

# Vintage Radio

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## The Lyric 8-Valve Console From The 1920s



This view shows the rear of the chassis, with the valve cover for the RF stages removed. All the valves were still in working order.

**Featuring no less than eight valves, the Lyric Model 70 broadcast-band receiver is an upmarket American-made set from the late 1920s. It's a tuned RF design with single-knob tuning and a number of interesting design techniques.**

**E**XPERIMENTERS in the early days of radio produced some very ordinary looking receivers, mainly because they were forever changing things to improve the performance of their sets. Sometimes they were successful but mostly they just thought their set was definitely superior to their mate's set.

Those early sets were built on wooden boards and these were commonly referred to as "breadboards". In fact, some were built on a real breadboards,

pirated from the kitchen!

The breadboard-style layout was a very convenient method of construction during the early days of radio, as it made it very easy to continually change a set's circuit or layout. As a result, experimenters' sets used this style of construction for many years and even today the term "breadboarding" is used when building makeshift circuits.

Breadboarding led directly to the

so-called "coffin style" radios when companies began manufacturing domestic receivers in the early 1920s. In reality, these were breadboard sets with a nice wooden cabinet built around them, with a hinged lid on top that allowed ready access to the set's internals. This also made it easy to occasionally tweak the circuit for better performance.

Receivers in the 1920s were attractive pieces of lounge-room furniture and that certainly applied to many coffin-style receivers. However, as the 1920s progressed, most manufacturers quickly developed new methods for constructing their receivers. For a start, the top-of-the-line receivers needed to be more elegant in appearance. They also had to perform better and be easier to operate than the early 1920s sets.

In particular, those early receivers commonly used several single-gang tuning capacitors, a regeneration control and a filament control (for volume), which made them difficult to tune and adjust. What was wanted by the average user was a receiver with just one tuning control and a volume control that had no time delay (as occurred with filament rheostats). They also wanted sets that didn't whistle when the volume was increased above a certain level and they also needed to be more sensitive than the earlier 1920s models.

In short, ease of use was the aim and people were prepared to pay more for sets that met that aim.

Breadboard-style construction had reached its zenith during the 1920s. It was not easy to build relatively high-gain receivers with multiple radio frequency (RF) stages without shielding between the stages. What's more, these stages had to be close together in the later sets because people wanted single-knob tuning.

Initially, single-knob tuning was achieved by mechanically coupling single-gang tuning capacitors via metal bands. These were then coupled



The unit features a 4-gang tuning capacitor, a large drum-type dial and a plug-in capacitor box.



Mohawk Corporation which Wurlitzer controlled.

Once such unit was the Lyric Model 70, which is a very interesting set from the 1920s era. The unit featured here is owned by Mark and has been overhauled by Marcus, both fellow enthusiasts in our local vintage radio club. In fact, the chassis was

both above and below the chassis while still retaining accessibility.

The downside was that many servicemen initially didn't like the idea of working on both sides of the chassis because the concept was foreign to them. The same sort of attitude initially greeted PC boards during the 1960s.

### The Lyric Model 70

The Wurlitzer Company made many magnificent organs over many years but what is not so well known is that the company also dabbled in radio manufacture during the 1920s and early 1930s. In particular, the radios were made by the All-American

to a single tuning control. However, with the advent of multi-gang tuning capacitors, shielding became critical.

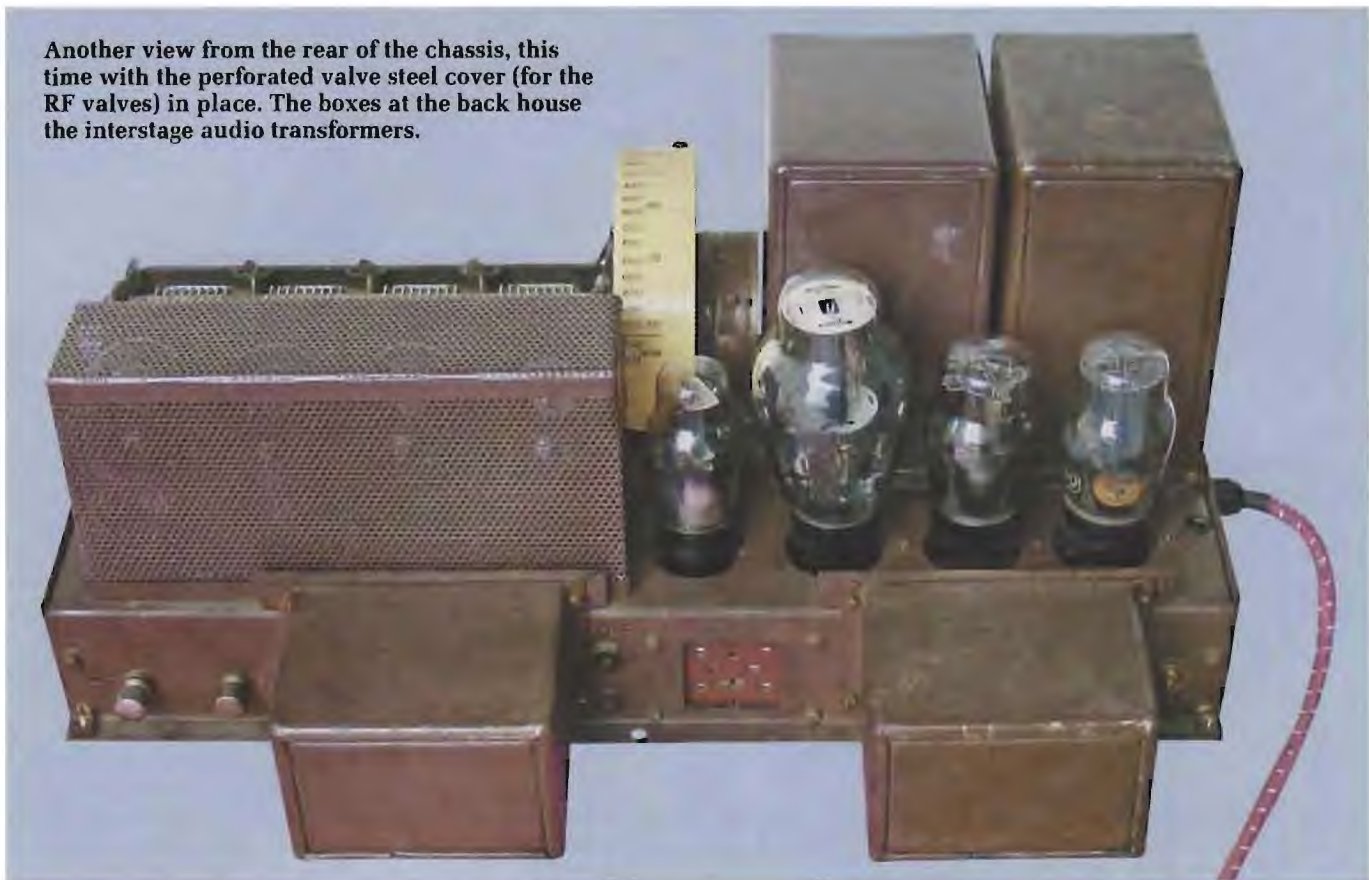
To overcome this problem, manufacturers hit on the idea of using a metal chassis – basically a “cake tin” turned upside down. A metal chassis had several advantages over the traditional breadboard: (1) it was possible to produce a layout that worked well with no feedback; (2) the shields for the RF coils were effectively earthed to the chassis, which made them more effective; (3) cut-outs in the chassis could be standardised so that assembly was easier to manufacture (and therefore less costly); and (4) more components could be used as they could be fitted



Above: the dial has both wavelength and kilocycle markings, while the Tuning and Volume controls are mounted directly beneath the dial escutcheon. The toggle switch in the centre is the On/Off control.

Left: the iron-cored chokes, the speaker transformer and the electrodynamic speaker are all attached to each other to form a single assembly. This assembly is connected via a cable and plug to the chassis.

Another view from the rear of the chassis, this time with the perforated valve steel cover (for the RF valves) in place. The boxes at the back house the interstage audio transformers.



regularly brought to club meetings as the restoration progressed, to discuss any problems that had occurred along the way.

The set was originally imported from America and has been operating via a 240V to 110V isolation transformer for most of its life. In fact, the person who originally owned it must have been quite wealthy, as a set of this calibre was a top-shelf model in its day.

The set has also obviously been well looked after because its cabinet is still in very good condition. It was initially cleaned and then the inside brushed out with linseed oil thinned with mineral turps. A commercial furniture restorer was then applied to the outside using a soft rag.

The views from both the front and back show that the manufacturer took pride in the appearance of this set. The dial escutcheon is of similar style to the better sets of the era and has both wavelength and kilocycle markings. The ornate Tuning and Volume control knobs are mounted directly under the escutcheon, while the toggle switch in the centre is the On/Off control.

The cabinet is solid and the finish on the timber is good, with no short

cuts in the making of this cabinet. It is definitely a 2-man job to shift, as the cabinet and chassis combined are quite heavy. In fact the speaker assembly and the chassis weigh in at 6kg and 12.5kg respectively, which the cabinet adding to that.

### Circuit details

The Lyric Model 70 is an 8-valve TRF (tuned radio frequency) receiver, designed to be powered from 110V AC. It has a number of features that were quite cutting edge for the era plus a few other features that, while interesting innovations, were really not practical in the long term.

Fig.1 shows the circuit details. As can be seen, the antenna connects to the primary of the first RF tuned circuit. It also connects to a 12k $\Omega$  rheostat (R9) that gradually shorts out the antenna as it is rotated and forms part of the volume control network.

Following the antenna, the signal is fed to the first tuned circuit where it is amplified by a 226 triode. The resulting signal on the plate of this valve is then fed via a second tuned circuit to another 226 triode where it is further amplified. A third tuned circuit and

RF amplifier stage, again based on a 226 triode, follow.

From there, the signal is fed via a fourth tuned circuit to a 227 triode detector stage. This has an audio transformer connected to its plate circuit (approximate step up ratio: 1:3) and the secondary of this is connected to a second 227 audio stage. The output of this stage is then fed through another audio step-up transformer to the grid of a 250 audio output stage.

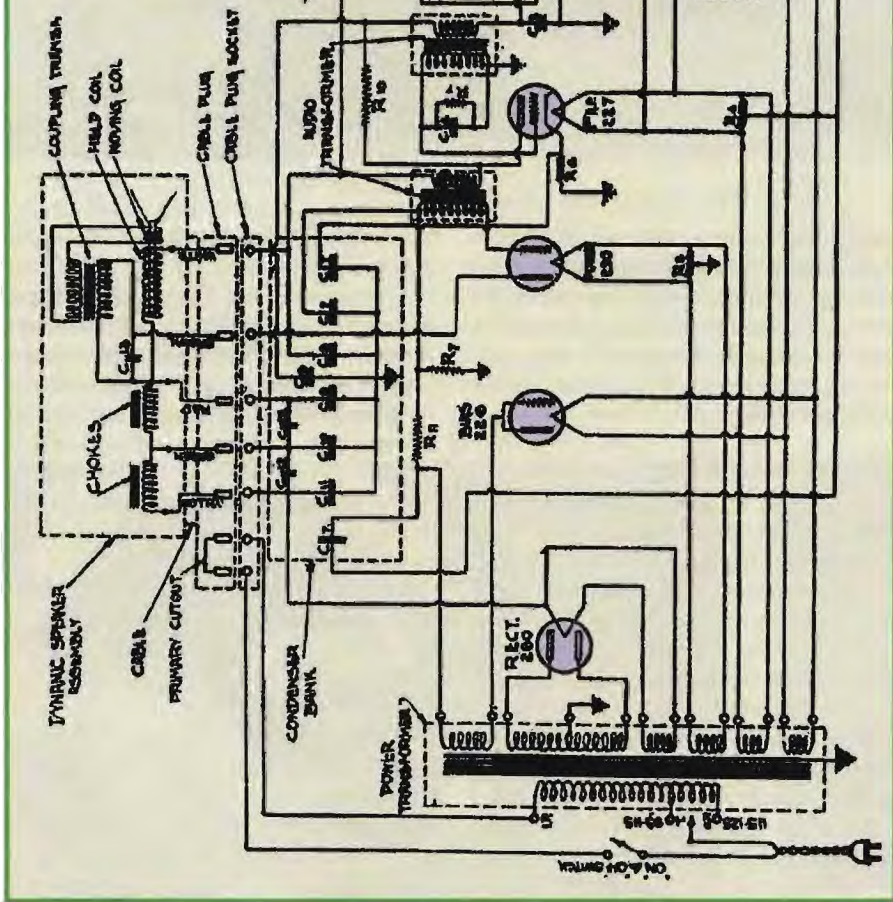
Finally, the audio output stage drives the loudspeaker via a speaker transformer.

### Interesting points

There are a number of interesting features in the RF amplifier stages. First, each RF triode stage is neutralised using neutralisation capacitors that are mounted on the 4-gang tuning capacitor – see photo. These are adjusted during manufacture (via three screws along the bottom edge) so that the receiver is stable under all conditions with the volume control set at maximum.

Another unusual feature of the 4-gang tuning capacitor is the method used to achieve tracking across the

Fig. 1: the circuit features three tuned RF stages based on 226 triode valves. The amplified RF signal is then fed to a 227 detector stage, after which the audio passes through a second 227 stage and then via a transformer to the grid of a 250 audio output stage. A 280 valve functions as the rectifier, while the remaining 226 triode provides the bias for the 250 audio output stage.



broadcast band. As shown in the photo, there are another six adjustment screws positioned on the edge of the frame, three between the four gangs at the front and three more at the back. These screws are adjusted

to shift a plate between each gang section, to alter the capacitance between the fixed plates and earth so that the tuned circuits could be adjusted to track correctly. There are no cores in any of the RF coils, so getting the cir-

cuits to track would have been quite a task and certainly not one for the faint-hearted to attempt.

As mentioned above, rheostat R9 progressively shorts the antenna signal and functions as the volume control. This control also has a second section which is connected to capacitor C2 in the plate circuit of the first RF stage. In operation, R9 and C2 progressively detune and partially short out the signal in the plate circuit to increase the effectiveness of the volume control.

Another interesting feature is the filament supply arrangement. The first three stages have their filaments fed from a 1.5V line and they have a centre-tap resistor (R2) wired across the filament line. This was known as a "humdinger" and its function was to reduce any hum that may be induced from the filaments into the signal path. A resistor from the centre tap of this "humdinger" to the chassis provides bias for these stages.

The detector and the first audio stage also have a "humdinger" (R4) across their 2.5V heater line to null out hum that could affect the audio signal. These are the only two indirectly heated valves in the receiver. The centre tap of this "humdinger" goes to the same bias resistor used for the 226 valves.

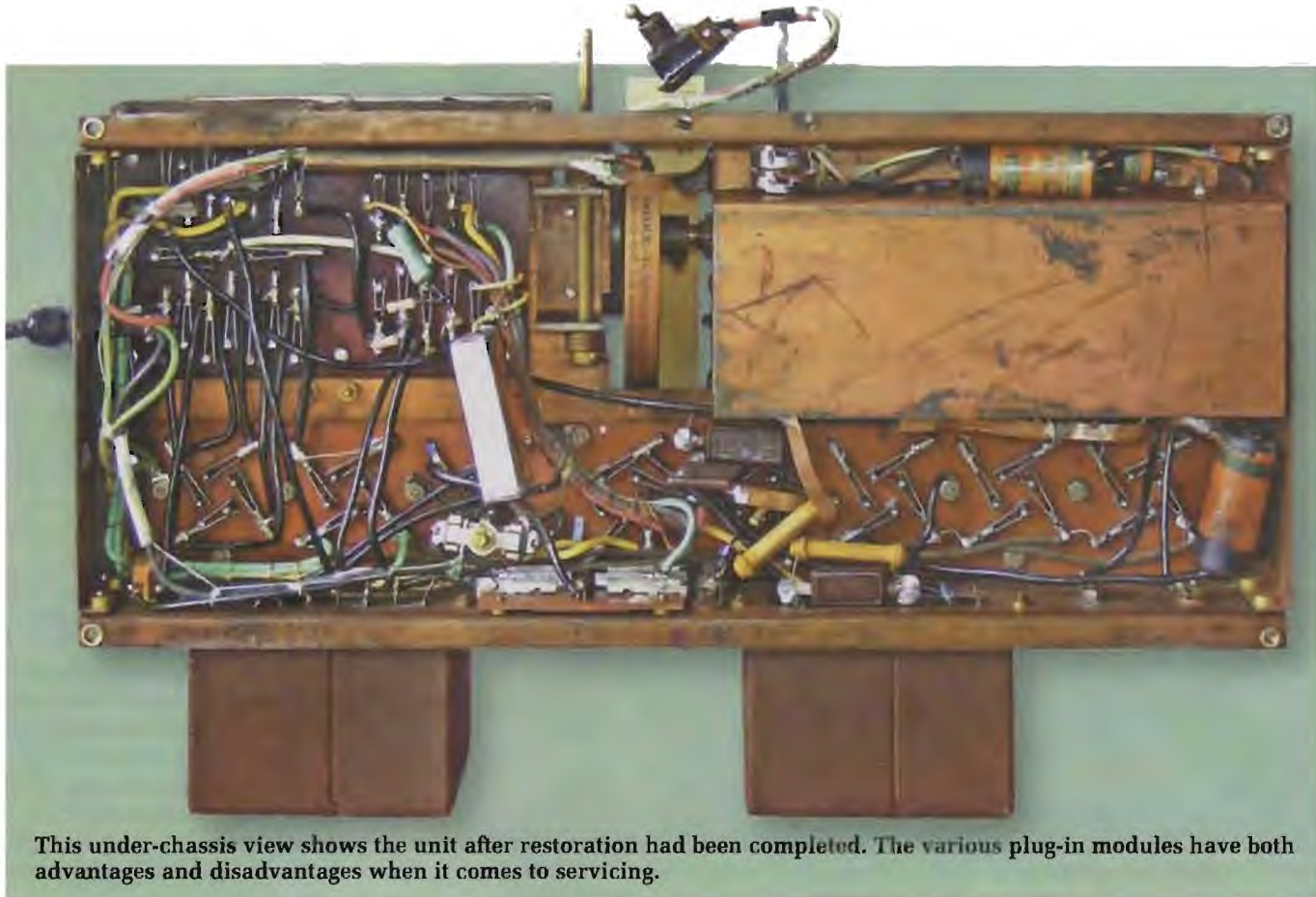
The audio output stage uses the rather large 250 valve. It is fed from its own 7.4V filament line, and once again it has a "humdinger" across the filament line to chassis. The 250 is a low-gain valve with a gain of less than four. It also requires quite a high bias voltage, which can be as high as -84V. However, in this receiver a bias of only -52V to -56V is required.

The bias for this stage is derived from a separate bias supply. This consists of a separate winding on the power transformer which is connected to a 226 valve wired as a diode, with a 0.5µF filter capacitor. This filtered is then fed through a resistive divider and the secondary of the driver transformer to the grid of the 250.

## HT supply

The HT supply is conventional with a full-wave 280 rectifier supplying the HT to all stages of the receiver. The line is filtered by two 13-Henry iron-cored filter chokes plus five capacitors.

This receiver was built before electrolytic capacitors were available, so large paper capacitors of 2µF and 3µF



**This under-chassis view shows the unit after restoration had been completed. The various plug-in modules have both advantages and disadvantages when it comes to servicing.**

were used instead. However, from the circuit, it's apparent that the 280 rectifier is running close to its limits, with around 400V on the filament on load and a total HT current drain of around 70-80mA.

### Record player input

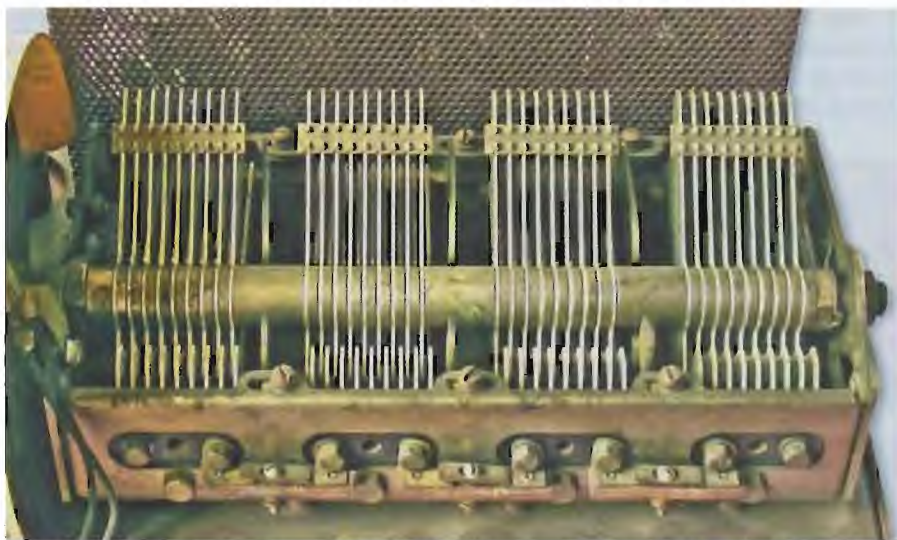
The receiver has provision for a record player input but it's doubtful that it would work. As shown on the circuit, the audio from the record player appears to be connected across the secondary winding of the RF tuned circuit feeding the detector. As a result, the audio signal would be effectively shorted out by this RF coil winding.

Finally, the valve types used lost their prefix around 1930 and became known simply as the 26, 27, 50 & 80.

### Plug-in modules

As shown in one of the photos, the iron-cored chokes, the speaker transformer and the electrodynamic speaker are attached to each other to form a single assembly. This assembly is connected via a cable and plug to the chassis.

The plug is wired so that when it is disconnected, the power is automatically disconnected from the primary of



**The 4-way tuning gang carries three variable capacitors along the bottom edge and these are used to neutralise each of the RF stages. In addition, there are six adjustment screws between the four gangs (three at the front and three at the back) and these are adjusted to ensure correct tracking across the band.**

the power transformer. This prevents the power supply from generating excessive voltage on the output of the rectifier when the assembly is unplugged. It also helps to protect a careless serviceman from electrocution. However, C11 is part of this assembly and is normally connected directly to the output of the rectifier. As a result, it

would stay charged and could deliver a fatal shock if touched.

The next plug-in module is the capacitor bank, consisting of 10 capacitors housed in a metal box (see photo). This was designed to be replaced as a single unit, meaning that if one became faulty the whole lot had to be replaced. This would have been expensive and



The chassis sits on a horizontal shelf in the top half of the cabinet, while the loudspeaker assembly is mounted in the bottom half and is connected via a cable and plug. Note the 240V to 110V step-down transformer at bottom right.

as a result, plug-in modules like this didn't find general favour at that time.

Finally, the power transformer and

the two interstage audio transformers are also plugged into sockets. Each of these is then secured to the chassis using four bolts.

In short, this set had a number of modules that could easily be replaced if necessary, making it straightforward to service.

### Restoration

When the set first arrived on Marcus's bench it was in a remarkably good condition considering its age. The cabinet and chassis only required a dust-out to make it easy to work on. However, he had no circuit diagram at that stage and this made things difficult. It is a complex set and it's not easy to figure out what exactly is inside the plug-in capacitor and choke boxes.

Despite having no circuit, Marcus immediately began restoring the set. His first task was to replace some poor-quality wiring, a legacy of some previous servicing. By contrast, the original wiring was found to be quite neatly done, even if it wasn't always easy to follow.

As mentioned previously, because it was designed for 110VAC, the set was powered via a 240V to 110V isolation

transformer (not an autotransformer). In the interests of safety, the original mains wiring was replaced to Australian standards.

Next, the valves were removed and tested and all were found to be in good working order. That was fortunate as replacements would not be cheap and in any case, would be difficult to source. The only electrolytic capacitor in the set, which proved to be a ring-in, had dried out and was replaced.

A Faraday shield had originally been fitted over the RF valves but this was now missing. As a result, a perforated metal shield was made up and painted the same colour as the chassis before fitting it into place.

The capacitors were the next on the list. After examining the chassis, Marcus concluded that any leaky capacitors in the capacitor box were unlikely to cause problems with the valves, as transformers are used for the interstage coupling. Further checks also indicated that there were no shorts to earth or excess leakage to earth, so it would be safe to run the set for a short time in order to check voltages in the various stages.

Well, it worked but it didn't work very well. A heat-sensitive intermittent fault soon became apparent and there was also a fault with the volume control.

Fortunately, a circuit diagram became available at about this time and this made troubleshooting so much easier, as it revealed the contents of the two "boxes".

First, the speaker/filter choke box was opened up and paper capacitor C12 across the speaker transformer primary replaced. All the other components in this box were in good order but the capacitors in the capacitor box were a different story.

Removing the capacitors from this box was a difficult job as they had been set in pitch. In the end, a heat gun was used to soften the pitch, after which a carving knife was used to separate the capacitor assembly from the case. In short, it was a time-consuming and messy job.

As expected, the 10 paper capacitors were all leaky and so had to be replaced. This was done by mounting much smaller replacement capacitors on two pieces of fibreboard (see photo). In particular, the 2 $\mu$ F and 3 $\mu$ F capacitors were replaced with mains-rated motor-start capacitors and the rest



The plug-in capacitor box contained a large number of faulty paper capacitors, which meant that a complete new assembly had to be made up.



The new capacitor bank was made up by mounting the parts on a couple of pieces of fibreboard and connecting them via flying leads. This assembly was then housed in the original box. The original capacitor bank is visible at top left.

with mains-rated MKT and polyester types. The value of each capacitor was marked next to it on the fibreboard, to aid future servicing.

As shown in the photo, the various leads were then soldered to the appropriate pins on the capacitor box plug, after which the box was plugged back into the set.

By the way, the two capacitors marked C12 are used to tune the filter chokes for maximum filtering effect. However, the originals were meant to resonate on 120Hz ripple, not the 100Hz ripple with Australian mains. As a result, it was unnecessary to increase the values of the two C12 capacitors to achieve resonance in the filter network. The mica capacitors were tested and found to be in good order.

### Tracking down the intermittent

It was now time to find the thermally-sensitive intermittent fault. The volume of the set would vary at a slow rate, indicating a problem with either a valve filament, a socket or some other

part of the filament supply line.

Careful testing revealed that the filament voltage on the lines to the 226 valves was varying and was low at around 0.9V AC. This problem was traced to the two “humdinger” centre-tap resistors on the filament lines to the 226s and 227s. These had riveted terminals which were making poor contact. They were cleaned and then soldered so that there was no discontinuity between the rivets and the riveted metalwork.

When this was done, the filament voltage to the 226s was restored to the correct 1.5V AC. This markedly improved the set’s performance and it was now obvious that it would be worthwhile spending the money to get the speaker re-coned. This was subsequently done and it now has a high-quality foam-suspension cone which complements the quality of the rest of the receiver.

The defective volume control was the next item on the list. This item is quite different in construction to con-

ventional pots and is basically a dual rheostat rather than a potentiometer. It only has one gang but two separate tracks, which in this circuit are earthed via the wiper.

The markings on the control, although appearing to relate to the resistance of the sections, are probably type numbers. It all confused Marcus before he obtained the circuit which revealed that each track has a resistance of 12k $\Omega$ . The unit was replaced with a dual-gang 10k $\Omega$  potentiometer.

Finally, all the resistors were checked and five out-of-tolerance components replaced.

### Testing

It was now time to see what the receiver was capable of. There was no apparent instability in the RF sections so the neutralisation adjustments were left alone. The tuning coils and tracking adjustments were also left as they were, as the performance was very good and no adjustments were deemed necessary. The bias on the 250 audio output triode was checked and found to be in the design range of -52-56V.

In operation, the receiver proved to have quite good selectivity and each station appeared in only one spot on the dial. It certainly had no trouble selecting stations that were relatively close in frequency to the local broadcasting stations.

In summary, its performance is quite good for a set of its age and style and it would have been the focal point of any lounge-room it graced during the late 1920s and early 1930s. However, it would have become obsolete, at least in a design sense, by around 1935 due to rapid advances in technology and the increasing popularity of superhet receivers.

That said, it still would have been a great set to have in the home and even today its performance is quite credible. It’s a set well-worth having in a collection, particularly as it is in such good working condition. **SC**