VINTAGE RADIO

By JOHN HILL

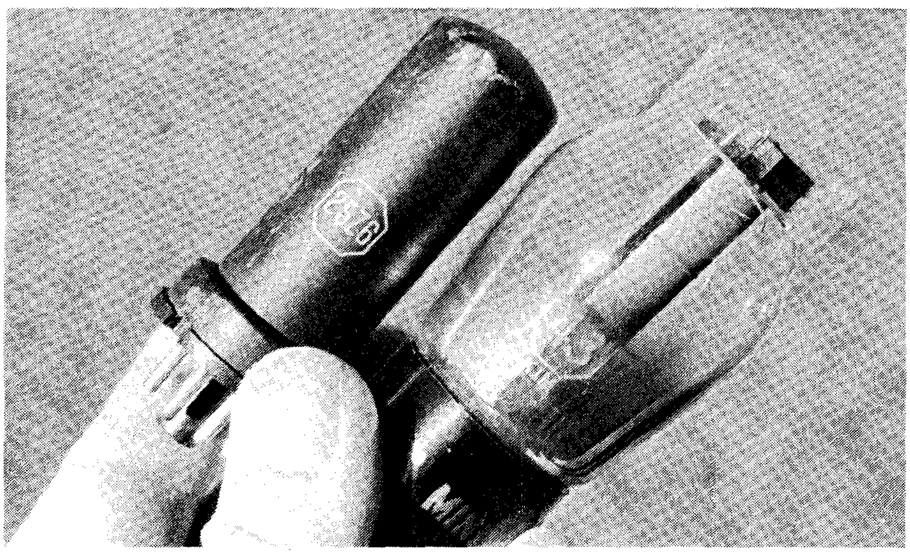
How to recognise AC/DC sets

There are several major differences between AC/DC sets and sets designed to run on AC power only. AC/DC sets don't have a mains transformer but include a special device known as a barretter tube.

During the early days of electrification, not all household power supplies were AC. Many small country towns had their own generating station and in most instances, the supply was direct current. While this mattered little regarding lighting or heating, there were considerable problems as far as radios and any other device that used a power transformer were concerned.

If a standard AC-operated radio is plugged into a DC supply, it will not work. What's more, if the set is left plugged in for even a few minutes, considerable damage can be done to the power transformer. In a very short space of time the transformer will overheat and smoke will billow forth.

I have this on good report from my father-in-law who did just that. He tried to use his radio (a 1940 model 5-valve Kriesler) on a DC supply and it belched smoke almost immediately. Fortunately, the set was turned off before any serious damage was incurred and the old Kriesler still works today. This happened at Charlton, Victoria in the early 1950s — not that long ago.



AC/DC sets usually have two or more valves with higher voltage heaters than the more common 6.3V types. Shown is a 25Z6 rectifier and a type 43, both of which have a 25 volt heater.

The reason for the problem is simple: DC cannot be transformed to other voltages. It just surges through the primary winding in one direction, rapidly heating the winding in the process. There is no constantly reversing primary current with its accompanying back EMF to protect the primary winding of the tranformer. There is also no useable electromagnetic induction to the secondary windings as is the case when AC is transformed. Such a situation will wreck a power transformer in a very short period of time.

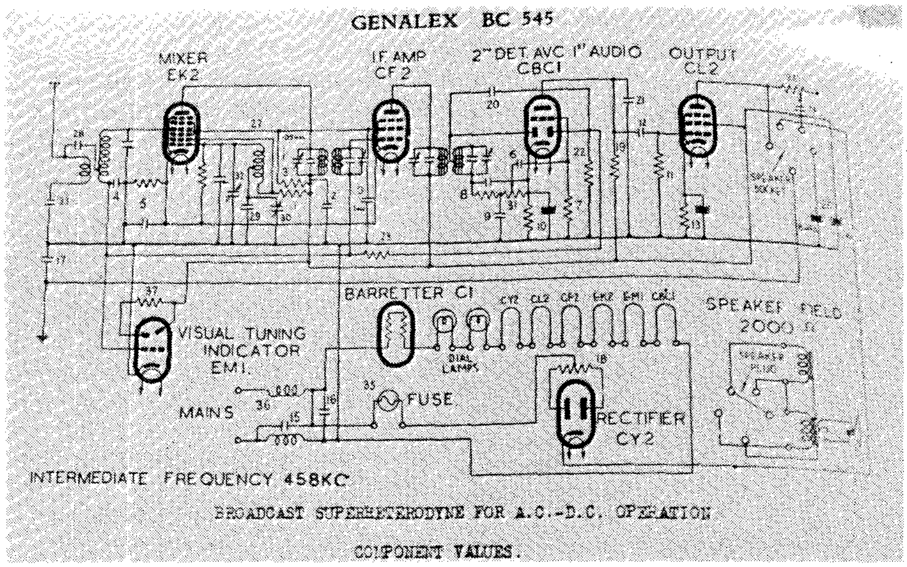
AC/DC sets

If radio manufacturers were going to sell radios in towns that had DC power, they needed to produce a set that would operate on DC — and that they did! Not only were suitable DC mains receivers designed but some of these sets would also function on AC power as well. These versatile receivers were known as universal or AC/DC sets because of their ability to operate on either type of supply voltage.

A straight DC mains radio is very similar in construction to the AC/DC version, the difference being that the AC/DC model required the addition of a rectifier valve. However, there are a few quite major differences between an AC/DC receiver and an ordinary AC set.

First, an AC/DC set has no power transformer. As previously explained, a transformer simply doesn't work on DC so there is little point in having one.

Second, some valve types are peculiar to DC and AC/DC receivers in that they have much higher heater voltages. Valves with 25 to



This circuit of an AC/DC receiver is just one of several dozen that are illustrated in the 1938 Radio Service Manual. This suggests that there was a larger market for these receivers than one might think.

35-volt heaters are standard types in AC/DC sets. The reason for these high voltage valves is that the heaters and the dial lamps are all connected in series and such a set-up on a 240 volt supply requires valves of higher voltage than the usual 6.3 volt variety.

Some of the more common valves used in universal receivers and their heater voltages are as follows: CL2-24V, CL4-33V, CY2-30V, 43-25V, 35Z3-35V, 25Z5-25V and others. Many standard 6.3V valves can also be used provided at least two of the high voltage types are included.

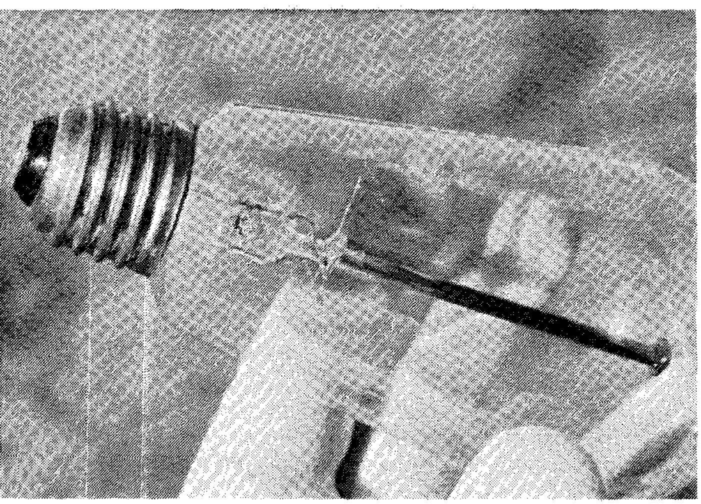
The barretter tube

Now one does not have to be a mathematician to realise that the collective heater voltages of four or five valves does not add up to 240 volts. Even if connected in series, placing those valve heaters across a 240 volt power supply will ensure their immediate destruction. To save them from such a terrible fate, a "barretter" tube is also wired into the heater circuit.

A barretter is a special resistor that is constructed in much the same manner as an early electric light bulb with an Edison screw base. However, instead of a tungsten filament in a vacuum, the barretter has an iron filament in a hydrogen atmosphere. The barretter tube has the ability of maintaining a constant current flow over a wide variation of voltages.

One common barretter is the 302. The Philips valve specification catalog describes it as a 300 milliamp current regulator with a voltage range of 112-195 volts.

When a device such as a 302 barretter is placed in series with a number of valve heaters and dial lamps (which are all rated at 0.3 amps), it gives a reasonably even current flow through the heaters provided the voltage across the barretter is within its specified range



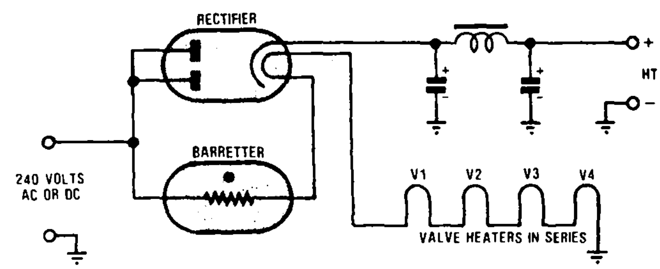
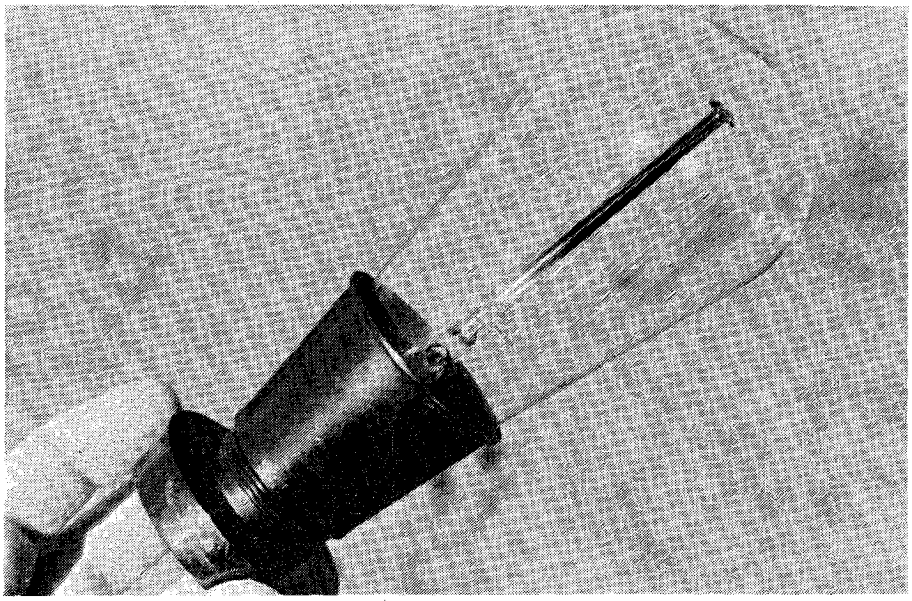


Fig.1: simplified circuit diagram showing the heater connections and high tension supply for an AC/DC set. Note the barretter tube in series with the rectifier's heater.

Left: the 302 barretter tube had an Edison screw base and was rated at 112-195 volts and 0.3A. A barretter tube is basically a constant current regulator and consisted of an iron filament in a hydrogen atmosphere.



The large barretter tube and its special screw socket are one obvious indicator that a set is a DC or AC/DC type. In addition, DC and AC/DC receivers do not have a power transformer, so this type of receiver is easy to recognise.

of 112-195 volts. Regardless of variations in the supply voltage (200-250 volts), the barretter will operate well within its voltage tolerance and keep all the valve heaters working at close to the correct voltage.

One drawback is that the barretter becomes very hot during operation and so special consideration must be given to its mounting position because of radiated heat.

AC/DC radios are very susceptible to noise originating in the power supply and are prone to hum problems. Wiring the valve heaters in a particular order supposedly helps to reduce hum but a study of old circuit diagrams reveals many variations in use. This seems to suggest that maybe it's not all that important. However, the use of radio frequency chokes and numerous capacitors in the power lines indicates the presence of mains-borne interference that requires special filtering techniques.

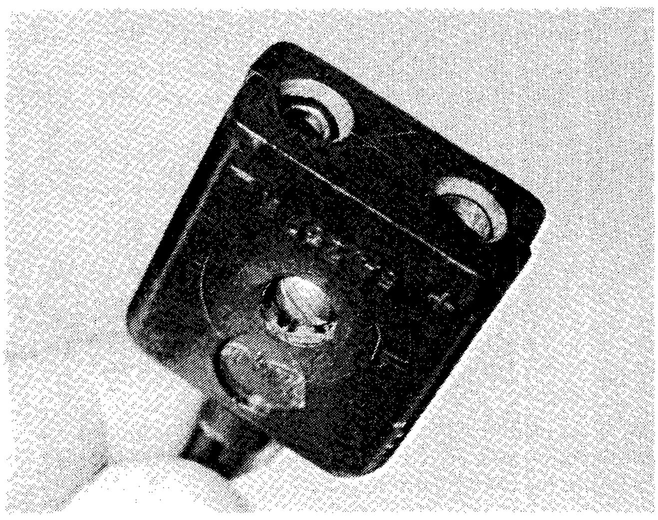
An AC/DC receiver, like any other valve receiver, requires a high tension DC supply. In the case of DC operation, the set obtains its high tension straight from the DC mains. When operating on DC, the receiver must be connected to the mains so that the anode(s) of the rectifier valve is connected to the positive side of the supply voltage.

When on AC operation, the rectifier valve is used to supply the DC high tension. Due to the nature of the design, half wave rectification is used, resulting in the need for a larger than normal electrolytic on the input side of the HT filter. This helps to both reduce the hum and maintain a constant DC voltage.

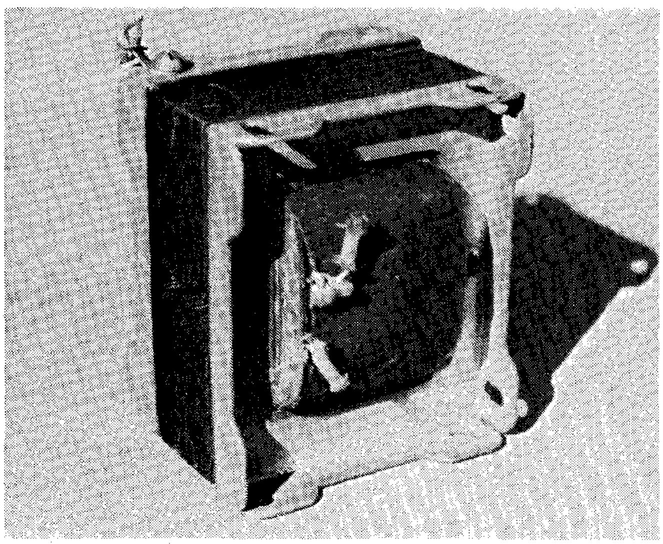
A real shocker

Now one of the problems with AC/DC sets is that they can be very dangerous to work on. Incorrect wiring at either end of the power cord or the power point itself can give the set a live chassis with a 240 volt AC potential. For the unsuspecting, that can be a real shocker!

Because of the fact that a live chassis is always a possibility on AC operation, AC/DC receivers are well insulated to prevent electric shock. These radios are always totally encased with closed backs and all controls fully insulated from the chassis. Even the screws that hold the chassis into the cabinet will be insulated from the set so as to prevent trouble.



AC/DC receivers are fitted with a special power plug and socket. Note that the two plug connections are different sizes so it will only fit one way. Reversing the plug connections can lead to a situation where the radio chassis has a 240 volt AC potential.



This large high tension choke could be easily mistaken for a power transformer by someone not familiar with valve radios. This unit came from a Healing AC/DC receiver.

Before working on a universal receiver, the chassis potential should be checked using an AC voltmeter, with one probe on the chassis and the other to earth (careful — don't touch the chassis). If the chassis is live (ie, at 240V AC), then check the power cord — the active side of the power supply should *not* go to the earthy side of the receiver. It is also a good idea when working on these radios to use an isolation transformer in the power supply.

One out, all out

One unusual problem associated with servicing a DC or AC/DC set is the "one out all out" syndrome. In other words, should any valve heater or dial lamp filament burn out, it effectively puts everything else out too because they are connected in series. In such a case, all the valves, dial lamps and the barretter will need to be checked to find out which one is at fault.

It may save time to start with the dial lamps. Some circuits have resistors across the dial lamps which lowers their operating voltage and reduces the likelihood of them burning out.

In contrast, parallel connected valve heaters are unaffected by an inoperative dial lamp.

A well restored AC/DC set should work as well as any standard receiver and about the only difference one is likely to notice is a much longer warm up time due to the current restricting barretter. Because the barretter will only pass a maximum of 300 milliamps, the warm up time is considerably longer.

While sets of the DC and AC/DC variety were common only in some country areas, they can show up just about anywhere. Always remember that this particular type of radio can be a dangerous proposition for the unwary, so make sure that you know what you are doing before you plug it in and start tinkering.

At the very least, make sure that the power cord is in good condition and check the wiring at both ends of the cord. Then, when you do plug in, check the chassis for 240V as described previously.