Vintage Radio

By RODNEY CHAMPNESS, VK3UG

Kellogg TRF receiver: home made or manufactured?

This simple little receiver is an excellent example of a 3-valve TRF set from the mid-1920s and has quite reasonable performance. Its exact origin is somewhat obscure, however.

IN THE EARLY DAYS of radio/wireless, many listeners used home-made receivers to pick up the broadcasts. Some early experimenters even made some of the components and only bought those parts they couldn't make themselves, such as valves. Of course, this strictly wasn't necessary as many companies supplied a variety of parts for radio constructors as well as making their own radios.

The set described here is owned by Mark and was restored by Marcus, both fellow club members. All of us are unsure as to whether it is a Kellogg receiver made by the Kellogg company, a home-made receiver made using Kellogg parts or a receiver built from a kit supplied by Kellogg.

In fact, it's often not easy to be 100% sure as to whether receivers from the 1920s were home-made or built by a manufacturer. All used the ubiquitous breadboard construction style of the era, with the parts mounted on the top of the breadboard. As a result, it's usually impossible to distinguish between home-made and commercial receivers on the basis of their construction.

Certainly, in those early days, there was no need to tip a chassis upside down to access components. In fact, there was no chassis – that innovation came towards the end of the 1920s.

The Kellogg company

In Australia, the name "Kellogg" is synonymous with cornflakes. However, the company we're talking about here was started by Milo Kellogg of Chicago, who established the Kellogg Switchboard and Supply Company in 1897. His factory concentrated mostly on telephones and telephone equipment and was quite a large concern.

Milo Kellogg was a prolific inventor and on one day in 1899 he was granted 125 patents for telephone-related equipment. Subsequently, when radio became the next technological advance, Kellogg began making components for receivers and other equipment. I am unsure as to whether they manufactured complete radios or not but they certainly made some high-quality components, as is evident from their 1923 catalog.

Kellogg remained an independent company until 1951 when ITT bought a controlling interest. The Kellogg name subsequently remained until 1962 when it became ITT Kellogg and then in 1965 it changed again to ITT Telecommunications. There were several other amalgamations into the 1980s and it is now a part of Cortelco.

The circuit

The Kellogg, for want of a name, is a conventional 3-valve TRF receiver from the mid 1920s. The antenna tuned circuit consists of a single winding that is tapped for different-size

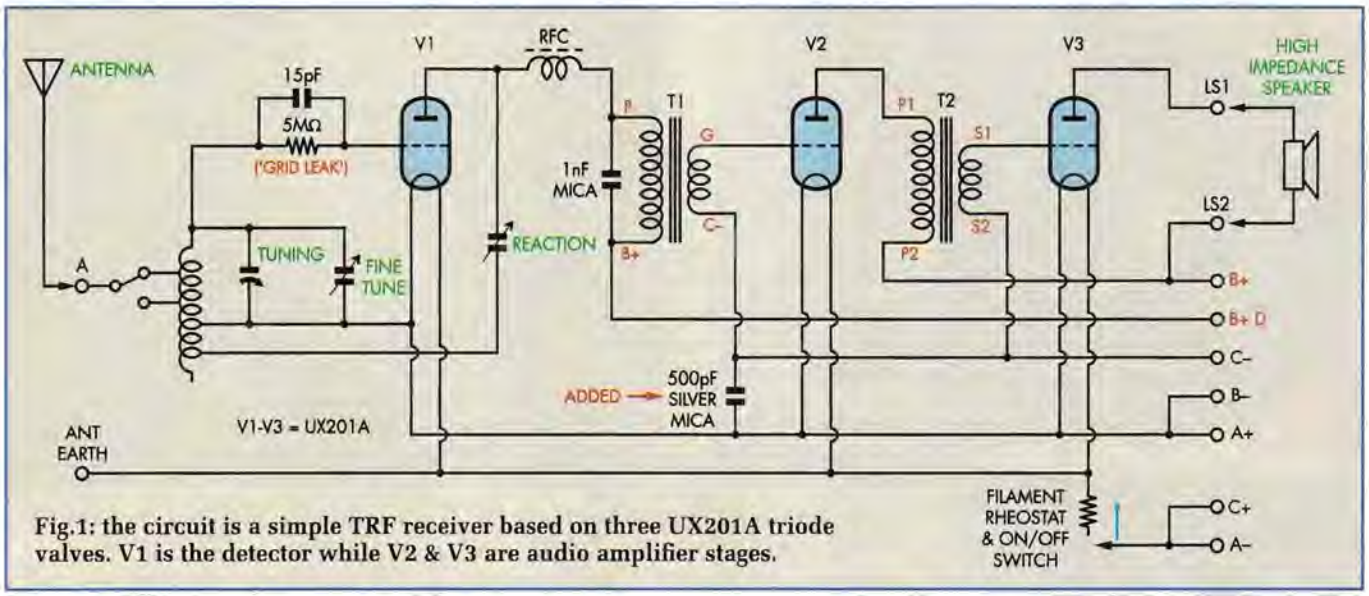

Fig.1: the circuit is a simple TRF receiver based on three UX201A triode valves. V1 is the detector while V2 & V3 are audio amplifier stages.

antennas. It also has a tapped feedback winding for regeneration (or reaction).

The top of the tuned section feeds a parallel 150pF mica capacitor and 5MΩ resistor. This combination forms a "grid leak" and is connected to the grid of V1, a UX201A valve used as a regenerative detector. Regeneration is controlled by the variable capacitor connected between its plate and the tuned circuit.

Some readers will not be familiar with the terms "regeneration" and "reaction", both of which are generally used to mean the same thing. To explain, early radio valves had quite low gain and were expensive, so every endeavour was made to get the most out of each valve. And that's where regeneration came in.

Regeneration is a technique whereby the incoming radio signal is amplified and then a portion of this amplified signal is fed back to the input again and re-amplified. As a result, the overall gain of the stage is multiplied many times. This means that the stage may have as much gain as a more complicated (but non-regenerative) circuit using one or two additional valves.

Each technique has its advantages and its disadvantages. A regenerative detector is simple, cheap to make, sensitive and reasonably selective. However, it can be difficult to adjust for optimum performance, which makes it unsuitable for non-technical users. In addition, the audio output has higher distortion levels than that from most superhet receivers.

In the 1920s, however, before superhets became available, enthusiasts had little option but to accept sets with regenerative detectors if they really wanted to listen to radio.

This is the view inside the set with the top cover removed. Note the breadboard style of construction, with all parts readily accessible from the top.

Following detection in V1 the audio component of the signal appears at the plate of the valve and is fed though a radio frequency choke (RFC) to the primary of T1, an iron-cored 1:3 step-up transformer. A 201 valve has a nominal gain of around eight and by feeding its output to this transformer, the overall theoretical gain becomes 8 x 3 = 24.

From there, the signal is applied to V2 where it is amplified and applied via another audio iron-cored 1:3 step up transformer (T2) to a third UX201A valve (V3). The amplified audio signal is then fed to a high-impedance horn speaker.

Step-up transformers

Step-up transformers were necessary in the 1920s because the valves

These two photos show the tuning knob before (top) and after repair (bottom). The small central knob is the vernier fine-tuning control.

of that era had such low gain. Their main disadvantage was that the audio quality was increasingly degraded as the step-up ratio increased. However, that didn't matter all that much as the detector itself had considerable distortion, as did the horn speakers that were used.

In fact, it's probable that none of the early sets had distortion figures below about 20% or more. In addition, the frequency response was limited to around 300Hz-3kHz but even that would have had 10dB peaks and troughs over its range. It may have sounded terrible but that's all that was available in the 1920s.

Finally, the filament rheostat and the regeneration control set the volume of the receiver. The filament rheostat also acts as the on-off control. This works by having the wiper break contact with the wire resistance element at one end of the control's rotation.

Restoration

Like almost-all "ancient" radios, the Kellogg TRF receiver wasn't exactly in pristine condition when Mark obtained it some time ago. The cabinet, however, was still in remarkably good condition. It was dusted out with a brush and a vacuum cleaner and then rubbed down with linseed oil to make it look almost new again.

The dial had a section that had broken away but fortunately, the broken piece was supplied with the set. The dial, the dial shafts and the tuning capacitors are rather unique. As usual, a large knob turns the main part of the tuning capacitor but now we come to the unusual part of this tuning gang – a separate shaft inside the main tuning shaft controls a vernier plate at the back.

The tuning knob for the vernier is the small knob in the centre of the main dial. It's a very clever way of doing the job but it would have required more precision during manufacture than a more conventional tuning gang and so would have been more expensive.

Of course, the added complexity also makes it difficult to repair any damage if the set is mishandled. And that is exactly what had happened in this case – the set had been dropped at some stage and had landed on its tuning knob. As a result, a section had broken out of the knob and although this was easy enough to repair, considerable damage had also been done to the tuning capacitor shafts.

Suffice to say that the repairs to the dial mechanism were not done in five minutes. On the contrary – professional machine-shop equipment was needed to drill and realign the mechanism. The earthing braid that was on the centre shaft had fatigued and broken off too. It was replaced but it appears as though it will be a continuing problem that requires routine repair.

Just why such a complex and costly mechanism was produced for sets like this is anyone's guess.

Missing valves

The set was obtained with just one valve in place and this proved to be a Philips A415. However, although a variety of valves could be fitted to the set (the valve base arrangements at that time were reasonably standardised), it was decided to fit UX201As to the receiver. They weren't cheap but are more applicable to this American-style set than Philips valves.

Once the valves had been obtained, it was discovered that the filament polarity had been reversed in the wiring. This was easily corrected.

Further checking of the circuit revealed that there was a short to the 5MΩ grid leak resistor and that audio transformer T1 had an open-circuit winding. The short to the resistor was easily fixed but then it was discovered that the resistor had gone high in value, to 14MΩ. This resistor is a

The tuning gang is unusual in that it features an additional single moveable plate at the back which is controlled by a separate shaft inside the main tuning shaft. This allows the station frequency to be precisely adjusted when tuning.

The regeneration (or reaction) control resembles a mica padder capacitor. Rotating the control knob varies the distance between the plates and thus the capacitance and the amount of regeneration.

glass-mounted type and could not be dismantled without risk of damage, so an 8.2MΩ resistor was wired across it. This brought the total resistance down to the required 5MΩ.

The audio transformer problem was fixed by replacing it with a new one. This, along with the valves, was obtained from overseas, as they are difficult to find in Australia.

With the faulty parts replaced, it was time to test various sections of the set. To do this, an antenna, earth, horn speaker and external power supply were connected to the set and the supply's DC outputs adjusted to the levels suggested in the valve data sheets. This ultimately consisted of 5V for the three filaments, -4.5V to bias the two audio stages, +100V to the plate circuits of the audio stages and 45V to the detector.

The 45V HT for the detector was derived from a variable power supply. At just 17V HT, the detector was going into oscillation so it was in good order and some stations could be heard behind the whistling. However, an HT of 45V appears to be about optimum for this stage. Certainly, regenerative detectors used voltages ranging from 22.5-45V for valves such as the 201A during that era.

At full volume (ie, minimum resistance setting of the filament rheostat), the set had a tendency to go into supersonic oscillation. As a result, a 500pF capacitor was wired from C- to A+ and this fixed the problem. Sets of this era had little if any decoupling, instead relying on the batteries to act as filters and de-couplers between stages. In addition, the sets had relatively little gain so extensive decoupling was unnecessary.

One problem with this type of circuit is that the audio transformers sometimes had to have their primary or secondary leads transposed to prevent feedback. In other words, the terminal marked "grid" has to be connected to the bias line while the "bias" terminal has to go to the grid, for stability to be achieved.

The power leads from the set are connected via an octal plug into a purpose made AC power supply. This eliminates the possibility of errors being made when connecting the set to power.

Alignment & performance

There are virtually no alignment adjustments to be made in this type of set. The tuned winding has no alternate taps to alter the tuning range and must be accepted as it is. However, the antenna can be tapped at two points and a simple switch selects between them. The tapping nearer to the earth end of the tuned section is intended for long antennas, while the higher tap results in greater gain from the set to compensate for short antennas.

The regeneration winding has one tap so that either it or the end of the winding can be selected to ensure regeneration with either a 22.5V or 45V supply. The regeneration control is rather unusual and is constructed somewhat like a mica padder capacitor. When the plates are brought closer together by rotating the control, the amount of capacitance increases and the regeneration increases.

Three UX201A triode valves are used in the old Kellogg TRF receiver.

Not surprisingly, the set is not par-

The old Kellogg 3-valve receiver was built into a wooden cabinet which is still in good order. The on/off volume control is at bottom left, while the reaction control is at bottom right.

ticularly sensitive but was probably average for its time. However, it has good selectivity and is able to discriminate between adjacent stations quite well.

The loudspeaker

The "Little Spitfire" horn speaker shown in the photos didn't come with the set but is the type of speaker that would have been used with it. This item was obtained separately but unfortunately its high-impedance winding was open circuit.

Rewinding the coil to get the speaker going again wasn't worth the effort. Instead, its internals were removed from the base and its mounting points modified so that a small line-to-voice-coil transformer could be fitted, along with a 50mm speaker mounted above it. As a result, it still looks original and its performance is pretty much as expected of a horn speaker, as it still has the original horn baffle.

A close-up view of the "Little Spitfire" decal that's attached to the horn-loaded loudspeaker that's now used with the Kellogg receiver.

Summary

As with many very old receivers, this unit required a lot of work to restore it to working order. However, it's now a good-looking set and is an excellent example of a mid-1920s TRF receiver.

Its performance is fair and its ability to discriminate between stations is good. A 10kW broadcast transmitter is located just 8km away from my location, while a second 5kW station is also located at a similar distance. Together, these two station provide a good test of a set's selectivity.

Finally, I'd like to thank Marcus who supplied me with the photos and information for this article. SC