VINTAGE RADIO

By JOHN HILL

Checking out the power supply

The power supply must be carefully checked out before switching on a vintage radio. The components most likely to be at fault are the electrolytic capacitors, most of which should be replaced as a matter of course.

Although only a few parts are involved, the power supply is a common source of problems in vintage radios. It should be carefully checked out before power is applied, as a fault here can quickly cause damage to critical components.

Most mains-operated valve radios have three separate secondary windings on the power transformer. These secondary voltages are used as follows: 5 volts for the rectifier filaments, 6.3 volts for the heaters in the other valves, and a high tension (HT) winding ranging from 285 to 385 volts a side (equivalent to 570 volts, centre-tapped).

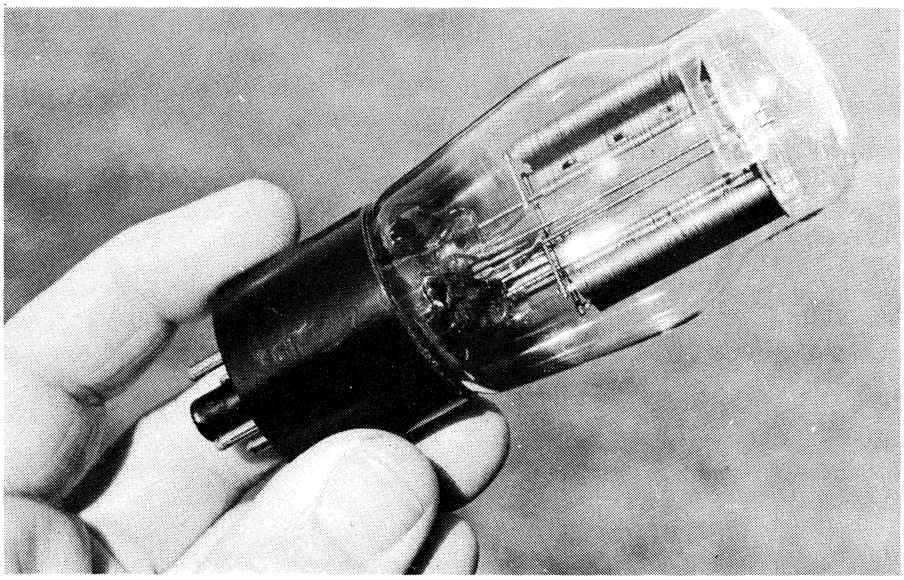
The 5V and 6.3V AC supplies are wired straight from the transformer to the filaments and heaters. However, the high tension supply must be rectified to give a high-tension DC supply for the anodes and screens for the various receiving and output valves. A vacuum tube rectifier of the full wave type (two diodes in the one envelope, with the cathodes joined together) is used for this purpose.

Now the figures presented in the preceding paragraphs work in with a good many Australian-made sets from the mid 1930s-1950 era. Fig.1 shows a typical circuit configuration but there are other variations. For example, some rectifiers require a cathode voltage of 6.3V AC, not 5V.

Similarly, not all radio valves use 6.3V heater supplies. There are 2.5V valves, 4V valves and 12V valves in some late model sets. In these radios, the low tension voltages on the transformer will be different — but that's about all. The high tension voltage will still be well in excess of 250 volts.

The output from the rectifier valve will not be pure DC but does contain some 100Hz hum. The amount of hum will depend on the degree of "smoothing" provided by the following filter network. Whilst mains hum can be eliminated completely, most radio manufacturers settled for reducing it to a reasonable level.

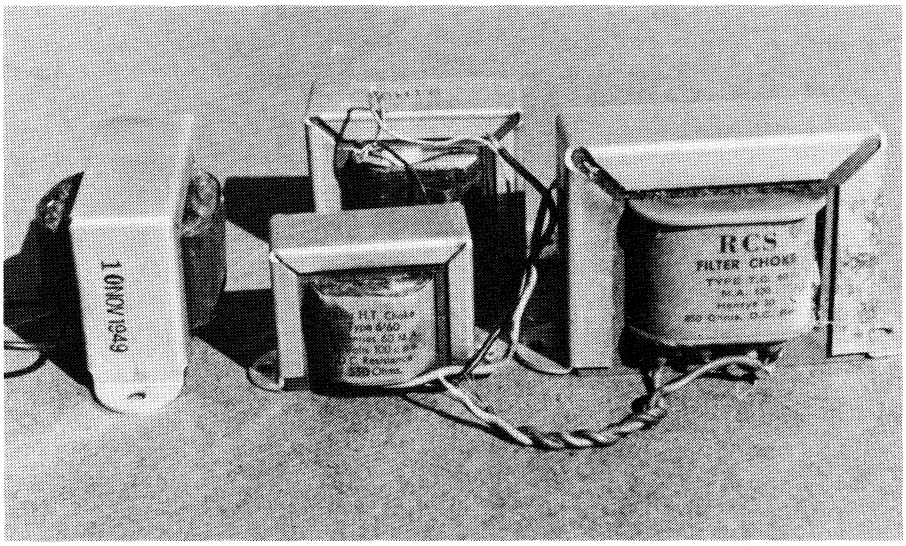
This smoothing of the rectifier output was accomplished in several ways. The most common method in the older valve radios involved filtering the rectified DC with a choke and two high-voltage electrolytics, as shown in Fig.1. Both the choke and the capacitors help to smooth out the ripple, which reduces the intensity of the hum. In later radio designs, a high-wattage resistor was often used instead of the choke.



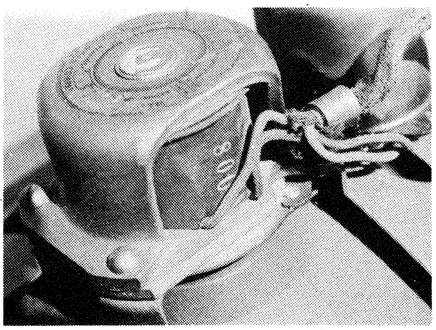
The heart of many an old set's high tension supply — a 5Y3G rectifier valve. Other common rectifier valves likely to be found in vintage radio sets are the 5Y3GT, 280, 80, 5Z3, 5U4G, 6X4, 6X5GT, 83V and the 5V4G.

Electrodynamic speakers

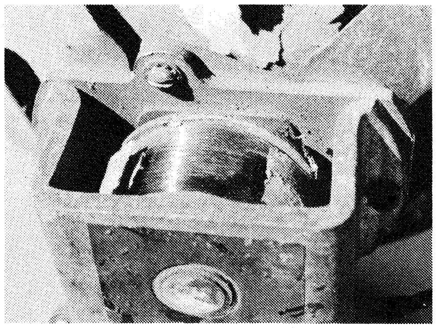
Most radios made up to the late 1940s incorporated the high tension choke in the loudspeaker, where it served a dual purpose. As well as smoothing out the rectified DC, the current flowing through the choke



Sets from the late 1940s and early 1950s used a chassis mounted choke. Spare chokes come in handy from time to time.



Many high tension chokes in early valve sets doubled up as a field coil in the loudspeaker.



This derelict electrodynamic speaker shows the field winding to be a large coil of fine wire.

provided the magnetic field for the "electrodynamic" loudspeaker. This type of loudspeaker was used before the devolpment of permanent magnet speakers.

Electrodynamic loudspeakers are not without their problems, but more about that some other time.

If a radio set has a permanent magnet speaker, then the choke will be bolted to the chassis somewhere. A choke looks like a small transformer but only has two connections. It is nothing more than a large coil of wire with an iron core.

An open circuit choke, whether it be in the field coil of the loudspeaker or a separate choke unit, is frequently a problem with a 40 or 50-year old radio. Often the set has been stored unprotected for years in an outdoor shed. This can promote corrosion where the fine wire of the choke coil joins the lead-out wires, but this is not the only mishap that can happen to a high tension choke.

The point is, if the choke becomes open, that effectively disconnects the high tension supply to the valves and a very mute set is the result.

A burnt-out winding is another common cause of choke failure. I remember once observing smoke quietly pouring out of a choke within a minute or so of switching the radio on. The set seemed to be working fairly well, yet the choke was overheating enough to produce visible smoke. If prolonged operation under these circumstances is allowed, the choke will soon burn out.

The cause of this problem is usually a faulty capacitor; eg, a faulty electrolytic on the choke output, or a faulty paper capacitor on the HT line. As we've seen in a previous episode, the waxed paper dielectric that separates the two layers of foil breaks down and causes electrical leakage between the plates of the capacitor. This breakdown can result in anything from slight leakage to a complete short circuit.

The more current through a leaky capacitor, the greater the current flow through the choke. Hence, a choke can be overloaded if the set has defective capacitors. It is good practice to replace all paper and electrolytic capacitors when restoring old valve radios — particularly those capacitors which operate with high voltages across them.

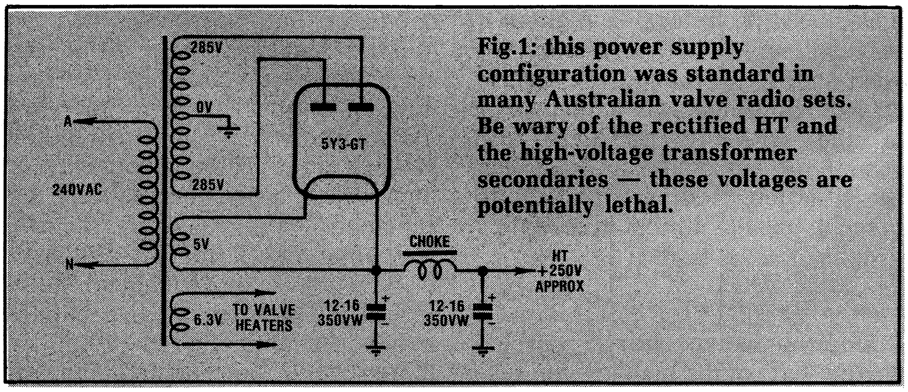
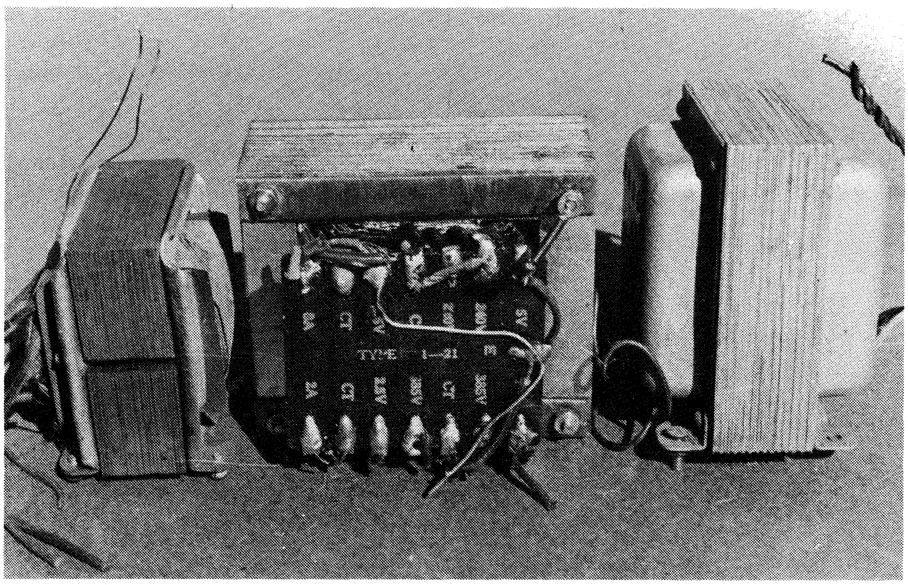


Fig.1: this power supply configuration was standard in many Australian valve radio sets. Be wary of the rectified HT and the high-voltage transformer secondaries — these voltages are potentially lethal.

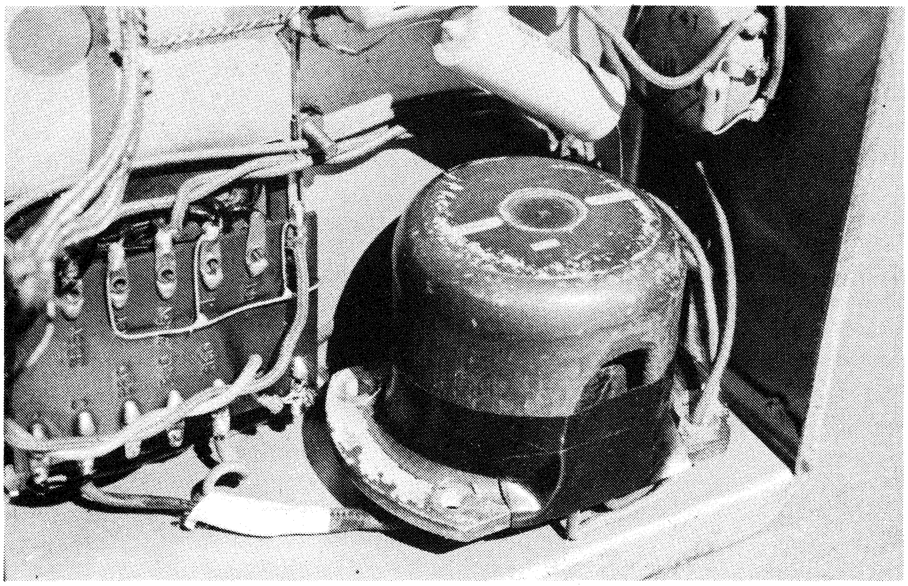
Replacing chokes

It will be fairly easy to replace a choke that is attached to the chassis, but the job will be more difficult if the choke forms part of the loudspeaker. In the latter case, you will have to replace the loudspeaker as well and that usually means substituting a modern permanent magnet type unless you happen to have a suitable spare.

So, before switching an old radio on, it is a good idea to thoroughly check out the high tension supply — if there's a short somewhere, you could wreck a perfectly good elec-



Replacing a power transformer is not difficult if it is clearly marked like the one in the middle. In other cases, you will have to first identify the primary winding, then locate the other windings by making voltage checks.



The speaker field coil can be mounted under the chassis if an old set is converted to permag (permanent magnet) speaker operation. Make sure that the choke is properly secured.

trodynamic loudspeaker.

If in doubt, put a milliamp meter in the choke circuit and find out what's going on. Most chokes that are fitted to a 5-valve receiver are rated at 60 milliamps. Remember, it is quite normal for a choke or speaker field coil to become warm when in use but it is not normal for it to become hot or to give off smoke.

By the way, the HT voltage on the output side of the choke should be about 250 volts DC and this can be quickly confirmed using a multimeter. If the voltage is higher, it may be caused by a non-standard component replacement (eg, a replacement choke or loudspeaker of the wrong impedance) and something should be done to correct the situation. Adding a resistor to the high tension line could solve this problem.

Electrolytic capacitors

Electrolytic capacitors are an important part of the high tension supply. As previously mentioned, a shorted electrolytic can soon wreck the choke or the speaker field coil. The rectifier valve could also be damaged due to excessive power dissipation — the anodes will get red hot.

Although I recommend that all electrolytic capacitors be replaced, this may not be strictly necessary in all cases. In post-war sets, you may be able to get away with the original capacitors. They should be thoroughly checked though.

A visual inspection is a good starting point when checking electrolytic capacitors. It will be fairly obvious if the fluid inside the capacitor has been leaking: the seal at the positive end of the capacitor will be cracked or punctured in some way. Any capacitor that shows signs of leakage must be replaced, even if the set still appears to be working OK.

Old electrolytics should also be checked for electrical leakage and this can be done using an ohmmeter set to the 1kΩ scale. When the test probes are applied, a good electrolytic will initially cause the meter needle to rise dramatically (half scale deflection or more), then fall back to almost zero as the capacitor reaches full charge. A reading of several megohms indicates a good electrolytic with very little leakage.

However, old electrolytics that have not been in use for many years often show a much higher reading on the meter. In many cases, this high degree of leakage is only temporary. Putting the capacitor back into service helps to reform the aluminium oxide dielectric inside the capacitor and it often works normally again.

You can check whether the capacitor has been reformed by another leakage check. After the set has been running for five minutes, turn it off, let the capacitor discharge and do another leakage check. If the leakage is still high, the capacitor should be replaced.

A final check for an old electrolytic is a capacitance test. Many digital multimeters have a capacitance function up to 20μF or thereabouts. Be warned though;

without the correct polarising voltage, the measured capacitance will only be a guide. Remember also that old electrolytic capacitor tolerances were very wide (typically +100% to −50%).

It is a good idea to always discharge the electrolytic capacitors before working on a set. However, don't do this by directly shorting the capacitor terminals with a screwdriver blade or similar instrument. Discharging a capacitor in this manner can cause internal damage due to the high discharge current involved.

A far better method is to use a 10kΩ resistor fitted with a couple of probes. This will limit the current to a safe value.

The rectifier valve

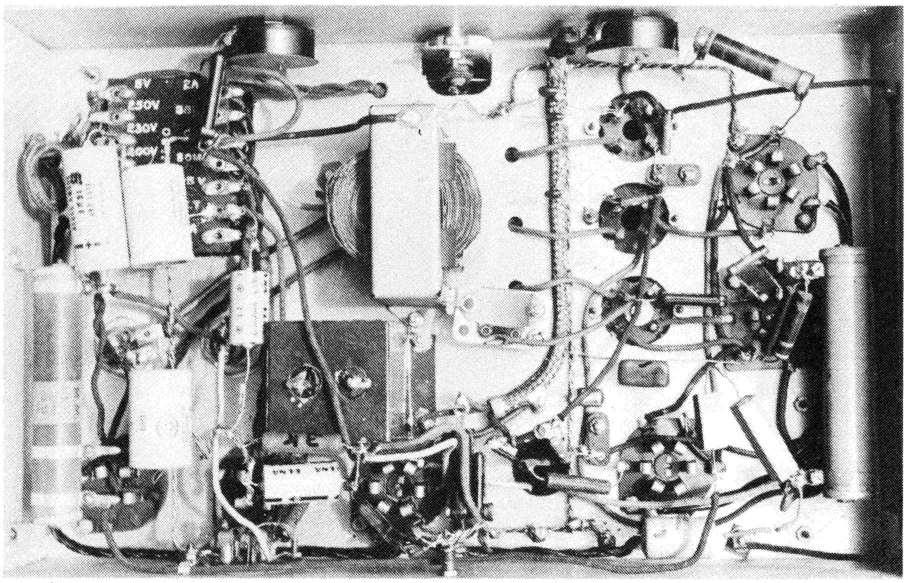
The rectifier valve itself must not be overlooked in this discussion on high tension. A rectifier may light up OK but that doesn't mean that it will work properly.

Filament type rectifiers have specially coated filaments that give off high electron emission at relatively low temperatures (red heat). This coating is easily seen by looking into the glass envelope of the valve. Such a visual inspection is a reasonable way to determine the general condition of the rectifier, excluding short circuits and other nasties.

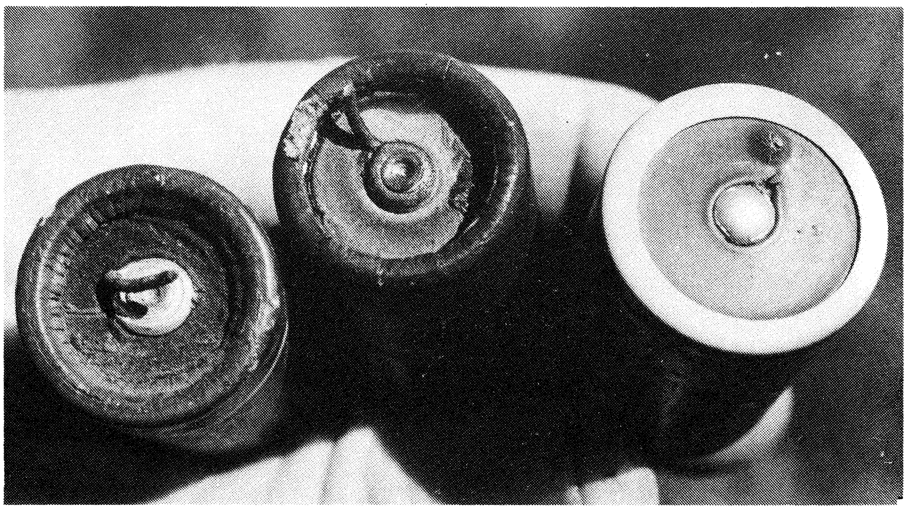
If the filament is white, the coating is intact. If the filament is bare and metallic looking, then the coating has either burnt off or has fallen off. In some cases, the filament coating can be seen in bits and pieces drifting around inside the glass envelope.

What the foregoing really means is this: if the filament is bare, the electron emission will fall to such a low level that the rectifier will not pass sufficient current for the set to operate correctly. In many cases, low volume in a valve receiver is the result of abnormally low high-tension voltage due to a worn-out rectifier valve. Simply replacing the rectifier will boost the volume considerably.

Much the same can be said about rectifiers with indirectly heated cathodes. The cathode is coated and, if this coating has cracked or



There are many high voltage connections underneath the chassis. Don't take unnecessary risks when working on the high tension supply, as the voltages are potentially lethal.



Old electrolytic capacitors can cause serious problems in the high tension department. Their replacement is always a good move.

worn away, the performance of the valve is suspect.

Naturally, a valve tester can save a bit of guesswork in this regard. However, a good many restorers work without such an instrument and a visual inspection followed by an in-circuit check will do the job just as well.

Power transformers

Power transformers in old radios are usually very reliable. However, they do break down occasionally and the usual problem is a burnt out primary winding.

If the primary or any of the other windings has broken down, the only solution is to replace the transformer. This is another situation where it pays to have a good supply of spare parts. Radio wrecking is a very important aspect of vintage radio work and every restorer should have a good range of power transformers on hand to cope with emergencies.

Changing a transformer over is a fairly simple job if the connections are clearly marked. However, in many cases, there is nothing more than a bunch of multi-coloured wires emerging from the transformer. This means that a bit of circuit tracing is required to identify the leads. This can be done by tracing the leads back to the 240 volt AC line, the rectifier filament (5 volts), the rectifier anodes (285 volts) and the valve heaters (6.3 volts).

The connections on the replacement transformer may also need sorting out. The primary leads are usually the leads closest to the core. Once these have been identified, the unit can be temporarily connected to the mains and the remaining windings identified using a voltmeter. Note that, in most cases, the high-voltage secondary winding will be centre-tapped.

Take great care when making these measurements. Both the mains and HT secondary voltages are dangerous and getting tangled up with them could well be the last thing you do on this earth.

In fact, it's a good idea to terminate all leads from the transfomer in a terminal block before applying power. It should only be installed in the chassis after the leads have all been identified.

Another way of identifying transformer leads is to apply an AC test voltage to one of the low-voltage secondary windings (either the 5V winding or the 6.3V winding). The leads to these windings use stout single-strand copper wire, so they're easy to identify. All you have to do is to apply the test voltage (say 6.3V AC) to one pair of leads that have the same colour code, then identify the remaining leads using a multimeter.

It doesn't matter which low-voltage secondary winding you feed the test voltage into. If you guess correctly and feed a 6.3V test voltage into the 6.3V winding, then all the other voltages will be correct. But if you pick the 5V winding, all the other voltages will be high by a factor of about 1.26 (ie, 6.3 ÷ 5).

If you use a test voltage other than 6.3V AC, the expected output voltages will be scaled accordingly.

Finally, always remember to disconnect the power supply and discharge the electrolytics before working on the set. If you follow this simple safety routine you will live to enjoy your hobby for some time to come.

Next month's vintage radio topic will be on loudspeakers. SC