1920's Browning Drake receiver.

Discoveries at a GARC auction.

Some will remember the ancient radio at the recent GARC auction. I must have got excited; as if I needed another distraction! Naturally I ended up with it.

In my enthusiasm to get it going I overlooked the need to take "Before" photographs of a more general nature, the ones I have were specifically so I could get it back together after pulling it apart for restoration.

In this Photograph I have already initially repaired the aerial tuning capacitor. I have also sat an AF transformer on the board in view on the left hand side to replace the missing units.

Clean up and restoration.

Initially a rough cleanup followed by a rough tracing of the circuit and wiring enabled me to safely proceed without risk of losing parts or information that may be destroyed by a more thorough clean. It turned out that a Grid leak resistor was stuck to one of the tuning capacitors with mud and could have easily ended up in the vacuum cleaner.

The next stage was to sketch out a schematic, take photographs and do a placement drawing with notes on any parts that were not obvious as to where they went back. After this the entire radio was stripped to component parts. This process was continued on a piece by piece basis through the valve sockets, dials, tuning capacitors and rheostats. Most parts were cleaned in an ultrasonic cleaner before being repaired and re assembled. Nickel plated

screws were carefully scraped under a smear of oil and then buffed with 000 steel wool. All traces of steel wool were carefully removed after this operation, and items were rubbed over with light oil.

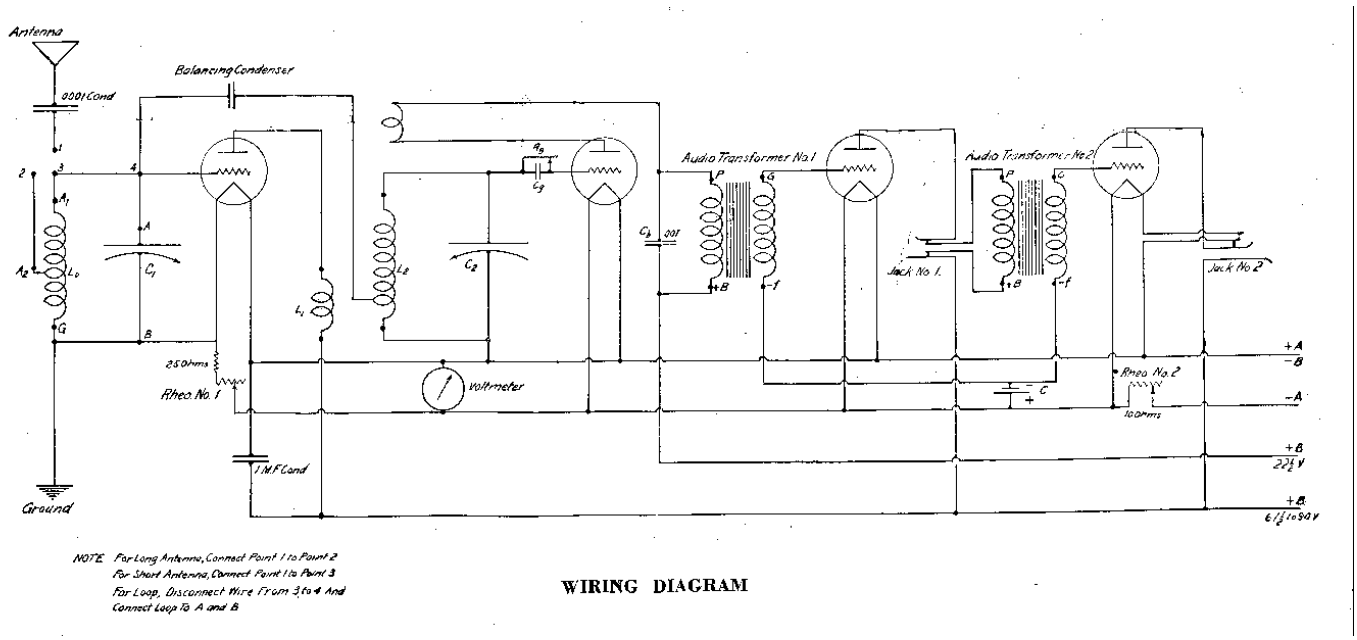
The dial scales were both heavily stained and I decided to carefully scan and have new ones printed. As I kept the original celluloid window, and while the markings are not perfect, the result still looks authentic. An alternative option would have been to reproduce new scales with “GALVA”. As the originals came up well I decided against this. I have also kept the original scales.

The biggest single challenge was one of the tuning capacitors. The set had been dumped in a shed with the capacitors in an open position that made them vulnerable to damage. In this set one had been bent over nearly at right angles and I didn’t hold much hope for recovering it. Fortunately the old aluminium was very soft and flexible and had not actually fractured or torn away and I miraculously managed to very carefully straighten it out whilst keeping it warm to reduce the risk of fracturing. This was done before most of the cleaning took place.

The panel and base plate were badly warped. To straighten them, I heated them to a point where they became rubbery, then clamped them down on a rubber sheet under a sheet of plywood and allowed them to cool. This left the panels flat but with a patchy greenish tinge. I think this was where they were exposed to UV light as there were shadows and areas that were not affected. The solution was to rub them back with emery paper and eventually finish up with “Ajax” powder cleaner.

Identification.

“Google to the rescue” The circuit was for a neutralised triode RF amplifier followed by a regenerative detector and two stages of AF amplification; a fairly common arrangement in the mid 1920’s. As there are several ways of achieving neutralisation it was simply a matter of looking at various circuits from this vintage. It turns out that this radio is based on the early version of the Browning Drake receiver designed at Harvard University USA when Mr F.H. Drake conducted experiments based on a mathematical model of a RF amplifier. The results were first published in “The Christian Science Monitor” in a series of articles starting on June 13 1924 after one year of development and design work. I suspect that a proper paper would have been published but I have not looked for it. The primary claim for this radio is the coupling / matching between the RF and detector stages. Browning and Drake organised manufacture of the special coupling unit they named a “Regenaformer” along with matching capacitors and dials this work was undertaken by the National Company. This was the first venture into radio parts for this toy and small parts factory. They obviously liked this field, as around 10 years later they started production of what is probably the most famous communications receiver ever made, the National HRO.



NOTE For Long Antenna, Connect Point 1 to Point 2
For Short Antenna, Connect Point 1 to Point 3
For Loop, Disconnect Wire From 3 to 4 And
Connect Loop To A and B

WIRING DIAGRAM

My radio has coils of very similar design, but probably made locally. There are advertisements for "Browning Drake" coil sets from local manufacturers in Australian radio publications however I have not found anything that matches the coils in my set. The "Regenaformer" in my set conformed roughly to the original Browning Drake design having around 350uH of inductance. This gives a tuning range down to 400 KHz. Unfortunately with a minimum capacitance of 26pF plus strays all adding up to a total of around 45pF the upper limit was around 1270 KHz.

Missing parts.

The radio was missing several parts when I purchased it. The two audio coupling transformers were missing, as were two knobs and a terminal screw from the battery connection panel at the rear. Also missing was a filament switch and a mystery component. Fortunately a quick scratch around in my junk box revealed two suitable working transformers and two of the three exact knobs. The third knob was for one of the rheostats so I had another one for comparison. It turned out that I had the matching knob from the same manufacturer in Sydney but a different part number. The difference was the knob I needed has a 5/32 Whitworth thread for the shaft and the one I had was a conventional ¼" shaft. The solution was obvious, I turned up an adapter and the problem was resolved. The final mystery is the missing component on the bottom row. For now this is not resolved. I have fitted a volume control, but this is not the original application for this hole.

Choice of valves.

As acquired the set did not have any valves. The sockets fitted were for the American four pin UX (Long pin) valves. These were available in Australia in many forms so it is impossible to know what was originally fitted. Initially I used some type-30 triodes (2V filament) that I have. These were not around until the late 1930's, possibly the A409, A415 or B409 may have been used. These 4V valves were available with two different 4 pin bases and popular in Australia. The recommended valves in the original article were the (2)99 3V triode with a low Grid Plate capacitance for the RF amplifier, followed by (2)01A 5V triodes in the preceding stages. The use of a valve with low G/P capacitance for the RF amplifier will help stability and ease neutralising.

Getting it going or should it be Display only.

The initial challenge was to decide what I wanted to do with it, I almost always want to get an old radio going. This is something that you really need to consider with anything very old and valuable or rare. The act of replacing parts often devalues old equipment as it is no longer original. As this was obviously home constructed or perhaps put together by a local wireless shop from a kit or in any case commercially made parts I decided that it was acceptable to get it back in working condition. I decided that it was to be clean and functional without looking like it had just been made as a replica.

I was mostly successful in this aim. Unfortunately I had to replace all the old tinned copper wire as the joints were cracking between the tin and copper. I had two old interstage audio transformers that were about the correct size. As It turns out, there were already holes in the baseboard that matched the new transformer mounting holes. I suspect that one of the originals had failed and been replaced. Possibly both had failed later and this would have been the end of the wireless set.

These transformers were prone to failure due to electrolysis. The fact that high voltage was almost always left on and bias voltage definitely was. Combined with paper and organic insulation and very fine wire together with the manufacturing capabilities of the time and failures were bound to happen. Even today with better materials this is still a problem in electronic devices.

Performance and limitations.

Although the radio has picked up around 30 individual stations including VK1, 2, 4, 5 and 7 from my home with a long wire around the fence, the selectivity is often lacking. The RF stage can easily go in to oscillation depending on how the set is adjusted. This can sometimes be used to advantage to improve the selectivity provided it is held just short of this point. I suspect that this issue is made worse by the fact that the two coils are not exactly in line. This

will allow some mutual coupling between them. Another problem is how the coil and tuning capacitor are connected together. The original article refers to this problem with the line “And several interesting facts brought out which will not be considered here.”The issue involves current in the tuned circuit flowing in wiring on the filament circuit. This produces unwanted coupling between stages causing instability that cannot be corrected with neutralisation. The “National kitset” has coil capacitor units with terminals arranged so as to eliminate this problem. I suspect that it was a commercial advantage to say that the “Official” sets gave better performance, without disclosing why. Another issue nowadays is that the tuning range is still limited to 1370 KHz after my coil modifications and there are many stations above this frequency that cannot be tuned, I did however receive an NDB before removing turns from the main coil. This tuning range was probably an issue when the set was first built, ironically in Australia this extended to both ends of the dial. The sound quality is “ordinary” at best with high distortion and restricted bandwidth. This is made even worse when I use a horn speaker that I have. As this type of speaker is likely to have been used with this set originally this is what it should be compared with.

How to “Drive” it.

The process of putting the radio in operation is rather complicated and requires a level of skill and perseverance, especially if you want to receive more than a few local stations.

Firstly the batteries have to be connected. The “A” (Filament) battery is fitted first, being careful to ensure it is connected to the filament circuit. The other batteries will instantly blow all the valves filaments if they are connected to the filament circuit. Next come the “C” (Grid bias) batteries, and finally the “B” high tension batteries with multiple taps to 135V. The filaments should be switched off to minimise the risk of electric shock during this procedure.

Now we have a dilemma: To work properly, the RF stage has to be neutralised. But to do so requires the set to be working. I will describe this operation after describing how to use the set. Initially, the neutralisation control is set to somewhere near its middle and the RF rheostat backed off to maintain stability until neutralisation can be adjusted correctly.

After the speaker and aerial are connected and the filament switch turned on the rheostats are adjusted to give the correct brightness of the filaments. The regeneration or tickler coil as it is usually called is then adjusted until the set goes in to oscillation, then both tuning knobs are moved until a whistle is heard. At this point, the aerial tuning is adjusted until the whistle is loudest, and then the tickler is backed off until the station is heard clearly. Now both tuning controls can be retuned followed again by a slight adjustment of the tickler whilst also adjusting the RF filament rheostat. This often alters the regeneration so the tickler will have to be adjusted again.

Neutralization

To neutralise or “balance” the RF stage, a strong station must be found, preferably in the middle of the band and tune in carefully with both tuning capacitors for maximum signal. At this point the RF rheostat is turned off to disable the RF stage and the tickler coil adjusted for best received signal. Carefully adjust the neutralisation control for minimum signal and the job is done. If the initial setting was a long way out it is advisable to repeat the process.

Modifications.

I have replaced a power switch that was missing with a switch that probably dates to the 1930’s. I also decided to remove some turns from the main tuning coil to enable the set to tune up to 1370KHz. There was a missing control on the bottom row of holes on the front panel in which I have fitted a volume control. I was unable to determine its original function.

History of the Broadcast band in Australia and the USA.

The tuning range of the receiver was very limited at the high frequency end, and this caused me to look in to the history of the broadcast band. There is a lot of information on the web relating to this. Many articles contradict one another, and I have not bothered to go looking for original material. Instead I have tried to put together what I

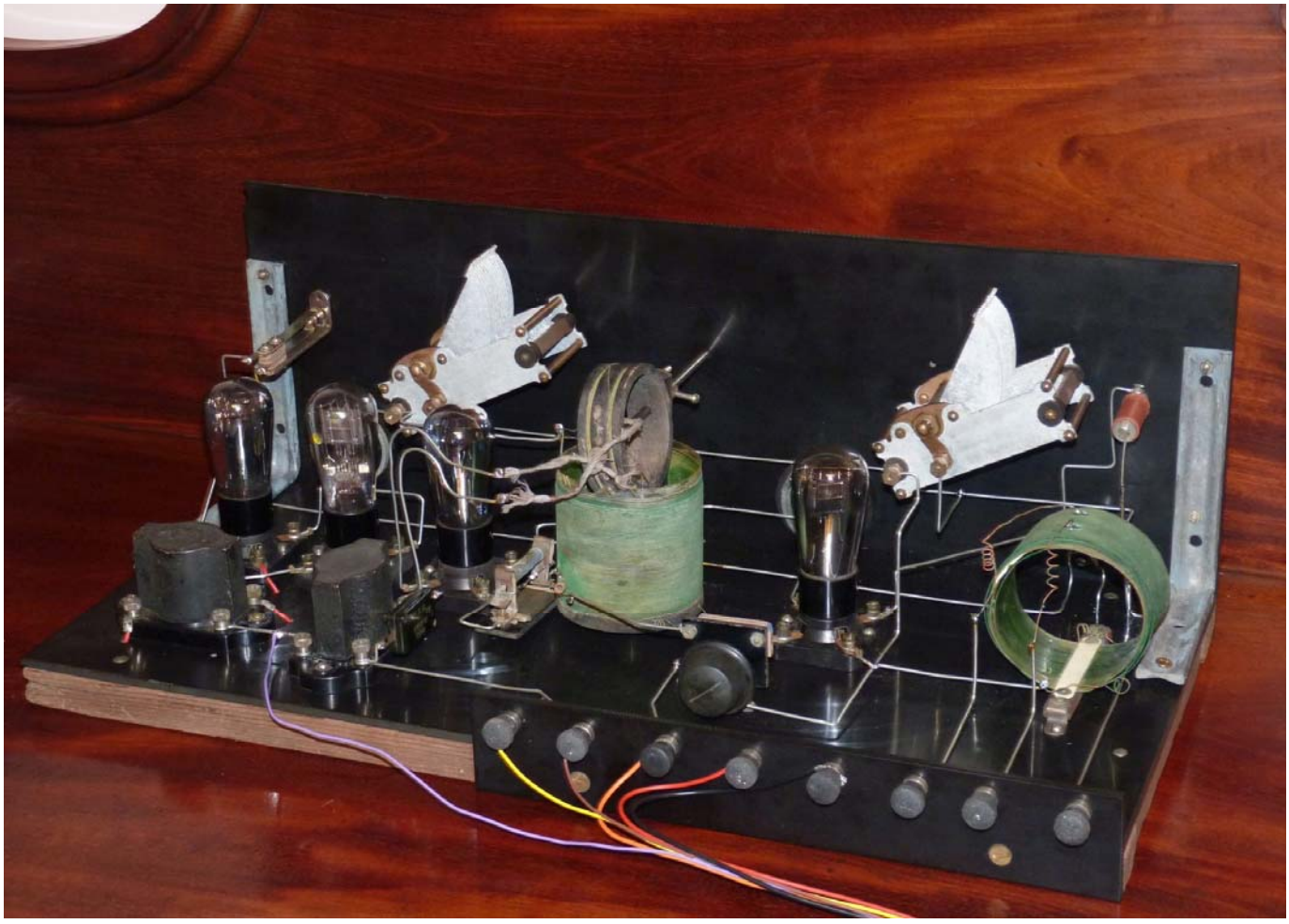
hope is representative from the more reputable on line sources, but it may not be totally correct. **Take care, do not quote!**

The situation was very dynamic in the USA before the end of 1927. It appears that very few broadcasters operated above 300m or 1000KCPS and the broadcast band stopped at 222m, 1350KCPS.

At this time, and indeed into the 1930's wavelength was used rather than frequency. Frequency was used by regulators from around 1923.and eventually this filtered through to mainstream use. Frequency was given in Cycles Per second. The Hertz as a unit of frequency was not adopted until around 1960.

In Australia from the very early 1920's there were limited entertainment transmissions by amateurs, some of which were on a well scheduled program and popular with audiences. One of the most famous was Charles Maclurcan 2CM who transmitted regular scheduled transmissions from Strathfield Sydney. Included among these were Sunday night concerts of recorded music that demonstrated his fine programme sense. There were also demonstration transmissions by AWA. The first was to the Industrial Section of the Royal Society of NSW on 13 August 1919. Further demonstrations followed including to journalists at The Argus newspaper office in Melbourne and Federal Parliament at the request of Prime Minister, W.M. Hughes on Wednesday 13th October 1920. To help the public keep track of all this activity a publication Wireless Weekly, the first regular radio journal in the Sothern Hemisphere was launched by an amateur William Maclardy in August 1922. The Wireless Institute was also busy, they organised Australia's first radio exhibition in the Congressional Hall, Pitt Street Sydney on 22-23 September 1922. Officially broadcasting in Australia began with a "sealed set" policy on 5 August 1923. This scheme involved an approved set that was tuned to your station of choice and then sealed so you could not alter the tuning. The post office collected annual fees and passed on some of the money to the broadcaster to which your set was tuned to. The popularity of this scheme was such that in the whole of Australia there were only 1400 licences issued. On 11 July 1924 this concept was finally abandoned in favour of "Open Sets"

Initially, some stations were on "long wave" 3LO for example was on 1720m (174 KHz) when it first went on air on 13 October 1924. In July 1925 it moved to 371m (808 KHz). 6WF in Perth was still on 1250m (240 KHz) until 2 September 1929 when it moved to 435m (690 KHz). The Australian broadcast band was set down as 200m to 550m fairly early on. I have not determined what frequencies were in use at what time but the highest was 3AK on 200m (1500 KHz) and commenced broadcasting on 29 November 1931 long after the set described above became obsolete. 3AK's licence conditions were very restricted and it was noted that many receivers would not tune that high and it also shared the band with Amateurs. Of interest in Geelong, 3GL commenced broadcasting on 3 December 1930.



Images used in this note are from a variety of web sites, and scans from magazines and personal photographs.

David Learmonth VK3QM 2014