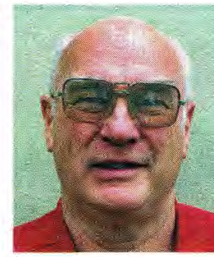


By RODNEY CHAMPNESS, VK3UG

Building A Browning-Drake Replica

Many vintage radio enthusiasts would like to have sets from the 1920s but these are now difficult to obtain. There is an alternative, however – build a replica that's as close to the original design as possible.

Collectors and restorers of old cars, steam engines and, of course, vintage radios, etc all like to have at least one really special item. That item usually takes pride of place in their collection – it can be a real talking point and gives the collector an opportunity to encourage others to take up the hobby.

Wireless/radio sets from the 1920s are often beautiful pieces of furniture that catch the eye. Collectors like to have at least one of these but unfortunately, they are not all that common. As a result, replicas of that era are often made. Often, they look almost identical to the originals, with their construction and performance being similar too.

In fact, the dedication of some constructors is so exacting that many replicas are almost impossible to distinguish from the originals.

This view shows Jim Birtchnell's completed Browning-Drake replica receiver. The hinged lid allows easy access to the circuit components.

During 2000, the Historical Radio Society of Australia (HRSA) decided to promote a constructional project for its members, the idea being to build a replica of a popular "wireless" from the mid-1920s. The set selected was the Browning-Drake tuned radio frequency (TRF) set, a fairly simple receiver consisting of a neutralised RF stage, a regenerative detector and two stages of audio amplification. This circuitry was housed in a "coffin-style" cabinet (see photo) which was almost universally used during the 1920s and into the early 1930s.

Many such replicas were built, with the parts scrounged from all sorts of sources. As a result, they came from many different manufacturers.

Jim's Browning-Drake replica

One member in our local vintage radio club is keen on building replicas from the 1920s. His name is Jim Birtchnell and just recently, he also decided to build a Browning-Drake receiver.

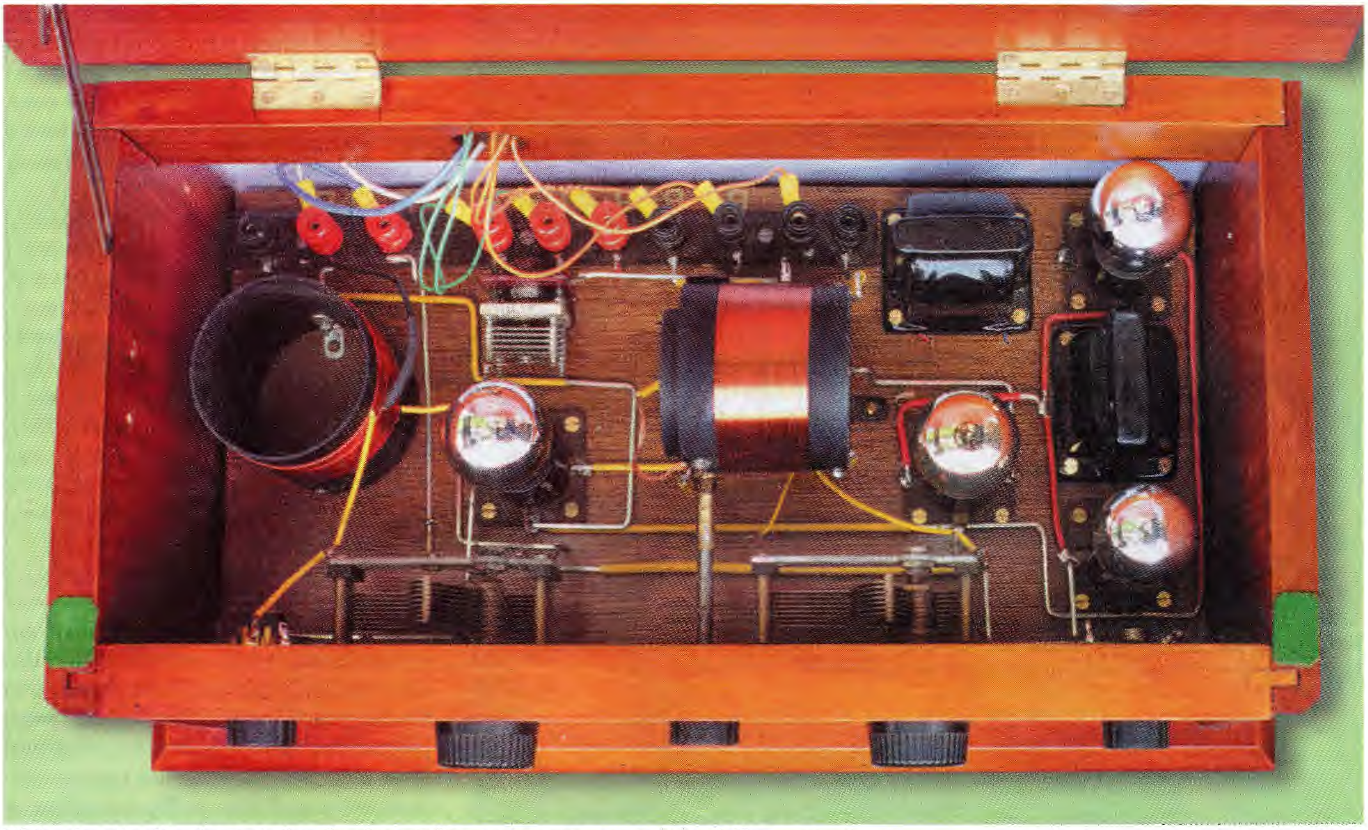
Like all constructors of replicas, Jim needed to scrounge as many parts as possible for his project. These parts either had to be identical or similar to those used in the original receivers. If he couldn't get them, he had to make them.

The cabinet

The cabinet is one of the most important parts in this receiver. The original HRSA specification stated that cabinets could be made from dressed kiln dried timber, 7-ply board, veneered plywood or veneered timber.

Jim selected Kauri timber to make his cabinet and, as can be seen from the photographs, the cabinet is first class. Wood-working is one of Jim's other hobbies, by the way.

The cabinet size is nominally



This view inside the set clearly shows the parts arrangement and the general wiring layout. A lot of the wiring was run using bare square-section busbar, while the coils were wound on 76mm and 57mm-diameter PVC pipe.

530mm long, 275mm deep and 235mm high, while the front panel is made from black Formica. Jim decided to use normal bronze butt-hinges to secure the lid to the cabinet, although it's interesting note that most constructors opt for a piano hinge.

A number of finishes for the cabinet were suggested in the original HRSA articles. These articles even included a complete description of how to prepare the cabinet before applying the final finish coats. Either lacquer or French polish was recommended and there was sufficient detail for constructors to do a good job using either finish.

I must admit that the thought of applying around 30 coats of Shellac, to provide a beautiful French polish, is not something I would look forward to – especially as it's outside my field of expertise. Jim decided to finish his cabinet with Mirotone lacquer, which is an easier alternative to French polishing, and the standard of the finish can be seen in the photos.

The various labels on the set were made by a local screen printer and they too look the part. In fact, the only thing that looks a little out of place on the cabinet is the round power socket that's mounted at the rear. Although there is a row of power supply terminals along the back, Jim decided to also run extended leads from them to the power socket.

This was done so that the set could be powered from an external supply. In fact, Jim uses this same supply to power other replicas which have similar requirements. In short, the external power socket is a matter of practicality.

Circuit details

Obtaining components of the right vintage – or at least looking as though they are of the right vintage – is not an easy task when it comes to building a replica of a set that's about 80 years old. Jim, like most others, had difficulty sourcing some items but his replica still looks very close to the original set.

As shown in the photos, most of the wiring has been done using bare square-section busbar, some of which has been enclosed in coloured spaghetti sleeving. However, a small amount of the wiring was also run in normal plastic-covered hook-up wire where flexibility was needed – eg, the connections to the coils.

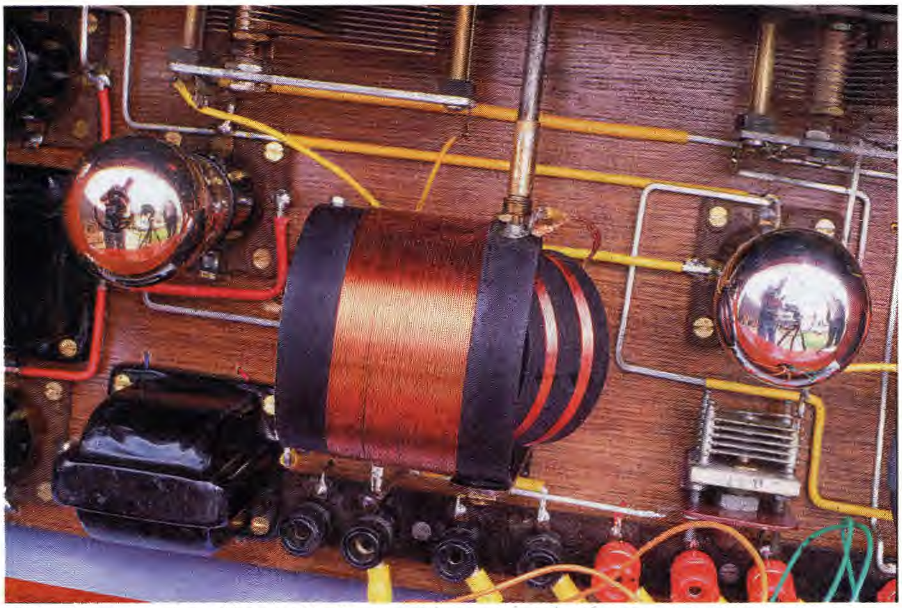
Generally, the wiring has been run parallel to the sides of the case, although there is some point-to-point wiring. "Squared" wiring always looks nice but may not be the most electrically efficient. However, in sets of this vintage, lead dress and length was not often all that important, as each stage had relatively low gain. This meant that the receiver was stable despite poor layout.

Coil formers

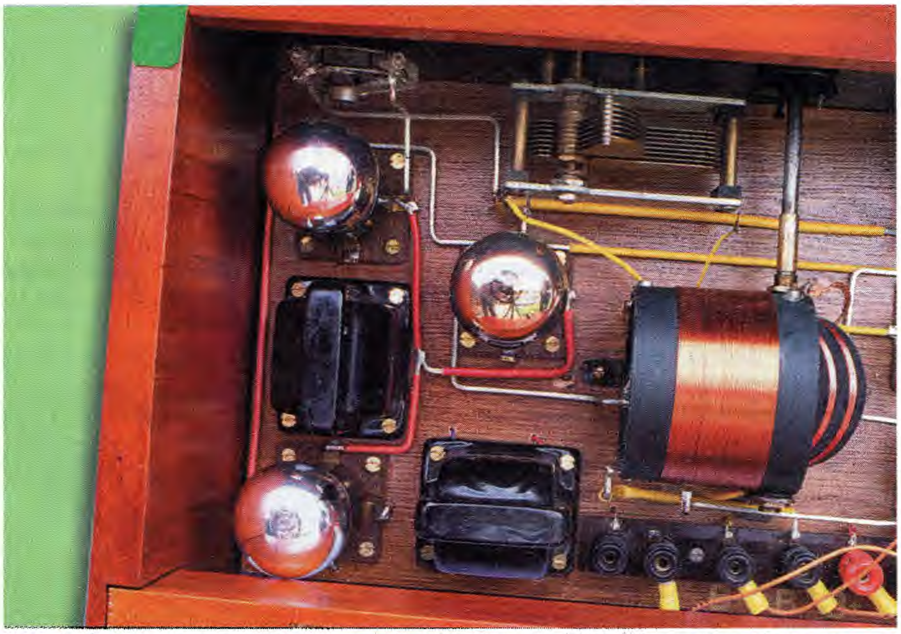
The coil formers were made from white PVC tubing, either three inches (76mm) or two inches (57mm) in diameter. The required lengths of tubing were first cut to length and then spraypainted matt black to give them an authentic look.

The windings on each of the formers were wound on Jim's wood lathe. In this case, ordinary enamelled copper wire was used but other constructors have used double cotton-covered copper wire, which was much more common 80 years ago.

By the way, it's sometimes not a good idea to close-wind enamelled copper wire. That's because the distributed capacitance between the turns can be so high that it restricts the



This close-up view shows the "regenaformer" with its rotatable "tickler" coil for adjusting the regeneration. The RF stage and its associated neutralising capacitor are immediately to the right of the coil.



The detector and audio stages are clearly shown in this photo. Note the two audio transformers.

tuning range to less than the complete broadcast band. To overcome this problem, the HRSA articles recommended that some space be left between turns. However, despite this advice, Jim close-wound his coils and found that the tuning range was quite adequate.

The rotatable "tickler" coil was more difficult to manufacture than the others. This coil was wound on the 57mm pipe and is mounted so that it can rotate inside the 76mm former.

As shown in the photos of the "regenaformer", the "tickler" consists of a split winding on the rotating coil former. This rotating former is in turn attached to a 0.25-inch (6.35mm) shaft which goes through the 76mm former via bushes scrounged from old potentiometers. One of these bushes can be seen on the side of the "regenaformer", nearest the front panel.

The rotating "tickler" coil former is clamped to the shaft to prevent any slippage and also includes a "stop" so that it cannot be rotated more than about 180°.

An important requirement for the "tickler" coil is that its leads must be capable of flexing many thousands of times before breaking. This rules out the use of single-strand wire and even multicore hook-up wire (single-core wire will fatigue and break after only a few bends).

As it turns out, the most suitable cable that's able to withstand repeated flexing is the "tinselled-wire" used in old headphones. In fact, most old headphones still have their original leads and these could be used for the job.

A practical alternative is to use a multi-strand braid cable or any thin cable that has many strands of very fine wire. Jim used copper braid for his set and this has proven to be successful.

The valves

The original Browning-Drake receivers used 201A valves and Jim decided to stick as closely as possible to the original design. The valves were around $A50 each and were obtained from the USA, as was the square section wire and the audio transformer inserts. The HRSA article also suggested a variety of alternative valves that could be used in a replica – eg, the 30 and the A609.

On first seeing the set, I immediately noticed the RF stage neutralising capacitor which had come out of an ex-service VHF transceiver. It was ideal for the job, even if made 20 years later than the original Browning-Drake receivers.

Jim also had some filament rheostats, a high-impedance Philips loudspeaker from the 1930s and some old audio transformers that would suit the set. Unfortunately though, the audio transformers had open circuit windings and so a couple of 1:3 step-up ratio transformers were imported and fitted into the old cases. The tuning capacitors were also in Jim's junkbox and so the set slowly came together over a period of several months.

Circuit details

Fig.1 shows the circuit details of the Browning-Drake receiver. It's a 4-stage TRF design using all 201A valves, the first stage functioning as a neutralised triode RF amplifier.

The antenna coil (L1) is tapped part way up the antenna coil and the antenna circuit is tuned by C2, after which the signal is fed to the grid of

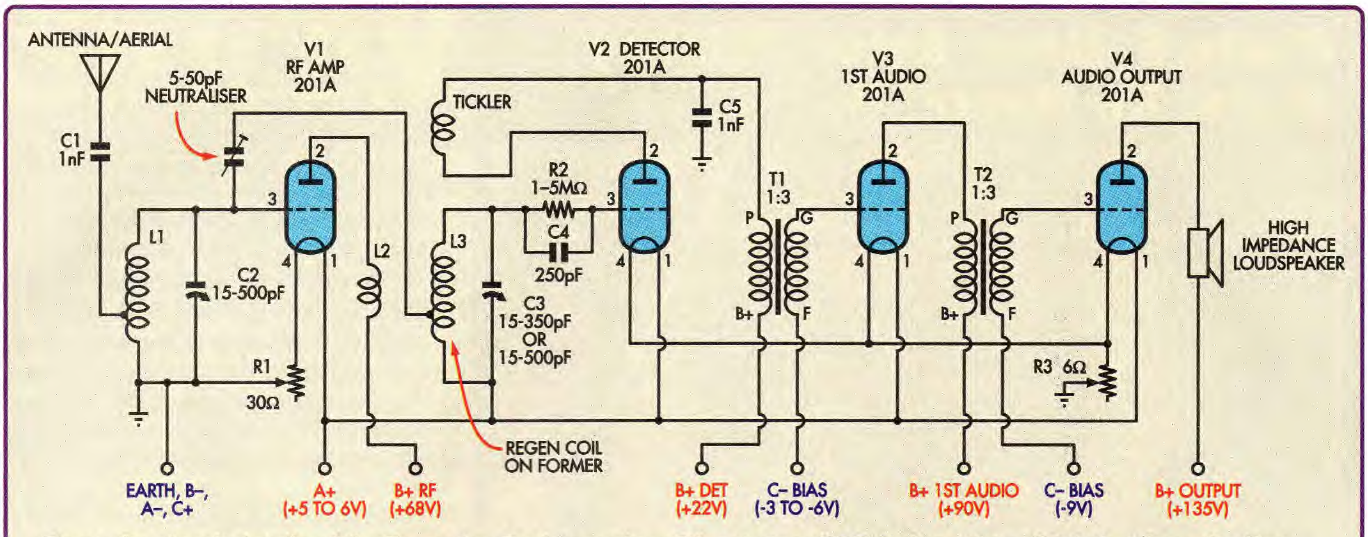


Fig.1: the circuit details of the Browning-Drake receiver. It's a 4-stage TRF design using all 201A valves, the first stage functioning as a neutralised triode RF amplifier.

V1. The resulting signal in V1's plate circuit is then inductively coupled from L2 (primary) to L3 (the tuned secondary winding). The phasing of the primary and secondary is such that the 5-50pF "neutraliser" capacitor feeds back a signal to the grid that is out of phase with the tuned antenna signal.

In practice, the "neutraliser" is adjusted to apply enough signal of opposite phase to cancel the grid-to-plate capacitance of the valve. This is most important if any worthwhile signal amplification is to be achieved in the RF stage.

V2 is a grid leak regenerative detector. The regeneration is controlled by rotating the "tickler" coil within the "regenaformer" until the set oscillates (whistles on any station tuned), then backing off for best performance. The two terminals of the "tickler" may need to be swapped over to obtain regenerative performance.

The output of V2 is then applied to a 1:3 step-up audio transformer and is then fed to V3. V3's output is in turn coupled to V4 via another 1:3 step-up transformer. As can be seen in the photos, the audio transformers are orientated so that there is minimal mutual inductance between them (this is necessary even though they are in metal cases).

The maximum gain of each audio stage will be the normal valve gain

This rear view of set shows the antenna earth and power supply terminals. Note the power socket which allows an external supply to be connected.

Photo Gallery: Astor "Mickey" Model KL Mantel Radio

Radio Corporation, Melbourne, used the name "Mickey" for almost 20 years on some their Astor mantel receivers from the late 1930s until the mid-1950s. The model KL was introduced in 1946 and used the following valves: 6A8-G frequency changer; 6B8-G reflexed IF amplifier/audio detector/audio amplifier/detector/AGC rectifier; 6V6-GT audio output; and 5Y3-GT rectifier. Later versions used a 6X5-GT rectifier.

A feature of the design was the rather elaborate tone compensation circuitry connected around a tap on the volume control and the loudspeaker voice coil. This resulted in quite good sound from the 5-inch loudspeaker, despite the relatively small Bakelite cabinet.

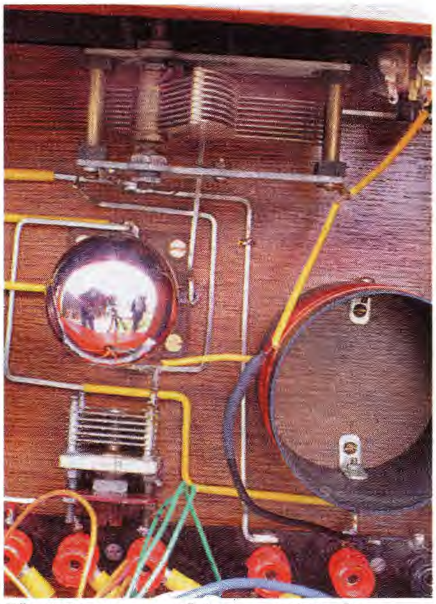
The KL was available in nine different cabinet colours: walnut, green, blue, champagne, ivory, Chinese red, mahogany, marble champagne and marble ivory. The set illustrated is the less common (today) champagne colour. (Photo: Historical Radio Society of Australia, Inc).

(<8) multiplied by the step-up ratio of the audio transformer (3) – ie, about 8 x 3 =24. This means that two stages will theoretically give an audio gain of 24 x 24 = 576 times. This won't be reached in practice but a healthy 400+ gain is likely.

Alignment and operation

In reality, there is very little alignment and setting up of the set – certainly a lot less than described in the articles I wrote in November 2002, December 2002 and January 2003.

First, the set is connected to a substantial aerial/antenna and earth system and the power applied. That done, you tune to a strong station somewhere near the centre of the dial, peak both tuning controls, then adjust the regeneration control until the set whistles. If it doesn't whistle and advancing the control reduces the audio output, it is likely that the two wires on the "tickler" winding have to be reversed.



The RF stage and its associated neutralising capacitor are shown in this photo. (Note reflection of photographer on the top of the valve).

Having tuned to the strongest station and peaked the controls, it is time to neutralise the set. However, if the set whistles and screams when the two tuning controls are being brought to a peak, it is likely that the neutralisation is well out of adjustment and the RF stage is going into self-oscillation. If this is the case, you leave the peaking just below the point where the oscillation occurs. Winding back V1's filament voltage (using filament rheostat R1) reduces the gain of this stage and this also helps to stabilise the set.

The next step is to remove the filament supply to V1 so that it is inoperative. However, the station that was being received may still be just audible in the loudspeaker but you will have to use headphones if the stations are not strong in your area.

Now, while listening to the station with the RF stage disabled, you adjust the "neutraliser" for minimum output or, if you are lucky, no sign of the previously tuned station. The set is then neutralised and should now be stable under all circumstances.

It's then just a matter of reconnecting V1's filament supply, after which you should be able to tune and peak the set for best performance. Adjusting the two filament rheostats makes this job just that little bit easier and they do act as volume controls.

Summary

Replica sets are an interesting part of the vintage radio hobby. In many cases, a replica is the only way that collector can obtain a particular 1920s receiver.

The performance of these sets is not something to write home about though and they need a substantial antenna and earth system to perform at their best.

Finally, over the last 80 years or so, the names of some components and circuit configurations have changed. There are three such names that stand out in the Browning-Drake receiver: (1) the "neutraliser" which is now commonly called the neutralisation control; (2) the "tickler" which is now commonly called the feedback or regeneration control; and (3) the "regenaformer" which is now known as a regenerative detector coil or Reinartz coil. **SC**