VINTAGE RADIO

Stromberg-Carlson 1936 model 496 mantel radio

By Associate Professor Graham Parslow

After many years at the masthead of Vintage Radio, finally, here is an article on the feature radio! It's an early superhet with Art Deco styling. You can see the dramatic change between its pre- and post-restoration appearance.

This radio was a one-family treasure until it came to me for restoration from Peter Lockhart (retired from careers in electronics and IT). Peter wrote:

"My first recollection of this Stromberg Carlson 496 was that it belonged to my great aunt, Beatrice Krentzin, who lived in Perth most of her life. She grew up in the goldfields of WA at the turn of the 19th century. It was used as a mantelpiece set. Though not very loud, it had a 'lovely tone'."

"For a long time, it was the family radio (ie, the only one). I recall it was not particularly sensitive to radio stations, particularly as the ABC 50kW 6WF transmitter was only 6km away. The fact that it could not play 'pop music' loudly added to its general appeal. It was a trusty deliverer of the news and sports and world events over a long period."

"The radio passed to my mother in the 1970s and was fully functional at that time. It then became something of a favourite ornament. I have carted this radio around for more than 30 years with good intentions to restore it. Unfortunately, the opposite occurred, and suboptimal storage only added to the woes of the poor old 496."

The circuit

Fig.1 is the radio's circuit diagram. Later superhet radios used dedicated converter valves with functionally distinct oscillator and mixer sections. Instead, the model 496 uses a 6C6 6-pin pentode as an autodyne oscillator with the signal introduced at the top-cap grid, at the frequency selected by the aerial coil and tuning capacitor. The coupled oscillator coils are drawn below the 6C6 valve.

Local oscillator (LO) action is accomplished using anode-cathode feedback. The mixing function is created by the LO-modulated electron stream from the cathode interacting with the input signal at the control

The 7-inch (178mm) electrodynamic speaker was missing its cone. A ferrite-magnet 4Ω speaker was instead placed inside the area where the cone would normally be as shown in the adjacent photo.

grid. This sort of autodyne configuration only became common again when transistor radios appeared.

The first intermediate frequency (IF) transformer feeds the signal into the top-cap grid of a 6F7 pentode-triode. The 6F7 pentode performs IF amplification and feeds into the second IF transformer.

The signal is detected in a slightly unconventional manner, by connecting the 6F7 triode grid and anode together to make a diode. The audio signal is then conventionally passed to the AL3 output valve.

The gain of the 6F7 pentode is controlled by the 4kΩ volume control potentiometer that acts as a variable grid bias resistor. I measured the grid bias in this radio as varying between 0V (maximum volume) to -40V, even though volume was negligible at -20V. The aerial coil is also shorted out at minimum volume.

The AL3 valve used in the output stage was released in March 1935 and had an 8-pin European side-contact base, with a recommended filament supply of 4V and a grid bias of -6V. Many restored radios of this type have the AL3 replaced with more readily-available octal types.

A 6V6 valve installed in this radio is definitely a retrofitted modification because the label at the cabinet base is stamped 10 July 1936, and Ken-Rad did not release the 6V6 until late 1936.

Substituting a 6V6 for an AL3 requires only installing an octal socket and a higher-value grid bias resistor. However, with a 6V6 in place of the AL3, the sensitivity will be only about half that with the original valve.

The seven-inch (178mm) speaker is an electrodynamic type and forms part of the high tension filter circuit, its coil acting as the 1kΩ choke.

The circuit is so minimalist that I had expected an easy electrical restoration, but this was not to be.

Cabinet restoration

I restored the case by taking the flat surfaces back to bare timber and finishing with polyurethane. Next, I repainted the parts and replaced the clear dial cover with a polycarbonate sheet. I also installed new speaker cloth. Finally, I selected appropriate knobs from my collection, because none came with the radio.

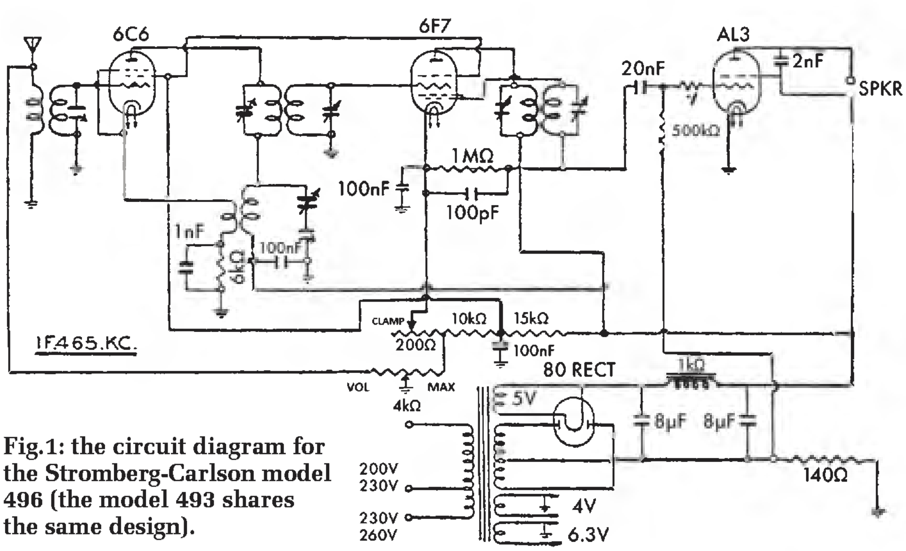
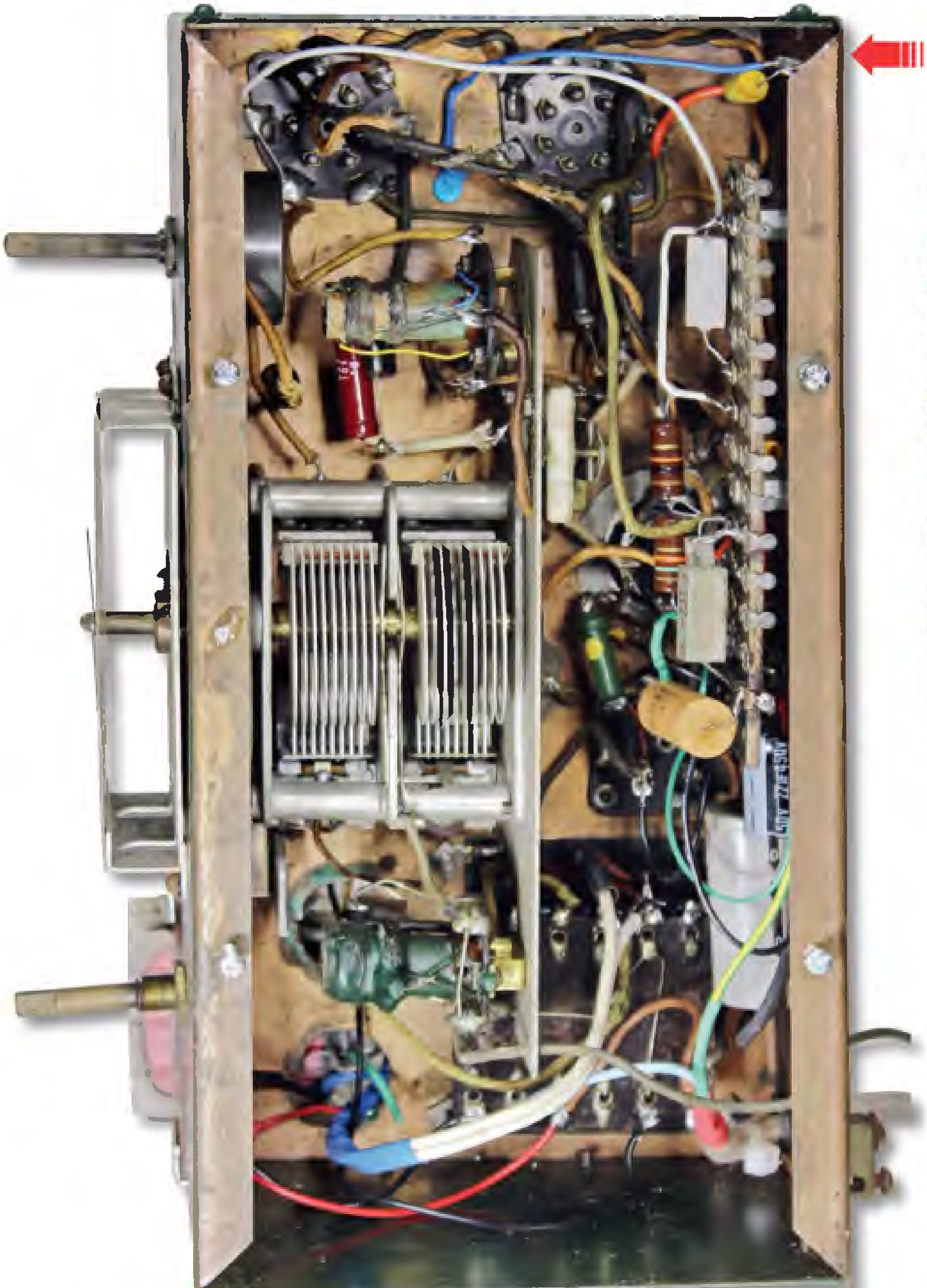


Fig.1: the circuit diagram for the Stromberg-Carlson model 496 (the model 493 shares the same design).

Electrical restoration

There was an obvious starting point for this radio. The seven-inch speaker cone was completely missing, presumably due to a moth or mouse attack. The family had tried to repair the cone, but I was told that they never managed to restore its tone.

I decided not to replace the cone, but rather insert a modern ferrite-magnet speaker into the cone space. One of the 4Ω speakers in my parts bin was perfect for the job. I painted the exterior of the new speaker matte black and, at first glance, it appears to be the cone of the original speaker (it's amazing how we see what we expect to see).



Shown at left is the underside of the chassis after restoration. A sub-section is shown above of the green multi-section wire-wound resistor which was replaced with a tag board.

It was not difficult to hook this speaker into the secondary of the speaker transformer. However, because the new speaker was a few millimetres proud of the old speaker rim, a reworking of the original baffle with an additional three-ply spacer was required. It was an excellent mental and physical exercise to finalise this solution.

The pictures show the result. I abraded the rust on the speaker transformer and speaker frame away and repainted them to optimise the appearance from the rear (the sides of the speaker cannot be seen in the assembled radio).

The next task was to clean up the rust and debris that degraded the appearance of the chassis.

The two dial-lamp holders looked forlorn, but they cleaned up well and remained serviceable. Unfortunately, the set had a short length of modern figure-8 flex coming out from the rear. I replaced that with a cloth-bound three-core mains lead, allowing the chassis to be Earthed.

Two circular holes in the chassis at the front of the power transformer show where canned electrolytic capacitors were originally installed – the only two in this radio. One of the replacement electrolytics added below the chassis was modern; I replaced the other, which was 1940s vintage.

Visual inspection suggested that it was now time to see if power would bring the radio to life.

Testing

The first power-up was to check the transformer, with only the dial lamps as a load (no valves). This made an excellent start, with a stable, low power consumption and two shining lamps. I then plugged in the valves and gave it another go.

After warming up, the radio was using a stable 41W and making no sound. The high-tension (HT) rail was slightly lower than expected at 235V after the choke. Optimistically, I tried a substitute 6V6 output tetrode, to no avail. All the DC voltages at the octal base of the 6V6 checked as OK, so the speaker transformer primary was intact and conducting high tension from the screen to the anode.

Applying an audio signal to the 6V6

grid produced clear sound, affirming that the speaker transplant was successful.

There were only three original Chanex-brand paper capacitors left in the radio, so I replaced all of them. None of them proved to be leaky, so there was no change in function. The circuit diagram indicated an IF of 465kHz, so I used a signal generator to check whether a 465kHz signal injected into the grids of the 6C6 or 6F7 would produce any output. Nothing.

Checking the voltages at the bases of the 6C6 and 6F7 showed no screen voltage. This usually indicates a leaky bypass capacitor, but new capacitors had already been put in place.

Checking the large green multi-section wire-wound resistor showed that the only functional section was the 140Ω grid bias resistor. The other clamps were not making contact with the wire beneath them. This explained why there was no screen voltage, because this is derived from a 15kΩ segment that was open-circuit.

To restore the function of the resistor series, I decided to populate a tagboard with discrete resistors. The tagboard I selected was unused and dated from about the time of this radio, so installing it was not an outrageous affront to its character.

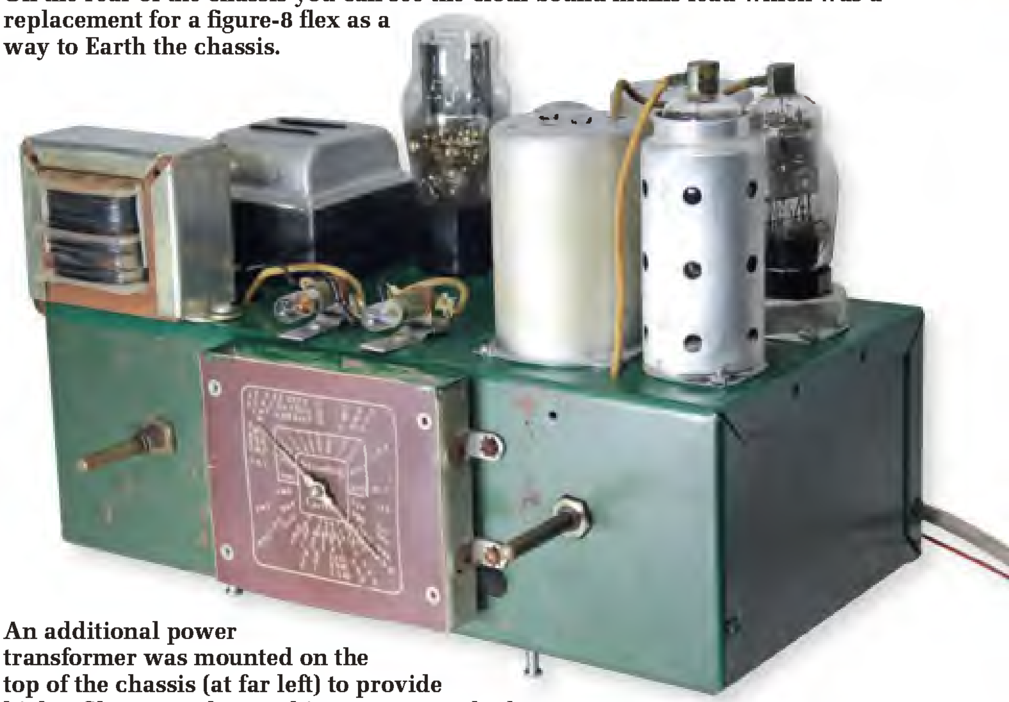
A previous modification had been to add a 150Ω resistor in series with the 140Ω resistor in the output valve grid bias circuit, so that the AL3 could be replaced with a 6V6. The result was that bias at the 6V6 was -15V. I instead used a 100Ω + 150Ω pair, resulting in a -14V bias.

The radio remained dead with its newly installed resistors. The only improvement was that an IF signal injected into the 6F7 grid now produced audio output, indicating functional IF amplification and detection.

The 6C6 oscillator had a screen voltage but no anode voltage, and this was traced to an open circuit in the tuned coil of the Armstong oscillator circuit. I removed the coil and tested it; both coil sections in the oscillator were open circuit.

My first attempted fix was to wire in a replacement from my salvage shelf. This was a failure, so it was back to repairing the original coils. This was not trivial because whole segments of the Litz wires connecting the base lugs to the coils were missing. Some

On the rear of the chassis you can see the cloth-bound mains lead which was a replacement for a figure-8 flex as a way to Earth the chassis.



An additional power transformer was mounted on the top of the chassis (at far left) to provide higher filament voltage. This was mounted where two old electrolytic capacitors used to be.

monumental trauma had been inflicted on the coils and hidden below a thick layer of green wax.

I used a heat gun over a ceramic tile to melt most of the wax away. Some micro-surgery then allowed me to re-establish the coil connections.

Mega relief! At last, the radio sprung into life, albeit rather feebly. Nevertheless, it was tuning with reasonable selectivity and behaving as a superhet should. The HT rail measured 282V, and the screens for the 6C6 and 6F7 were at +110V.

Testing with a signal generator led to the unexpected result that the intermediate frequency (IF) was 436kHz, not 465kHz as published.

Why so feeble? Stuart Irwin had told me before I started this restoration that a model 496 he restored was a surprisingly good performer for its type and age, with a sensitivity of 125µV @ 600kHz (I also need to thank Stuart


This photo clearly shows the new speaker inside the old speaker's frame.

for providing the circuit diagram for this radio).

The AC filament voltage measured as only 4.9V, an apparent reason for the poor performance. Valves usually specify a maximum of ±10% filament voltage tolerance. Cathodes subjected to chronic low filament voltage change their chemistry to poison the oxide layer, resulting in lower emission.

The reason for the low filament voltage is a real puzzle. The solder joints at the transformer showed no interference by anyone after the factory (at least before I made some modifications). A possible cause of this low voltage is shorted turns, but the transformer without load only drew 4W and did not overheat. It's truly strange.

The 4V secondary on the power transformer was left unconnected after the AL3 was removed. So a confusion with windings did not cause the low filament voltage.

The web has many references on cathode poisoning, but I failed to find a detailed source. The usually informative Radiotron Designer's Handbook makes only passing reference to the problem.

Full of hope to get better performance, I used an external filament transformer as the heater source that provided 6.9V on load (a bit up from the nominal 6.3V). The improvement in output was dramatic, although not as good as could be expected with new valves unaffected by cathode poisoning.

A surprise was that reverting to the onboard 4.9V AC supply produced a dead radio that thankfully came back to life with 6.9V applied. Any chemical change in the cathodes that might explain this could not be found online.

To provide the required higher filament voltage, I mounted an additional transformer on top of the chassis over the two holes formerly occupied by electrolytic capacitors.

After a longer-than-usual period at the bench, it was highly satisfying to marry the chassis back to its resplendent cabinet. SC

Why doesn't this set use a converter valve?

Many sets produced earlier than the model 496 used dedicated converter valves. It is unusual that they reverted to the autodyne converter. The 2A7 and 6A7 were readily available from about the middle of 1933, the 6A8 from 1935 and the popular European AK1 from 1934.

Using a 6C6 instead of a 6A7 also means forgoing automatic gain control (AGC), as an autodyne converter can't be gain-controlled easily. It might have been a cost-saving exercise by Stromberg Carlson to use a 6C6. It isn't easy to find out for sure, but they might have had to pay higher royalties for using a proper converter valve, as well as the difference in the cost of the valve itself.

As an aside, royalties on the number of electron streams in the valves used in the set might be why reflexing was so popular in Australia. A reflexed valve was counted as only one electron stream in terms of royalty payments, even though it was being used twice.