Vintage Radio

By Rodney Champness, VK3UG

Restoring an AWA B15 AM broadcast receiver

Housed in a unique plastic case with a concave front panel, the AWA B15 Radiola is a 5-valve set that's easy to troubleshoot and restore. This particular set had several unusual faults though.

THE AWA B15 is a typical 5-valve mantel receiver from the 1960s. Designed towards the end of the valve era, it's a conventional superhet design with a converter stage, an IF (intermediate frequency) amplifier, a detector with AGC (automatic gain control), two stages of audio amplification and a power supply using a valve rectifier.

For many manufacturers of that era, marketing such receivers often came down to cabinet styling. A couple of unusual cabinet styles that are now highly sought after were used with the Healing "scales" and the Astor "football" receivers and these now fetch quite high prices on ebay and other auction sites. Some sets even came in different colours like green or blue or with different coloured flecks in the finish, the cost of such radios now varying according to rarity.

The AWA B15 is not quite in this league. It has a rather unique concave front panel which looks interesting but it doesn't generate as much excitement as the Healing "scales" and the Astor "football" receivers. That's not to say that the B15 and many other receivers of the era don't look good. They do but they don't fall into the "must have" category.

That said, I have two such sets in my collection and I described the restoration of one of these sets back in the June 1999 issue of SILICON CHIP.

Another restoration

Just recently, I was asked to restore another one of these sets. Its owner claimed that it only required a new dial cord (the original had broken) and a new dial lamp. Apart from that, he thought that the set was in working order.

Despite this, I gave him an estimate as to what I thought it would cost to completely overhaul the receiver. He was rather taken aback at the amount but I explained to him that, based on my experience, it wouldn't end with the dial cord and lamp. Instead, lots of other components (such as capacitors) would also have to be replaced, especially as this particular set had been sitting in a shed for many years exposed to dust, moisture, mice, moths and various insects.

My policy is that any receiver I work on must be returned to its owner in good condition. That means it must be reliable, it must work correctly and the cabinet must be clean and intact. And of course, it must be safe to use.

Some restorers only give a "footpath warranty", whereby the set is only guaranteed to operate until such time as it leaves the property. On the other hand, I'm prepared to give several months' warranty on the work I do and the parts I replace. However, as I always explain to the customer, I cannot give a warranty on any other parts in the set as they may be up to 90 years old.

I've yet to come across anyone who doesn't accept this as being reasonable. And because I'm always careful to check and test the set thoroughly, I rarely have a return due to a fault.

In this case, the owner accepted the quote and left the set with me. Fortunately, the B15 is a set that's easy to work on – the chassis is easy to remove and all parts under the chassis are easy to access.

Circuit details

Fig.1 shows the circuit details of the AWA B15. It uses a fairly standard 5-valve line-up, a ferrite rod antenna and 455kHz IF stages.

As shown, an external antenna

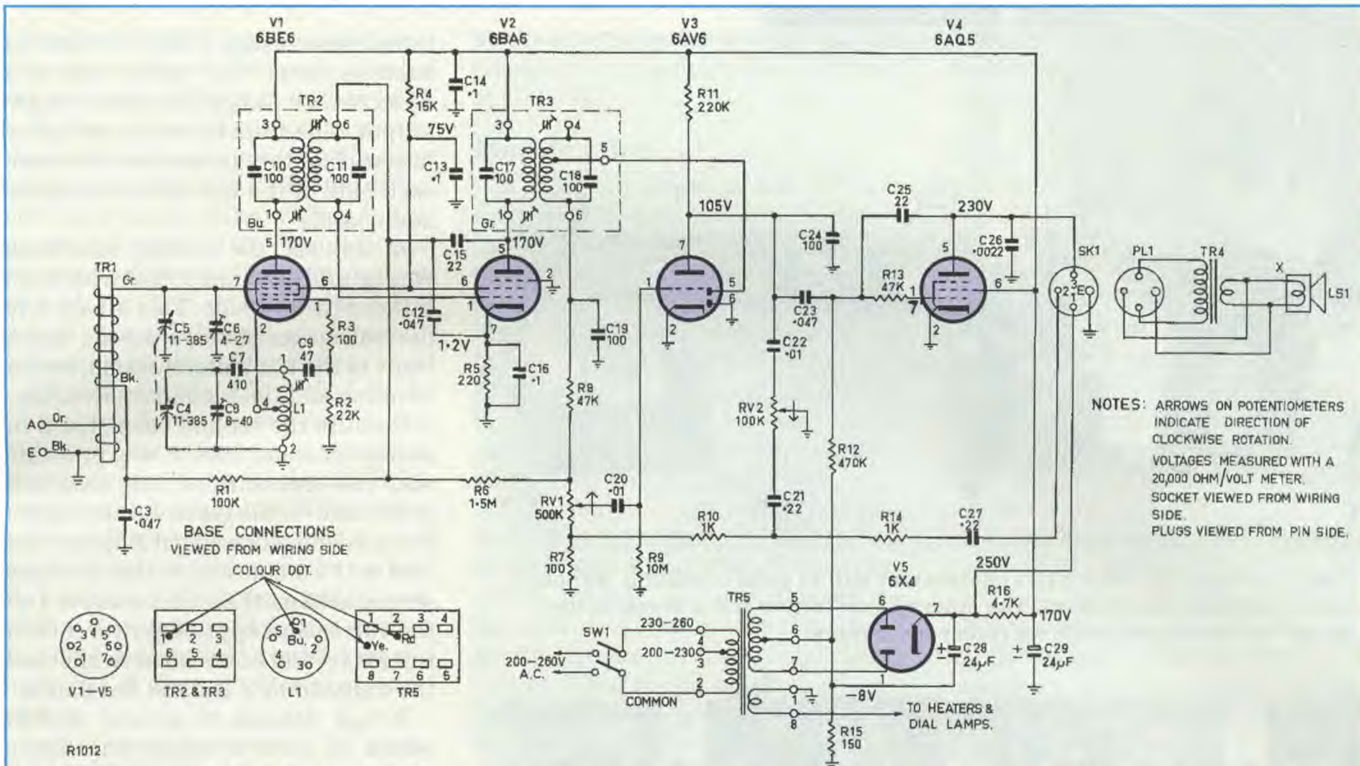
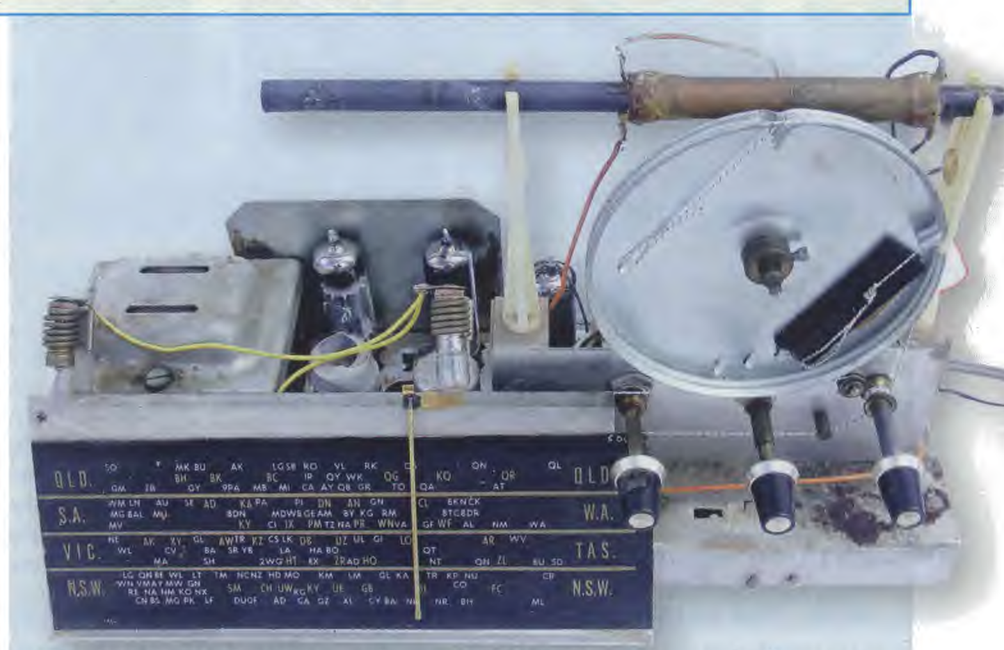


Fig.1: the circuit is a standard 5-valve superhet design using a converter (V1), an IF amplifier (V2), a detector & first audio stage (V3), an audio output stage V4 and a full-wave rectifier (V5).

and earth (if used) are connected to a "link" winding on the ferrite rod and this is inductively coupled to the main tuned winding on the ferrite rod. These windings are on a former that can be slid along the rod to achieve best performance at the low-frequency end of the tuning range. Note too that the ferrite rod is mounted high on the chassis, so care needs to be taken when turning the set upside down for servicing to ensure the rod isn't damaged.

The converter valve (V1) is a 6BE6 pentagrid and the oscillator coil (L1) is wired into the cathode circuit, with the cathode being connected to a tap part way up the coil. The resulting 455kHz signal from this converter stage appears on the anode and is fed via 455kHz IF transformer TR2 to the grid of V2 (a 6BA6) where it is amplified and fed to the second IF transformer (TR3).

Following TR3, the signal goes to a detector diode in V3 (a 6AV6) and the resulting audio signal filtered by C19 is fed to volume control RV1 via resistor R8. The audio signal at RV1's wiper is then fed to the grid of the 6AV6 where it is amplified and then fed via an RC network (C23 & R13) to the grid of V4, a 6AQ5 audio output stage. This in turn drives the loudspeaker via speaker transformer TR4.

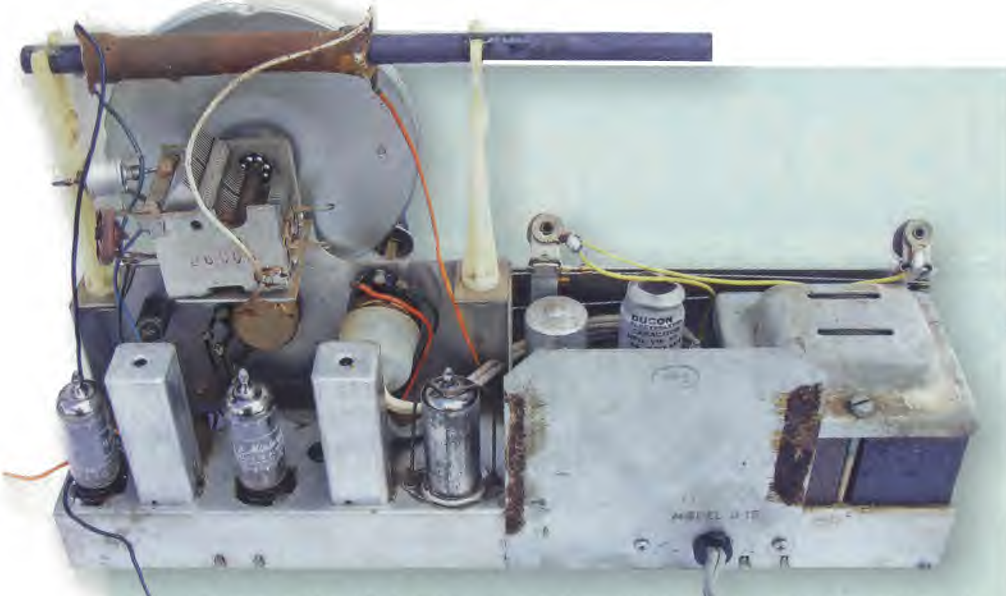


The AWA B15's chassis is easily removed from the cabinet and all parts are readily accessible. This photo shows the unit with it new dial cord in place.

Only simple AGC is applied in this set, with the DC voltage developed across RV1 and R7 applied via R6 and R1 to the converter and IF amplifier stages (V1 and V2). The IF stage is neutralised by the combination of C15, C12 and (to a lesser extent) C16.

The audio output stage includes negative feedback. This feedback signal is derived from transformer TR4's secondary and applied to the top of R7 via C27, R14 and R10. Bias for V4 is derived from the voltage across R15, the back-bias arrangement in the power supply.

Finally, the power supply uses a conventional mains transformer and a 6X4 full-wave rectifier to derive the HT rail. This is filtered by C28, R16 and C29. A separate 6.3V secondary



Despite its age, the AWA B15's chassis was still in good condition, although some corrosion was evident. The antenna coil former hid a break in the ferrite rod which made the set rather insensitive.

All the parts under the chassis are easy to access and the work here mainly involved replacing six of the paper capacitors that were in critical locations. The original 2-core mains cable shown here was also replaced with a 3-core cable so that the chassis could be earthed.

winding on the transformer is used to power the valve heaters and the dial lamps.

Mechanical restoration

I didn't spend a lot of time on the mechanical restoration, as the owner is quite capable of doing some of this and wanted to keep the cost down. As a result, I gave the chassis a quick clean with a kerosene soaked rag, which got the worst of the muck off and left a film of oil on both the chassis itself and the transformer metalwork.

That done, I turned my attention to the broken dial cord. Most people don't like re-stringing dial mechanisms and often find it difficult to work out the layout. Of course, many service sheets show how the dial-cord is run but AWA didn't do that with this set.

Fortunately, I didn't have to waste time figuring it out for myself. Instead, it was just a matter of quickly checking the arrangement in my own B15 set. The dial cord installation subsequently went without a hitch, after which I oiled all the pulleys and the bearings on the tuning gang. I also lightly smeared the dial pointer slide with grease so that it operated smoothly.

The blown dial globe was then replaced and the valve socket pins sprayed with Inox (a contact cleaner/ lubricant) to eliminate any contact resistance that may have developed during the set's many years of storage in less than ideal conditions.

Initial tests

My next step was to test the power transformer using a high-voltage insulation tester. The tester I use is a SILICON CHIP design and has a 1000V output. The transformer is tested by measuring the resistance between each side of the transformer primary and chassis.

In this set, the leakage resistance was initially around 50MΩ which is a little on the low side. This is basically the leakage resistance from the mains leads to the transformer frame, heater winding and the secondary winding.

Because the set had been stored in a shed for some time, it was probable that the transformer has absorbed moisture over the years. Accordingly, I replaced the set's original 2-core power lead with a 3-core lead so that the chassis could be earthed, then removed all the valves and applied power. I let it run for several hours, then re-checked the transformer's leakage resistance.

It had climbed to around 100MΩ which is quite a satisfactory figure and indicated that the transformer had "dried out".

At this stage, the transformer was only slightly warm to touch. The AC voltages between pins 5 & 6 and pins 6 & 7 of the transformer (ie, on either side of the centre-tapped HT winding) were then checked. They were identical, which is how they should be. The voltage across the 6.3V winding (between pins 1 and 8) was slightly higher than 6.3V but that's only to be expected when it's unloaded (ie, with the valves removed). In fact, in many sets, it can be as high as 7V unloaded.

Having verified that the transformer was OK, my next step was to test and replace any paper capacitors in critical positions in the receiver (ie, in locations where low leakage is critical). I ended up replacing C3, C12, C20, C22, C23 & C26. The remaining paper capacitors were in low-impedance circuits where leakage is not critical and were left in circuit.

For example, C16 (in parallel with a 220Ω resistor in V2's cathode circuit) could have an electrical leakage as low as around 2kΩ before upsetting the operation of the IF amplifier stage. Even quite leaky capacitors will generally have a leakage resistance of more than 1MΩ, so it's not a problem in this situation.

In this set and in others of the same era, low-voltage paper capacitors had a minimum voltage rating of 200V. However, C3, C12 & C20 were all replaced with 50V ceramic capacitors, since the voltage across each of these capacitors is unlikely to exceed 20V.

By the way, it's not always necessary to substitute a capacitor with the exact same value, provided it isn't too different. For example, if the original circuit used (say) a 10nF (0.01μF) capacitor as an audio coupler, substituting a value as high as 22nF or as low as 6.8nF would generally have no apparent difference on the performance.

Capacitor C26 isn't critical as far as leakage is concerned but it was replaced because many capacitors in this position go short circuit. If it's connected from the plate of the output valve to the screen grid, then it's not a critical failure (although the set will stop working). However, when it's connected between the plate and earth as it is here, the speaker transformer can burn out if the capacitor goes short circuit.

In this circuit, it has 230V DC across it to which is added the audio voltage which, if the valve is never cut off, can rise to a peak of around double the DC voltage – 460V in this case. And it can rise considerably higher than this if the valve is suddenly driven into cut-off by the input signal at its grid. For this reason, this capacitor is usually rated at 600V DC.

Modification

A small modification can be made to B15 sets to make them slightly more sensitive and more stable. While the circuitry from the detector onwards is supposedly only involved in amplifying the audio signal, this is not strictly true as it also amplifies the 455kHz IF. There isn't a great deal of IF amplification but it is enough for a significant amount of the IF signal to appear at the plate of the audio output valve.

This signal is radiated and feeds back into the front end of the set where it can cause problems. However, adding a 47pF capacitor between the junction of R6 & R8 and the chassis and another from pin 1 (or 7) of the 6AQ5 output valve to the chassis, reduces this unwanted IF signal at V4's plate by 20-30dB. In fact, this simple modification will benefit most domestic valve AM radio receivers.

Other parts

A quick check with a digital multimeter (DMM) showed that all the resistors were within tolerance, so no replacements were required. In addition, the electrolytic capacitors looked to be in good condition but running the set would prove this one way or the other.

Initially, I simply used my DMM (set to a high ohms range) to check the resistance between the positive terminal of the first electrolytic and the chassis. This showed that there was an initial low-value resistance to earth but this quickly climbed to quite a high value. That meant that the electrolytic capacitors had had some capacitance and that there were no obvious shorts to earth.

Those checks completed, I plugged the rectifier valve in but left the other valves out for the time being. I then applied power to the set while monitoring the voltage across the electrolytic capacitors and checking to ensure that nothing untoward was happening inside the rectifier.

No faults showed up in the rectifier and as soon as the HT voltage started to rise, I switched the set off. I then waited for the capacitors to discharge and the powered the set up again for a short time, this time letting the HT

Removing the back of the cabinet gives good access to the valves and to other parts on the top of the chassis. The original loudspeaker still worked but foreign matter had found its way into the voice coil assembly and it had to be replaced to improve the sound quality.

voltage rise a little further. After repeating this procedure several times, I found that the electrolytics now discharged quite slowly, which meant they had quite good capacitance and did not have excessive leakage.

This procedure effectively reforms the electrolytic capacitors, so that they function normally after being left unused for many years. In this case, the capacitors proved to be OK but if they had discharged quite quickly after switch-off, they would have had to have been replaced.

This test also proved that there were no shorts on the HT line due to component breakdown under high voltage.

The speaker and speaker transformer were tested next, although it's usually best to test these parts earlier in the restoration process. The test itself is quite simple – select a low-ohms range on a moving coil multimeter and connect it across the primary of the speaker transformer. When that was done, there was a healthy click from the loudspeaker which indicated that both it and the transformer were OK.

Mains lead

As mentioned earlier, the original 2-core mains lead was replaced with a 3-core mains cable so that the chassis could be earthed. This new cable was securely clamped into position using the existing through-hole cord clamp grommet.

Tracking the gremlins

At this stage, the other four valves were inserted into their sockets, and the set switched on. I then connected the negative lead of my multimeter to the chassis via a clip lead and proceeded to check all the relevant voltages in the set to see how they corresponded to the published figures.

As I did so, the set started operating and stations could be heard at low volume as I tuned across the dial. All voltages were reasonably close to the published figure except for the bias on the 6AQ5 – it was only about -5V instead of -8V, indicating that one or more valves weren't drawing as much current as they should.

At this point, the set suddenly stopped but it could be made to sometimes come on briefly if the chassis was jarred or by moving the 6AQ5 in its socket. A quick check of the voltages around the set soon revealed that the 6AQ5's grid was at +146V, the same as the screen.

This indicated that the grid and screen had shorted together and so the valve was replaced. And that fixed the problem; the bias voltage was now correct and the audio output had significantly improved. The internal intermittent short had obviously caused the faulty valve to draw more current than normal and it had lost most of its cathode emission.

After running the set for half an hour or so, I turned it off and carefully felt all the capacitors that I hadn't replaced, to see if they were hot. Any undue temperature increase can indicate excessive electrical leakage, which means that the capacitor would have to be replaced. In this case, the only ones at all warm were the electrolytic capacitors and this was because they physically are located close to the 6AQ5 and 6X4 valves. In short, their locations are not the best, which is a bit of a design failure in this set.

By now, the set was now operating reasonably well, although its sensitivity was lower than I expected and there was some buzz in the sound at high volume. To get to the bottom of this, I first aligned the two IF transformers (TR2 & TR3) and but this gave only a slight boost to the performance.

Next, I turned my attention to the oscillator circuit. I adjusted the dial pointer on the scale and found that the oscillator circuit was almost perfect across the band. It required only a small amount of tweaking to tune it correctly.

Finally, I took a look at the antenna circuit and found that this tuned to an apparent peak at the low-frequency end of the dial as I slid the coil along the ferrite. However, the trimmer capacitor adjustment at the high-frequency end of the dial didn't end up where I would expect it to be for best performance.

Broken ferrite rod

Although all the tuning adjustments appeared to be working as they should, the set's performance was still lacking. Physically, all looked well with the loop-stick antenna but it was as if the coil didn't have enough inductance. Eventually, I decided to slip the ferrite rod out of the coil former for a closer look. When I did this, half the rod stayed inside the coil – it had broken in two inside the coil former at some stage in the past!

Broken ferrite rods can be repaired by gluing the pieces together. To do this, I laid the two parts on a piece of Glad Wrap on the workbench, then put some super glue on the ends, pushed them together and wrapped the Glad Wrap partly over the rod. I then placed a ruler along the side where I had wrapped the Glad Wrap to ensure that the rod was straight in all directions.

Once the joint was dry, I added some more glue to make the join more permanent. This was then allowed to dry, after which the excess glue was scraped off and the rod reinserted into the coil former. The antenna coil was then adjusted at the low-frequency end of the dial for best reception, while the antenna trimmer was adjusted for best performance at the high-frequency end.

As expected, the AWA B15 was now performing like it should, with quite good sensitivity – hardly surprising since the ferrite rod antenna was now picking up much more signal. And with an outside antenna and earth connected, the set now really performs.

So if a set lacks sensitivity for no apparent reason and it has a ferrite rod antenna, always check that the rod hasn't broken inside the coil former.

Fixing the noise

Both the volume and tone controls were noisy so each was given a good spray of Inox to get rid of any muck that was adhering to the tracks. That fixed that problem but I wasn't happy with the quality of the sound from the speaker.

By gently pressing on the speaker cone, I could feel voice coil grating against dust and other debris. As a result, I removed the speaker and peeled back the felt cover over the centre of the speaker so that I could take a look inside.

There was quite a bit of dust and some rather sharp grains of abrasive material in there. This was removed but foreign material was still present in other sections of the voice coil/magnet assembly. In the end, there was nothing for it but to replace the speaker.

As shown in the photos, the speaker is a special type with large mounting holes that go over plastic spigots on the rear of the front panel. However, as luck would have it, I just happened to have a spare on hand. It had been salvaged from an identical receiver with a burnt-out power transformer some years ago and I had saved the ferrite-rod antenna as well.

The new speaker worked perfectly and I could have also substituted the ferrite rod if the original had been beyond repair.

The lesson here is that old sets not worth restoring can often be a very useful source of bits and pieces when restoring another receiver. However, if you dismantle an old set, always be sure to clearly mark the parts and, if necessary, mark how they are connected. For example, IF transformers have primary and secondary windings and the pin connections can vary from one type to another.

With the restoration now completed, the set was run for several hours to make sure there were no other gremlins lurking in the works. This is always a good idea because many intermittent faults are heat-sensitive and will only show up after a period of prolonged operation. In this case, the AWA B15 passed with flying colours and was eventually returned to its owner.

Summary

Restoring this set was quite straightforward, even though there were some unusual faults, ie, the short in the 6AQ5 valve, the broken antenna rod and the damaged speaker. It's an easy set to work on, with good access to all parts, and the restored set works quite well.

There was also an element of luck in the restoration in that I had a spare loudspeaker from a junked identical set. Keeping the critical parts from junked sets sure pays off when it comes to restoring old radio receivers. **SC**

The faulty loudspeaker was replaced with an identical unit salvaged from another B15 chassis that was unrepairable.