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1/6

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THE AUSTRALASIAN

RADIO WORLD

DEVOTED ENTIRELY TO TECHNICAL RADIO

and incorporating

ALL - WAVE ALL - WORLD DX NEWS

PUBLISHED BY THE PROPRIETOR—
A. G. HULL,
Balcombe St., Mornington, Vic.
'Phone: M'ton 344.

Short-wave Editor—
L. J. KEAST,
7 Fitzgerald Rd., Ermington, N.S.W.
'Phone: WL 1101.

REPRESENTATIVES

In Queensland: John Bristoe, Box 82, Maryborough, Q.

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THIS month's front cover picture shows a corner of the Rola acoustic laboratory, claimed to be the best fitted in the Commonwealth. Equipment includes loud-speaker curve tracing apparatus, inter-modulation and wave analysers, and the latest laboratory - type wide - range microphones.

Vol. 14 — MARCH, 1950 — No. 10

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EDITORIAL

YOU have no idea just how many minor problems arise in the publication business these days. To obtain intelligent assistance seems to be quite impossible. To operate the many intricacies of a technical publication as a "one-man show" is quite a task. Bogged down with trifles it becomes most difficult to find the inspiration which is such an essential part of really good journalism.

The way in which Radio World continues to sell in thousands; the way in which our subscribers renew their subscriptions year after year, makes it quite evident that there is not much need for apology. Yet I know in my own heart that there is plenty of room for improvement.

In order to carry out the ideas I have in mind it is necessary to have considerable re-organization. Urgently needed are alert technical representatives in both Melbourne and Sydney to keep contact with the trade. If one, or both, of these can also help with technical articles, so much the better.

This issue may be late; the next may be later. I am determined, however, that sooner or later there will be not the slightest need to apologize for the old Radio World.

If you can help, whether by taking an active half-share in the business as a going concern, or only by contributing an interesting paragraph for publication, I will be pleased to hear from you.

—A. G. HULL.

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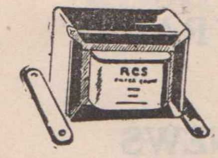

1

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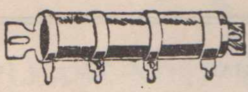

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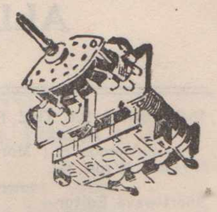
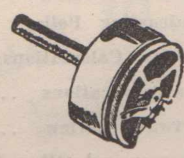


D.W. 37
Dual Wave Unit with R.F. Stage £6/10/-

D.W. 29 .... 4/5
Dual Wave Unit £1/14/-

POTENTIOMETERS AND RHEOSTATS **5**



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PT 40	6 ohm 25 amp
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Compromising With Sound

Here is another article of the kind that makes Radio World famous. It is the story of an enthusiast's efforts to obtain exceptional results.

By
KEVIN J. BRADY
Physics' Dept.,
Central Technical College, Brisbane, Qld.

THIS is a summary of the conclusions reached about home sound equipment after the study, search and trial involved in providing a satisfactory system for my own home.

1. The power required had to be sufficient to cope with dance parties for the youngsters, as well as low level quality listening for the adults when the infants were asleep. That meant a minimum output of five watts, and the good quality for discriminating listeners meant push-pull output. The wattage required was a little high for 45's, about right for 2A3's, and suitable also for triode connected beam power valves from 6V6 to 807. I had a suitable heavy duty (150 m.a) transformer, with 2.5v. windings, so used the 2A3's.

2. The obvious circuit to get the required wattage was the Radiotron's version of the Williamson, with 2A3's in class A push-pull instead of 807's. The modified circuit is attached (A.).

3. As the amplifier was a good straight line job, it was adequate for volume level appreciably near that of the original sound source, but certain corrections were needed, as follows: (a) Compensation for apparent lack of tonal balance for low level listening. Both bass and treble boost of at least 6 d.b. per octave were necessary to get realistic fullness with volume just adequate for two people in a small room; (b) compensation for bass cut in standard recordings. This amounts to 6 d.m. per octave below middle C, 256 c.p.s., so this compensation, combined with (a) gives a total bass lift requirement of 12 d.b. per octave. (c) The third compensation was to provide a further treble boost to offset side band cutting. It was found in practice that provision of 12 d.b. octave gave much the same effect as switching the I.F's to resistance coupling, and it simplified the tuning circuit considerably, cutting out some difficult switching. (d) Bass cut was desirable to help make short-wave speech bearable, and treble cut to make our older records bearable with wide range equipment.

Compensations a, b, c and d added up to a preamplifier giving two steps of boost and cut in bass and treble, each step of 6 d.b. per octave above or below a mean frequency which was taken as the normal 1000 c.p.s.

A suitable circuit came to light again in Radiotronics No. 114. The circuit is attached (B.).

4. The speaker had to be of respectable range, and to get uniform bass response had to

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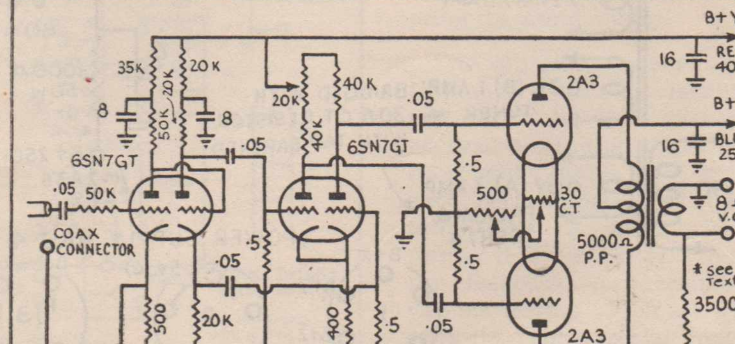


WILLIAMSON AMPLIFIER MODIFIED *for* 2A3's OUTPUT

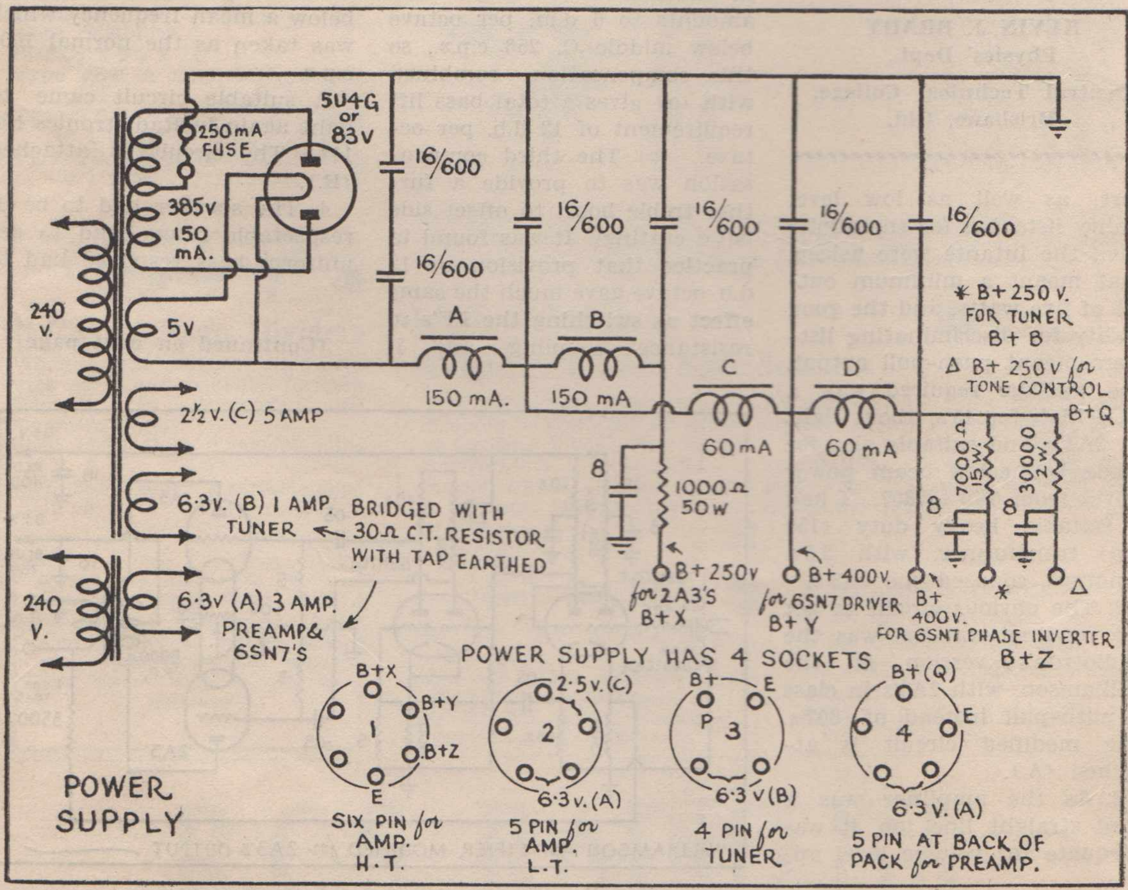
QUALITY (Cont.)

be in a vented enclosure. Suitable types considered were (a) Jensen Auditorium, and (b) Rola G. Many servicemen have excellent dynamic speakers which would do the job very well, but, as I wanted my vented enclosure some distance from the amplifier, I asked for the Rola G and got the R, apparently the new version of the old favourite. The frequency response covers 50 to 8000 c.p.s. with some diminished output outside these limits. I found the transient response excellent, and an orchestra doesn't jumble together in fortissimo passages. Wireless World supplied the formula for calculating dimensions for the vented enclosure. Formula and dimensions are attached (C.).

5. The pickup had to combine good range with ruggedness, as it could not be put out of bounds to the children. In fact, I wanted them to use it on their own records. The best available under these specifications was the Rothermel, fed through an equalizing network to level up its response curve so that it delivered one volt to the amplifier grid.

6. The tuner was a simple superhet—our old set was quite adequate with the audio side deleted.

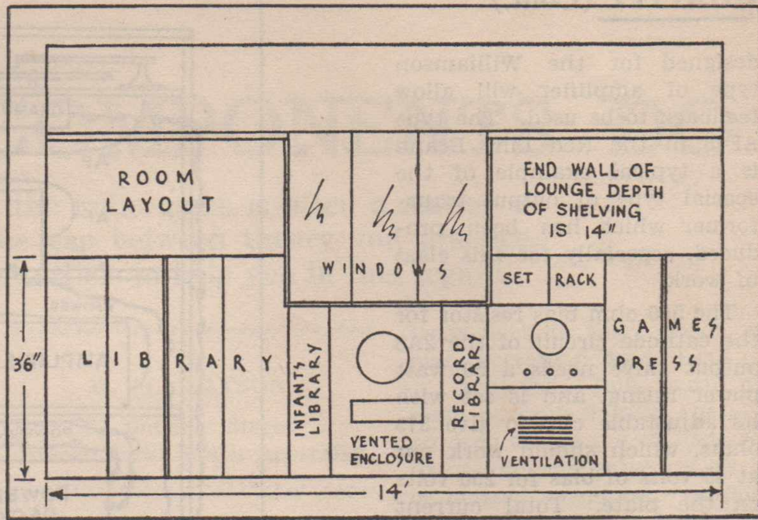
7. The power supply was the big headache. At first the amplifier and tuner had their own built-in packs, but the hum could not be quietened sufficiently. Many trials were made, and finally the whole power was concentrated in one pack and fed to the tuner, preamp. and amp. separately, with decoupling networks in each unit. Fixed bass resistors were placed right at their proper sockets, and heater and fila ment windings earthed through centre tapped resistors. Very large 50 watt resistors ex-disposals were used for the plate and cathode circuits of



the 2A3's to limit the toasting effect on electrolytic condensers. This hum hunting took by far the most time, but the final arrangement is completely free from any trace of hum, except for a trifle with bass boost fully on and volume at maximum.

Incidentally, to guard against pickup from the switch lines and gramo motor, all low level audio links—tuner to preamp, pickup to preamp, and preamp to amplifier—are made with coax cable and connectors obtained from disposals.

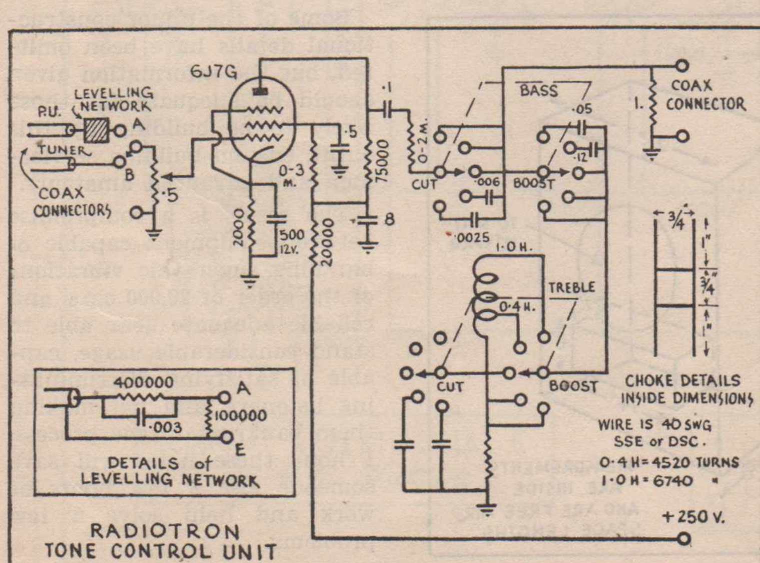
8. The mechancal layout of the outfit is shown in attached block diagram. The rack and the vented enclosure took up two sections of a long low set of cupboard shelves built along one lounge wall and under window level, and the record library filled another, leaving reasonable space for the library, infant's library, toy cupboards and music shelves.



9. One of these days I may acquire a record changer, but most I've seen look too flimsy to stand up to a young family. One major fault still remains to be remedied. I've tried three new 6J7's in the pre-amplifier and they're all slightly microphonic, although the effect is not noticeable after the first ten minutes when everything is warmed up. I'll acquire a non-microphonic 1620 one of these days, but there's no acoustic coupling back to the valve now and the microphony is a mystery.

For the tone control unit the choke can be wound without any particular case, as it carries no d.c. current. About a quarter of a pound of wire is required. The whole of the tone control unit should be mounted in a steel box and located about two feet from the power supply unit in order to avoid hum.

The job gives excellent performance without feedback, and should be used without it at least until the amplifier is thoroughly stable and giving good performance. With certain types of output transformer it is not possible to add the feedback, on account of various factors which are quite critical. The special output transformers which have been



RADIOTRON TONE CONTROL UNIT

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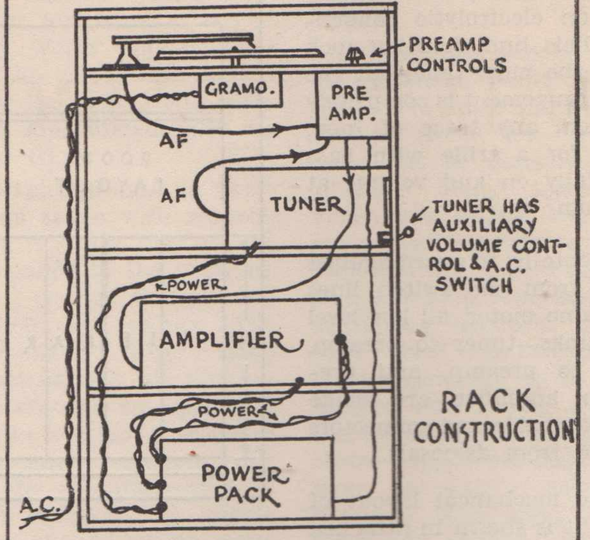
QUALITY (Cont.)

designed for the Williamson type of amplifier will allow feedback to be used. The type AF15 in the Red Line Brand is a typical example of the special type of output transformer which has been produced, especially for this class of work.

The 500 ohm bias resistor for the cathode circuit of the 2A3 output valve needs a 50 watt power rating, and is set with its adjustable clip to give 375 ohms, which should work out at 45 volts of bias for 250 volts on the plate. Total current drain from the power pack should be about 135 milliamps.



RACK CONSTRUCTION

The somewhat extravagant choke layout was found to be a workable alternative to voltage regulator tubes, and is sufficient to de-couple the various audio channels.

Filament leads were of heavy car cable to avoid voltage drop. It is advisable to bond all earths to a heavy brass or copper pipe which continues to earth, or to lead separate earths from units to clip on a water pipe,

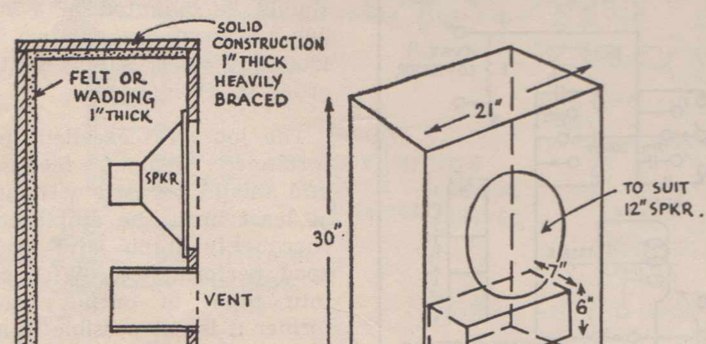
It may be necessary to take precautions against microphony in the pre-amp stage. Use a rubber-mounted socket, and insulate the whole unit from vibration.

The power on and off switch is on the front panel, giving three knobs, the a.c. switch, tuning and the wave-band switch. Originally the pre-amp volume control was the only one, but it proved to be too awkward to manipulate, particularly on short-wave without a.v.c.

To keep the required load on thediodes with the two half-meg pots in parallel, a .25 meg. half-watt resistor was wired in series at the tuner output.

Some of the minor constructional details have been omitted, but the information given should be adequate for those likely to be building up this outfit, custom-building servicemen and advanced amateurs.

The result is a compromise between equipment capable of handling supersonic vibrations of the order of 20,000 c.p.s. and reliable adequate gear able to stand considerable usage, capable of satisfying discriminating listeners, and not making them bankrupt in the process. I hope these notes will save someone else a few hours of work and help solve a few problems.



VENTED ENCLOSURE

PRACTICAL THEORY

WHAT COMPONENTS DO

Success in the radio game is often a matter of bridging the gap between theory and practice. Here is an article to help you in this regard.

By
H. M. WATSON,
89 Botting Street,
Albert Park, South Australia

THE printing of circuits without some explanation is a good idea for those who know "what's to do," and those who think they know, but how many of us think there is nothing more to learn only to be tricked by some simple problem that we have previously taken for granted? For instance, suppose we desire to bias a valve to cut-off. O.K. We insert a resistor in the cathode circuit and return the grid to earth, the drop across this resistor due to current flow through it makes the cathode positive to earth, or in other words places a negative bias on the grid. Now, when this resistance is of such a value that the grid repels all electrons back to the cathode, no plate current flows and cut off is achieved. But, with no plate current flowing there is no drop across the cathode resistor and the valve ceases to be biassed to cut off. Or does it? Something like which came first the chicken or the hen, isn't it? Some of you will know the solution straight away; others will spend some

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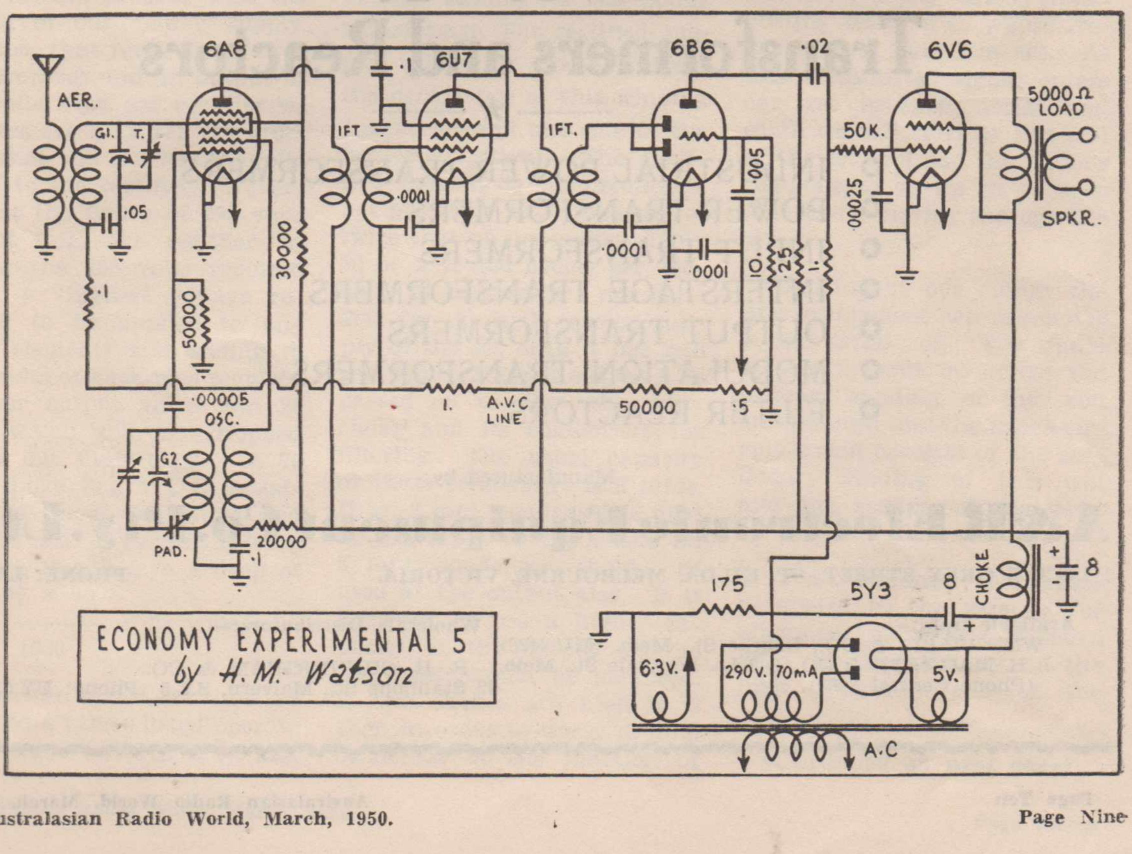


COMPONENTS

(Contd.)

time thinking over it and the remainder will give it away. This is all by the way. There are, however, dozens of radio enthusiasts who can read a circuit diagram and build a set from it without having any idea of just what part the various components play in their respective positions or what frequency is present at any given point along the signal path. It is for these readers that this article has been written in the hope that added enjoyment will be gained in constructing a set, and at the same time knowing just why such and such a part is soldered in a particular circuit should assist with layout as well as enabling the substitution of valves that happen to be on hand for those shown in any circuit. How many just wire their set from the circuit, saying, "250 ohm resistor and 25 mfd. condenser pin 8 to earth," instead of thinking, "250 ohm to place the cathode 12 volts positive to earth which is equivalent to biasing the grid by 12 volts negative to cathode as the grid is returned to earth, and a 25 mfd. to ground the cathode as far as audio frequencies are concerned?" Don't just take it for granted but think just what part the components play as you solder them in and you will soon find that you can design your own circuits and before long wire sets without reference to a diagram at all.

The first step is to decide which valves are to be used; we will take a standard 5-valve superheterodyne, and as we only wish to build it up as a second set or for experimental, cutting down on expense as much as possible. At the same time we will endeavor to keep the performance reasonable enough to listen to.

First we have a look in our console and see what valves it uses and design our set for the same line-up, when it is finished we can borrow these valves for a try out and then see if we think our effort is worth a new set of valves.

Peering into the console we see 6A8, 6U7, 6B6, 6V6, and a 5Y3. So we list these and design our set around them. The next step is to consult a valve data book and copy out the following data.

	Heater volts	Heater amps	Plate volts	Plate M.A.	Screen volts	Screen M.A.	Grid bias
* 6A8 Frequency Converter	6.3	.3	250	3.5	100	2.7	—3
6V7 I.F. Amplifier	6.3	.3	250	8.2	100	2.0	—3
6B6 Detector, AVC & Audio	6.3	.3	250	—			—2
6V6 Output	6.3	.45	250	45	250	4.5	—12.5
5Y3 Rectifier							

* Anode grid: 250 volts through 20,000 ohms res., 4 M.A.

Adding our plate and screen currents, 56.7 + 9.2 plus 4 = 70 m.a., total H.T. drain of all valves.

Next we refer to our valve data book for the operation characteristics of the 5Y) with condenser input to filter so that we can proceed with the design of our power supply. We note that for a drain of 70 milliamperes and an output of 290 volts from our rectifier we will require a power transformer that will deliver 290 volts r.m.s. to the rectifier. We arrive at the figure of 290 volts output from our rectifier by taking the 250 volts required at B + (highest voltage required to be applied to any valve element) and adding to it 12 volts of back bias required for our output valve and 28 volts which will be dropped across our filter choke. A 70 m.a. choke has a D.C. resistance of about 400 ohms and with 70 m.a. of current flowing through it will give a drop of

$$\frac{400 \times 70}{1000} = 28 \text{ volts}$$

From the above data we see that the 4 valves listed operate with heater voltages of 6.3 and as our heaters will be parallel connected we add up the total drain of these and find it to be 1.35 amps. Again from our data book we see that the 5Y3 requires 5 volts for its heater at 2 amps.

We now have all the necessary information to complete our power supply and can draw up this much of our circuit.

Before proceeding with our set we will stop and study our power supply. The rectifier valve has its plates connected to each end of the H.T. secondary winding of the power transformer. The rectified output voltage is available from the centre tap of this winding (negative) and one side of the heater (positive). The rectified current is undirectional, but pulsating at a frequency of twice that of the mains supply 50 × 2 = 100 cycles per second. It is therefore not suitable for the high tension supply of the set until it has had the ripples filtered out, so it is passed on to the smoothing choke and its condensers for filtering. The usual capacity of these condensers is 8 mfds. If an 8 mfd. condenser is used at the input to the choke an 8 mfd. condenser should be used at the output also. It is incorrect to use a higher capacity at the output end as the filter should be balanced. If two chokes are used it is then in order to use a 16 mfd. condenser at the junction of the two and an eight at the input end of the first choke and another eight at the output end of the second choke. This is the equivalent of two identical filters each with 8 mfds. at either end.

So much for our power supply which does nothing more than take the place of A and B batteries as used in a battery set. We have 250 volts of direct current voltage that we can apply to the valve elements either in full or in part as required, 6.3 volts of A.C. to apply to our heaters so that the cathodes will emit electrons and 12 volts dropped across the 175 ohm resistor for the bias of our output valve.

The only other voltages we require are radio frequency voltages (R.F.). One of these we must generate locally, the other is provided for us by whichever of the various transmitting stations to whose frequency we tune our set. As this transmitted signal enters our set between aerial and earth we will start at this end of the set and add the various components as we go to keep that signal moving through the set.

Glancing at our circuit the first component we encounter is the aerial coil. The signal voltage is built up across the primary winding of this coil and induced into the tuned circuit which consists of the secondary winding of this coil and the section of the gang condenser that tunes it.

The trimmer condenser paralleled to the gang is for alignment purposes and sets a limit to the capacity at the high frequency end of the

(Continued on next page)

COMPONENTS

(Contd.)

gang. You will notice that the bottom end of the secondary winding is not earthed directly but through a .05 mfd. condenser. This condenser effectively grounds the coil as far as the signal voltage is concerned but its inclusion is necessary to prevent the grid from being earthed as far as D.C. voltages are concerned as this would upset our A.V.C. (automatic volume control) system which we will deal with later. The value of this condenser must not be too low as it is in series with the tuned circuit and a low value would affect the tracking, at the same time it must not be too high as it would then affect the time-constant of the A.V.C. We now have our signal voltage applied to our valve between grid 4 (mixer control grid) and earth.

We must now generate a signal to heterodyne or beat with that from the station, for this we make use of grid 1 (nearest cathode) which is the oscillator control grid and grid 2, which acts as the oscillator anode. The grid winding of the oscillator coil is tuned by the remaining gang section to the signal frequency plus 455 k/cs (kilocycles) to give the required oscillator frequency, the plate winding of this coil is inductively coupled to the grid winding to give self oscillation, the two windings constituting a reversed feed oscillator. We now have a self-generated voltage due to feedback from the oscillator anode grid to the oscillator grid. Owing to the difference in inductance between the aerial and oscillator coils, mainly, no matter to what station we tune our condenser the oscillator frequency will always be 455 k/cs higher than that of the station. If we are tuned to a station operation on 1500 k/cs then our oscillator frequency would be 1955 kcs. If we swing our dial to a station transmitting on 600 k/cs then our oscillator would be generating a voltage varying at 1055 k/cs per second. The trimmer across the oscillator gang again serves for alignment purposes at the higher frequency end (plates out of mesh), whilst the padder being in series with the gang sets a limit to the capacity at the low frequency end (plates in mesh), where it is used for alignment. You will notice a 20,000 ohm resistor through which the oscillator plate is fed. This serves to drop our 250 volts at B + to that laid down by the valve manufacturers. The .1 condenser at the junction of this resistor and the oscillator plate winding grounds the oscillator as far as R.F. is concerned without grounding our D.C. voltage, which we are applying to the oscillator anode. The value of this condenser is the lowest that will satisfactorily by-pass R.F. voltages. Higher values would be in order but are larger and more expensive. The 50,000 ohm resistor is a grid leak which, with the .00005 mfd. condenser is used to provide a small bias for the oscillator grid thus improving the efficiency of the oscillator.

THE MIXER

The coupling between the signal and the oscillator occurs in the electron stream of the valve (electron coupling) and the oscillator anode grid acts as a modulating electrode for the electron stream. Grids 3 and 5 are connected inside the valve to form a screen, grid 3 screening the oscillator section of the valve from the mixer section. The plate shown at the top of the valve is the mixer anode in which circuit the I.F. signal appears, in our case and most others these days, 455 k/cs. The mixer section has no actual cathode but utilises the electron accumulation that forms between grids 3 and 4 to form a virtual cathode. These electrons amass here due to escaping through grid 2 (oscillator anode) in pulses determined by the oscillator frequency. They are attracted to grid 3 (screen grid) and supply the operating power for the mixer section of the valve. As these pulses of electrons arrive from the oscillator section at a frequency governed by the oscillator circuit, the virtual cathode of the mixer is also varying at the oscillator frequency at which it modulates the mixer section of the valve to produce the required intermediate frequency (I.F.).

FREQUENCY CHANGER

We now have on I.F. ready to impress across our first I.F. transformer, but before leaving our 6A8 we will first consider the 30,000 ohm resistor and .1 condenser in the screen circuit of this valve. The resistor serves to drop our 250 volts at B + to 100 volts, which we listed in our data for the screen voltage. As the 6U7 valve also requires a screen voltage of 100 we can wse one resistor for these two valves (part of our economy plan) not forgetting that the screen current for both valves will be flowing through this resistor, so we add the two screen currents together (again from our copied data) and find them to total 4.7 m.a. As we have to drop our voltage from 250 to 100 we have 150 vlts to drop at 4.7 ma., which gives a resistance of

$$\frac{150}{4.7} \times \frac{1000}{1} \text{ ohms}$$

or 32,000 approx. and use the nearest standard resistance of 30,000 ohms. The .1 resistor grounds our two screens as far as R.F. is concerned.

The mixer plate is fed through the primary of the first I.F. transformer with 250 volts B+, there will be a slight voltage drop across this primary, but as its D.C. resistance is low this drop is negligible. Now, when a signal is impressed on the grid circuit its polarity is alternating at radio frequencies from positive to negative at the grid and positive at the cathode the next it is the reverse. Now when the control grid is negative electrons will be repelled and when it is positive they will be speeded on their way to the late, at the same time this electron flow will be modulated by those from the oscillator, the combined effect being a signal of 455 k/cs across the primary the impedance of which is very high to radio frequencies (I.F. is a radio prequency) so that a small voltage change on our control grid will give a large voltage charge across this primary. This is the principle of amplification.

THE INTERMEDIATES

Our signal has now been changed to the I.F. and amplified, we will now proceed to further amplify it by the 6U7 valve, or I.F. amplifier valve. The signal is induced from the primary to the secondary of the I.F. transformer (both windings of whic hare tuned to a fixed frequency of 455 k/cs by means of iron slugs) and then fed into the 6U7 control grid, the purpose of this valve is solely to amplify the signal and this is carried out by the smaller change of grid voltage causing a bigger change across primary of the second I.F.T. as in the previous stage, the .0001 condenser serving to ground the secondary winding as far as I.F. is concerned, whilst at the same time not grounding the grid for D.C. voltages which have to be supplied to it via the A.V.C. line.

At this stage it may be just as well to give a brief idea cf the operation of valves generally. The heater heats the cathode causing it to emit electrons. These negative particles of electricity are attracted towards the plate as this element is at a positive D.C. potnetial. As stated before the control grid has control over this electron stream slowing it up r accelerating it as the grid swings negative and positive respectively the large voltage drops across a high resistance or impedance in the plate circuit effecting signal amplification.

It will be noted that as the grid swings positive and the electrons are accelerated on their way to the plate a large voltage drop takes place across the impedance in the plate circuit and the voltage at the plate drops or goes more neg-

(Continued on next page)

HAM NOTES

The spare time services of an enthusiastic amateur transmitter are needed to conduct our Ham Notes. If you feel that you can help, please write to The Editor.

COMPONENTS

(Contd.)

ative; alternatively as the signal swings the grid negative electrons are repelled and there is less drops across the impedance when the plate is most positive. This explains the fact that the plate is 180 degrees out of phase with the grid.

I have spoken of the grid swinging positive, actually the grid is never allowed to swing positive as this would cause distortion due to grid current flowing. The grid bias holds the grid negative at all times. When the positive alternation of the signal voltage is present at the grid its effect is to reduce the grid bias to a figure less negative.

The screen grid is inserted between the control grid and plate to reduce grid to plate capaciance making it possible to obtain much higher amplification without feedback and instability.

The suppressor grid between the screen and plate is operated with a negative potential and retards any secondary electrons driving them back to the plate.

The I.F. signal is induced from the second I.F. transformer primary into the secondary and this time is applied between diode and cathode, the .0001 condenser from the bottom of the secndary to earth serving to ground the transformer as far as I.F. is concerned at the same time not grounding it as far as D.C. or audio voltages are concerned.

Our 6B6 serves three purposes, that of detector, A.V.C. rectifier, and audio amplifier. Electrons will only flow through a valve from negative to positive (cathode to anode), hence its name valve. When our signal voltage across the I.F. secondary is positive at the diode end, the diode conducts, that is it conducts on every half cycle and so rectifies or demodulates the signal by eliminating alternate half-cycles of the I.F. voltage, the audio variations of the other half cycle of I.F. voltage are picked off across the diode load resistor consisting of the 0,000 hm resistor and the .5 meg potentiometer. We now have our audio signal ready to feed into the grid of the amplifier section of this same valve but first let us go back to our diode circuit and study the A.V.C. action. We are using simple A.V.C. as we are only concerned with local station reception.

Portion of the signal voltage is rectified by the diodes and the D.C. component is fed back to the grids of the converter and I.F. amplifier valves. This voltage increases with an increase of input signal strength and being negative, increases the grid bias on these preceding volves thus reducing the volume automatically, roughly in proportion to the signal carrier. The resistors and condensers used in the A.V.C. line are used to block and bypass R.F. and I.F. voltages to earth and smooth out irregularities caused by A.F. variations on the D.C. control voltage. These C. and R. valves are set by the time constant of the A.V.C.

You will notice that except for "contact potential," A.V.C. voltages is the sole source of bias applied to the two preceding valves, this again is part of our economy plan and also simplifies wiring as all cathodes are grounded.

"Contact potential" voltage is due to stray electrons reaching the diode when the cathode is heated even when no signal is applied. This voltage would be in the vicinity of 1 volt.

By varying the setting of the potentiometer we can pick off any portion of our audio voltage we require (volume control) and feed it to the grid of the triode section of the 6B6 via the .005 condenser. This coupling condenser is necessary to pass audio, whilst at the same time it musn't ground the grid as far as D.C. is concerned as this would short out the 10 meg. resistor which is returned to earth for grid bias. Amplification is carried out as previously only this time at audio frequencies with the drop in the plate circuit occurring across the .25 meg. resistor which value is that recommended by the valve manufacturers for a resistance coupled amplifier.

We now have our amplified audio signal present in the plate circuit of the 6B6, the audio voltage appearing across the plate resistor. This audio valtage is applied to the output valve grid via the .02 coupling condenser. The valve of this condenser is governed somewhat by the value of the grid resistor, higher values of capacity would be used for lower values of grid resistance. The capacity should be at least .01 however, as lower values would cut the bass response. This condenser is necessary to isolate the grid from the D.C. plate voltage of the 6B6. The 1 meg. grid resistor is connected to the

HAM NOTES

For some weeks past, airline radio operators have reported that, upon nearing Essendon Aerodrome, Melbourne, they have experienced severe interference on the aircraft Traffic Control Tower frequency 118.1 fc/s. This interference takes the form of a programme from a local broadcasting station.

It was established by Civil Aviation Dept. officials that the interference was in the nature of cross-modulation.

The phenomenon of cross-modulation requires two carriers. Obviously, one of the carriers was coming from a broadcasting station harmonic, but the second mysterious carrier had the department baffled.

At first it was thought that the second carrier may have been a fourth harmonic radiation from an amateur transmitter operating in the 28-30 mc/s band, on a frequency of 29.5 mc/s.

As you are all aware, this interference constitutes a serious danger to aircraft, and the safety of passengers.

Just within the last few days, at the time of writing, investigations by P.M.G. listening posts and D.F. cars have found the trouble, or rather, its source; a fifteen-year-old superhet which had become a transmitter from its original state of receiver.

The receiver was located several miles from the airport, at the suburb of Preston.

The set had not been tampered with in any way, but had made the change from reception to transmission all on its own; sending out, or re-broadcasting the prgramme of the commercial station to which it happened to be tuned.

This case has all the Departmental and Technical School officers baffled. What do you make of it?

Noticed that G3BUU is still coming through great guns on 20. Heard him working many of the boys in VK3. All gave him a solid 5 and 9.

Travelling with the French Antarctic Expedition, on its second voyage, following their first unsuccessful attempt last year, is CN8AO, who will operate from the expeditionary ship under the official amateur call-sign of FB8AK.

FB8AK will be in operation on both 10 and 20, phone and C.W.

COMPONENTS

(Contd.)

centre tap of the power transformer which is held 12 volts negative to earth due to the drop across the 175 ohm resistor from the centre tap to earth. As the cathode of the 6V6 is earthed the grid of this valve will be biased negatively by 12 volts in respect to its cathode. It must be remembered that the total current drawn by all valves flows through this 175 ohm resistor, not only that drawn by the output valve.

The 50,000 ohm resistor in the grid circuit of the output valve is known as a grid stopper and with the .00025 mfd. condenser serves as an R.F. filter to prevent any R.F. that may mave reached this point from entering the grid.

So far all our valves have been voltage amplifiers, that is their main function being to give a large voltage drop across the impedance in the plate circuit. Our output valve however is designed for the purpose of power output as we require watts to drive our loudspeaker. As power = volts × amps, our output valve is designed to operate at a high current drain. The plate current flowing through the primary of our speaker transformer rises and falls at the same frequency as the oudio voltage fluctuations. This voltage is induced into the secondary of the output transformer and impressed across the voice coil of the speaker. The transformer serving to match the low impedance of the voice coil moves along the iron core f the speaker at the same audio frequency as the voltage varies which is applied to it from the output transformer, pulling the cone in and out with it, displacing air at this same frequency thus converting electrical energy into sound.

On increase or decrease in current flowing through this voice coil aids or opposes the magnetism given to the iron core by the permanent magnet thus increasing or decreasing the volume or amplitude of the output by reason of the fact that the cone displaces more air as it is pulled further backward and forwards.

We have now followed the signal right through our set, touching lightly on all components used which is all that can be done in an article of this length. If any readers would like a little more detail on any particular point and care t oenclose a 2½d. stamp, I will reply by mail. This will serve two purposes; in the first place it will help the reader, and secondly it may make me think more deeply into some point which, not practising what I am preaching, I have taken for granted.

Among Our Readers

NEWS AND VIEWS FROM THIS MONTH'S MAIL

"I fell for your amplifier in the October, 1949, issue. Well, what a cranky job! I have a mate who talked me blind all about direct1coupled sets. Well, I kicked off trouble plenty. It was nearly tossed out a few times, but eventually I tamed the beast. I have several other amplifiers, such as the Vox Minor and Major, but this new job sure has magnificent tone and volume around ten watts. I used a 6J5 instead of the 6B8G, to dodge the long grid lead. I used a voltage divider on the first power supply. Output transformer was a very old R.C.A. push-pull one which was on the earliest American-made Magnavox speakers. I don't think I'll worry about trying to get a better one. I chased hum by changing the leads of the chokes, the 385 aside plate, and even the voice coil leads, till now the job is as silent as one could wish. The speaker is a heavy magnet Yank disposals one about 10in. cone, weighing 6½lbs. I have it on a 3ft. 3in. solid baffle of old pine, and, as I said before, this ugly duckling has grown up."—C. W. McIntyre, 8 Macalister Street, Ipswich, Q.

* * *

"I would like you to know how much I appreciate Radio World. I don't read every issue from cover to cover, but I nearly always find something of interest in each month's copy. My main interest is in high fidelity work, and I have found the issues from January to August of 1948, and the more recent issues on direct coupling, an invaluable source of reference. I recently built a gramophone for a friend, using a Connoisseur magnetic pick-up, Williamson's amplifier, and a Rola 12-0 speaker. This sounded really out of the box. I got most of the information out of Radio World. Thanks a lot and keep up the good work."—Bernard Thomson, 356 Orrong Road, Caulfield, Vic.

* * *

"I have been taking Radio World for years now and find it the most favoured radio magazine on the market today. I am writing this to give you praise for the pre-amplifier circuit which you published in the March, 1949, issue.

WANTED — A BETTER

CONSTRUCTIVE CRITICISM

We could get far more pleasure out of our radio sets if commercial broadcasting stations would not be at war with each other, but would collaborate to their mutual and listeners' benefit.

At the present moment their main ambition seems to be to snatch up as many patrons as they can get for themselves, which, outwardly, seems to be just the natural thing for free commercial enterprise. But competition, which normally benefits the customer by giving him best quality goods at reasonable prices, does not work out in such a beneficial way to the radio listener. If John Citizen wants to buy himself some furniture, he can go from shop to shop, look at the quality and value of the goods on display and finally buy what he likes best. If, however, he wants to enjoy a radio programme between 5 and 6 p.m. he cannot sample through the one-hour programmes of six or eight stations at the same time and finally pick the one he prefers — after it is all over. It is a very unfortunate fact that you can only listen to one station at a time and that all other programmes transmitted simultaneously are forever lost to you. Between 8 and 9 p.m., for instance, all stations present the pick of their programme, which often cost thousands to the sponsors. As the quality and appeal of the presentations are nearly all in the same class, each station will only have a limited patronage, which will be formed at a certain percentage of "available" listeners. As a result of this splitting up of listenership, sponsors of costly star programmes don't get the full benefit of their money, while the public loses a lot of good entertainment.

I got hold of a connoisseur pick-up, so started to look through Radio World for a pre-amp circuit. I did not have to go far. I built this circuit up and took the h.t. from the voltage divider on the set. It was very noisy. I pulled it down, re-built it again, but still the same. So I got a 5 watt, 100,000 ohm resistor and took the high tension through this from the main 270 volt line. This brought the plates to around 100 volts, and it did the trick. With my ear up against the speaker I can just tell that the set is working. My speaker outfit is a G12 for lows and a K8 for highs with a dividing network made up by the A and R people. If you have anyone interested that wants a helping hand I will put them on the right path regarding pre-amps, speaker dividing networks and so on."—Henry N. Anderson, Flat 7, Moonbria, 68 Mathoura Road, Toorak, Vic.

* * *

"I would like to add how much I appreciate your magazine. Being a University student, I don't get much time to read radio publications, so I like concentrated articles. I consider Radio World the best Australian radio magazine. I am particularly interested in high-fidelity equipment and test equipment."—K. G. Smith, 1 Wallis Avenue, Strathfield, N.S.W.

* * *

"A little comment on the quest for pleasing tone. I find during my travels that most ordinary people do not like the low booming tone, especially when it causes a thud-thud effect. Nor do they like needle scratch. I find most controls set mid-way between high and low. n the other hand, I have found people who disregard the tone control altogether. One person even told me that he didn't use the 'other volume control.' On the whole I think most non-technical people prefer a slight bass prominence."—C. A. Lloyd, 79 Victoria Street, Lewisham, N.S.W.

* * *

"I was glad to see your articles on direct-coupling and fully endorse your remarks (October issue) regarding the subtle and somewhat indefinable difference in reproduction from direct-coupled amplifiers. I am particularly interested in the double power supply circuits, as I used these in England about 1922-1925, when, with the British Broadcasting Corporation, in making tests in connection with the Manchester and Sheffield stations. Batteries were used in my circuits, which gave magnificent results considering the poor quality of transmission in those

(Continued on next page)

Broadcasting Policy

FROM FRANK TALK

Lack of collaboration between broadcasters also creates other annoying features, which could be easily avoided. You try, for instance, to listen to a musical programme between 7 and 8 p.m.! This time seems to be reserved for a concentrated dose of serials on nearly every Sydney station, two or three often following each other without interval. On Saturday afternoon 5 out of 8 Sydney stations broadcast the same races—as if one or two would not do! After all, there are fortunately still a lot of people who are not interested in horses and would like a larger selection of entertainment programmes for their Saturday leisure hours.

In England, the B.B.C. has created a fine scheme, which allows everybody to get the class of entertainment he likes. There is a high, middle and low brow programme on three different stations and you can tune in to what you just feel like listening to.

However, programme co-operation would make a wonderful improvement to listeners, stations and sponsors. We would be able to listen to music, talks, vairety, etc., at any time we like, from different stations. We would not have to miss out on any plays or star shows as these would be presented at different times and days. Simultaneous programmes from various stations should cater for different tastes. A symphony will hardly interfere with a variety or comic show, as they appeal to a different type of listener.

Here, the A.B.C. could do that, too, if they had more stations available within a certain area. As for commercial stations, this scheme would not work at all, as it would give distinct advantages to popular features.

Yes, a great deal could be achieved with a little co-operation.

OUR READERS

(Contd.)

days. My compliments on your publication. Only fault Ihave to find is with the proof reader. He slips occasionally, but I know that times are hard, staff scarce and printers difficult."—A. M. Chalmers, "Glen Lewis," Scott Avenue, Leura, N.S.W.

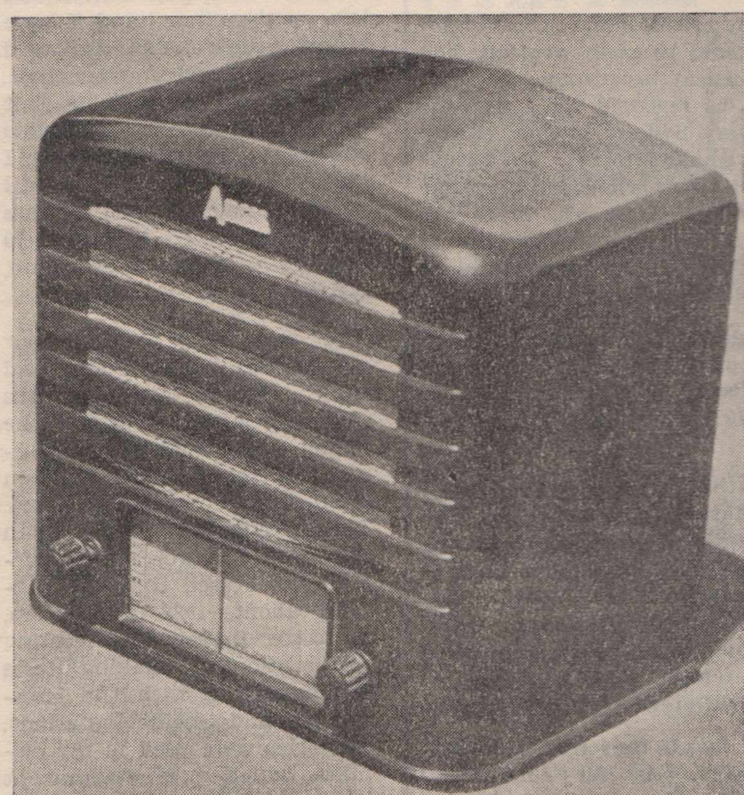
* * *

"As regards myself, I have been interested in radio as long as I can remember. Although I hold a ham ticket (VK5DM), I am more interested in experimenting than taking part in rag chews. Your articles on amplification are very enlightening, especially those on direct coupling. Frankly, I wasn't interested in direct coupling until I read your articles, although my cobber in Tassie (VK7PW) used to thump my ear about its merits. Here are a couple of tips for what they are worth: Firstly, I made a portable and found that it would work well with only 45 volts h.t. and the current drain fell from 13 mills with 90 volts to 5 mills with 45 volts, yet the general performance was still quite good for home use. So I fitted a Tecnico midget 3X3 switch to give me the choice of running off battery number one, battery number two, or both in series. So now I alternate between the two 45-volt batteries from week to week, and use the full high tension only when long-range or greater power is required."—R. P. Mills, 28 Penfold Road, Magill, S.A.

* * *

"You ask for comment on Radio World. Well, the two items I consider essential are plenty of service notes, how to use substitutes, and more reprints from overseas magazines. The service hints will give the younger readers something to learn as well as show the old hands a point or two. I cnsider that it is a good idea to reprint the best articles from American magazines, as these are hard to come by these days."—Clifford A. Lloyd, 79 Victoria Street, Lewisham, N.S.W.

ATTRACTIVE KIT-SET



This is the finished receiver which can be made up from the Aegis "Metropolis" kit-set which was fully detailed in last month's issue.

APPLICATION OF THEORY

Capacity Calculations

There are some tricky little points to remember about condenser capacities, and the effect of reactance on the behaviour of the condenser when in circuit.

By

G. W. BUTTERFIELD,

"The Broadcaster,"

Perth, W.A.

THOSE who read the article on decoupling given in these columns a while back will remember the importance of capacitive reactance in decoupling circuits, and how this reactance varies according to the frequencies being dealt with—the lower the frequencies, the greater the reactance for a given capacity, and vice versa. You will also remember that the reactance can be reduced by increasing the capacity or increased by decreasing the capacity. In other words, although the values of capacity for decoupling, and also coupling for that matter, is not usually a highly critical factor in the majority of cases, it is an advantage to know the approximate reactance required, or to be expected, from a given capacity. In the case of decoupling, or by-passing, this must always be substantially less htan the decoupling resistor used so as to provide an easier path for the A.C. component. In other words, when dealing with any form of A.C. whether low or high frequency, reactance can be looked upon in the same manner as resistance and if you have two alternative paths—one, say, provided by a pure resistance of 5,000 ohms and the other a reactance of 500 ohms provided by a condenser—the A.C. component will naturally go by the capacitative path intead of that offered by the pure resistance.

Calculating the reactance of a condenser to a particular frequency is not difficult and can be done by multiplying together the capacity of the condenser in mfd.; the frequency being dealt with in cycles per second, and the number 6.28; dividing the result into 1,000,000. The answer being expressed in ohms.

CAPACITY CALCULATOR
TABLE 1.

Reactance of Large By-pass Condensers.

Capacity (mfd.)	Reactance Ohms (approx.) at 50 cycles	at 100 cycles
.25	13,000	6,500
.5	6,500	3,250
1 0	3,250	1,600
2.0	1,600	800
4.0	800	400
8.0	400	200
12.0	250	120
25.0	120	60
60.0	50	25

TABLE 2.

Reactance of Small Coupling and By-pass Condensers.

Capacity (mfd.)	Reactance Ohms (approx.) at 50 cycles	at 1,000 cycles
.001	3,250,000	160,000
.002	1,600,000	80,000
.003	1,000,100	50,000
.004	800,000	40,000
.005	650,000	32,500
.006	500,000	25,000
.01	325,000	16,000
.02	160,000	8,000
.05	65,000	3,250
.1	32,500	1,600

However, time and the chances of error can be reduced by making use of the simple tables given in figs. 1, 2 and 3 as these tables cover a sufficient choice of capacities near enough for most practical purposes, together with their reactances at the most comman frequencies dealt with. Table 1 gives the reactances of the larger by-pass condensers from 0.25mfd. upwards at 50 and 100 cycles. Table 2 gives the reactances of smaller coupling and by-pass condensers at 50 and 1,000 cycles; the latter being the low to middle audio frequency range. Table 3 deals with reactances of condensers used to deal with R.F., the examples ranging from 0.0001 to 0.01mfd. at 200 and 1,000 kc/s.

(Continued on next page)

CAPACITY (Contd.)

Whilst on the subject of capacities it would be as well to remind those not too familiar with their wide uses that it is not essential to purchase every value recommended for a particular circuit. In most cases values are not critical and other values may be substituted so long as they are well within the frequency range being dealt with and, in the case of decoupling condensers, so long as they offer a substantially lower impedance than the decoupling resistor or as is sometimes used instead of a resistor—an inductance. This can mean a saving in expense especially for the real enthusiast, who is never satisfied for long with one particular hook-up. Even if one does not possess a condenser of high, or low enough value this can be obtained by connecting a number in parallel or series as required, or, in many cases, a combination of both methods can be used with advantage. For the newcomer it may be as well here to explain this simple process. For instance, you may require a capacity of 1mfd. but have on hand only a couple of 0.5mfd. condensers. In such a case connecting them both in parallel will give you the sum of the two, i.e., 1mfd. as required, but it is important to remember that the voltage rating wil be the same

TABLE 3.

Reactance of Condensers at Radio Frequencies.

Cacpacity (mfd.)	Reactance in Ohms at 1,000 kc/s.	at 200 k/cs.
.0001	1,600	8,000
.0002	800	4,000
.0003	500	2,500
.0004	400	2,000
.0005	300	1,500
.001	160	800
.002	80	400
.003	50	250
.004	40	200
.005	30	150
.01	16	80

as for one, or, in the case of each condenser being of a different voltage rating, the total will be that of the lowest.

Any number of condensers can be connected in this manner to obtain the capacity required and the same rule holds good. On the other hand, you may have two capacities of a higher value than required. We will take the same figures as an example. In this case we require only 0.5mfd. and we have on hand two 1mfd. condensers. To obtain the required reduction they must be connected in series in which case the total capacity will be less than either one. The formula, when dealing with only two is quite simple—the two capacities to be multiplied and the result divided by their sum. Thus: 1 x 1 divided by 1 plus 1 equals 0.5 mfd. It is also important here to remember that the resultant working voltage will be the sum of the working voltages of both condensers. Thus, if each of our 1mfd. condensers was rated at 500 volts, the two working in series would have a maximum working voltage of 1,000.

As with condensers in parallel, any number and value of condenseds can be used in series to reduce the total capacity and the working voltage will be the sum of all. However, it is just as well to mention here that in cases where high voltages are being dealt with, such as in the filter circuit of a power supply, it is usual to connect a high resistance bleeder resistance across any bank of series condensers so as to evenly distribute the voltage. In dealing with more than two condensers in series, the following formula is a little more difficult though still quite simple:

$$\frac{1}{C} = \frac{1}{C1} + \frac{1}{C2} + \frac{1}{C3} \text{ etc.}$$

But for those who do not feel like exercising the brain too much, especially when it comes to calculating capacities of different values, a few helpful tables are given.

Table 4 consists of two columns, the first of which is headed, "Capacity in Mfd" and the second "Reciprocal." To find the capacity of any combination of condensers in series, it is necessary first to write down the number in the "reciprocal" column corresponding to each of the condensers. These numbers must then be added together, after which the combined capacity will be found in the first column opposite the number in the "reciprocal" column corresponding to the sum of the reciprocals already obtained.

For example: Suppose that two condensers each of 0.01 mfds are connected in series. The reciprocal of 0.01 from the table is 100, and as there are two such condensers we must add another 100 to give a total of 200. The capacity in column 1 corresponding to 200 in the "reciprocal" column is 0.005mfd.

TABLE 5.

Minimum Values of L.F. Coupling Condensers for Various Grid Leak Values.

Grid Leak (megohms)	Coupling Condenser (mfd.)
1.0	.006
0.5	.012
0.25	.024
0.1	.06

TABLE 4.

Capacity in Mfd.	Reciprocal	Capacity in Mfd.	Reciprocal
.0001	10,000	.005	200
.00015	6,666	.006	166
.0002	5,000	.01	100
.0003	3,333	.02	50
.0005	2,000	.05	20
.001	1,000	.1	10
.0015	666	.2	5
.002	500	.25	4
.003	333	.5	2
.004	250		

TOLERANCES

It will probably happen that when the sum of the reciprocals has been obtained it will be found that there is no number in the "reciprocal" column exactly corresponding to this figure. In those circumstances the nearest figure must be taken. This does not very much matter, for, as already explained, the values of fixed condensers in a circuit are seldom very critical. For example, a 0.01 and a 0.02mfd. condenser in series correspond to reciprocals of 100 and 50 respectively; these two added together give 150. The nearest to this in column 2 is 166, and this coresponds with the condenser of 0.006mfd. Therefore, a condenser of 0.01 in series with a condenser of 0.02mfd. can be considered as approximately the equivalent of a 0.006mfd condenser, although, if the values were worked out mathematically their actual capacity would be 0.0066. The error is only about 10 per cent. which is of the same order as the tolerance in many manufactured jobs.

From the simple formula and the table given you now have a ready means at hand to ascertain the values of any combination of series or parallel condensers you may have on hand. However, it should also be understood that a combination of both methods can be used, thus reverting to our original simple figures of 0.5 mfd and 1mfd, we may require a capacity of, say, 2.25mfd. in which case two 1mfds connected in parallel will give us the 2mfds and two 0.5mfds. The two combinations then connected in parallel will total 2.25mfds. The voltage rating will be the lowest of the two combinations.

A little thought and practice will show that the whole business is really quite simple.

Coupling Condensers

We now come to cases in which a little calculation is required to arrive at the best value for a fixed condenser. This usually occurs in connection with the coupling conden-

(Continued on next page)

CAPACITY (Contd.)

ser in a resistance-capacity amplifier. A full discussion of the factors governing the design of such couplings is outside the scope of the present article, and in any case they have been dealt with before in these columbns, and it must suffice to remark that the liability to pass the lower audio-frequencies without serious bass attenuation suggests a fairly large capacity, while an upper limit is set by the necessity of avoiding choking the grid circuit, due to the inability of the grid leak to discharge the coupling condenser rapidly enough.

There is a fairly generally accepted rule of thumb governing the size of such a condenser. Briefly stated, it is that the capacity of the coupling condenser in microfarads, multiplied by the resistance of the grid leak in megohms, should not be less than .006, and it may also be added that the grid leak should not be less than four times the value of the anode load of the preceding valve and not greater than .5 megohm, or such lower value as may be recommended by the valve-maker. (See Table 5.)

According to this formula, therefore, the correct size of condenser for use with a .25 megohm grid leak would be .024 mfd. as a minimum, but in actual practice a rather larger value would be chosen, such as the standard .05 mfd. component.

RECORDING

Owing to Mr. Bennett having broken a toe while swimming, he has not been able to contribute Part 4 of his series on Home Recording. We hope it will be available for next issue.

—Editor.

VALVE APPLICATIONS

A sound knowledge of valves and their correct application is most helpful in practically every phase of radio work.

By

W. S. LONDEY,

8A Barkly St.,

Sale, Vic.

IN part VIII the basic principles of the radio valve were discussed and a few of the terms involved explained. In this part it is proposed to consider the more commonly used types encountered in the modern radio and to determine the reasons for their use.

1. The Diode. These have two main applications in radio receivers, namely, detection and power rectification.

(a) As Detectors. The diode detector has become a more or less permanent part of the modern radio receiver, being the simplest and least troublesome type that will give low distortion at high signal levels. Fig. 1 shows a typical circuit: If the signal being detected is very heavily modulated the diode will introduce some distortion in the normal type of circuit used but for signals up to about 80% modulation it is completely free from distortion provided certain design precautions are observed. The foremost of these is to make the diode load resistance (R_2) as much lower than the following grid resistance (R_3) as possible. Typical values are $R_2 = .25$ to .5 megohm, $R_3 =$ 1 megohm. Either of these resistances may be the volume control potentiometer. The condensers C_1 and C_2 should not be too large, C_1 up to 150 mmfd. and C_2 100 mmfd. The audio coupling condenser C_3 should be large enough to pass the lowest desired frequency without attenuation. Should these precautions not be observed there will be distortion due to peak clipping on the heavily modulated parts of the signal. A voltage suitable for automatic gain control may be taken from point "X" although modern practice is to use a second diode which is biassed to delay the A.V.C. operation until the signal reaches a certain value. (Fig. II). The two diodes are often enclosed in the same bulb and use the same cathode as an audio or R.F. amplifier.

Frequency modulation receivers almost without exception use diode detection and require two diodes having separate cathodes. Type 6H6 is the most common valve of this type, while the 6SQ7 and the 6B6 are valves having two diodes and a triode with a common cathode. The 6B8, 6G8, and the 6AR7 are double diodes in the same tube as a pentode amplifier.

(b) As Rectifiers in A.C. Receivers. These rectifiers are made in a number of different

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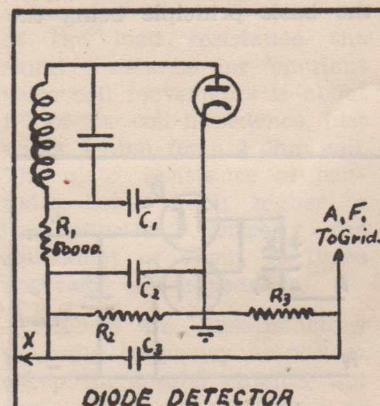
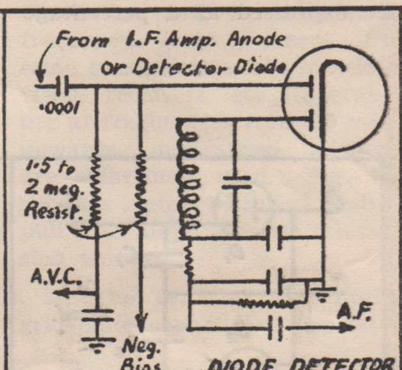


DIODE DETECTOR Fig 1



DIODE DETECTOR with SEPARATE DELAYED A.V.C. Fig II

THEORY (Cont.)

types and with different current ratings. They are made in directly heated types for most transformer type sets, the majority being double units, permitting full wave rectification, examples being the 80, 5Y3, 5Z4, etc.

OTHER RECTIFIERS

Some indirectly heated types of full wave rectifier are also made, the principle advantage being that, if the cathode is brought out to a separate terminal, as in the 6X5, it allows the heaters to be all operated from the same winding. Some indirectly heated full wave rectifiers, such as the 5V4 and 5Z4, have the cathode connected to one of the heater pins. The advantage of this construction is that, as the cathode is more rigid than the filament of the directly heated type, the anodes may be set much closer to the cathode, reducing considerably the valve voltage drop on load and thus improving the regulation. (The regulation of any electrical generator or transformer is defined as the change in voltage output from no load to full load. This may be expressed as a percentage of the full load voltage.) This type of rectifier should be connected so that the output is taken from the cathode pin.

The third type of rectifier is the half wave type which is usually designed with a high voltage low current heater which is insulated from the cathode. These are designed for use in AC-DC receivers and are generally operated straight from the line, the maximum AC. voltage to be applied to the plate being 250. The 12Z3 and 1V are .3 amp. heater types, while the 35Z4, 35Z5 and the U76 have .15 amp. heaters, the 35Z5 having a tap for a pilot lamp. When used on 250 volt supply these rectifiers should have a series resistance to limit the peak current.

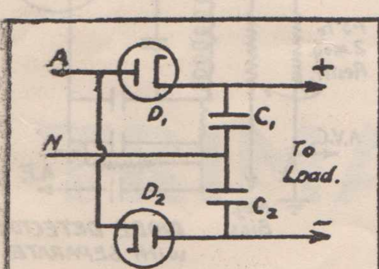
There is another type of rectifier worthy of mention, although there is little call for it in Australia, that is the double diode type such as the 25Z5. This has two completely separate diodes, like the 6H6, each capable of delivering 75 ma. They can be used in parallel as a 150 ma. half wave unit, as a 150 ma. full wave unit, or as a voltage doubler. Two different voltage doubler circuits are used in practice, the basic principle being the same in each case, the utilization of both halves of the sine wave to get double the voltage.

Fif. IIIa shows the simple full wave voltage doubler circuit. This uses two diodes, connected so that D_1 charges condenser C_1 while the line terminal "A" is positive, and D_2 charges C_2 when the line terminal "A" is negative. These two condensers are connected in series so that the total D.C. output is double the rectified line voltage. This system has the disadvantage that the high tension negative terminal is not connected to either line and may cause high heater cathode voltages in some stages, with consequent hum troubles.

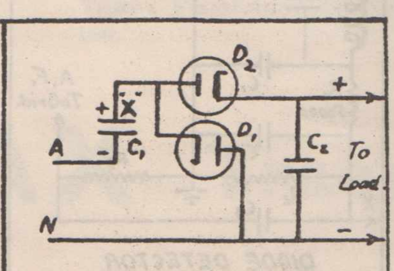
VOLTAGE DOUBLERS

To overcome this the circuit shown in Fig. IIIb has been developed. The operation is somewhat different from the full wave doubler and is as follows: Condenser C_1 is charged by diode D_1 when line terminal "A" is negative, the point "X" of C_1 being positive. On the next half cycle line "A" becomes positive and point "X" will, therefore, be even more positive, the line voltage and the voltage of C_1 being in series and of similar polarity. This total voltage is used to charge C_2 through D_2. The voltage regulation of this connection is not as good as that of the full wave type as the output condenser is only charged once per cycle (it is thus termed a half wave doubler circuit).

Voltage doubler circuits are not required in Australia as the supply voltage using an ordinary half wave diode will give ample voltage for ordinary receiving valves, in fact many sets made for 110 volt



FULL WAVE VOLTAGE DOUBLER Fig IIIA



HALF WAVE VOLTAGE DOUBLER Fig IIIB

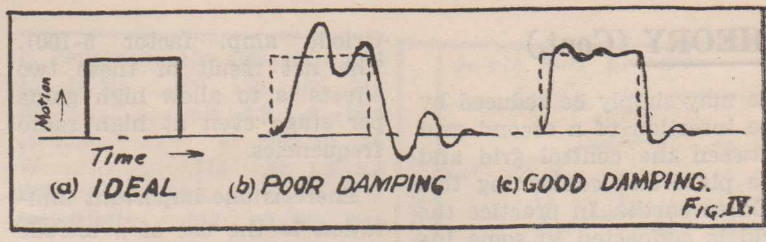
supplies use a H.T. supply of about 100 volts from a half wave rectifier. Voltage doublers cannot be used in A.C.-D.C. receivers.

Amplifiers. The majority of valves used in radio receivers are, of course, used as amplifiers. They may be used as RF, IF, or audio (AF) amplifiers. The requirements of the first two cases are similar, and the same valve types are used for these purposes. Amplifier valves may be triode, tetrodes, or pentodes.

2. **The Triode.** Triode valves are used principally as audio amplifiers and as power valves in good quality amplifiers. The voltage amplification obtainable from a triode as a resistance coupled amplifier ranges from about 12 to 60, the amplification factors ranging from 20 to 100. Triodes having a low amplification factor, with consequent low plate resistance, may, with advantage, be used in transformer coupled circuits, with a resultant gain (grid to grid) of 20 to 40. The cost of the transformer becomes prohibitive if any real quality is desired as a resistance coupled valve is cheaper than the audio transformer, and gives little distortion.

As a power amplifier the triode has the disadvantage of a fairly low power output, but with very little distortion. Two triodes in push-pull are often used to give greater power output with low distortion. It has the important advantage of a low plate resistance which, being connected across the speaker, is very effective in damping any undesirable speaker resonances.

Fig. IV shows the effect of these resonances, their effect being most noticeable when a



steep fronted wave is applied. Fig. IVa shows a square wave (the worst case possible) as applied to the voice coil, IVb shows the effect of poor damping of the speaker, and IVc shows the effect of a well damped speaker. The simplest method of damping a moving coil is to connect a resistance across it. This resistance acts as a partial short circuit and if the coil tends to move differently from the applied voltage the voltage generated by the coil's motion (back e.m.f.) will cause power to be dissipated in the resistance loading the coil against resonant movements. The resistance, unfortunately, would cause some power loss and reduce the output, but there is a form of resistance which operates only in the event of the coil not moving correctly, that is, the driving valve's plate resist- By using triodes the plate resistance of which is about 1-3 of the load resistance the shunt resistance for spurious voice coil movements is about 1-3 of the coil impedence, just under 1 ohm for a 2 ohm coil. The plate resistance of pentodes, being much higher is less effective, normally the equivalent of about 10 times the voice coil impedance.

Triodes are unsatisfactory as radio frequency amplifiers, except in special circuits, but are quite satisfactory as oscillators at normal frequencies. The reason for their being unsatisfactory as r.f. amplifiers is the high grid plate capacity, which is in the order of 1 to 5 mmfd. This causes feed back from plate to grid, and, when both plate and grid circuits are tuned to the same frequency there may be instability and loss of gain. Triodes may be used with advantage in grounded grid circuits for V.H.F. work, where their low noise is an advantage. They are sometimes used as frequency changers in some superheterodyne receivers. It is possible to use a triode as an r.f. amplifier but if reasonable gain is to be obtained it is necessary to neutralize the stage by feeding back from the plate circuit to the grid a small voltage which will be equal and opposite to that reaching the grid through the grid-plate capacity. Neutralized triodes are little used in broadcast frequency work, except in some transmitters, but in television receivers, etc., operating at frequencies from 60 mc. upwards, neutralized triodes are sometimes used. Fig. V shows a typical balanced push-pull r.f. amplifier for television work.

3. **The Tetrode.** The high grid-plate capacity of the tri-

(Continued on next page)

THEORY (Cont.)

ode may simply be reduced by the insertion of a second grid between the control grid and the plate and connecting this grid to earth. In practice the grid is connected to some intermediate high tension voltage and earthed by a by-pass condenser. This grid not only acts as an electrostatic shield, reducing the grid-plate capacity from about 5 mmfd. to .005 but it also has a great effect on the valve characteristics.

EFFECT OF SCREEN

Firstly, the screen grid, as it is called, being nearer to the cathode than the plate, and being positive, attracts electrons, increasing the cathode current, but, as there is considerable space between the screen grid wires, most of these electrons pass through the screen grid and are attracted by the plate, which is at a higher potential. The result of this is to make the plate current more or less independent of the plate voltage —provided the plate voltage is higher than the screen voltage.

This greatly increases the plate resistance of the valve and increases the amplification factor to several hundred (triode amp. factor 5-100). The net result of these two effects is to allow high gains per stage even at high radio frequencies.

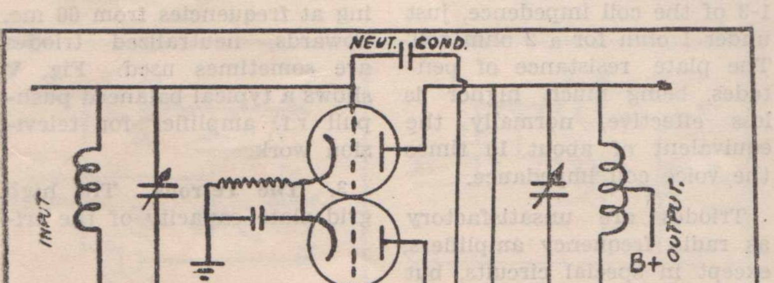
There is one important limitation to the use of a tetrode as an amplifier — the plate voltage must not be permitted to become less than the screen voltage **at any point in the cycle.** Should this occur a phenomenon termed secondary emission may take place, causing instability and possibly oscillation.

If the plate voltage is less than the screen voltage some of the electrons striking the plate may rebound, and in addition knock other electrons off the plate by collision. These electrons enter the space between the plate and the screen and are attracted by the higher voltage screen, with a consequent rapid rise in screen current. At very low plate voltages the electrons move slowly from screen to plate and do not return so much. As a result of this secondary, as it is termed, the plate current may, given suitable conditions, rise as the plate voltage falls. The curves of plate, screen and cathode current v. plate voltage for a typical tetrode are shown in Fig. VI. Consideration of the curve in the unstable region (Ep less than Es) will show that the plate resistance is negative and the valve will therefore oscillate at a frequency determined by the plate circuit provided the dynamic resistance of the plate tuned circuit is high enough. This principle is used in the dynatron oscillator which has the advantage of requiring no feed back from plate to grid —only a simple tuned circuit in the plate. It suffered from one bad fault, however, the valve had to be carefully selected by trial as different valves varied greatly.

Examples of tetrodes or screen grid valves are the 32, 24A, 35, all of which have been displaced by more modern types.

4. The Pentode. The secondary emission troubles of the tetrode may be eliminated by the addition of a third grid between the screen and plate. This grid is connected to the cathode and at all times prevents any electrons reaching the plate from returning to the screen, being highly negative with respect to the plate and screen. This supressor grid, as it is termed does not affect the passage of electrons to the plate as they are moving too rapidly, having been accelerated by the screen, but effectively prevent any slower moving electrons moving back to the screen. Pentodes may, therefore, be operated with the plate and screen at the same initial potential, which would be impossible with tetrodes as any voltage swing at the plate would make it less than the screen voltage.

Modern radio receivers use pentode valves as amplifiers



As r.f. and i.f. amplifiers the in r.f., i.f., and audio stages. pentode gives more stable and uniform operation than the tetrode, while as an a.f. amplifier the pentode at ordinary voltages can give a much greater voltage output and gain than a triode with a considerably greater plate current. Pentodes, like tetrodes, have a very high plate resistance and it is impossible to make the plate load approach the plate resistance in value (Rp for pentode amplifiers may reach 1 megohm) but a load impedance of about 1-10 to 1-5 Rp gives good gain.

Pentode Power Output Valves. The pentode is effective as a power output valve as well as an audio amplifier (with suitable changes in characteristics). The pentode has the advantage of a high plate efficiency and power sensitivity.

The plate efficiency is the ratio of the power output in watts to the plate power consumption (Ep × Ip), usually expressed as a percentage.

Power sensitivity is the ratio of the power output in watts to the square of the R.M.S. grid volts input, and is given in mhos. ($W = E^2$, then $W/E^2 = 1/R$, Conductance $= 1/R$ mhos.)

The following table gives a comparison between several triodes and pentodes as power valves. (Those marked with x are battery types.)

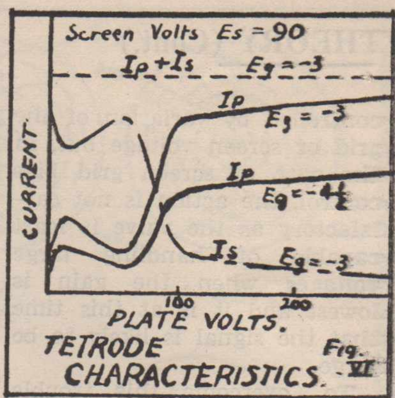
a. Triodes		31x	45	2A3
Plate Volts	Ep	180	250	250
Grid Volts	Eg	-30	-50	-45
Plate Curr.	Ip	12.3ma	34	60
Output Watts	W	.375	1.6	3.5
Efficiency	....	17%	19%	23%
Sensitivity (mhos)		.00008	.00013	.00035

b. Pentodes	1A5x	1F5x	6G6	6F6
Ep & Es	90	135	180	250
Eg	-4.5	-4.5	-9	-16.5
Ip m.a.	4	79	15	36
W	.115	.31	1.1	3.2
Effic.	32%	26%	41%	35%
Sensitivity	.011	.03	.025	.024

From an examination of the above tables it is seen that the pentode valves require much less high tension power for a given power output than do triodes, and, in addition require a much lower grid driving voltage. Compare 6F6 and 2A3 which have similar power outputs. The pentode has the disadvantage that it produces more harmonic distortion than does a triode, and the distortion in the case of the pentode is largely third harmonic, which cannot be cancelled by the use of two valves in push-pull.

The load to give the best balanced between low distortion and high power output is usually about 1-10 of the plate resistance and is fairly critical in value so the maker's specifications should be followed in this direction.

5. **Beam Power Valves.** The beam power valve is a development from the pentode in which precautions are taken during manufacture to ensure that the screen grid wires are each shielded by one of the grid wires. This has the effect of causing the electrons to travel in sheets or beams from cathode to plate, few reaching the screen grid. A supressor grid is not necessary as beam forming plates at the sides of the electron beam prevent electrons reaching the screen outside the beam and the space charge produced by the slowing down of the electrons after passing the screen when the plate voltage is lower than the screen voltage prevents electrons passing directly to the screen from the plate.



TETRODE CHARACTERISTICS. Fig. VI

Beam power valves have even higher power sensitivities and plate efficiency than pentodes as the following table shows.

c. Beam power valves.	1Q5x	6V6	6L6	6L6
Ep & Ss	90	250	250	350/250
Eg	-4.5	-12 5	-14	-18
Ip ma.	9.5	47	79	66
W	.27	4.5	6.5	10.8
Effic.	31%	38%	33%	47%
Sens. mhos.	.027	.058	.066	.066

Beam power valves, like pentodes, have a higher distortion than triodes, and generate more of the higher harmonics. The effect of the distortion may be reduced by the use of inverse feed-back.

6. **Variable-mu or Super-control R.F. Amplifiers.** A simple high gain tetrode or pentode may be used as an r.f. or i.f. amplifier provided the signal to be handled does not exceed a certain (rather small) value. Gain may be

(Continued on next page)

THEORY (Cont.)

controlled by variation of the grid or screen voltage but, in the case of screen grid bias control, the action is not satisfactory as the valve is least capable of handling large voltages when the gain is lowest and it is at this time that the signal is likely to be large.

To overcome this trouble the super-control type of pentode and tetrode has been developed. The control grid of this type of valve is not evenly spaced, having the grid wires close together at the ends of the grid and spaced wider at the centre. The effect of this is to make the valve capable of handling a wide range of grid voltage. When the grid bias is a minimum the grid operates as a normal valve, but as the grid is a minimum the grid operates as a normal valve, but as the grid bias is increased the outer ends cut the current off completely, but some electrons still pass through the centre part where the grid wires are wider spaced. Now the amplification of a valve is higher if the grid wires are close together than it is with wide spaced wires so that the amplification will be less when the grid bias is large. The result is that the gain of the valve may be controlled by changing the grid bias, the higher the bias the lower the gain. This gives an effective means of gain control, and is used in all modern radio receivers, the control voltage being obtained by a variable resistance in the cathode or by using the negative voltage produced by a diode detector, the latter method being automatic in operation.

Examples of super-control pentodes are: 1T4, 1P5, 1D5, 58, 6U7, 6SK7, and 6BA6.

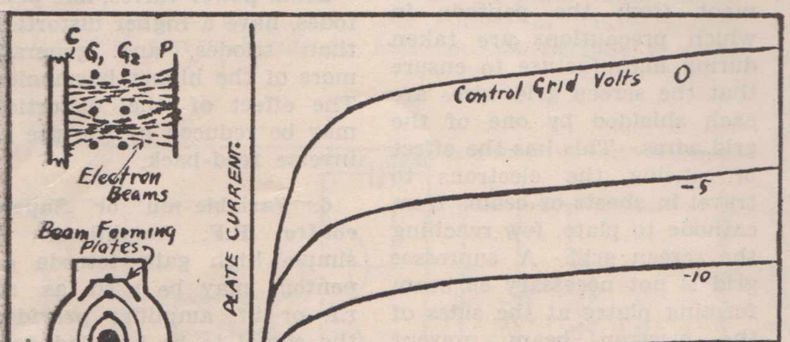
These valves are said to be of the remote cut off type because the cathode current does not become zero (cut off) until a very large negative bias is applied (about -50 volts compared with -6 for a sharp cut off type).

7. **Heterodyne Converter Tubes.** These tubes are sufficiently numerous to warrant special mention, being almost universally used in modern superheterodyne receivers. They range from the heptode having a combined oscillator and detector with a common electron stream to double tubes with separate oscillator and detector sections, and one type which requires a separate oscillator.

The basic principle of all these tube types is that there is a screen grid valve, usually of the remote cut off type, having another grid which is shielded from the first (usually by the use of a double screen grid) and of the sharp cut off type. The incoming r.f. signal is applied to the remote cut-off grid and a second signal from an oscillator in the receiver is applied to the sharp cut off grid. The resultant signal at the plate of the converter, as it is called, contains, in addition to the r.f. and oscillator frequencies, their sum and difference, both of these signal frequencies being modulated like the r.f. input. The intermediate amplifier is arranged to select the difference freq. and amplify it.

There are three main types of converter in use:

a. **Pentagrid converters** which include the 6A8, 6SA7, 1A7, 1C7, 1R5, etc., and use a single electron stream passing through each grid in turn. The arrangement of the elements of the 6A8, 1A7, 1C7 type are shown in Fig. VIIIa, grid No. 1 being the control grid for the oscillator; grid No. 2 is the oscillator plate; Nos. 3 and 5 are screen grids, one on each side of the r.f. input grid, No. 4. Types 1R5 and 6SA7 have no oscillator plate and use the screen grid as the oscillator plate terminal (or the cathode and a tapped



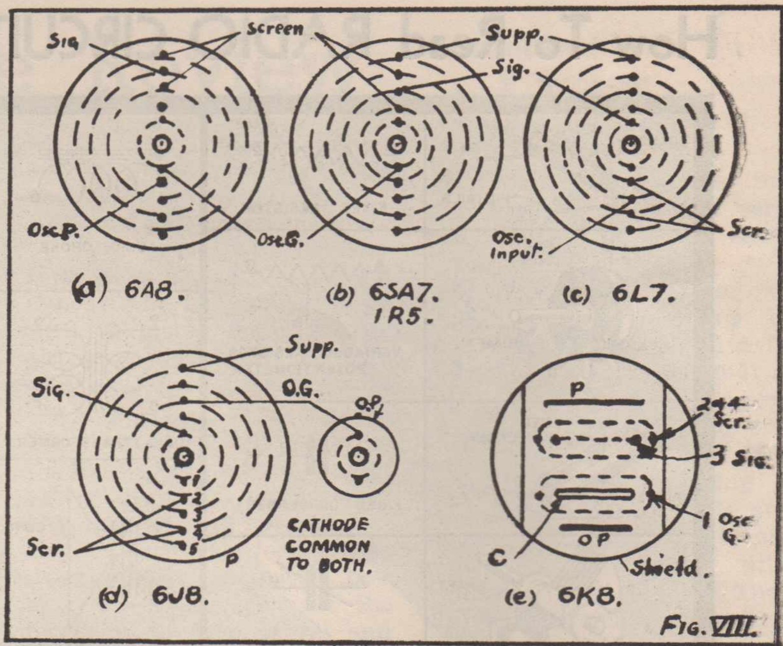


FIG. VIII.

oscillator coil). The grids then become—

No. 1 Oscillator grid.
No. 2 Screen.
No. 3 R.F. input.
No. 4, Screen (connected internally to 2).
No. 5 Supressor grid.

Fig. VIIIb shows the electrode arrangement.

b. **Heptode Mixers. The** 6L7 is an example of this type and is a single unit valve having a cathode, five grids and a plate.

The arrangement of grids is as shown in Fig. VIIIc.

No. 1 Signal grid (remote cut off).
No. 2 Screen grid.
No. 3 Oscillator injector grid (Sharp cut-off).
N. 4. Screen grid (connected to No. 2).
No. 5 Supressor grid.

This valve requires a separate oscillator valve.

c. **Triode-Heptode Converters.** The 6J8 is the principal example of this type of converter and it consists of a triode oscillator and a heptode mixer like a 6L7 in one envelope with the oscillator grid connected internally to grid No. 3 of the mixer.

The X61M and the ECH35 are similar to the 6J7 but have no supressor grid being triode-hexodes.

A different type of triode hexode valve is the 6K8 in which the hexode grids are arranged differently, Fig. VIIIe showing the electrode arrangement.

No. 1 Oscillator grid.
No. 2 Screen grid.
No. 3 Signal grid.
No. 4 Screen grid.

All these converters require a certain minimum oscillator peak voltage for optimum conversion gain.

The above are the principal valve types used in radio receivers but some types are made which may have more than one type in a single envelope, e.g., diode triodes, diode pentodes, triode pentodes, double triodes, etc., the basic principles of each type remaining unchanged.

IF . . .

You are intersted in this series, but have missed previous issues, you can obtain any one or all of them from our Back Dates Department, at 1/- each.

NEW STATIONS

ETA, Addis Ababa, 15.055 m.c: 19.92 met.:

This is more of a change of frequency than a new station, and the choice has probably been made to steer clear of GWC. Signal is not as good as the other Ethopian outlets.

Radio Tangier, Tangier, 11.73 m.c 25.58 met.:

According to "Sweden Calling" Tangier has been heard testing on this frequency. So watch for it, but time is troublesome . . . round about 3 a.m.

Radio Tangier, Tangier, 12.59 m.c. 23.82 met.:

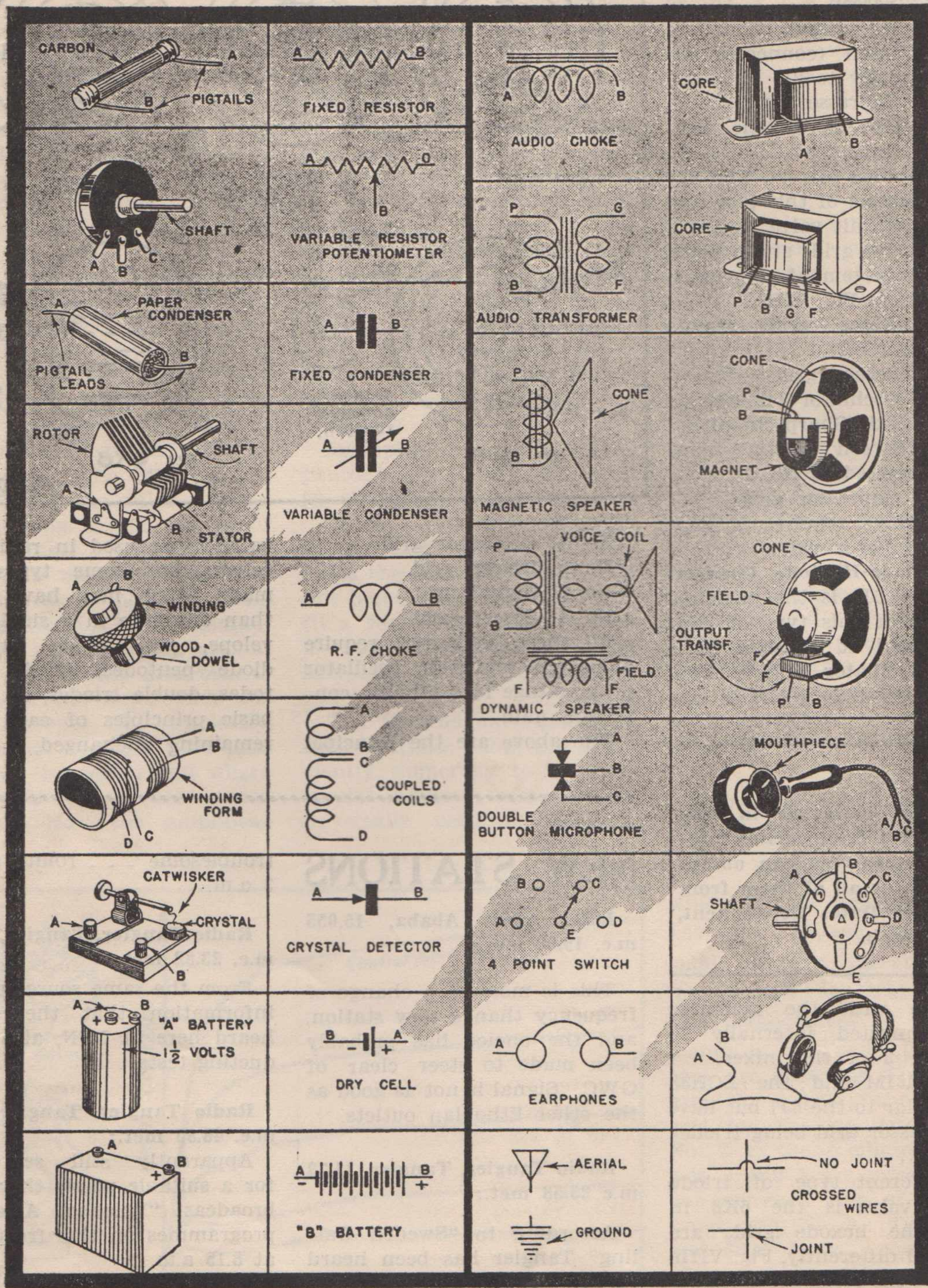
From the same source comes information that they were heard here at M/N, also conducting tests.

Radio Tangier, Tangier, 6.14 m.c. 48.85 met.:

Apparently still searching for a suitable possie they now broadcast "Voice of America" programmes on this frequency, at 8.15 a.m.

Radio Tangier, Tangier 21.59 m.c. 13.90 metres.:

How To Read RADIO CIRCUIT SYMBOLS



Once you understand meanings of schematic symbols pictured in two vertical center columns above, radio circuit diagrams will no longer be a mystery. Pictorial sketches are shown at right or left of each symbol, with letters to show proper connections. Remember that short bar on battery symbol is always negative. Use terminals A and B for variable resistor; all three for potentiometer. B on potentiometer is always movable contact. Parallel lines always indicate iron core.

Shortwave Review

Conducted by
L. J. KEAST

BBC YEAR BOOK, 1950

Once more that welcome yearly has come along. This issue returns to pre-war size, with more photographs (44 pages) than ever before. The 176 pages of text include eighteen leading articles, and nineteen Radio Personalities of the year.

The Report Section is enlarged to give a full picture of BBC organization, with a particularly valuable outline of the Engineering Division.

I can recommend it as a valuable addition to any Dxers' library.

★

HELP THE OTHER CHAP TO HEAR

As suggested in February issue I have devoted a fair amount of space in this issue to Overseas Stations, and I trust the schedules shewn will be found reasonably correct. I want to thank the several Consuls who have provided me with so much material and also those well known regulars who have been so kind as in the past, and kept me informed of their loggings.

I want to ask all readers not to hesitate to let me know of any changes they hear of as it is quite impossible for any one listening-post, no matter how long the hours spent at the receivers, to keep a full and correct tally of the times on the air or the full frequencies used. So let me know what you hear and I'll tell the other fellow and we can then say, "Hear, Hear!"

VERIFICATIONS

Arthur Cushen, who has now brought his list of verified countries up to 124, sends some interesting notes.

Received veri. from O. Wilker, engineer-in-charge of studios of Kol-Israel, Tel Aviv. Shedule is 2-4.15 p.m.; 6-11.15 p.m.; M/N-7.30 a.m. English is given at 10 p.m. and 6.30 a.m. Power on 9 m.c. is 7500 watts and they are using a RCA transmitter rhombic antennae. On 6.83 m.c. transmitter is 2500 watts with semi-directional dipole. They also have a small transmitter at Haifa on 8.17 m.c.

Other verifications are from ZRB (9.11); Ceylon (17.73); LKV; KGEI (9.67); Salisbury (7.29); KRHK (17.80); KCBA (15.13); WNRI (18.16); WNRA (21.60); WOOC (15.13); Athens (9.605); VUC-3 (7.21); VUC-2 (4.88); VLC, Malaya (9.715); YVMO and KGEX (17.76 m.c.).

New Stations

4VRW, Port-au-Prince, 9.795 m.c. 30.61 met.:

This is a new call-sign for the old HH3W in Haiti, who will be remembered on 10.31 m.c. 4VRW can be heard at increased strength from around 10 p.m. Identification is four chimes after several minutes of recording. Announcements are made in French—then English.

4VRW, Port-au-Prince, 10.2 m.c. 29.41 met.:

Have been told has now moved to here.

Radio Nigeria, Lagos, 9.655 m.c. 31.07 met.:

Arthur Cushen reports this one. It is the headquarters of the Catholic Mission at Lagos, British West Africa. They operate on 9.656 and 6.035 m.c. from 4-5.15 p.m.; 9 p.m.-8 a.m. This is experimental and they relay the General Overseas Service of the BBC. Reports are welcomed.

Radio Mecca, Djedda, 11.95 m.c. 25.11 m.c.; 11.76, 25.51; 9.645 31.11.:

Reported heard in Arabic from 3-4 a.m.

HVJ, Vatical City, 7.28 m.c. 41.21 met.:

Here is a new outlet for HJV, heard at 6.30 a.m.

SHORTS

FXP8, Tahiti, 12.08 m.c. 24.83 met.:

Heard from 1.15-3 p.m.; power is 600 watts.

Radio Vorarlberg, Dornbirn (French Zone), Austria, 5.98 m.c. 50.17 met.:

Note slight change in frequency . . . was on 6 m.c. Signal is now much clearer. Opens at 4 p.m. with news in French at 5 o'clock.

TIFC, San Jose, Costa Rica, 9.645 m.c. 31.11 met.:

Signal is much better now and station closes at 1.05 p.m. with hymn, "The Lord of Life My Shepherd Is" or "Ave Maria."

(Continued on page 33)

EUROPEAN AND OTHER S.W. STATIONS

It is confidently hoped the following list of S/W stations will be of particular interest to those who, whilst having taken up this country as their abode, will quite naturally desire to know what is going on in the land of their birth.

I will endeavour to keep same up-to-date as regards changes of schedules, etc. In the little space available it is impossible to list all the countries but next issue will contain quite a number of those not shewn in this number.

EUROPE.

Albania: ZAA, Tiranna, 7.852 m.c. 38.23 met.: 6-9 a.m.

Radio Shkdora, 8.22 m.c. 36.50 met.: 4-5 p.m.; 10.30-M/N; 2.30-6 a.m.

Austria: Radio Wein, Vienna, 11.785 m.c. 25.45 met.:

Radio Wein, Vienna, 9.664 m.c. 31.04 met.:

Radio Wein, Vienna, 9.563 m.c. 31.37 met.: Closes at 8 a.m.

KZCA, Salzburg, 7.22 m.c. 41.55 met.: Closes at 6.30 a.m.

7.175 m.c. 41.80 met.:

Belgium: Radio Brussels, 21.45 m.c. 13.98 met.: Around 7 a.m.

Radio Brussells, 17.845 m.c. 16.85 met.:

Bulgaria: Radio Sofia, 9.398 m.c. 31.92 met.:

9.35 m.c. 32.09 met.:

9.31 m.c. 32.22 met.:

7.67 m.c. 39.11 met.:

Czechoslovakia: OLR - 4A, Prague, 11.84 m.c. 25.34 met.: 9.50-11 a.m.; 7-7.30 p.m.

....OLR-4D, Prague, 11.76 m.c. **25.51 met.:** 4-4.30 p.m.

OLR-3A, Prague, 9.55 m.c. 31.41 met.: 3-3.55 p.m.; 7-7.15 p.m.; 9.30-9.45 p.m.; 12.45-4.10 a.m.

....OLR-2A, Prauge, 6.01 m.c. **49.92 met.:** 4.15-9.45 a.m.

Radio Prague, 6.765 m.c. 44.34 met.: Can be heard after M/N and appears to leave the air about 4.30 a.m.

Denmark: OZH-2, Copenhagen, 15.165 m.c. 19.78 met.: 12 30-2 a.m. daily. On Tues., Thurs. and Sats. heard from 8-9 p.m.; concludes with English.

OZF, Copenhagen, 7.26 m.c. 41.32 met.: Heard signing o: at 8.30 a.m.

France: Radio Paris, 17.85 m.c. 16.81 met.: 6-6.45 p.m.; 10-10.30 p.m.; 11.30 p.m.-1.30 a.m.

15.35 m.c. 19.54 met.: 2.15-3.15 a.m.

15.10 m.c. 19.87 met.: Around 9.30 p.m.

9.68 m.c. 30.99 met.: 2.45-3.50 a.m.

6.145 m.c. 48.82 met.: 4-5.45 a.m.

Germany: Radio Leipzig, 9.73 m.c. 30.84 met.: Good around 3.45 p.m. in German.

6.12 m.c. 49.02 met.: 10 p.m.-2 a.m.

KZPA, Salzburg, 9.53 m.c. 31.48 met.: "The Blue Danube Network," good at 4 p.m.

Munich 1, 15.28 m.c. 19.64 met.: 2-3 a.m.

Munich II, 9.54 m.c. 31.45 met.: 2-8.30 a.m.

Munich IV, 7.25 m.c. 41.35 met.: 2-8.30 a.m.

Munich I, 6.17 m.c. 48.62 met.: 5.30-8.30 a.m.

Munich III, 6.08 m.c. 49.34 met.: 2-8.30 a.m.

Greece: Radio Athens I, 6.34 m.c. 47.29 met.: "The Forces Station," is at fair strength till 5 p.m. daily, but on Sundays has church service till sign off at 6 o'clock; also heard from 1-6.45 a.m.

Radio Athens II, 7.05 m.c. 42.25 met.: This station is heard at better strength aroun same time but does not carry same programme.

. . . . Larisas, 6.745 m.c. 44.50 met.: This army station gives the following schedule: Daily at 3-5 p.m.; 8-11 p.m., 2-6.45 a.m. A programme in English is given on Thursdays at 6 a.m.

Holland: PCJ, Hilversum 21.48 m.c. 13.96 met.: "The Happy Station" is heard from 8-9 p.m. in special programme for Pacific Area on Tuesday.

17.775 m.c. 16.88 met.; 15.22 m.c. 19.71 met.; 6.025 m.c. 49.8 met.: Same remarks apply.

Hungary: Radio Budapest, 9.82 m.c. 30.55 met.: Full schedule 3-9 a.m.; gives a 15-minute news service: 3.20 Russian, 4 French, 5.20 German for Austria, 6.30 German, and 7.30 a.m. English.

Radio Budapest, 6.247 m.c. 48.00 met.: Same remarks apply.

Italy: Radio Italiana, Rome, 15.12 m.c. 19.83 met.: 11.30 p.m.-4 a.m.; 8.10-10.25 a.m.

Radio Italiana, Rome, 11.81 m.c. 25.40 met.: 4.05-8 a.m.; 8-8.30 p.m.

9.63 m.c. 31.15 met.: 4.05-8 a.m.

A GUIDE FOR "NEW AUSTRALIANS"

Vatican City: HVJ, Vatican City, 7.28 m.c. 41.31 met.: 3-7 a.m. (At 6.30-7.28 is badly jammed by Paris on same freq.)

6.19 m.c. 48.47 met.:

5.968 m.c. 50.28 met.:

Persia: EQC, Teheran, 9.66 m.c. 31.06 met.: Transmits to Europe from 4.30-8.30 a.m.

Poland: Polskie Radio, Warsaw, 9.53 m.c. 31.48 met.: 3-7 p.m.; 8.57-9.30 p.m.

Polskie Radio, Warsaw, 6.215 m.c. 48.25 met.: 1-9 a.m. on Mondays.

Luxemburg:

Serbia: Radio Belgrade, 9.42 m.c. 31.85 met.:

Spain: Radio National Espana, Madrid, 9.37 m.c. 32.02 met.: News in English at 6.20 a.m.

Switzerland: HER-5, Berne, 15.305 m.c. 19.60 met.: 8-9 a.m.; news in English at 8.25.

11.865 m.c. 25.28 met.: 6.45-8.15 a.m.; excellent programme on Sunday from 5-8 p.m.; news in English at 5.

11.715 m.c. 25.61 met.: Excellent at 5 p.m. on Sundays.

HER-4, Berne, 9.535 m.c. 31.46 met.: Morning and afternoon. met.: Morning and afternoon.

HER-3, Berne, 9.665 m.c. 31.04 met.: 6.45-8.15 a.m.

Yugoslavia: Radio Belgrade, 9.506 m.c. 31.57 met.: News in English at 4.15 p.m. and 2.15 a.m.

AFRICA.

French Equatorial: FZI, Brazzaville, 11.97 m.c. 25.47 m.c.: 5-9 a.m.; news in English at 6.45 and 8.30.

Nigeria: Radio Nigeria, Lagos, 9.655 m.c. 31.07 met.: 4-5.15 p.m.

....Tangier: Radio Tangier-1, **15.24 m.c. 19.69 met.:** 2-6 a.m.

Radio Tangier-1, 7.22 m.c. 41.55 met.: 6-8.30 a.m.

Radio International, 6.11 m.c. 49.10 met.: 9 p.m.-1 a.m. 3-9.30 a.m. in English, French, Spanish and Arabic.

SCANDANAVIA.

Finland: OIX-5, Lahti, 17.8 m.c. 16.85 met.: 1-7 a.m.; also heard at 7.30 p.m.

OIX-4, Lahti, 15.19 m.c. 19.75 met.: 1-3 p.m.; 10-11 p.m.; and 2.45-3.45 a.m.

OIX-1, Lahti, 6.12 m.c. 49.02 met.: No reports.

Norway: LLP, Oslo, 21.67 m.c. 13.84 met.; LLN, Oslo, 17.825 16.83 met.; LKV, Oslo, 15.17 19.79 met.: 11 p.m.-M/N. (LKV particularly good.)

LKQ, Oslo, 11.73 m.c. 25.58 met.: Norwegian at 9.30 p.m.

Sweden: SBP, Stockhalm, 11.705 m.c. 25.63 met.: Good at 5.15 p.m.

SDB-2, Stockholm, 10.78 m.c. 27.81 met.: Same remarks apply.

MISCELLANEOUS.

Arabia: Radio Mecca, 11.958 m.c. 25.11 met.; 11.76 m.c. 25.51 met.; 9.645 m.c. 31.11 met.: In Arabic from 3-4 a.m.

Canada: CHOL, Sackville, 11.72 m.c. 25.60 met.: 6.15-9 a.m. Special programme for Pacific on Sundays from 6.45-8.35 p.m. ,

CKLO, Sackville, 9.63 m.c. 31.15 met.: Same remarks apply.

Turkey: Radio Ankara, 9.465 m.c. 31.70 met.: 1 a.m.-8.15 a.m. Special broadcasts in English on Fridays from 7.30-8.15 a.m.

S.W. NOTES (Cont.)

ETA, Addis Ababa, 15.05 m.c. 19.92 met.:

Heard at 11.45 p.m. in Eng-
24.11 met.:
lish.

HCJB, Quito, 12.445 m.c.
Very good signal at 9.30 p.m. Generally hymns and talks in English. "The Voice of the Andes" is one of the old reliables.

SBO, Stockholm, 6.065 m.c. 49.46 met.:

For you early tuners . . . you can hear news in English at 4.45 a.m.; also on SDB2, 10.78 m.c. 27.81 met.

And here are two to watch for:

DZH-8 on 11.855 m.c. 25.30 met. and DZH-9 in the 19 metre band. Both will be operated by The Far East Broadcasting Company, Manila.

Radio Belgrade, Yugoslavia, 9.535 m.c. 31.57 met.:

Now giving a news session in English at 4.15 p.m. daily. Signal is at good strength.

BED-2 and BED-4, Taiwan, reported as new stations in Xmas issue are actually operating on 11.725 m.c. and announce as "The Voice of Free China." Reception is particularly good and is striking contrast to that "furry" note usually associated with broadcasts from China.

Whilst passing it is interesting to note that the frequency of 11.725 m.c. was one of the best of the pre-war Japanese stations, JVW-3, Tokyo.

Radio Budapest is giving a news bulletin in English at 7.30 a.m. on 6.247 m.c. 48 metres and also on 9.82 m.c. 30.55 met.

Speedy Query Service

E.R. (Dunolly) complains that we have not published much in the way of instructions on how to repair vibrator units.

A.—It is not considered advisable to attempt much in the way of vibrator repairs. Nearly all authorities on the subject simply state that if a vibrator unit is giving trouble it should be replaced, together with the buffer condenser which is connected across its secondary points. Sometimes it is possible to clean up the points of a vibrator with a magneto file, but it is a ticklish job. Progress can best be measured by the performance of the cartridge when it is replaced in its socket. If the high tension voltage goes up to normal you can consider that you have done a good job, or had a lot of good luck, as the case may be. Most vibrator sets have fixed bias on the output valve, arranged from the heater circuit. If the high tension voltage falls away to about half and the bias remains normal you can expect to get the distorted reproduction. It is not much use fiddling around with the distortion problem until you have the correct high tension voltage. As a precaution, however, check the high tension current drain to make sure that the voltage drop is not due to abnormal drain, caused by such faults as a broken down coupling condenser between detector plate and output grid.

V.G.H. (Bendigo) asks about the correct value of resistance for a centre-tapped resistor not marked in a recent circuit diagram.

A.—Yes, we tend to take it for granted that all of our readers understand these things. The idea is simply to get a connection to the filament circuit of the directly-heated power valves. If the power transformer has a suitable filament winding with a centre-tapping brought out to a terminal on the strip you will not need a resistor at all, but will simply connect to the c.t. terminal. If the power transformer winding does not have a centre-tapping, then you make an artificial one by using the centre-tapped resistor. The resistance is not important within wide limits, but general practice is to use 25 ohms. for 2.5 volt filaments and 50 or 70 ohm. resistors when the filaments are at 6.3 volts. The two halves of the centre-tapped resistor are in parallel with each other and then in series with the main bias resistor, therefore increasing its effective resistance a little. In most practical cases this is not important, as any tendency towards too much bias means less plate current and so things balance out.

A.D.H. (Brunswick) wants to buy egg insulators.

A.—Enquiries seem to indicate that there is a shortage of these at the moment. Can any reader help?

Bargain Corner

WANTED, V.A. 13 A.S.S. Amplifier, will exchange Cadet Portable, ¼ h.p. 32v. motor. F. P. Brown, Corner Mayple and Yew streets, Barcaldine, Q.

FOR SALE.—Type LSD3 Photo Flash Tube, guaranteed in new condition; £7. Apply "8513," c/o Radio World, Box 13, Mornington, Vic.

INSTRUCTION BOOKS on following: Radio Set, S.C.R. 522A-T2, 542A-T2, S.C.R. 808 & 828A, S.C.R. 508-528-538D; R.A.A.F. Trans. ATR2B, A.S.V. Beacon Manual, AT20 Inst. Manual, AT15, Inst. Manual; Monual on BC312, and BC 342M; Valve Data Book on English forces Vales. What offers in wire-wound and metalised type F Resistors? Write G. Masters, Papuan Theatre, Port Moresby, Papua.

WANTED TO BUY, Ampmeter, to read up to 25 amperes d.c. "8519," c/o Radio World, Box 13, Mornington, Vic.

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