenly breaks down, becomes very hot and the speed suddenly decreases. By taking the motor apart now and placing the armature once again on the test frame while in this condition, we can locate the trouble.

Other methods are sometimes used to check motors. In the "buzzer method" of Fig. 3 the test prods are contacted on two adjacent segments and the sound in the receiver is noted. Each adjacent pair is thus tested. An open or short will be indicated by a different tone or no tone at all.

Another simple method is that shown in Fig. 4 in which a step down transformer is used to supply a low safe voltage in series with an ammeter and the armature winding. In this case, as we are supplying A.C. each winding will offer an impedance which reduces the current flowing. A partial short in the winding under test will mean a reduction of impedance and consequently a higher current reading than the others. An open circuit will result in no reading. This test could also be applied to the field coils. As the buzzer method previously decribed gives also a form of A.C., a suitable meter connected in series instead of phones would give similar indications.



ALL-WAVE SET
(continued from page 6)

tion may go soggy. A small baffle for the speaker is probably the simplest way of curtailing the lows.

In conclusion, we would recommend the Aegis tuning unit for those who want to build a really powerful set. The units are completely reliable and every report indicates that success is certain if they are used according to the manufacturers' instructions.

RADIO THEORY COURSE, Part 10

A Sectional Analysis

As we near the end of our course in radio theory we run over the various sections of the receiver to see just what each portion has to do, and how it does it.

IN this and the succeeding parts it is intended to discuss the common types of radio receiver, considering the operation of each part and the reasons for its inclusion.

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1. Power Supplies: As all radio receivers using valves must have some form of power supply it would be as well to begin with this portion of the set. There are three different power supplies in most receivers, these being:—

(i) A low voltage supply capable of delivering a fairly large current to heat the valve cathodes to the operating temperature. This is termed the **low tension** (L.T.) or "A" supply.

(ii) A high voltage supply capable of delivering a current of 10 to 40 m.a. (battery receivers) or 30 to 200 m.a. (mains operated types). This is termed the **high tension** (H.T.) or "B" supply.

(iii) A source of voltage which is fairly steady but is not required to deliver appreciable current, the voltage being used simply to provide negative bias for the valve grids. This is termed the bias or "C" supply and, if supplied by batteries, requires only light duty batteries.

These power supplies may be obtained from batteries; this being unavoidable in country areas or for portable receivers, from home lighting plants or, wherever possible, from the power mains.

(a) **Battery Systems:** There are several different means used in practice to obtain the required power supplies from batteries:—

(i) All dry battery. This is the simplest system and uses directly heated (filament type) 1.4 volt valves. The batteries used are a 1.5 volt "A" battery, a 90 volt (two 45 volt units in series) "B" battery, and in most cases no separate "C" battery, the negative bias being obtained from a small resistance in the negative battery lead. The only valve in this series requiring a set negative bias is the output valve and the series resistance method has the advantage that the bias is reduced as the batteries run down. Fig. 1 shows the basic battery connections for this system. The batteries are designed so that, with normal filament and H.T. drains the two batteries will become exhausted at about the

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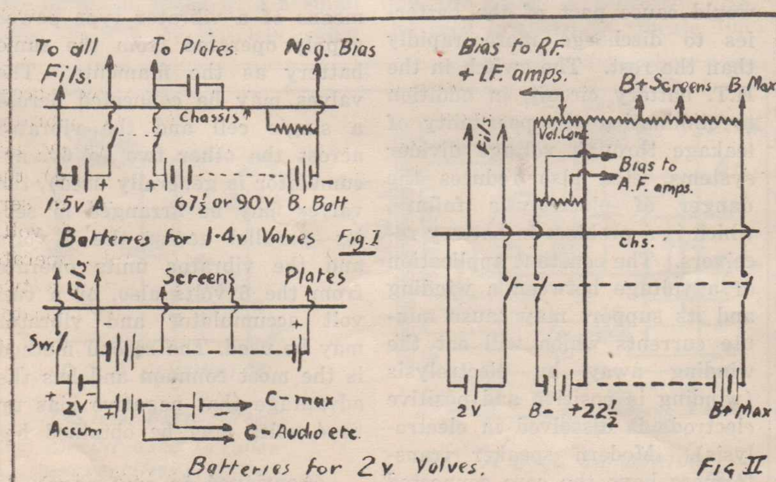


Batteries for 1·4v Valves Fig. I

Batteries for 2v Valves. Fig II

THEORY

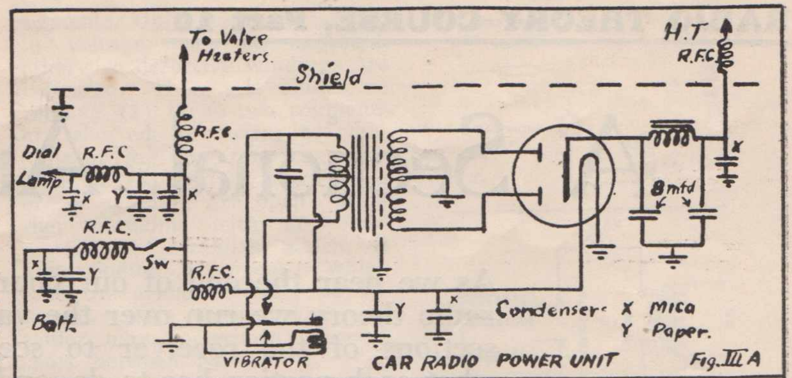
(Continued)

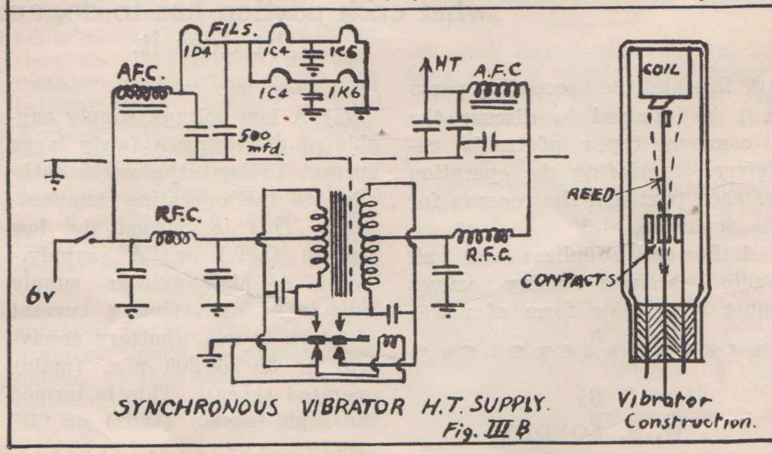
same time and it is generally good practice to replace both "A" and "B" batteries together.

(ii) Accumulator and dry battery system: This arrangement uses the two volt series of valves and the battery complement consists of a two volt lead-acid accumulator and a suitable set of "B" and "C" batteries. The H.T. batteries are usually 135 to 180 volts. These receivers have a much heavier H.T. and L.T. drain than the previous type but have a much better performance. The accumulator may be recharged as required but the batteries must be replaced when discharged.

(iii) Air cell and dry battery system: This arrangement is little used now (I have not seen an air cell, or an advert. for one, for years) but sets built about 1938 were sometimes arranged to be used with an air cell instead of a two volt accumulator. The air cell was a packaged cell which was supplied dry, and simply required the addition of water to place the cell in operating condition. The voltage was higher than the 2 volt accumulator and a series resistance was fitted in the filament circuit. The air cell could not be recharged but was useful when recharging facilities were not available. The introduction of the 1.4 volt valve series rendered the system obsolete.

Negative bias for these systems may be obtained from a "C" battery or by a resistance in the H.T. negative lead. In some cases one section (usually 22½ volts) of the H.T. batteries was used for bias purposes, and to ensure that the batteries ran down uniformly the bias section was loaded with a resistance so that the drain from that part of the battery was the same as that drawn from the remainder by the set. Fig. II. shows typical battery connections. Note that the H.T. and L.T. are both switched and that no taps are taken from the batteries for intermediate voltages as this would cause part of the batteries to discharge more rapidly than the rest. The switch in the H.T. battery circuit, in addition to eliminating the possibility of leakage through voltage divider systems, etc., also reduces the danger of electrolysis failure, which is a problem in battery receivers. The constant application of a voltage between a winding and its support may cause minute currents which will eat the winding away by electrolysis (winding is positive and positive electrode is dissolved in electrolysis). Modern speaker transformers have the core connected to the winding and insulated from the frame to reduce this trouble.





(iv) Vibrator H.T. supply: This type of receiver uses the two volt valve series and obtains its high tension voltage by means of a vibrator type power supply operated from the same battery as the filaments. The valves may be connected across a single cell and the vibrator across the other two (a 6v. accumulator is generally used), the valves may be arranged in series—parallel across the 6 volts and the vibrator units operate from the 6 volts also, or a two volt accumulator and vibrator may be used. The second method is the most common and has the advantage that negative bias up to 4 volts may be obtained be-

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THEORY
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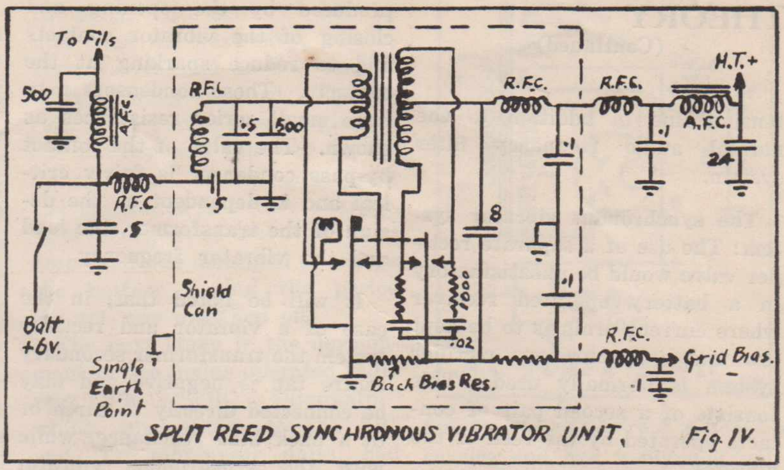

SPLIT REED SYNCHRONOUS VIBRATOR UNIT, Fig. IV.

tween the most positive of the valves and the battery negative terminal.

Car radios use vibrators for the high tension supply and use indirectly heated valves of the 6.3 volt series arranged in parallel for 6 volt operation or in series parallel for 12 volt cars, the vibrator unit being 6 or 12 volt as required.

Fig. III. shows the various circuits used, IIIa being that for a car radio using a separate indirectly heated rectifier, IIIb shows a synchronous vibrator system using 2 volt valves. The output valve, in this case, is a 1L5 (or 1D4) which requires a negative bias of about 4 volts, this being obtained as shown. In some cases a separate bias battery is employed.

The operation of the vibrator system is fairly simple, the vibrator operating to convert ("invert") the D.C. from the battery to operate a transformer, the high voltage from which is rectified to provide H.T. D.C.

The operation is as follows:—The vibrator (non-synchronous type) consists of a spring steel reed having a contact on each side of it and fitted with a small piece of iron at the tip. This iron tip is attracted by an electromagnet connected across one pair of contacts. As the reed moves over the contacts on one side close, connecting the battery across one half of the transformer primary, and at the same time short-circuiting the electromagnet in the vibrator. The reed being no longer attracted it moves back, and, due to its inertia, passes through the mean position to close the contacts on the other side. This connects the battery across the other half of the primary winding, and reverses the flux in the transformer core. The small electromagnet again attracts the reed and the cycle is repeated. As the reed is tuned to vibrate 100 to 150 times per second, there will be a complete cycle of flux reversals in the transformer core 100 to 150 times per second; in other words the D.C. from the battery is used to give the same effect as would a 100 or 150 c.p.s. alternating current in the transformer. For reasons of simplicity the reed is connected to earth and the active battery lead is connected to the centre tap of the primary winding.

It will be noted that there are several condensers and chokes in the high tension and low tension circuits. These condensers and chokes are necessary because of the comparatively sudden switching action of the vibrator. This would give rise to both radio and audio frequency interference in the receiver so r.f. and a.f. filters are necessary. In addition the sudden reversal in the primary would cause very high peak voltages in the secondary and the condenser across the primary makes the current changes more smooth. The high tension side is similar to that of an ordinary a.c. radio using a full wave rectifier, except that the rectifier is of the indirectly heated type and there are radio frequency filters in the high

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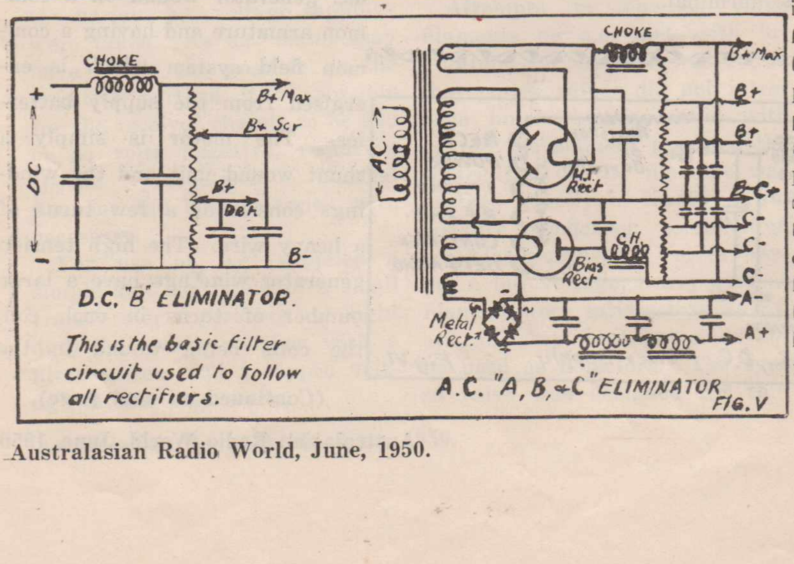

D.C. "B" ELIMINATOR.

This is the basic filter circuit used to follow all rectifiers.

A.C. "A, B, & C" ELIMINATOR FIG. V

THEORY
(Continued)

tension line in addition to the normal audio frequency filter system.

The synchronous vibrator system: The use of a separate rectifier valve would be unsatisfactory in a battery operated receiver where current drain is to be kept low and a synchronous rectifier system is normally used. This consists of a second pair of contacts operated by the reed of the vibrator.

A little consideration will show that, if the end of the centre tapped secondary which is negative is connected to earth, then the centre tap will be positive. When the coil polarity reverses the other end will become negative, necessitating a change of connection. However, this reversal will take place at the same rate as the vibrator moves so that a second pair of contacts can be used to connect the required end of the secondary to earth. This, then, gives a simple method of rectifying the high tension a.c. from the vibrator transformer. Fig. IIIb shows a typical circuit. It will be noted that there are bypass condensers across the h.t. switch contacts. These are to assist in reducing the steep wave fronts produced by the opening and closing of the vibrator contacts and to reduce sparking at the contacts. These condensers may have small series resistances as shown. The value of the contact by-pass condenser is fairly critical and is dependent on the design of the transformer, the load and the vibrator frequency.

It will be noted that, in the case of a vibrator and rectifier system the transformer secondary centre tap is negative and may be connected directly to earth or to a back bias resistance, while with the synchronous vibrator the transformer centre tap is positive and the negative side is earthed at the reed. By the use of a split reed, that is a reed having two insulated sections, one carrying the input contacts and the other the h.t. contacts, it is possible to isolate the h.t. and l.t. circuits and allow the use of back bias. In this case both positive and negative leads must be filtered to remove r.f. components which would cause background noise or "hash" as it is termed. Fig. IV shows the circuit of a split reed vibrator unit. Some vibrators have a separate set of contacts exclusively to operate the coil of the vibrator solenoid. This type has a separate terminal or pin which is connected to the live battery terminal.

One important point about synchronous vibrator systems is the polarity of the battery. Reversing the battery connections will reverse the high tension voltage and, in the case of car radios, provision is made to change the connections of the primary winding when the battery has the positive earthed. The two wires from the outer ends of the primary winding are simply crossed and connected to the opposite l.t. contacts of the vibrator. This, of course, applies only to synchronous types.

The contacts of the synchronous type of vibrator must be adjusted so that the high tension contacts open before and close after the low tension ones. This means that the l.t. contacts open and close under no load conditions and reduces the danger of arcing and burning of the contacts. It also reduces arcing at the h.t. contacts because the secondary reversal of polarity occurs while the contacts of the h.t. circuit are open.

(v) Dynamotor High Tension Supply: There is one other high tension supply system that should be mentioned and that is the motor generator unit. This consists of a d.c. motor and a d.c. generator wound on a common armature and having a common field system which is energised from the supply batteries. The motor is simply a shunt wound unit and the windings consist of a few turns of a heavy wire. The high tension generator windings have a large number of turns in each coil, the coils being wound in the

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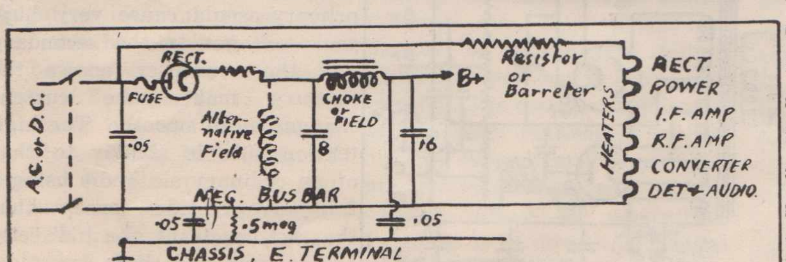


A.C., D.C. Power Supply Fig. VI.

THEORY
(Continued)

same slots as the motor coils. The units run at fairly high speeds and have reasonable efficiency but require a certain amount of filtering to remove the commutator ripple. The dynamotor is useful where power requirements are greater than can be obtained from a vibrator (vibrator units have a maximum power rating of about 50 watts), there being no limit to the power rating of the dynamotor unit. Dynamotor units may also be made with several output commutators and windings, giving different voltages. Units of this type can also be used to supply a.c. for the operation of a.c. type equipment from batteries. In this case one winding is brought out to slip-rings instead of a commutator. Many different types of dynamotor were used in army and air force equipment to supply high tension and bias voltages for receivers and transmitters from the 12 or 24 volt batteries in tanks and aircraft.

Mains Operated Power Supplies.

The first attempts at operating radio receivers from the mains consisted of the use of h.t. power supplies operated from d.c. mains. The "B Eliminator," as it was called, consisted of a filter choke and condensers and a voltage divider from which the various h.t. voltage tappings were taken. As d.c. mains may have either the positive or the negative earthed it is possible for the receiver chassis to be 240 or so volts negative, requiring special precautions. Normal filament and bias batteries were necessary.

For use on a.c. supplies a simple unit consisting of a small transformer operating a light duty full wave rectifier with a filter system and a tapped voltage divider was made.

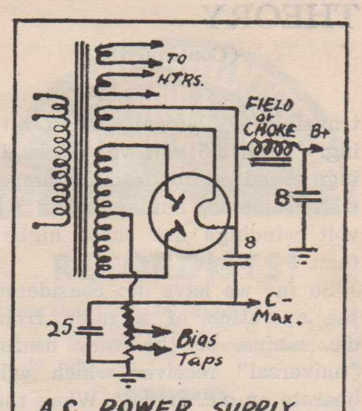
By using a second rectifier a combined "B" and "C" eliminator was the next step, battery type valves and a low tension battery being retained. The necessity of periodic recharging of the battery was removed by the introduction of a low rate charger called a trickle charger. This charged at about $\frac{1}{8}$ to $\frac{1}{4}$ amp., and was arranged to charge the battery during the period the set was switched off.

The next stage in the development of the mains operated radio was the "ABC Eliminator" which, in addition to the "B" and "C" eliminator units, had a low voltage transformer winding operating a dry metal rectifier (copper oxide) with suitable filters to supply smooth filtered d.c. for the filaments of the valves.

These receivers were still simply battery type receivers having a fairly bulky separate powly supply operated from the power mains.

The first attempts to operate a specially designed mains type receiver retained the filament type valves but used valves having a filament current in the order of 100 ma. and designed for series filament operation. The power supply delivered filtered d.c. for the series connected filaments and a few additional milliamps for the high tension circuits.

Attempts to operate valve filaments on a.c. met with indifferent success. It was found that power valves did not introduce hum when operated with a.c. on the filament provided the centre tap of the filament was earthed directly, or through a resistance condenser combination for bias purposes. Valves having a low voltage, heavy current filament were satisfactory as r.f. and a.f. amplifiers, but could not be used as detectors. The type 26 valve was designed for this



A.C. POWER SUPPLY FIG. VII.

service and had a filament voltage of 1.5 and a current of 1.05 amps. An indirectly heated type of valve such as type 27 was necessary as a detector. Early a.c. operated receivers used type 27 valves as detectors and type 71A or 45 as power amplifier, either singly or push-pull. The high tension supply was similar to that described earlier but used a heavier rectifier—the 80—which has been retained to the present (with a different base and glass envelope).

Bias was obtained by the use of cathode resistances with suitable bypass condensers. This system consists of raising the cathode to a positive voltage equal to the desired bias for the valve and connecting the grid to earth, making the grid negative with respect to the cathode as required. Several filament windings were required with this system as the directly heated valve filaments may be 30 to 80 volts positive while the indirectly heated valve heaters were usually connected to earth, the bias resistance being in the cathode circuit.

Modern radio valves (except battery types) are all indirectly heated and operate on 6 volts or higher greatly reducing the

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THEORY
(Continued)

transformer filament current rating. With 2.5 volt valves windings rated at 10 or more amps. were common, but very few 6.3 volt windings are rated higher than 2-3 amps.

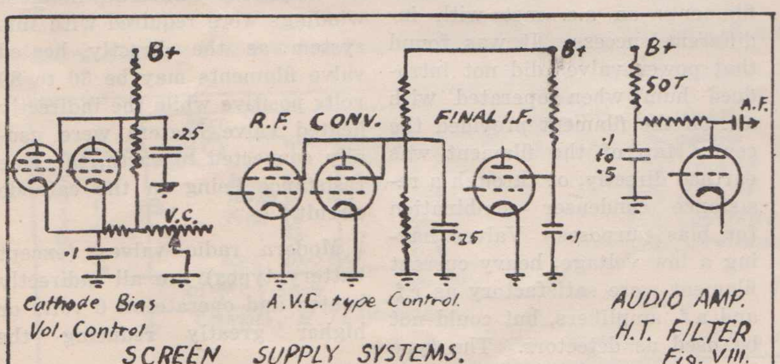
So far we have not considered the operation of a radio from d.c. mains, or the very useful "universal" receiver which will operate on a.c. or d.c. When the 6.3 volt valve series was introduced the low heater current of most of the series (0.3 amp.) permitted consideration of economical series operation and a number of power valves were made which operated with 0.3 amps. through the heater, the actual voltage across the filament being 12 to 25 volts. Rectifiers were also made with indirectly heated cathodes, the heater current being 0.3 amps. as with the rest of the series. This allowed all valve heaters to be connected in series across the line, an additional resistance being inserted to limit the current to 0.3 amp. In some cases a resistance having a high change of resistance with temperature was used as this tended to compensate for line voltage variations. These current limiting resistances were called "barreters."

With series heater connections certain precautions were necessary to reduce the possibility of hum being introduced due to heater cathode capacity, etc. It is generally recommended that the detector/audio amplifier valve heater be connected to that side of the line which is connected to the receiver earth line (which should be insulated from the chassis), the frequency changer should be next, then follow the r.f. and i.f. amplifier tube heaters, next the power valve heaters and the rectifier heater last. This keeps the a.c. heater cathode voltage to a minimum in those valves likely to introduce hum. The rectifier is usually a half wave type and a normal filter consisting of a choke and condensers is introduced in the rectifier output. The same rules apply to the modern low current heater series of valves such as 12SA7, 12SK7, 12SQ7, 35L6, and 35Z4. Fig. VI shows a typical universal receiver arrangement.

The introduction of the dynamic speaker with its field power requirements led to the use of the field coil as a filter choke for many years but the manufacture of the modern high-efficiency permanent magnet speaker has brought the filter choke back into use. The basic filter system is still unchanged, however, consisting of a choke with a filter condenser on either side of it. Where regulation is important a choke is placed between the rectifier cathode and the first filter condenser. This reduces the output voltage somewhat but makes it much more steady under varying loads. A normal filter is generally necessary following a choke input filter except in the case of push-pull output valves when filtering of the plate supply is unimportant, any hum being cancelled by the p.p. connection.

Bias for mains operated receivers: It is obvious that a second rectifier and filter could be used to obtain any negative bias voltages required, as, in fact, is done in transmitters and in high power public address systems where the output valves may require a constant value of vias. For average receivers and the like the bias requirements are not so critical, many valve makers recommending cathode bias, that is, bias by a resistance in the cathode circuit as mentioned above.

This method requires a separate resistance and by-pass condenser for each valve (or at least for each different valve type) and to overcome this a back bias system has been developed. This consists of a resistance in the lead from the centre-tap of the power transformer to earth. The value of this resistance is such that the total receiver current causes a voltage drop in this resistance equal to the greatest bias required—usually that for the output valve. Taps on this resistance allow lower values of negative bias to be taken off for the other valves in the set. This system has the advantage that all valve cathodes are connected directly to earth so that no cathode resistances or condensers are required, there being only a single 25 mfd. condenser across



(Continued on next page).

the back bias resistance, in addition to the normal a.v.c. filter. The earthed cathodes reduce the possibility of instability due to common cathode connections as well. Fig. VII shows the basic circuit of a power supply using back bias.

In the case of a.c.-d.c. receivers bias is always obtained by the use of resistances in the cathode circuits.

The application of remote cut off valves as r.f. and i.f. amplifiers and the development of converter valves with a similar characteristic makes a fairly large negative bias necessary for adequate control of volume. These valves require voltages up to about -40 in the case of strong local stations. Receivers having a.v.c. have the manual volume control in the audio section of the receiver but older receivers, and some designed only for local reception, still have the manual control operating in the cathode circuit of the super-control valves. In this case the cathode circuit has, in addition to the normal resistance to give the minimum bias, a variable resistance of several thousand ohms (5000-20000 ohms maximum value). As this resistance is introduced into the cathode circuit the bias is increased and the gain of the receiver reduced as required. It is usual to connect a bleed resistance from some point such as the screen voltage so that the volume control will always have some current through it, even when the cathode current of the controlled valves falls to a low value. This has an additional advantage—it maintains the screen at a reasonable voltage above the cathodes of the controlled valves. If the screen voltage is fixed with respect to the chassis at (say) 100 volts then raising the cathodes to 40 or so volts will reduce the effective screen voltage to 60 or so with danger of overloading on strong signals—the very case in which high bias values will be used. By supplying the screens from a voltage divider and by connecting the lower end of the divider to the cathodes the screen voltage will not be reduced as rapidly with rise in cathode voltage.

Another method of reducing the effect of the rise in cathode voltage is to supply the screen through a series resistance as the reduction in plate and screen current with increased bias will reduce the voltage drop in the screen feed resistance so that the screen voltage will rise with the cathode voltage. This method cannot be used with tetrode type valves but is recommended for use with pentode types. When automatic volume control is used the screen voltage should be maintained fairly steady as the cathode voltage does not change but the series resistance method is used to advantage in the last i.f. stage of powerful receivers as it reduces the danger of overloading this stage.

Audio filtering: Modern high gain audio amplifier stages require a certain amount of filtering in addition to that in the main h.t. supply, principally to reduce hum, and this is usually provided by a resistance condenser filter in the h.t. supply to the valve. This filter not only helps to eliminate hum from this stage but prevents audio feed back from the output stage to the driver.

SOME RECORDS

Production of gramophone records in the United States was at a peak of 110 million per annum previous to the depression, when it fell to about 4 million. Present-day production is almost astronomical, 265 million discs being waxed and processed annually.

SOMETHING NEW!

Our Technical Directory

For many months people have been writing to us wanting to know where they can have this done, or where they might be able to get that made for them.

It has long been our opinion that it would be of benefit to the readers, the suppliers, and to us, if we could make known the whereabouts of hard-to-get components and where to have those special jobs done for you.

This is the idea behind this directory. If you have any further suggestions as to what you want in the list, by all means let us know. It is intended to expand the list to several pages, so that everything will be covered, thus helping everyone along.

If you think you have something that will interest other readers, send us the information and we will follow it up.

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Aluminium Chassis and Panels supplied to order. 48-hour service.
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HAM RADIO SUPPLIERS,
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COMMANDER RECEIVERS.

Xtals and ham gear.
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1839 Lower Malvern Road,
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COMMERCIAL RECEIVER CIRCUITS.

Every serviceman should have Australia's Official Service Manual, £1 per volume, direct from—
A. G. HULL,
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Trade: R. H. Cunningham and Co., 62 Stanhope Street, Malvern, S.E.5.

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Connoisseur pick-ups, motors and amplifiers, Goodman's speakers, baffles, microphones.
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Manufactured by—
Scope Laboratories,
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TRIMAX TRANSFORMERS.
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TRANSFORMERS.
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TRANSFORMERS by FERGUSON.
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Ferguson Transformers Pty. Ltd., 12 McMahon Street, Willoughby, N.S.W.

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VEGA COILS.
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WHOLESALE ONLY.
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RADIO PARTS PTY. LTD.,
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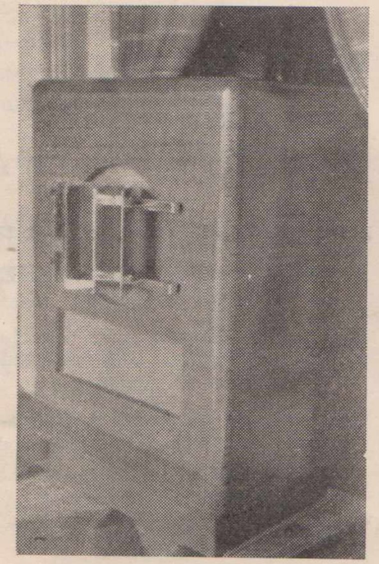
From the Far North-West

Our readers are a scattered lot in more ways than one. They are scattered geographically from distant Soviet Russia to the very-back backblocks of the bush. Socially, they are scattered from working on the council's garbage cart to Canons of the Church. Yet we are all welded into one big happy family by the common appreciation of the wonders of technical radio.

"As regards myself, I am a boring contractor (water) in a small way, usually working alone, very close to the half century in age, and very keen on radio as a hobby. Am always miles away in the bush with often fifty miles to the nearest human. Can, therefore, fiddle with circuits and make noises without fear of complaint from the chap over the fence. Operate a pedal set, an FS6 modified by myself with some ideas of my own and others taken from Radio World. Keep daily contact with Meekatharra, 400 miles away. Smoke a pipe and like it; drink a little beer when I can get it cooled off. Prefer summer to winter. Do a bit of shooting, 'roos mainly; some fishing from the pools along the Ashburton River for cobblers, which abound and grow to a couple of feet. Go to Perth about every ten years. You will gather from all this my knowledge of radio is self-taught from what I can read in books, and not very efficient. Yet it is surprising to find chaps sending along their radios for a look-over."—Henry McLeod, Onslow, North-West Australia.



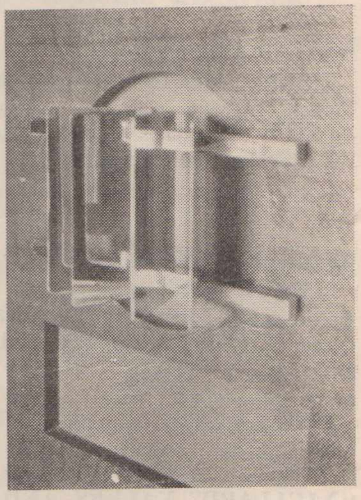
This photograph and the one opposite show a high note diffuser and box baffle for a Goodman's speaker as built by one of our readers, Mr. W. S. Ford, of 54 Oxford Street, Burwood.

. . . . . .

"The first copy of Radio World I looked at was of 1943 vintage. It was mainly this which started me on the radio road. I am only a beginner, being in the game for about three years as a hobbyist. It is my ambition to qualify for my ticket early next year, when I figure I should have mastered the code, theory and regulations." — W. Schultz, Strathroy, Hughenden, Q'land.

. . . . . .

"I have been interested in technical radio since the age of 15 years; that is 14 years ago. I have done a reasonable amount of service work in between farming, which is where my bread and butter comes from. I spent several years in the Army, in Wireless Tank Section, using 133 transmitters and Kingsley receivers; was corporal in charge of technical side in section in New Guinea. Since the war have been too busy establishing myself in the dairy farming to devote overmuch time to radio. I have my own 32-volt lighting plant, with radio, iron, sewing machine, soldering iron, grinder, drill and forge blower all operating from it."—C. O. Hildebrand, Glenburn, Leitchville, Vic.



"Your articles of a constructional nature using any type of equipment and not kit-sets, appeal mostly to me as I have plenty of junk lying around, but it is difficult to get the Australian kits in this country without going through a lot of legal formality. Other articles of a technical nature, with not too much in the line of mathematical formulae, also appeal to me. It seems to me that it is absolutely impossible for some people to write an article without delving deeply into the mathematics involved. This is always far over my head. I am an amateur operator, with the call sign ZLIQC."—J. V. Flowers, Thames, New Zealand.

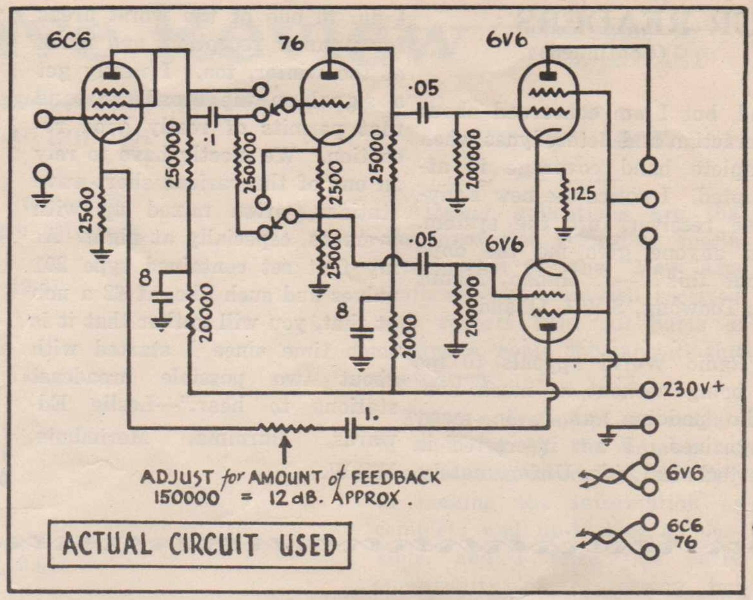
. . . . . .

"I was introduced to Radio World by a pal during the war when I was a radar mechanic in the R.A.A.F. This was my first taste of radio, and I have continued with it as a hobby since. I find Radio World a great stimulus, with ideas and articles on all aspects, as I have no particular leaning towards any branch of radio. I have built up a couple of sets, a portable and one of the Aegis kit-sets, but my time is limited, as I am doing final year science at the University. My one ambition is to build a complete set of test equipment."—R. H. Brann, 48 Gordon Street, Balwyn, E.8, Vic.

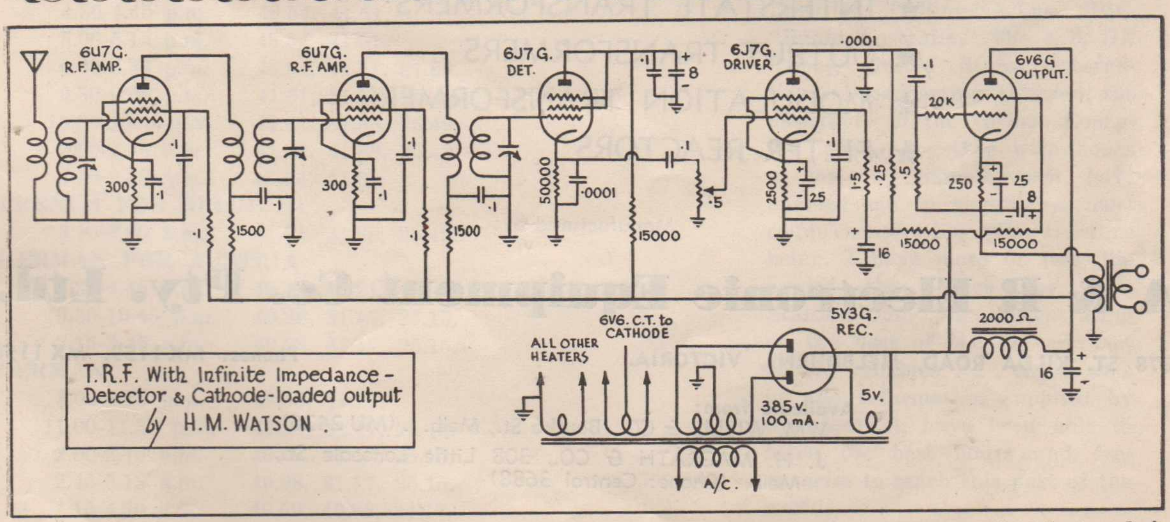
. . . . . .

"Advice concerning double conversion would be appreciated. I have built a communications receiver using R.C.S. coils with band-switching, and now wish to know if I could change to double conversion, using 1,600 Kcs. and 175 Kc. Several circuits for amateur band coverage are on

(Continued on next page).



To prove that there is no difference between resistance coupling and direct coupling, a reader built an amplifier with switching as above. Further details in next month's issue.



Bristling with interesting features, here is the advance circuit of a design to be featured in next month's issue.

OUR READERS
(Continued)

hand, but I am concerned about interaction and heterodynes when complete band coverage is attempted. I notice the new Eddystone receivers use the system. Can anyone give me the dope about this?"—J. Hanan, Mount St., Toowong, S.W.1, Q'land.

. . . . . .

"Radio World appeals to me as being without so much non-radio padding, as is in many magazines. I am interested in the technical side. Unfortunately, I am in one of the worst areas for summer reception, and much of the winter, too. I rarely get a signal on the broadcast band that permits of really good reception. We mostly have to rely on one of the various short-wave stations, often mixed up with overseas, especially at night. As my first set contained type 201 valves and such like, at £2 a nob at that, you will gather that it is some time since I started with about two possible broadcast stations to hear."—Leslie Edwards, Burnima, Merimbula, N.S.W.

Shortwave Review

Conducted by L. J. KEAST

B.B.C. SERVICES TO EUROPE.

★

IN FOREIGN LAUGUAGES.

Shown in Wave-length (Metres).

ALBANIAN:	
2.30-2.45 a.m.	41.49, 31.50, 19.61.
5.15-5.30 a.m.	30.96, 25.30.
BULGARIAN:	
2.45-3.00 p.m.	41.32, 31.50.
3.00-3.15 a.m.	41.49, 31.50.
4.00-4.30 a.m.	41.49, 31.50.
6 30-6.45 a.m.	30.96, 25.30.
CZECHOSLOVAK:	
3.15-3.30 p.m.	49.59, 41.21.
11 00-11.15 p.m.	25.30, 19.61.
3.00-3.15 a.m.	30.96, 25.30, 19.61.
3.30-4.00 a.m.	41.49, 31.50.
6.30-7.00 a.m.	41.49, 31.50.
DANISH:	
9.15-9.30 p.m.	49.67, 31.01, 25.68.
5.00-5.30 a.m.	49.67, 31.01, 25.68.
DUTCH:	
4.45-5.00 p.m.	48.54, 41.61.
11.15-11.30 p.m.	41.61, 31.88, 25.49.
3.30-4.00 a.m.	41.61, 31.88, 25.49.
FINNISH:	
1.00-1.45 a.m.	31.01, 25.68.
2.00-2.30 a.m.	49.67, 31.01, 25.68.
FLEMISH:	
3.00-3.15 a.m.	41.61, 31.83, 25.49.
FRENCH:	
4.30-4.45 p.m.	48.54, 41.61.
5.00-5.15 p.m.	48.54, 41.61.
6.00-6.30 p.m.	48.54, 41.61, 31.88.
9.30-9.45 p.m.	41.61, 31.88, 25.49.
10.30-10.45 p.m.	41.61, 31.88, 25.49.
2.00-2.15 a.m.	41.61, 31.88, 25.49.
4.30-9.15 a.m.	48.54, 41.61.
FRENCH FOR BELGIUM:	
3.15-3.30 a.m.	41.61, 31.88, 25.49.
GERMAN FOR AUSTRIA:	
4.30-4.45 p.m.	49.49, 41.21.
10.30-10.45 p.m.	40.98, 31.17, 25.15.
3.15-3-45 a.m.	40.98, 31.17, 25.15.
GERMAN:	
3.00-6.15 p.m.	49.59, 41.21.
11.00-11.30 p.m.	40.98, 31.17, 25.15.
2.00-2.15 a.m.	40.98, 31.17, 25.15.
2.45-3.15 a.m.	40.98, 31.17, 25.15.
4.15-4.30 a.m.	49.59, 40.98, 31.17.
5.00-7.15 a.m.	49.59, 40.98.

THE NEW LOOK.

Already indications are that our innovation regarding special information for the "New Australians" has been well received, and reports from all parts of Australia would substantiate this contention.

The co-operation of our readers is manifest by the number of new reporters anxious to help in making the information as complete and up-to-date as possible, and I seize this early opportunity of expressing my gratitude to Mr. Leo. Boyle, of Brisbane, Mr. W. J. Crossley, of Northbridge, N.S.W., Mr. Stan. Crane, of Allawah, N.S.W., Mr. Howard Feaks, Perth, W.A., and Mr. E. Fisher Caringbah, N.S.W.

Once more I thank Mr. Arthur Cushen, Invercargill, N.Z., Mr. Rex Gillett, Prospect, South Australia, and Miss Sanderson, Malvern, Victoria.

Reports from the above-mentioned, together with help of "Sweden Calling," The BBC, "Radio Australia," The N.Z. DX Times, United States International Broadcasting Division, the assistance of the various Consulate offices, together with hours at my own listening-post, have enabled me to compile a most comprehensive list. For the time being, I have more or less discarded the search for New Stations and am concentrating on the best of the old and not so old reliables . . . those who, by the information supplied by this journal, have been able to learn the best hours and frequencies to reach this part of the world.

(Continued on next page).

VOICE OF AMERICA.
PROGRAMME FROM TANGIERS.

Note: Changes in Frequencies.

VOICE OF AMERICA FROM TANGIERS:

TANGIERS	I.	15.25 m.c.	19.68 met.	2.00-6.00 a.m.
	II.	15.21 m.c.	19.73 met.	3.15-7.45 a.m.
	I.	11.79 m.c.	25.44 met.	6.00-8.30 a.m.
	II.	7.214 m.c.	41.61 met.	11.00 p.m.-Midnight.
	II.	6.06 m.c.	49.5 met.	8.00-8.30 a.m.

VOICE OF AMERICA FROM MUNICH:

MUNICH	I.	15.28 m.c.	19.64 met.	2.00-3.45 a.m.
		11.87 m.c.	25.27 met.	5.30-8.30 a.m.
	II.	9.54 m.c.	31.45 met.	1.45-8.30 a.m.
	IV.	7.25 m.c.	41.38 met.	2.00-8.30 a.m.
	III.	6.08 m.c.	49.34 met.	1.45-8.30 a.m.

VOICE OF AMERICA FROM THE PHILIPPINES:

MANILA	I.	21.57 m.c.	13.9 met.	6.35-6.45 p.m.
	III.	17.78 m.c.	16.87 met.	7.00-12-15 a.m.
				12.45-1.45 a.m.
	II.	15.33 m.c.	19.57 met.	5.15-6.45 p.m.
				7.00 p.m.-12.15 a.m.
				12.45-1.45 a.m.
	II.	15.25 m.c.	19.68 met.	7.45-8.00 a.m.
				9.00-11.00 a.m.
	I.	11.89 m.c.	25.23 met.	9.00-11.00 a.m.
				7.45-8.00 a.m.
				7.00 p.m.-12.15 a.m.
				12.45-1.45 a.m.
	I.	11.87 m.c.	25.27 met.	5.30-8.30 a.m.
	III.	9.53 m.c.	31.48 met.	9.00-11.00 a.m.

SWEDEN.
RADIO SWEDEN SCHEDULES FROM MAY 2nd - JULY 30th.

SBD-2, STOCKHOLM, 10.78 m.c., 27.81 met.:
10.00-11.30 a.m.
1.15- 8.00 a.m.

SBP, STOCKHOLM, 11.705 m.c., 25.63 met.:
5.30 p.m.-1.15 a.m.

SBD, STOCKHOLM, 6.065 m.c., 49.46 met.:
10.00-11.30 a.m.

SBT, STOCKHOLM, 15.155 m.c., 19.8 met.:
10.00-11.30 a.m.
3.15 p.m.-8.00 a.m.

The above times are not exact times of transmission, as there usually are intervals in week days from 5.30-9.00 p.m. and from Midnight-1.15 a.m.

Radio Sweden and the Swedish Grand Lodge of the International Order of Good Templars will direct a programme in German to German-speaking members of I.O.G.T. in Switzerland on Friday, 19th May, from 5.00-5.30 a.m.
over SDB-2 10.78 m.c. 27.81 met.
and SBT 15.155 m.c. 19.8 met.

OH! WIND IF WINTER COMES.

By the time this edition reaches our readers, daylight reception should be getting better; in fact, there are already indications that the cold spell has livened up the strength of signals, so those who can afford the time to sit down and relax will find that almost throughout the day many overseas will be coming in with a strength and clarity equal to the best night reception.

TALKING TURKEY.

In the first half of this year, getting pretty close now, Turkey hopes to be heard throughout the world with its new 100 kw transmitter.

They expect to extend their present schedules, to direct programmes to the U.S.A. and perhaps start a World Friendship Club and Turkish-English lessons.

NEW STATIONS

.....Madrid, 6.075 m.c., 49.38 met.:

This is a new station reported by "Sweden Calling" as heard around 6.30-6.45 a.m.

ZNB, Mafeking, 8.23 m.c., 36.50 met:

Have moved from 5.90 m.c., 50.85 met. Schedule is 3-5.30 a.m.

DZIB, Manila, 6.11 m.c., 49.10 met:

This is a new Philippine station reported by Rex Gillett. Owned by The Republic Broadcasting System, also operates on Medium wave of 580 k.c. Present schedule: 8.30 p.m.-3 a.m.

CR7-, Lourenco Marques, 11.77 m.c., 25.49 met.:

This is a new frequency for Mozambique and is reported by "Sweden Calling" as testing around 2 a.m. Ask for reports to be sent to P.O. Box 594, Lourenco Marques, Mozambique.

Short-Wave Station Schedules

VOICE OF AMERICA PROGRAMMES FROM TANGIERS.

Tangier 1	15.24 m.c.	19.69 met.	2.30-6 a.m.
Tangier 1	11.71 m.c.	25.62 met.	2.30-8.30 a.m.
Tangier 1	7.22 m.c.	41.55 met.	6.00-8.30 a.m.

VOICE OF AMERICA FROM MUNICH.

Munich 1 11.87 m.c. 25.27 met. 3.15-5.15 a.m.
Directed to Europe. This is an additional transmitter to those shown in last issue, all of which are still broadcasting as listed.

VOICE OF AMERICA FROM THE PHILIPPINES.

Manila 111	17.76 m.c.	16.89 met.	700 p.m.-1.45 a.m.
Manila 11	15.33 m.c.	19.56 met.	5.15-6.45 p.m.; 7.00 p.m.-1.45 a.m.
Manila 11	15.25 m.c.	19.68 met.	8.45-11.00 a.m.
Manila 1	11.89 m.c.	25.23 met.	8.45-11.00 a.m.; 7.00 p.m.-1.45 a.m.
Manila 111	9.53 m.c.	31.48 met.	8.45-11.00 a.m.

GREAT BRITAIN.

GSN, London, 11.82 m.c., 25.38 met.; GWH, London, 11.80 m.c., 25.42 met.; GRH, London, 9.825 m.c., 30.53 met; GRX, London, 9.69 m.c., 30.96 met.—Special prog. for Australia, New Zealand and South West Pacific: 4-5.45 p.m.

GSN, London, 11.82 m.c., 25.38 met.—For China and Japan: 9-10.30 p.m.; 11.30 p.m.-Midnight.

GVT, London, 21.75 m.c., 13.79 met.—To South and S.E. Asia: 8.30 p.m.-12.15 a.m.

GWC, London, 15.07 mc., 19.91 met.—To South and S.E. Asia: 10.30 p.m.-12.15 a.m.

GRZ, London, 21.64 m.c., 13.86 met.; GSF, London, 15.14 m.c., 19.82 met.—To India, Pakistan and Ceylon: Midnight-12.30 a.m.

Here is the latest information received from "RADIO AUSTRALIA." I am printing the schedules that I think will appeal particularly to the "New Australians."

RADIO AUSTRALIA

IN DEUTSCHER SPRACHE AN HOERER IN MITTEL EUROPA.

VLC	15.20 met.	19.74 met.
VLA-8	11.88 m.c.	25.25 met.
VLB-9	9.58 m.c.	31.32 met.

3-4.15 a.m. Daily.

SERVICE GENERAL D'OUTRE-MER.

Programmes En Francais.

Pour la France, et les pays de langue francaise.

VLG-6	15.24 m.c.	19.69 met.
VLA-4	11.85 m.c.	25.32 met.

To Indochine — Midnight-12.45 a.m.
To Tahiti — 6-6.45 a.m.

Pour la Nouvelle Caledonie et les iles voisines.

VLC 4	15.32 m.c.	19.59 met.
VLG-3	11.71 m.c.	25.62 met.

5.45-6.45 p.m.

GENERAL OVERSEAS SERVICE.

Programmes for the British Isles and Europe.

VLC-9	17.80 m.c.	16.85 met.	6-7.55 a.m.
VLA-4	11.85 m.c.	25.32 met.	6-7.30 a.m.; 5-6.15 p.m.
VLB-2	9.65 m.c.	31.09 met.	6-7.30 a.m.
VLG-6	15.23 m.c.	19.70 met.	8-9.15 a.m.
VLC-10	21.68 m.c.	13.84 met.	5-5.45 p.m.
VLB-2	9.68 m.c.	30.99 met.	5-6.15 p.m., except Sats.
VLG-6	15.32 m.c.	19.59 met.	Midnight-1 a.m.
VLA-6	15.20 m.c.	19.74 met.	Midnight-1 a.m.
VLB-4	11.85 m.c.	25.32 met.	Midnight-12.45 a.m.

HOLLAND.

PCJ, Hilversum, 21.48 m.c., 13.96 met.: 8 p.m.-12.30 a.m. 15.22 m.c., 19.72 met.: Daily, 11 p.m.-12.30 a.m.; Sundays, 1.30-3 a.m. 11.73 m.c., 25.58 met.: Mon., 1.30-3 a.m.; Mon. and Thurs., 7-8.30 a.m., 12.30-2 p.m. 9.59 m.c., 31.28 met.: Mon. and Thurs., 7-8.30 a.m.; 12.30-2 p.m.

GREECE.

The following schedules have been made available to me by the Consul-General for Greece in Australia:—

Radio Athens, 15.345 m.c., 19.53 met.: 1.15-1.30 a.m., News in Greek; 1.45-2 a.m., News in English; 2.00-2.15 a.m., News in French; 10.30-11.30 a.m., News in English; songs in Greek and special prog. for U.S.A. 9.60 m.c., 31.23 met.: 3-5.30 p.m., Greek Programme, also from 8-9.30 p.m.; note this prog. begins at 7 p.m. on Sundays. 7.30 m.c., 41.09 met.: Mon., Wed. and Fri., 4.35-7.25 a.m.; Tues., Thurs. and Sat., 5-7.25 a.m.

MALTA.

Forces Broadcasting Service.

FBS, Valetta, 11.895 m.c., 25.23 met.: 7.30-11 p.m. 7.27 m.c., 41.27 met.: 2.00-5 p.m.; Midnight-8 a.m. 4.965 m.c., 60.42 met.: 2.00-5 p.m.; 11.30 p.m.-8 a.m.

SPAIN.

........, Madrid, 6.075 m.c., 49.38 met.:
This is a new station heard around 6.30-6.45 a.m.

AFRICA.

Ethiopia.

ETA, Addis Ababa, 9.62 m.c., 31.19 met.:
Heard around 9 p.m. English is given from 1.30-2 a.m.

Radio Addis Ababa, 15.055 m.c., 19.84 met.:
Heard in English from 1.30-2 a.m.

Senagal.

FGA, Dakar, 15.345 m.c., 19.54 met.:
5-6.30 a.m.

FGA, Dakar, 11.895 m.c., 25.22 met.:
5-6 p.m.; 10.00-11.30 p.m.; 4.20-9 a.m.

Becuanaland.

ZNB, Mafeking, 8.23 m.c., 36.50 met.:
3-5.30 a.m. (appears to have moved from 5.90 m.c., 50.85 met.—L.J.K.).

DENMARK.

OZH-2, Copenhagen, 15.165 m.c., 19.78 met.:
8-10 p.m. on Tues., Thurs. and Sats., to Far East.

OZF, Copenhagen, 7.26 m.c., 41.32 met.:
3.40-8.30 a.m. daily. This is a relay of Home Service. ,,

BULGARIA.

Radio Sofia, 7.67 m.c., 39.11 met.:
4-8 a.m. English is heard from 5.30-5.40 a.m. and 7.30-7.45 a.m.

CANADA.

CKRO, Montreal, 11.76 m.c., 25.51 met.:
Heard at 11 a.m. in programme to Latin-America.

CHLO, Montreal, 11.72 m.c., 25.60 met:
News at 8 a.m.

CKLO, Montreal, 9.63 m.c., 31.15 met.:
News at 8 a.m.

U.S.S.R.

Radio Moscow, 11.96 m.c., 25.08 met.; 11.92 m.c., 25.17 met.; 11.90 m.c., 25.21 met.; 11.74 m.c., 25.55 met.; 11.71 m.c., 25.62 met.; 11.63 m.c., 25.79 met.: Heard at 5 p.m. in foreign languages.

HONGKONG.

ZBW-3, Hongkong, 9.525 m.c., 31.50 met.:
"Radio Hongkong" relays BBC at 9 p.m., closes at 1.30 a.m.

ALBANIA.

Radio Shkodra, 8.22 m.c., 36.50 met.:
I am advised that session after midnight, which was opening at 2.30, now commences at 4 and continues till 8.30.

FORMOSA.

BED-3, Taiwan, 15.235 m.c., 19.69 met.:
2-4 p.m.

BED-4, Taiwan, 11.80 m.c., 25.42 met.:
2.30 a.m. Announces as "Voice of Free China." Splendid Signal.

Speedy Query Service

Conducted under the Personal Supervision of A. G. Hull.

G.B.H. (Maryborough) asks how he can get rid of hum from a high-gain pre-amplifier. He is using a well-filtered power supply and has plenty of shielding in the circuit.

A.—You will find that you can often completely cure and almost always reduce hum in any stage by applying inverse feedback to the stage in question. The circuit for applying the feedback is quite simple. A .5 meg. carbon resistor and a .005 condenser are connected in series. The resistor is connected to the plate of the tube introducing the hum and the condenser is returned to the grid of the same tube. The nett overall effect is to reduce the gain of the stage, increase the bass response and cure the hum. The theory is that if you feed back an out-of-phase hum voltage from the plate to the grid of the tube it will cancel out the original hum.

* * *

M.R.D. (Hawthorn) asks whether it is possible to use the 6SH7 type tube in the same circuit or for the same purposes as the 6SJ7.

A.—As regards the construction of the two tubes there is little or no difference mechanically. However, electrically, there are quite a few differences. The pin connections for the 6SH7 and the 6SJ7 are the same except for one thing, the 6SH7 has two connections on the socket for the cathode. On the 6SJ7 the cathode is brought out to pin 5, the suppressor to pin 3. On the 6SH7 the cathode is brought out to both pin 3 and pin 5. The suppressor is still connected to pin 3. That is, in the 6SH7 the suppressor is internally connected to the cathode.

This allows the 6SH7 to be used in the same socket as a 6SJ7 where the circuit has the suppressor connected to the cathodes, as is normally the case.

The 6SH7 has much higher plate and screen currents than the 6SJ7, and has a slightly lower amplification factor. All this data may be obtained from recent valve data handbooks.

Our experience proves that the 6SH7 is inclined to be microphonic when used in high-gain audio circuits, such as microphone pre-amplifier stages.

* * *

D.K. (New Lambton) asks where he can have crackle enamelling done in light grey.

A.—We suggest that Allied Electronics Pty. Ltd. will help you out with this matter, as they handle this type of work. Their address is 6 Pacific Street, Newcastle.

* * *

H.F. (North Fitzroy writes:—"In reference to micro-groove recordings. After reading an article on these recordings, I understand they require a speed of 45 revolutions per minute. If this is the case, what is to become of motors in use at the present time? Are they to be discarded? Take my particular case. After reading one of your advertisements, I purchased a particularly good gramophone motor and pick-up. If I have to discard it on account of the new recordings I will give up amplifiers for ever and leave the game to those who can afford to throw money away."

A.—Whilst it is perfectly true that the micro-groove recordings need to revolve at 45 revs. per minute, and require a special pick-up head, we still don't think that you need throw away your present set-up. So far as we know the micro-groove recordings are only available in America, where they have not proved particularly successful. There is little chance of them ever becoming available in Australia. Even if they were available we feel sure you would be disappointed with them. We have spent a little time playing around with them and they appear to suffer from unduly high surface noise and seem to wear out after a short while. It would appear that you have been mislead by the sensational press, or something like that.

BARGAIN CORNER

Advertisements for insertion in this column are accepted free of charge from readers who are direct subscribers, or who have a regular order placed with a newsagent. Only one advertisement per issue is allowed to any subscriber. When sending in your advertisement be sure to mention the name of the agent with whom you have your order placed, or your receipt number if you are a direct subscriber.

WANTED TO SELL.—Ford model T utility. Good motor, tyres, appearance. Reg. 12 mos. Ideal for spare time radio mechanic. Bargain £45. Write or wire D. Patterson, Willawarrin, via Kempsey, N.S.W.

FOR SALE.—Swales & Swann (Red Line) 45-watt F.F.R. amplifier, Lexington pre-amplifier, Connoisseur motor and pick-up, University MVA/2 meter, t.r.f. tuner and power supply, Axiom 12 speaker. £80 or best offer. J. W. Nairn, 22 McLean Street, Morwell, Vic.

FOR SALE.—Best offer, complete sets of Volumes 1, 2 and 3 of "Australasian Radio World." R. W. Rose, Chemist, Longreach, Q.

FOR SALE.—Will accept any offer, a large parcel of back numbers of A.R.W. issues, 1944, 1945, 1946, 1947 and 1948. Send for full list. Will be burnt if not sold. K. L. Wells, 6 Carlyle Crescent, Mont Albert, E.10, Vic.

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