1. Summary

Combo 5W Valve Amplifier and 8” Rola speaker. Unknown maker.
, Dec 2017.

1.1 Original Amplifier

Professional construction – well made. No markings. Based on R&H Feb 1941 5-Watt Amplifier.

MIC socket to volume pot, with wiper to 6J7 pentode mode gain stage, with 2kohm bypassed cathode bias, and 250k load to VS3. Shunt RC 1M/5nF tone control on grid input to 6V6 SE output with 5k output transformer, and 250Ω 3W cathode bias with 25uF bypass, and VS2 on screen. Anode to VS3 feedback via 100k.

Full-wave 5Y3 rectifier to 16uF VS1, then choke to 16uF VS2, then 22k dropper to VS3.

Components

Power Transformer	Red Line; 0-200-230-240V; 290-CT-290V 60mA, 6V3 2A, 5V 2A; E.S..
	Markings on bellend: 347 , Type No 6292
Output Transformer	Rola CB G81 5,000 D L6
Choke	RCS Filter Choke, Type T.C.60, 100mA, 30 H, 250 ohm DCR.
Speaker	Rola 8” alnico , 45 374, D 33/1, A Cone: 62
Tubes	5Y3 GT/G Radiotron E4 I2
	6V6 GT/G Philips USA K66
	6J7 RCA metal K3
CAPs	Ducon aerovox leaded electrolytics 116
	Tecnico leaded electrolytics 4126, 4126
	Tecnico black mud;
Resistors	IRC WW
	IRC metal cap end 1W
	CC colour banded and colour/dot
	Weestat pots

Dating:

Red Line is in Sept 1948 advert, and 347 marking may indicate March 1947.
Tecnico cap marking 4126 may indicate 4 Dec 1946.
Rola frame marking 45 374 may indicate 1945. Most likely an 8-14 model.
R.C.S Radio was a part supplier from Sydney.

Issues:

Differences to R&H Feb 1941 circuit: 1M 6V6 grid leak (not 500k). 100nF for 6J7 screen bypass (not 500nF). 10nF for 6J7 output coupling (not 50nF). 16uF first filter, and no 1kΩ field-coil CL filter. 290-0-290 HV (not 385-0-385). Heater with one end ground (not 6.3V CT grounded). No 7k5Ω 10W pre-load on VS1. 5nF & 1M tone control across 6J7.

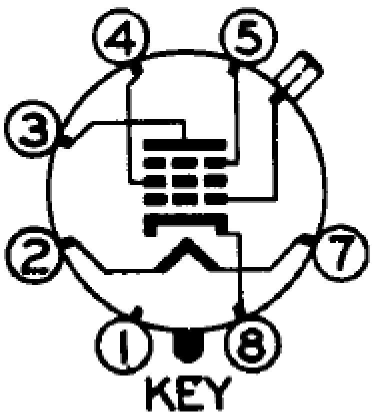
6J7 screen resistor open-circuit; 2k cathode +10%; 20k dropper +15%; 100k feedback +50%; 250 WW cathode +30%; 1M grid leak +26%. Old electrolytics, and mud paper caps. No AC switch or fuse. Bus ground, and heater to ground. Wire insulation old and cracking. Speaker cone with 2 small holes. Box handle leather broken at ends. Old box rubber feet.

2. Modifications

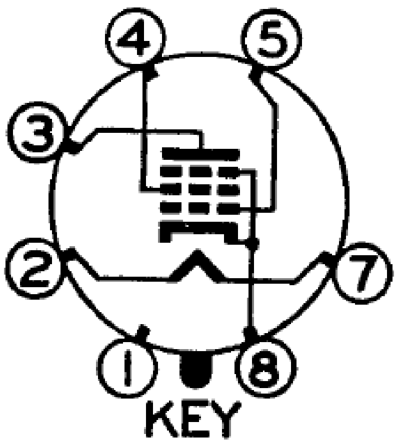
- New mains IEC socket and fuse (0.5A 5x20 IEC F). Nomex shielded rear.
- 431KD10 MOV across primary winding.
- Fuse PT secondary CT (125mA T IEC).
- Added 1N4007 diode in series with each 5Y3GT anode (290-0-290V is ok with single 1N4007).
- Replaced all caps (electrolytic, paper). First filter can be much larger due to PT series resistance.
- Heater with tuned humdinger pot.
- Replaced input jack with switched ¼" floating. Moved volume pot to 6V6 grid leak, with 1MΩ in parallel with wiper. Typical 1M grid leak, and added 10k grid stopper in top cap clip. Moved socket to top of chassis with neoprene washer, and used flexible wiring, to suppress microphonics.
- Replaced fixed 6J7 screen bypass with tone pot in series with 440nF (Wima MKS4 250Vdc rating gets hit at turn-on). Lowered cathode bypass to 680nF, and raised cathode resistance to 2k2, to give low frequency roll-off below 100Hz due to speaker.
- Added 270Ω 2W screen stopper to 6V6. No grid stopper – the volume pot provides that if needed. Reduced coupling cap to 4n7 (from 50nF) to raise high pass corner to ~65Hz. Reduced cathode bypass to 10uF (from 25uF) to raise high pass corner to ~65Hz. Raised cathode resistor to 330R to sit total idle dissipation at 12W.
- Tone pot modified to place series RC in parallel to Vol pot, with wiper at ground and cap can be low voltage - wiper at min = HF cut. Other side of pot used for 6J7 screen bypass cap.
- Speaker transformer primary taken to new terminals. Speaker frame connected to amp chassis.

To do:

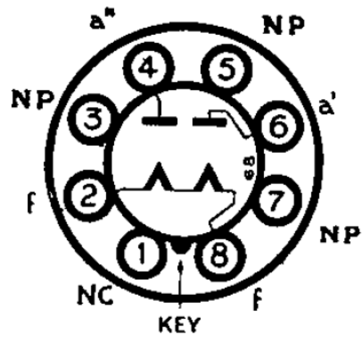
- Repair the two small holes in speaker cone.



RMA 7R
BOTTOM VIEW



RETMA 7AC



Measurements

Power transformer primary, secondary, and choke megger test ok.

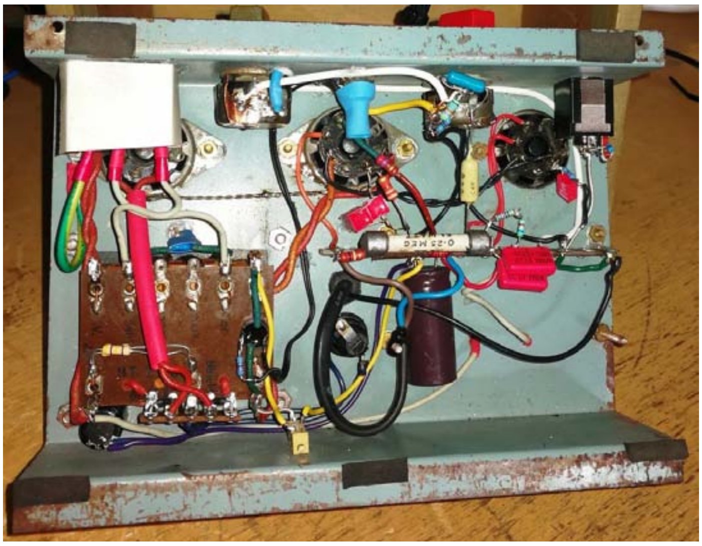
Rail	Idle levels (Mains 244V)
VS1	312V (4.3Vrms); turn-on peak 392V
VS2	300V (~20mVrms)
V2 cath/anode	15.2V/272V (46mA; 11.8W)
V1 cath/anode/screen	2.1V/79V/61V
Heater	6.4
Sec HT	280-0-280

Power transformer primary DC resistance: COM; 38Ω, 45Ω, 48Ω.
Power transformer secondary DC resistance: 173Ω + 185Ω.

Output transformer 5k SE primary DC resistance: 634Ω.

Choke DCR: 233Ω

See measurements folder for power level and tone setting spectrum plots. 5W cranked. Hum negligible. Low gain, so may need a pedal.



3. Design Info

3.1 Input stage – 6J7 pentode

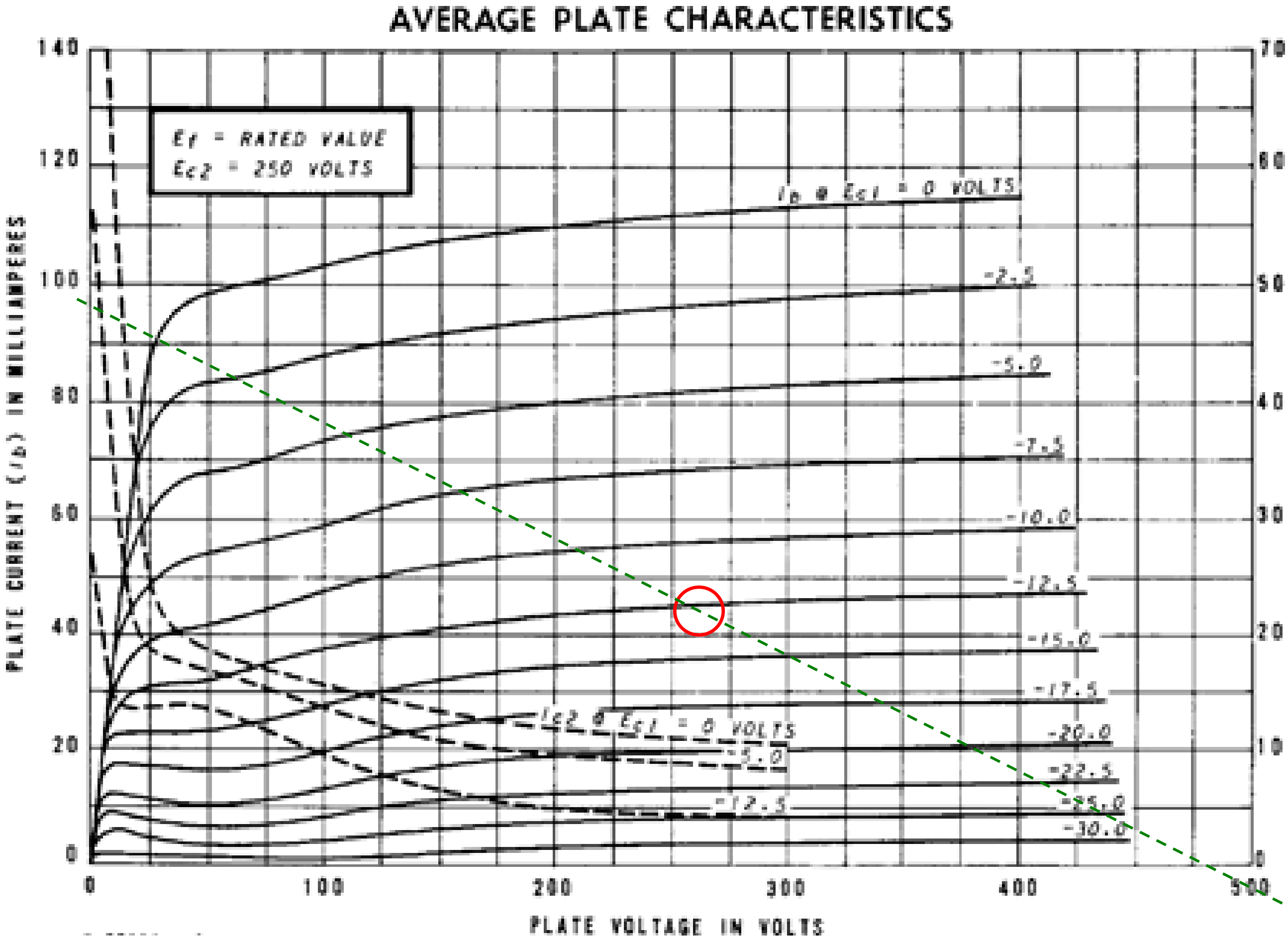
VS3 ~ 300V; 250k Plate ~ 92V (anode current ~ 0.83mA); 1140k Screen ~ 65V (screen current ~ 0.2mA); cathode=2.0V; 2k2=0.92mA.

3.2 Output Stage – 6V6GT Single-Ended

This Class A single ended output stage uses the 6V6GT pentode with bypassed cathode bias. A 5kΩ impedance is presented to the 6V6 plate by the Rola CBG81 OPT with a nominal 2Ω speaker load.

VS2 is lower than VS1 by about 11V: choke DCR of 233Ω and 45mA. Plate DC voltage will be lower than VS2 by an amount up to ~29V; ie. OPT primary resistance of about 635Ω with idle current of 45mA. Cathode voltage has an idle bias of 11V. So effective plate-cathode idle voltage is about 310-11-29-13=257V, and screen-cathode voltage is about 310-11-13=286V.

The maximum output valve bias current allowed is dependent on the maximum recommended plate and screen dissipation of 12+2W for the 6V6GT: Ibias(max) = Pd / Vb = 12W / 260V = 45mA. With a cathode resistance of 290Ω, and cathode voltage of 13V, the plate idle current is 45mA.



3.3 Power Supplies

A standard CT full-wave rectifier circuit with 5Y3GT is used with 290V secondary HT windings with centre-tap, and 16uF capacitor input filter, followed by LC filter, giving 310V at 44mA.

The effective source resistance is comprised of the reflected power transformer primary resistance = 48Ω x $(290/240)^2$ = 70Ω; plus the secondary resistance = 173Ω; which sums to 243Ω.

With choke, and 150uF VS2 filter, the ripple voltage is low enough not to be a concern.

The 5Y3 is directly heated cathode, so VS2 rises significantly before valves start conducting – an issue for 0.22uF coupling cap.

Heater 1 6V3 CT 2A: 0.3 + 0.45 = 0.75A.
Heater 2 5V-0V 2A: 2A.

No over-voltage protection is needed for the OPT, as the feedback circuitry loads the primary with 120kΩ.

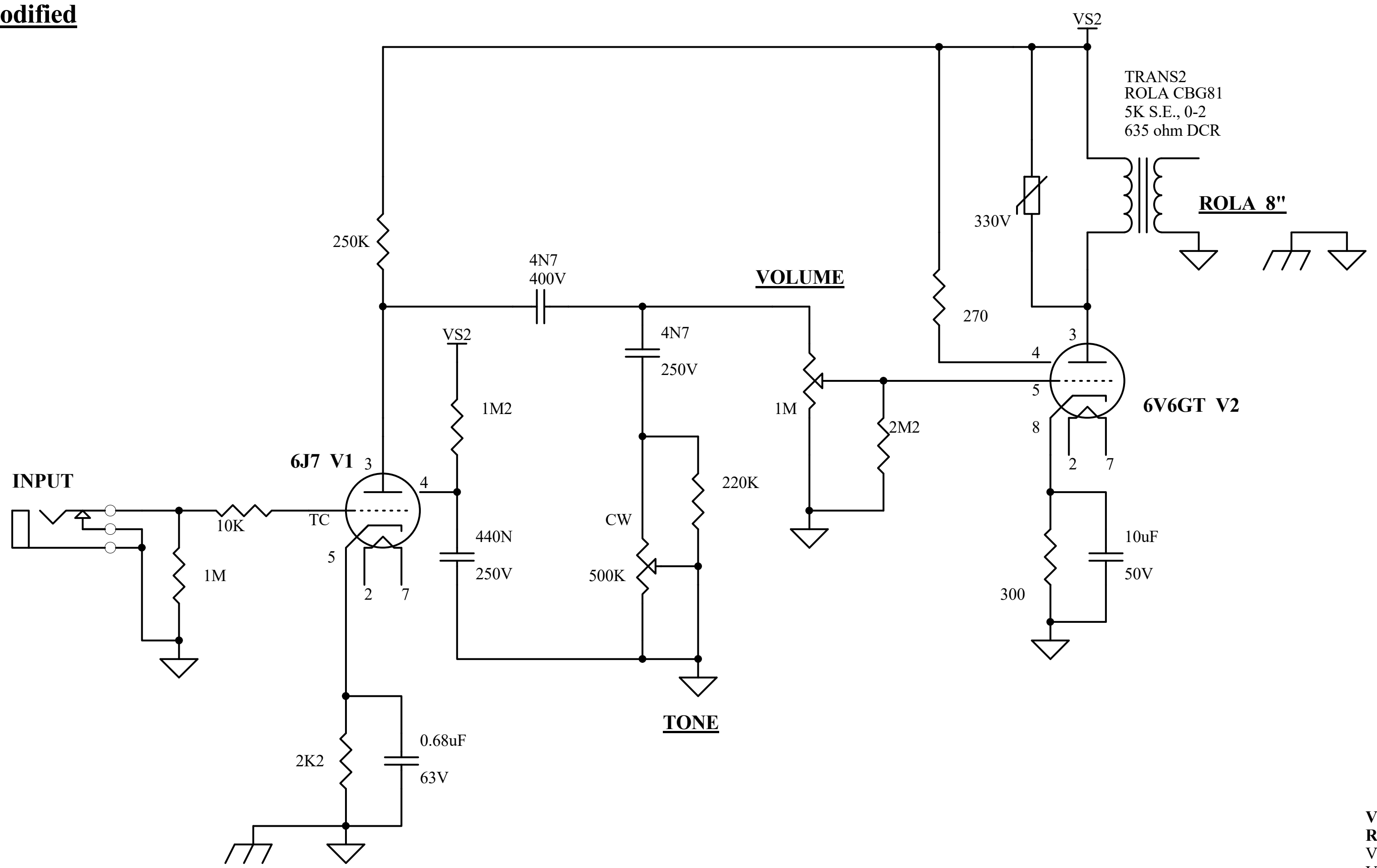
Simulation with 50mA loading on VS2 (301V, 60kΩ); fuse in CT line.

Simulate period in PSUD2	10ms	50ms	continuous
Simulated RMS current	0.47A	0.312A	0.085A
Multiplier (based on 0.125A fuse rating)	3.8	2.5	0.68
IEC60127-2 Quick-acting F min limit multiplier	4	2.75	1

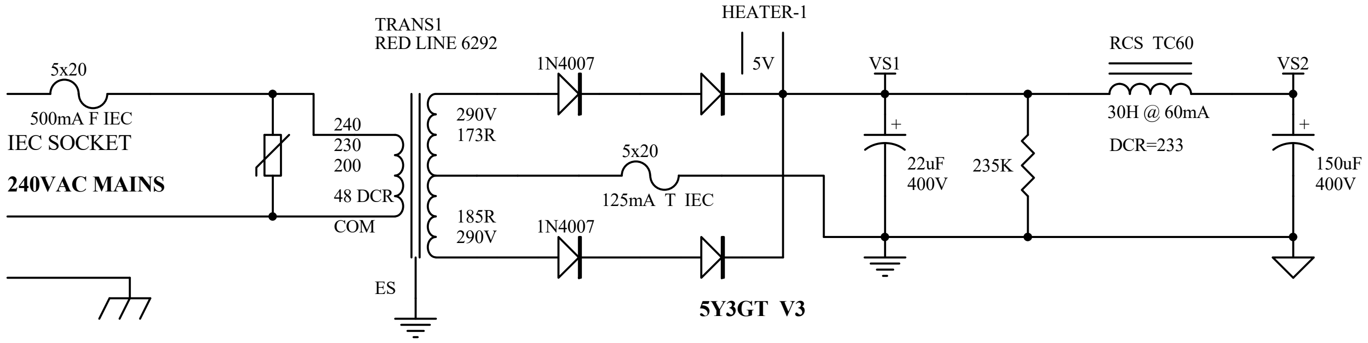
Simulate period in PSUD2	20ms	150ms	600ms	continuous
Simulated RMS current	0.39A	0.33A	0.2A	0.085A
Multiplier (based on 0.125A fuse rating)	3.2	2.6	1.6	0.68
IEC60127-2 Time-lag T min limit multiplier	10	4	2.75	1

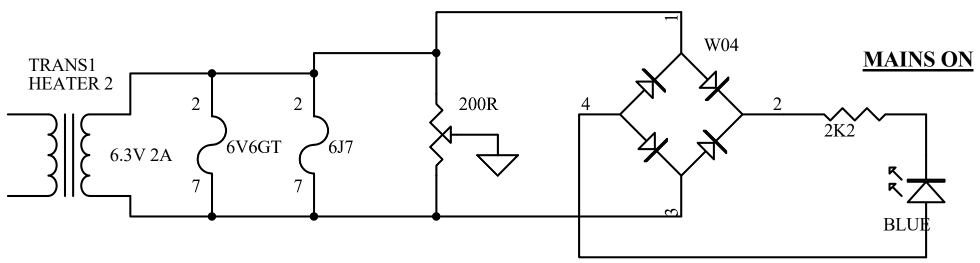
AUSTRALIAN 5W COMBO

Modified



VOLTAGE RAILS		VALVE	QTY
RAIL	**IDLE**	6V6GT	1
VS1	310V, 4.3Vrms	6J7	1
VS2	300V, 20mVrms	5Y3GT	1
HEATER 2	6.4V		





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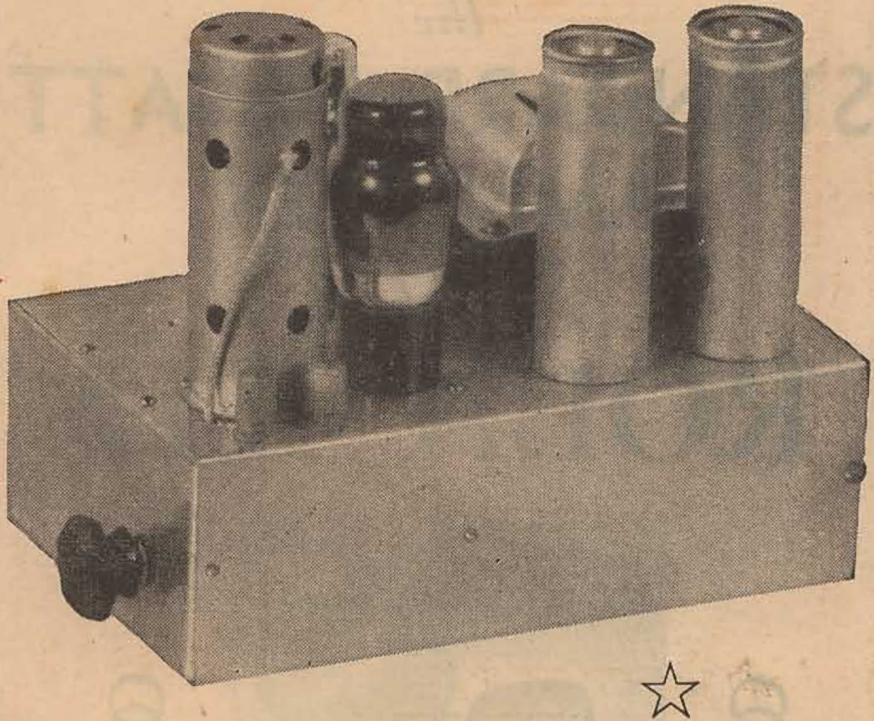
A 5-WATT GENERAL PURPOSE AMPLIFIER

WE have referred in articles previously published in "Radio and Hobbies" to the difficulty of obtaining certain types of imported valves which are not made in Australia. Naturally, our Australian valve factories must give first place in their production to valves for which there is the greatest demand. These are the valves one finds in most of the radio receivers of the day.

Such valves must be regarded as essentials, for, if we didn't have them, we couldn't have receivers.

However, there are quite a number of non-essential, but mighty handy, types which don't come on this list. If these valves are to be had at all, they must be imported, as a rule from the U.S.A.



Right: A general view of the amplifier. The input terminals are in the foreground, and behind them, the shielded 6J7G. The main electrolytics should be of the 600 volt type.

Valves such as the 6A6 or 6N7, 6C8G, 6F7, and 2A3 are on this list, as well as the beam power valve, 6L6G, and all equivalents.

Unfortunately, the home builder, because he doesn't mind using unorthodox valve types—in fact, he is generally intrigued with them when properly employed—is going to miss these types. But, on the other hand, it isn't much use turning out designs which revolve on the use of these valves, if they can only be obtained in small quantities, if at all.

All we can do is to take stock of the position, and see what can be done with the valves which are being made in Australia.

A typical example of this was our development of the 4/40 receiver, in which, for the first time, Australia was introduced to the idea of using R.F. pentodes as output valves.

This idea was so revolutionary that some of our readers may still be hesitating about using it. In this respect, we may say in passing that the original 4/40 has been in constant use ever since it was built some months ago, and has never given a minute's trouble. Our contention that half-a-watt was enough for any midget set has been entirely justified by our experience.

Dozens of people have heard this set, including quite a few engineers of some standing, and all have been quite impressed by its performance.

This amplifier is the first of a series we intend to describe, setting out standard circuit designs of the day. Such amplifiers are in constant demand, and we must have something for you when you require it. All these amplifiers will be thoroughly tested, and will contain only reliable circuit features. Wherever possible, the results of laboratory tests will be included.

PARTS LIST

Base—9½in. x 6in. x 3in.
1 Power transformer, 385 v. at 100 mills., 6.3 v. filament.
1 Filter choke, 100 mills.
2 8 mfds. 600 v. electrolytics.
1 16 mfds. tubular electrolytic.
1 .5 mfd. tubular condenser.
1 .05 mfd. tubular condenser.
2 25 mfds. electrolytics.
1 1.5 meg. resistor.
1 .5 meg. resistor.
1 .25 meg. resistor.
1 .1 meg. resistor.
1 20,000 ohms resistor.
1 2000 ohms W.W. resistor.
1 250 ohms W.W. resistor.
1 7500 ohms W.W. resistor (10 watts).
1 .5 meg. volume control.
3 Octal sockets.
1 4-pin socket.
1 Valve can.
2 Terminals.
Valves—6J7G, 6V6G, 5Y3G.
Speaker: Field coil 1000 ohms, input 5000 ohms.
Nuts, bolts, hook-up wire, &c.

OUTPUT VALVES

However, we aren't intending at the moment to talk about the 4/40. Our problem is concerned with output valves.

As you will have realised by this time, we have always been firm advocates of the 2A3 valves, or their counterparts, the 6A3's, when building high quality, high output amplifiers. This view is shared, of course, by most sound engineers, where audio limits are within those specified for these valves—about 15 watts maximum under any conditions of class A amplification.

But here's the rub—the 2A3 types are now very hard to obtain. They are also in the list of imported valves not made in Australia, and, at the moment, there doesn't appear much likelihood that they will be made here.

So there is nothing for it—we must think out other ways of building good amplifiers using the valves we have on the shelves of all radio dealers.

BACK TO THE 45

One suggestion which has been put forward is that the 45 type should be revived, using two valves in parallel to replace a single 2A3, and four in parallel push-pull to replace two 2A3's in push-pull.

> **USE WITH TUNERS**
>
> THIS amplifier is ideally suited for use with various types of radio tuners. A simple T.R.F. tuner will convert it into a high quality local receiver, while simple and more complicated dual-wave tuners can be added with ease. We hope as time goes on, to publish descriptions of such tuners, which may be added at any time, or incorporated with the tuner on the one chassis to make a regular receiver.

This idea gives an approximation of the 2A3 results, but there are a number of objections we see to it.

In the first place, twice the number of output valves would be required to get these results, and therefore twice the cost.

This disadvantage alone will, we fear, prevent most home builders from using the 45's, and, frankly, we can't blame them.

In this connection, we are including in this article a chart, issued by the A.W. Valve Co., setting out the characteristics of all valve types generally used, or recommended, for an output stage.

If you look at the ratings for a single 2A3, you will see that its output is given as 3.5 watts under optimum conditions (this rating comes from the standard valve chart, and isn't included in the list shown here).

Referring to the chart, you will see that a pair of 45's in parallel, at the same plate voltage (250 volts), will give 3.2 watts. Using 275v. on the plates, this is increased to 4 watts. The plate current and grid drive is about the same for each. Also, the plate resistance of the two valves in parallel is about the same as that for a single 2A3, which is 800 ohms.

PUSH-PULL CIRCUITS

So much for a single-ended amplifier. It is in the push-pull circuits that the difference becomes more marked, owing to the ratings of the 2A3.

Four 45's in push-pull parallel are shown in the chart to give 8 watts with 275 volts. But we have obtained nearly

5-WATT AMPLIFIER CIRCUIT

12 watts from a pair of 2A3's in a simple self-bias circuit, and, under conditions of extreme care, up to 15 watts is obtainable. With a little overloading, not advised by the valve makers, but which we have found in order, these figures can be still further improved.

It is also a fact that the 45 types can be severely overloaded to give more output, but this is a point on which we, at any rate, hesitate to say too much until we have had a chance to talk it over with the makers. In any case, we must still use four of these, against two, and an appreciably higher plate current is needed as against that required for the 2A3's. We haven't the distortion figures available at the moment, but they should be about the same.

So the question becomes: "How can we alter our standard circuits for a single-ended, and a push-pull amplifier, to preserve good quality and obtain the output we require?"

BEAM POWER VALVES

The most obvious alternative would seem to be the use of the 6V6G types with inverse feedback. Remember that we are investigating the possibility of using as few valves as possible, consistent with good results, and not the best results irrespective of cost, size, and design.

Let us consider, first of all, the small single-ended amplifier. You will remember the "Fundamental Amplifier" which used a single 6A3 in the output, and which achieved considerable popularity—a popularity which our letters show has been maintained.

Perhaps we can illustrate this point best by quoting an amplifier we have just built. It is, in fact, the subject of this article, and uses a pentode amplifier driving a single 6V6G with inverse feedback.

The circuit is completely standard, as you will see, and as far as possible we have kept to the recommendations of the valve makers.

This amplifier, with 250 volts between plate and cathode, will give an output of 5 watts with very low distortion, and has enough gain to achieve this figure from any type of pick-up, magnetic or crystal, obtainable on the market.

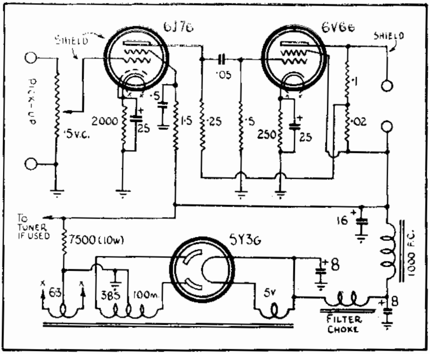
Only three valves are required—standard types, and none of them expensive.

After exhaustive tests with this job, we are quite convinced that, for all-round work, it is probably better than the 2A3 or 6A3 type in everything except perhaps the last little bit of quality.

This will show up probably most of all in the damping effect on the loudspeaker at the lower frequencies, where the lower plate resistance of the 2A3—800 ohms, as against 52,000 ohms—is a decided advantage, despite the use of feedback.

As against this, however, we have a good deal extra gain and enough extra output to cater for any but the real high-power fans. In our opinion, the output obtainable from a single 2A3 is just not quite enough when one gets a little reckless with a bright new record.

So that, taking it all round, we aren't going to miss the 2A3 so much in single-ended amplifiers. It is the push-pull circuits which feel the pinch much more.

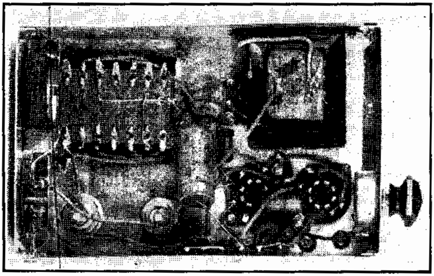


Here is the circuit of the amplifier. If a radio tuner is used, the 7500 ohms resistor may be omitted, and the tuner adjusted so that its average drain is equal to 35 mills. This will ensure the voltages being correct, and also provide sufficient energisation for the field. Although the 7500 resistor is shown as 10 watt, a 20 watt type will keep cooler and costs little more.

PUSH-PULL PROS. AND CONS.

The most we can get from a pair of 6V6G's without overloading is 9 watts at 250 volts, and 11 watts with 315 volts on the plates and 225 on the screens. This isn't so bad, providing we are careful enough in our design to make sure that we do get it. But, of course, we are still up against the matter of speaker damping, which isn't as good as it is with the 2A3's. And on high-powered amplifiers it is the bass end which probably takes the most getting, if we are fussy about the very best. There are quite enough difficulties ahead without adding more—difficulties tied round speaker systems, room acoustics, and so on.

On the credit side, we still have the



This picture shows the chassis layout of the original job. The filter choke could be mounted above the chassis if required. The .5 mfd tubular in the centre bypasses the screen of the 6J7G. To avoid parasitics, shield the 6V6G plate lead, or twist the plate and screen leads together as they run to the speaker socket.

higher sensitivity of the beam power valves, the easier drive they require, and the lower cost of the total amplifier, if we use resistance coupling, as, of course, we can. Our comparison now is with the four 45 types, which is our only other alternative for those 9 watts.

The fact that the total drain of the 6V6G's is only about 90 mills., against 144 for the 45's, is another worth-while consideration.

This is only a brief summary of the

PERFORMANCE FIGURES

A CHECK on distortion, output, and frequency response was made in the Airzone Laboratories by courtesy of that firm. They show a particularly fine result. The rapid fall in the curve at the extreme lower end is not abnormal, as the figures were taken with the speaker transformer in circuit, and in any case, the region below 50 cycles is very rarely employed in practice. Even so, a drop of 5.5 d.b. at 40 cycles cannot be regarded as excessive.

Frequency	Decibels Variation
30 cycles	minus 10
40 cycles	minus 5.5
50 cycles	minus 2
100 cycles	minus 0
200 cycles	minus 0
300 cycles	minus 0
400 cycles	minus 0
1,000 cycles	minus 0
2,000 cycles	minus 0
3,000 cycles	minus 0.5
4,000 cycles	minus 0.5
5,000 cycles	minus 0.75
6,000 cycles	minus 1.0
7,000 cycles	minus 1.0
8,000 cycles	minus 1.3
9,000 cycles	minus 1.75
10,000 cycles	minus 2.0
11,000 cycles	minus 2.1
12,000 cycles	minus 2.5

Reference level taken at 400 cycles
Output level at 2.5 watts.

OUTPUT

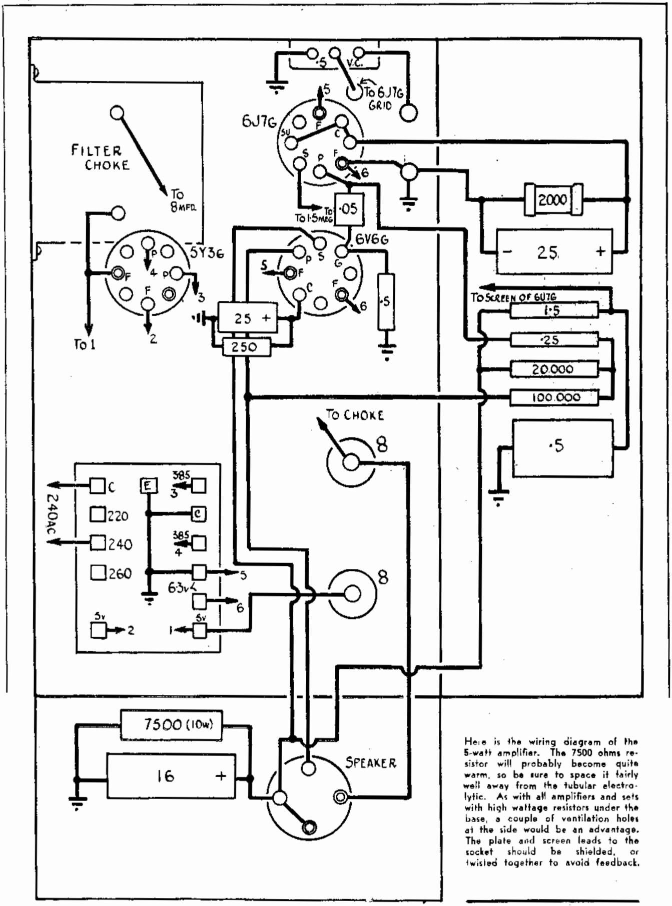
Maximum output without distortion of the wave-form at 400 cycles was 5 watts with an effective plate voltage (plate to cathode) of 250 volts.

Replacing the 5Y3G with a 5V4G, the effective plate voltage increased to 270 volts, and the undistorted output to 5.5 watts. Six watts were obtained with some distortion of the wave-form.

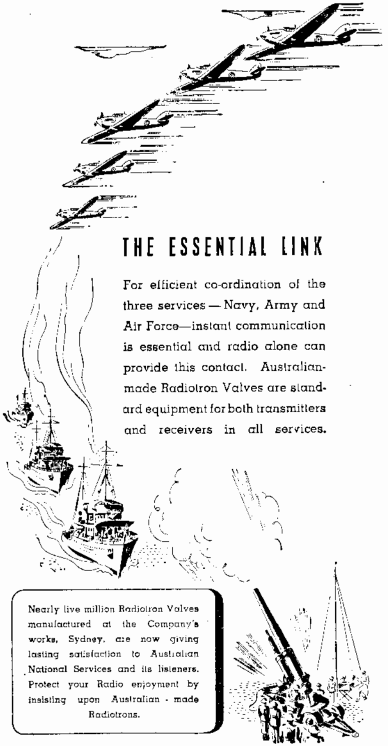
position as it stands, but so many people have written asking us what we intend to do about the 2A3 question that we feel bound to give some indication on our line of thought. At the present time, it looks as though the 6V6G valve will get some good use in the future, and we are still investigating the possibilities of using slightly higher ratings which will not seriously affect valve life, and improve our results.

In the matter of possible conversion from 2A3's to other valves, the 6V6G again seems to have the best case at the lowest cost.

In our next month's issue we hope to



Here is the wiring diagram of the 5-watt amplifier. The 7500 ohms resistor will probably become quite warm, so be sure to space it fairly well away from the tubular electrolytic. As with all amplifiers and sets with high wattage resistors under the base, a couple of ventilation holes at the side would be an advantage. The plate and screen leads to the socket should be shielded, or twisted together to avoid feedback.



have more to say on the matter of the high-powered jobs. For the moment, we shall have to leave this question, and get on with our description of this smaller amplifier.

As you will see, the circuit we use has a 6J7G pentode amplifier feeding a 6V6G output valve, with inverse feedback using the parallel feed method which has proved so popular, successful, and simple. The circuit allows for the 250 volt operating conditions using a 5Y3 or an 80 rectifier, or for a 275 volt rating using an 83V or a 5V4G.

This latter rating is "off the record," but it is accepted by many designers as not likely to be detrimental to the valve, and to give an increase in output. No

> AS a guide to constructors, we have prepared a list of voltage measurements taken with the original amplifier. These may be expected to vary slightly, particularly as the line voltage at different parts of the city and suburbs is not always the same. There was a difference of 10 volts in plate voltage when measured at the workshop and at the laboratory. Such a variation should not be serious, however.
>
> Voltage output at rectifier, 390v.
> Chassis to output screen, 285v.
> Cathode to output plate, 260v.
> Grid bias across resistor, 13.5v.
> Voltage drop across choke, 15v.
> Voltage drop across F.C., 90v.
> Drop across output trans. 12½v.
> Total high tension current, 92 mills.

alterations are required to the circuit or wiring other than to use a different rectifier.

As we have said, the output of the job measured in a laboratory is 5 watts for 250 volts, and nearly 6 watts with 275 volts.

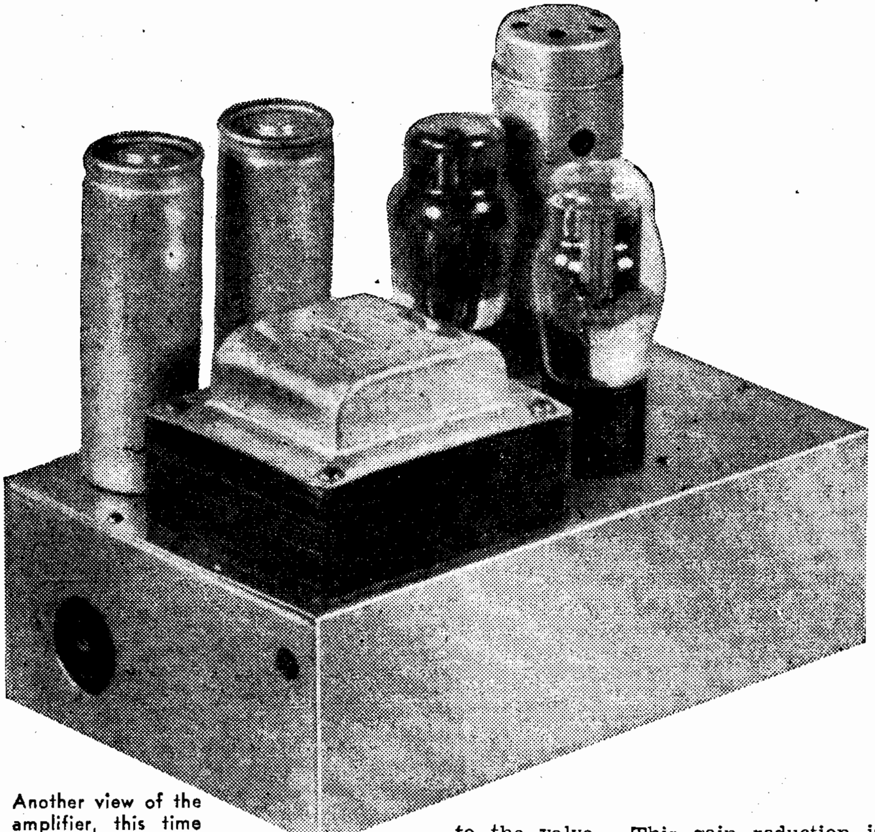
One of the disadvantages of the feedback method used is that the plate circuit of the 6J7G cannot be "de-coupled" without upsetting the inverse feedback circuit. So we must use other methods to attack the hum problem.

Now, the circuit as shown, but without the filter choke, has a hum level no worse than the ordinary radio set we hear every day. Our view is that this isn't low enough for the real amplifier enthusiast. He wants a circuit so quiet that he can't tell whether the amplifier is on or off, unless he gets down on his hands and knees.

It is our policy, in such a case, to recommend the extra filter choke as a standard thing. It doesn't cost very much to install, and it does make an enormous difference to that last bit of hum.

Even the larger 12-inch speakers advised for this job haven't a very high inductance in the speaker field—probably about 12 henries—and, although some of the filter chokes we buy don't measure much more than this, they do make a difference. In addition, of course, there is the extra filter condenser to help things along.

Wired immediately after the rectifier, as we have shown it, the choke not only smooths the set, but also the speaker



Another view of the amplifier, this time from the rear.

field. Such a choke also improves the power supply regulation—quite an important matter when maximum outputs are being considered.

The final result is probably more effective than a de-coupling of the plate circuit would be. At any rate, when standing more than about 3ft. from the speaker, it is almost impossible to detect even the slightest hum, even in a dead quiet room in which "not a leaf stirs." And that's the way we like 'em!

INVERSE FEEDBACK

There are a number of ways in which inverse feedback can be obtained. All have their enthusiasts, and all have a good case. However, the difference in results between them all is pretty well even, and at this stage we don't want to enter into a discussion as to how and why. This might serve as a good article for a future occasion. We have used this parallel feed idea because, as we have said, it is simple, involving no varying characteristics with varying components, and is practically fool-proof in actual practice.

A few remarks on feedback mightn't be out of place. In this circuit, some of the voltage appearing across the output circuit of the 6V6G is picked off through a voltage divider network, and fed back into the grid circuit through the plate circuit of the 6J7G.

This voltage is out of phase with the input voltage which drives the valve, hence the name "negative" feedback. Had the voltage been in phase, we should have used the term, "positive" feedback.

Naturally, you will see at once that there must be a reduction in gain, due to some cancellation of the input voltage to the valve. This gain reduction is directly proportional to the percentage of feedback. This percentage is governed by the ratio between the values of the resistors in our network. In this case, the resistors are 100,000 ohms and 20,000 ohms. The percentage of feedback and gain reduction, therefore, is 20 per cent.

Actually, the plate resistor of the 6J7G, its own plate resistance, and the 6U6G grid resistor are in parallel with this 20,000 ohms, so that the effective percentage is a good deal lower than this.

Now, although there is this reduction in gain, there is also a reduction in distortion. This can be shown almost equal to the amount of reduction in gain. Moreover, the feedback allows a more linear response over the full frequency range than would be the case without it.

As the output of any amplifier is limited by the maximum output obtainable at the frequency most favored by the circuit, it will be seen that the net result of all this is to allow us a higher output from the amplifier without distortion. And, moreover, a more linear output. This general statement holds, whether the amplifier is small, large, or whether the feedback is over one or more stages. The only difference is in the methods of obtaining such feedback and the circuit values employed.

Another advantage with important results is a "reduction in the internal generator impedance" of the amplifier. Although this isn't actually the same thing as altering the actual plate impedance of the 6V6G, its effect is much the same, and an improvement on loudspeaker damping at the lower frequencies is achieved in practice.

As we have said, to explain more fully the various factors involved requires a special article, and, as we will be talking a good deal about feedback, we are hope-

OUTPUT VALVE CHARACTERISTIC CHART

TYPE	PLATE VOLTS	SCREEN VOLTS	PEAK A-F GRID VOLTS	BIAS RESISTOR OHMS	PLATE CURRENT mA.	SCREEN CURRENT mA.	PLATE LOAD IMP. OHMS	POWER OUTPUT WATTS
POWER TRIODES—Single Valve Class A_1.								
6J7-G*	250	—	8	1230	6.5	—	22,000	0.275
6B8-G*	250	—	20	2500	8	—	20,000	0.35
6F6-G*	250	—	20	650	31	—	4,000	0.8
6V6-G*	250	—	15	400	37.5	—	3,500	1.0
45	250	—	50	1470	34	—	3,900	1.6
6V6-G*	300	—	20	513	39	—	4,800	1.65
45	275	—	56	1550	36	—	4,600	2.0
2 type 45 in parallel	250	—	50	735	68	—	2,000	3.2
	275	—	56	775	72	—	2,300	4.0
POWER TRIODES—Push-Pull Class A_1.								
6F6-G*	250	—	40 (g-g)	325	62 (total)	—	8,000 (p-p)	1.6
6V6-G*	250	—	30 ,,	200	75 ,,	—	7,000 ,,	2.0
45	250	—	100 ,,	735	68 ,,	—	7,800 ,,	3.2
6V6-G*	300	—	40 ,,	256	78 ,,	—	9,600 ,,	3.3
45	275	—	112 ,,	775	72 ,,	—	9,200 ,,	4.0
6V6-G*	300	—	50 ,,	†	42 ,,	—	6,000 ,,	4.75
4 type 45 push-pull parallel	250	—	100 ,,	370	136 ,,	—	3,900 ,,	6.4
	275	—	112 ,,	390	144 ,,	—	4,600 ,,	8.0
BEAM POWER TETRODES AND PENTODES—Single Valve Class A_1.								
6B8-G	200	100	5.0	970	3.8-4.1	1-1.1	39,000	0.31
6J7-G	250	100	2.5	600	2.8-3.3	0.7-0.9	56,000	0.38
6B8-G‡	250	125	6.25	880	5.3-5.6	1.4-1.5	35,000	0.54
6V6-G	250	100	5	250	17.5-18.4	0.7-1.3	14,000	1.5
6F6-G	250	250	16.5	410	34-35	6.5-9.7	7,000	3.1
6F6-G	285	285	20	440	38-38	7-12	7,000	4.5
6V6-G	250	250	12.5	232	45-47	4.5-7	5,000	4.5
6V6-G	315	225	13	317	34-35	2.2-6	8,500	5.5
BEAM POWER TETRODES AND PENTODES—Push-Pull Class A_1.								
6F6-G	250	250	33 (g-g)	205	68-70 (total)	13-19.4 (total)	14,000 (p-p)	6.2
6F6-G	285	285	40 ,,	220	76-76 ,,	14-24 ,,	14,000 ,,	9.0
6V6-G	250	250	25 ,,	116	90-94 ,,	9-14 ,,	10,000 ,,	9.0
6V6-G	250	250	30 ,,	§	70-79 ,,	5-13 ,,	10,000 ,,	10.0
6F6-G	315	285	58 ,,	320	62-73 ,,	12-18 ,,	10,000 ,,	10.5
6V6-G	315	225	26 ,,	158	68-70 ,,	4.4-12 ,,	17,000 ,,	11.0
PUSH-PULL PARALLEL (4 valves):—								
6V6-G	250	250	25 (g-g)	58	180-188 (total)	18-28 (total)	5,000 (p-p)	18.0
6V6-G	315	225	26 ,,	79	136-140 ,,	8.8-24 ,,	8,500 ,,	22.0

* triode connection.
† fixed bias −25 volts.
§ fixed bias −15 volts.
‡ this condition has been calculated by conversion factors only.

This chart prepared by the A.W. Valve Co. shows operating conditions and output available from all the various types recommended for the output socket. It should be found invaluable to the average amplifier enthusiast.

ful of including such an article in our next issue.

All this is nothing very new. But the fact remains that, until the present, attention on the matter has not been focused so urgently as it is now. Many of our readers will be wanting amplifiers of this type in the very near future, and we intend this to stand as a standard design for them.

CONSTRUCTIONAL POINTS

We have laid out the amplifier so that it can be used "as is," or in conjunction with some standard tuning units we hope to describe in following issues. For this reason, we have included a power supply with enough power rating to take care of any such amplifier.

You will notice that in the circuit there is a 7500 ohms resistor wired across the output voltage to act as a bleeder.

This will allow approximately 35 milliamps. to flow through it, and it takes the place of the average tuner load where it is not used.

Many readers may have noticed this resistor included in the recommended circuit issued by the valve manufacturers. Examination of it in practice shows that the estimate is a pretty fair one, and we see no reason why we should be different just to be different.

So we have worked on the assumption that the total drain of the amplifier will be the 50 mills. drawn by the amplifier itself, plus the 35 mills. for the tuner. This makes the total 85 mills. Thus, power equipment of the 100 mills. rating is advised.

A field coil of 1000 ohms is used, which means a voltage drop of just about 100 volts. This means a wattage in the field of nearly 9 watts—ideal for use with the smaller 12-inch speakers on the market.

The resistance of the filter choke in our amplifiers, added to that of the field, is enough to give exactly 260 volts measured between the plate and cathode of the 6V6G. This isn't the same as the voltage measured from high tension to the chassis, as from this we must subtract the bias voltage of 12.5 plus the voltage drop in the transformer primary. Your amplifier may vary as much as 10 volts from these exact figures, but this isn't important, and will depend on the actual characteristics of the choke, power transformer, etc.

The output voltage from the rectifier in our amplifier was almost exactly 400 volts. The use of the indirectly heated rectifier is enough to raise the voltages all round by about 25 volts, hence the second rating we have indicated of 275 effective volts on the plate.

Under these conditions, the output of the amplifier is just under 6 watts. At this maximum output, the screen wattage of the 6V6G, which is the first limiting factor we must watch, will be right on the maximum amount allowed by the makers. However, no amplifier reaches this maximum limit all the time, and the average dissipation of the screen we do not think will be high enough to cause any noticeable reduction in valve life, and, in any case, will be definitely below maximum.

CONSTRUCTION

Building the amplifier is a very simple matter. Our photographs, circuit diagram, and wiring diagram will give all the details you require to put it together.

Most of the smaller components are mounted on a small terminal strip bolted to the side of the chassis—a practice which makes for solid construction and easy connection.

The filter choke may be mounted under the chassis, as shown, or it could be bolted to the top if its construction makes this necessary. In the latter case, a couple of holes through the chassis would be required to allow the connections to be made.

It is most desirable to shield the lead running through the chassis to the grid of the 6J7G, and also to place a can over this valve.

As indicated in the circuit, it is also a good plan to shield the plate lead to the speaker socket, in case audio oscillation should appear, particularly at full outputs. This latter is merely a precaution, and should not really be necessary.

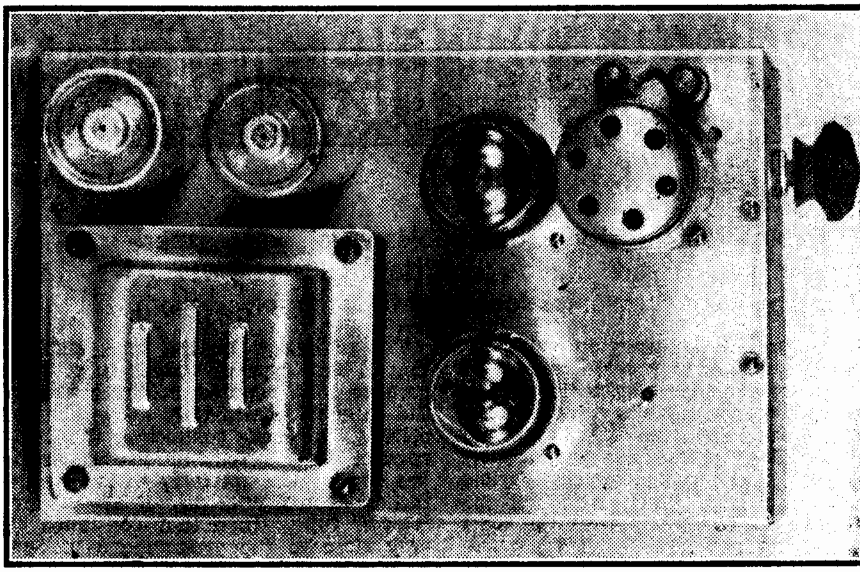
The speaker should be of the 12-inch type, and the better-known makers each have a suitable model. Smaller speakers are not advised, as they are not sturdy enough to take the output, and the field wattage will probably be too high for them.

The best pick-up to use is probably the crystal type, although there is ample gain for any of the better-known magnetic pick-ups now on the market.

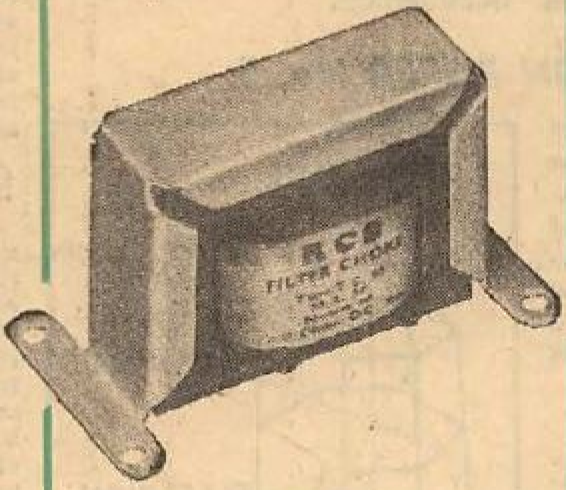
This amplifier will give good results with a microphone, particularly of the carbon type. However, many prefer to use the crystal microphone these days, and its convenience makes it more suitable in many cases than the carbon.

The best model to use would probably be the D104, which is also one of the least expensive. If the announcer speaks close to the microphone he will get plenty of volume from the amplifier as it stands. However, if a switch is wired to short-circuit the 20,000 ohms resistor in the feed-back circuit, thus removing it altogether, a considerable increase in gain will be obtained.

To realise the full output of the amplifier from a crystal microphone under all conditions, an extra stage of amplification would be preferable. This, however, would need some careful design and shielding for perfect results, and we would prefer to work out an entirely new job for the purpose, particularly if some method of mixing is desired. This amplifier will, however, serve the purpose in the great majority of cases, as most of our readers build such amplifiers for the reproduction of records in their own homes.



Here is a picture of the amplifier showing the layout of the parts.



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TC70. H.T. Vibrator Chokes.