VINTAGE RADIO

By RODNEY CHAMPNESS, VK3UG

The Radio Corporation WS122

In May 2002, the AWA FS6 army transceiver was described. This month we cover another military transceiver, the WS122. This was a much more portable set, requiring only three men to carry it!

The WS122 as a type or model number will mean nothing to many readers, while others will become dewy-eyed dreaming of their beloved WS122 that they used many years ago. Commonly the "WS" was dropped off the type number; it simply stood for "Wireless Set".

The 122 is one of several different portable high frequency (HF) radio transceivers used during World War II by the Australian Army. As mentioned above, in May 2002 I described the AWA FS6, a popular HF transceiver from the same period. After reading this article you will see that these two transceivers are as different as chalk and cheese.

The WS122 (Aust) was the final unit in a series of sets which had their start in the British-designed 22 set. Radio Corporation (Eclipse Radio Pty Ltd) was charged with the job of building an Australianised version of the English 22.

Their first attempt was something like the British 22 and probably not much different in performance or facilities.

They then built the "Yellow Band"

Not exactly a thing of beauty, this WS122 war-time military transceiver was still being widely used in Victorian rural fire services until the 1980s. Its transmitter output valve is an 807.

This photo shows the WS122 ready for service with power supply and ancillaries hooked-up. The protective grille at the front made it difficult to operate and most users discarded these.

22 (Aust). It had an Australianised circuit using American and Australian designed valves and while still a grid-modulated transmitter, it used only one 807 valve in the transmitter output section. I doubt that this was a particularly common set. I've never seen one anyway.

However, Radio Corporation felt that they could do better. Their design engineers really got the bit between their teeth and came up with the 22 (Aust) set. This was soon partnered by the 122 (Aust) set which was identical except that it had provision for crystal control as well as variable frequency control (VFO) of the transmitter operating frequency.

The 122 remained in service until the mid 1950s when it was progressively replaced by the No 62 set.

Early interest

In my mid teens, I became interested in radio communications and was itching to be able to use radio transmitters and receivers.

My chance came in 1957 when I became involved with the local Emergency Fire Service (EFS) in country South Australia. I was given a much-modified Type A MkIII transceiver (described in the October 1998 issue) to use at fires for communications back to base in a nearby town.

I ultimately built my own transceiver, based on designs in "Radio & Hobbies". It worked well but it could not be licensed for fire brigade radio communications. However, it was acceptable for amateur radio use.

I moved to rural Victoria in 1961 and joined the local Country Fire Authority (CFA) radio communications network.

A couple of radio friends leant rather heavily on me to get a 122 – "the best transceiver since sliced bread, just what you need". I was far from convinced, as looking inside their sets and looking at the circuit diagram was enough to give me the horrors. How would I find my way around the insides of the set and understand the circuit?

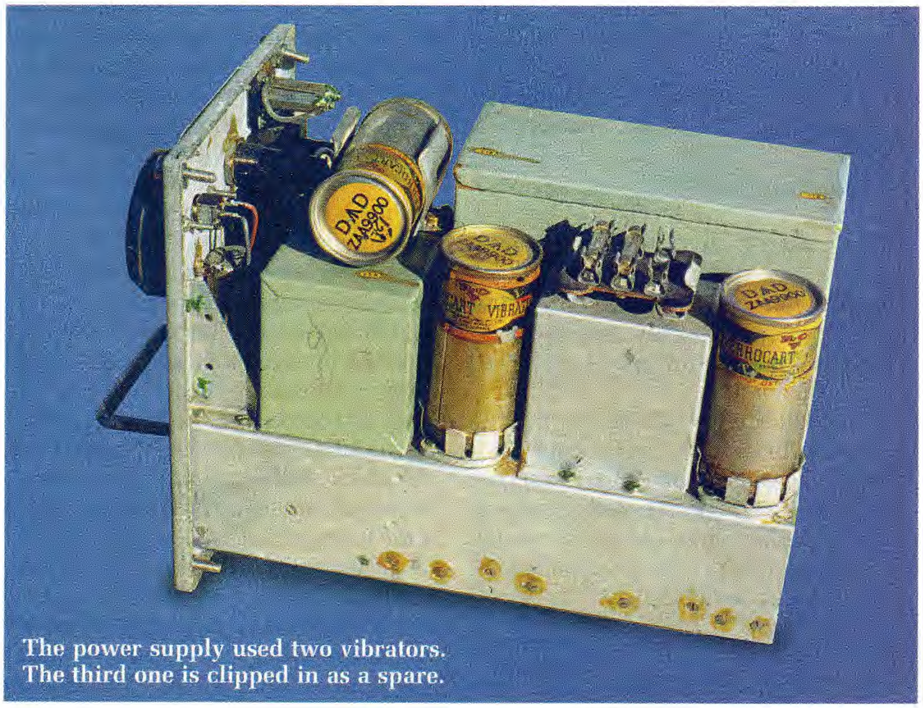
I was, to say the least, scared of such complex (to me) military equipment. No doubt new collectors feel much the same as I did at that stage. Fortunately, I gradually overcame that fear.

Anyway, they succeeded in convincing me to part with some hard-earned cash and I bought a 122. I set the transceiver up in my vehicle as one of the local licensed mobile stations for the CFA on a frequency of 2692kHz.

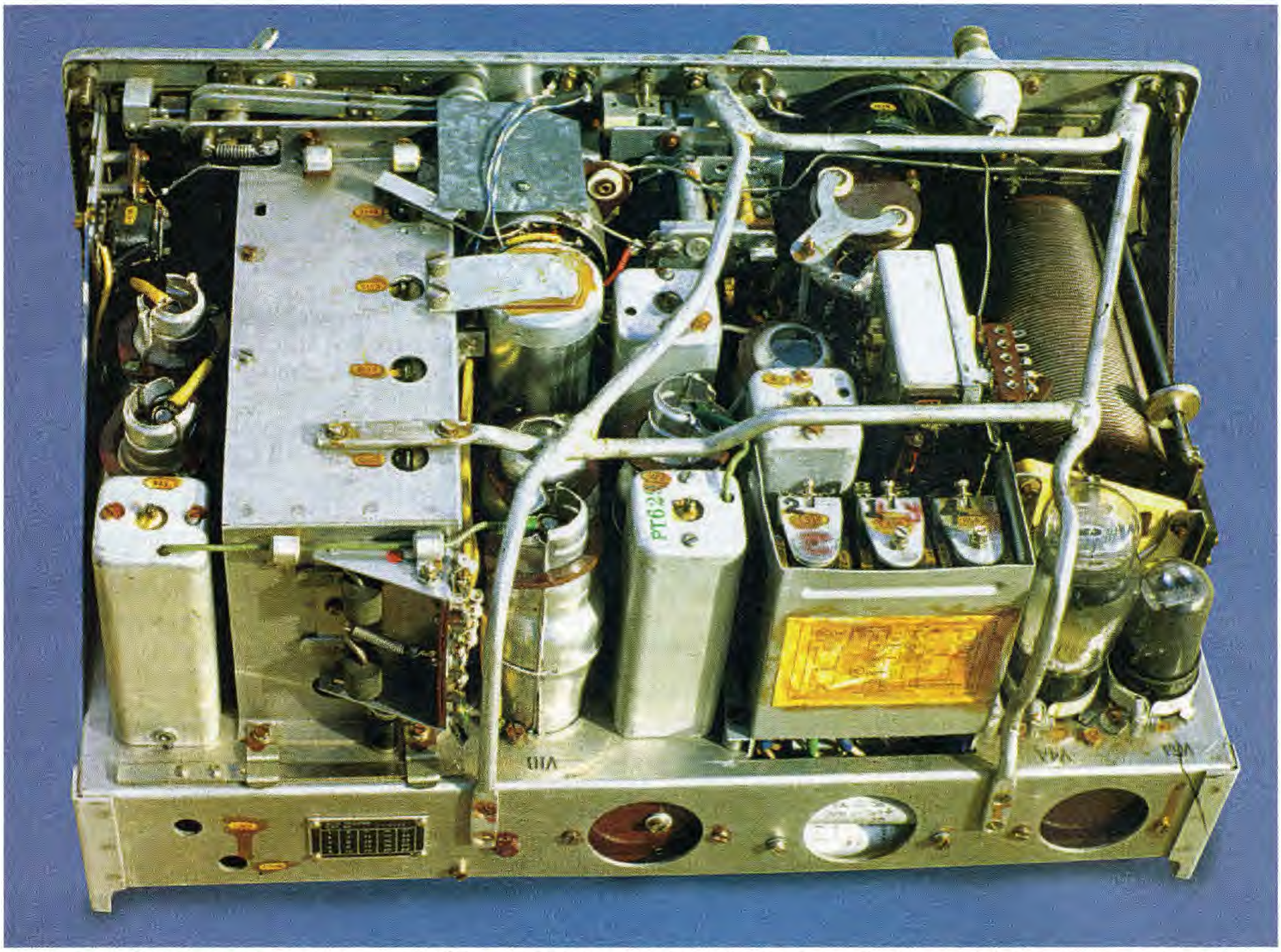
I took it out to show my friends and they immediately commenced the "modification" process to get it to look like all the other 122 transceivers used in the various CFA networks. So if the set which is the subject of this article doesn't look quite original, you'll understand why.

These sets proved very popular in the HF fire brigade networks. They were not expensive to buy, they worked well after a routine service and they could be licensed without any modifications to the electronics. The owners and operators became rather fond of these big, bulky, complex and complicated-to-operate sets.

They were also popular with amateur radio operators who used them as mobile and portable transceivers during the late 50s and into the 60s.



The power supply used two vibrators. The third one is clipped in as a spare.



Rear view of the transceiver chassis, out of its case. Note roller inductor tuning coil at the right of photograph. Crystals are mounted near the back at the lefthand end of the chassis.

They were finally retired from service in the 1980s. What a phenomenal run, from the early 40s to the 80s!

Originally, the 122 came into use around 1942 as an army portable HF transceiver operating between 2MHz and 8MHz. It operates from a 12V battery and can be used as a ground station, vehicle station or a man-pack station.

As a man-pack station, it was carried by three men, one carrying the transceiver, one the ancillary parts like the power supply, headphones, aerial wire, etc and one the 12V 20 amp-hour battery.

The transceiver cabinet top side is designed like an "A" frame back-pack (as can be seen in one photograph) to make carrying the set easier (or perhaps less difficult!). The load was distributed so that no man carried more than 35 pounds (16kg). The set itself weighs 15kg.

The set could also be fitted with immersion covers to stop water getting into the set when amphibious landings were required. However, this was really a "belts and braces" approach as the set was already well sealed against ingress of moisture.

All the rotating controls have rubber seals around the shafts, the toggle switches have rubber boots (these have all perished on my set and have been removed) and the edges of the cabinet and transceiver front have rubber seals too. The phone type jacks each have a spring-loaded cover with a rubber gasket. This is held against the jack opening to prevent water getting into the set via this route.

If this wasn't enough, the cabinet has a Silica Gel capsule screwed into the back of the cabinet. This can be screwed out for replacement from time to time. So the set was extremely well protected against ingress of water.

50 years on, the seals are largely ineffective due to the rubber perishing. And while rubber was used in some areas, the actual wiring is in plastic coated hook-up wire - quite an innovation for the time. This is probably the best protected set I've come across of its era. Many of the components were/are coated in "tropicalising gunk".

The set has an aluminium chassis and the protection bars and other bits and pieces are Duralumin.

As can be seen from the photographs, the transceiver is very complex, with lots of components in and on the chassis. The valves are held in position by clamps to ensure that they do not come out of their sockets due to rough handling.

The power supply is equipped with a spare vibrator and three fuses. The set itself has a relay-adjusting tool in a holder on the back of the chassis; all very handy.

There are two sets (red and blue) of mechanical preset tuning adjustments that can be adjusted to allow rapid selection of two frequencies. The ad-

Under chassis view showing the shielded RF section compartment and the crowded wiring.

justments are similar in concept to the pushbutton tuning on older car radios. These are locked with the screwdriver located on the top right of the front panel.

With the front protection grille in place, the set is not easy to operate but quite OK once it is removed. Most of us just threw these grilles away.

Certainly it is far from an easy set to service. Some parts are extremely difficult to gain access to. However, considering the amount of parts there are, the set is quite reasonable to work on, provided you're not in too much of a hurry to get the job done.

Receiver valve line-up

The receiver uses a total of seven 2V battery valves, with a 1D5GP radio frequency (RF) amplifier, followed by a 1C7G as a mixer. The intermediate frequency (IF) stages use a further two 1D5GP valves while a 1H6G functions as detector and delayed automatic gain control (AGC). Note that the triode section of the 1H6G isn't used in the receiver – only in the transmitter.

The audio stage is an 1F5G audio output type valve and in the receiver it only feeds two pairs of headphones. (The 1F5G has sufficient gain and output to feed a speaker in a modified set.)

In Morse code (CW) mode, the beat frequency oscillator (BFO) is another 1H6G valve.

The receiver is designed to receive AM, MCW and CW transmissions which it does quite competently. With careful tuning and attention to the radio frequency gain, the receiver can also adequately tune single sideband transmissions.

One attribute it has which is not common on portable military equipment is a meter measuring the effect of the AGC voltage in controlling the gain of the RF and IF sections of the receiver. This is very handy for determining the relative strength of received signals.

In amateur radio, this feature is usually called an "S-Meter" which equates to "signal strength meter". Its reading is useful in aligning the receiver and transmitter circuits.

Transmitter valve complement

The transmitter has two RF stages. The VFO and crystal oscillator is a 6U7G (V5A). This stage drives the output valve which is an 807 (V7A) small transmitting tetrode.

The FS6 described in May 2002 uses grid modulation but the 122 uses the much more efficient plate and screen modulation method.

The modulator is much more elaborate than that used in the FS6. The 1D5GP used as the 2nd IF amplifier is also used as the first audio amplifier in the transmitter, followed by the triode section of the 1H6G (receiver detector/AGC).

The next stage is the receiver audio output stage and modulator driver (1F5G). This drives the modulator valve which is a 6N7 run as a push-pull class-B stage.

To my knowledge, the 22 (Aust) and the 122 (Aust) were the only portable, mobile, man-pack military transceivers that used such a sophisticated (for that time) modulation system, except for the ATR4.

The transmitter has three modes of operation: voice (radio telephony - RT, AM); Morse (CW) and Modulated Continuous Wave (MCW).

On voice, a press-to-talk button on the microphone is used to change over from receive to transmit.

The microphone has a dynamic insert which explains why so many audio stages are necessary to achieve full modulation; a carbon microphone has greater output but poorer audio quality. In addition, the quality of the audio being transmitted can be monitored through the headphones.

On CW, the Morse key is depressed and the unit changes over automatically to transmit. It has what is called "semi-break-in" keying.

A tone (sidetone) in synchronism

Photo Gallery: STC Model 5017A

A product of STC (Sydney), the model 5017A uses the same chassis as the STC 5017 but is housed in an alternative cabinet style. This example is from 1936. This set covers the medium wave band and uses the following valves: 6A7 frequency changer; 6D6 IF amplifier; 6B7 first audio/detector/AVC amplifier; 42 output and 80 rectifier.

with the Morse key is heard in the headphones. This sidetone makes it so much easier to check the quality of the signal. The modulator is inactive in this mode.

MCW is the same as for CW, except that the modulator is operating and a tone is transmitted in synchronism with the operation of the Morse key.

Vibrator power supplies

The power supply is really two supplies, both based on vibrators. One supply is used to provide the HT (150V) for the receiver.

On low power transmit, the same supply is used and it is switched to provide 180V to the transmitting valves. On high power transmit, the two vibrator power supplies are connected in series to provide 250 to 260V on MCW and voice and 320 to 360V on CW. It is well-filtered which reduces vibrator hash to a very low level.

General Overhaul

As mentioned earlier, my 122 had been modified to suit work on the Country Fire Authority radio networks. Some of the modifications could be easily reversed but some had to be left "as is", hence the non authentic look of the set in places.

Generally, the components in the sets have been quite reliable and very few needed replacement. If you are going to work on one of these sets it is imperative to obtain a handbook, as the sets are very complex (for their time) and difficult to work on.

In the back of the transceiver case is a circuit diagram of the set and in the power supply is a copy of its circuit. These are better than nothing but are hard to follow.

I replaced a few paper capacitors in the audio sections. On transmit, I found I could tune the transmitter up and obtain good output but then the output would just die away. The plate current of the 807 was dropping but the HT voltage was remaining constant.

The problem was that the 807 had lost its emission and a replacement soon fixed that. I suppose that after 40-odd years it was entitled to be tired.

The 1D5GP receiver RF valve was also slightly weak and was replaced. The 1F5G valve seems to be the one most likely to require replacement from my experience. Every other valve has proved very reliable and long-lasting, despite being bumped around in a vehicle for many thousands of kilometres.

The "crash limiter" is a pair of diodes wired anode to cathode so that any voltage AC or DC above around 0.2V is clipped to that level. It can be switched across the headphone output and is designed to limit the effect of static crashes.

This it does but it also severely limits the audio output and distorts it. Radio amateurs thought it was useless and I didn't use it.

I wired another four diodes (1N4148) in the same way as the original diodes and put these in series with the existing ones. This improved the audio quality while still retaining the static reducing ability.

I decided that it would be a good idea to check the alignment of the transmitter and receiver circuits. I tackled the receiver first.

I found that the intermediate frequency (IF) alignment was peaked on 460kHz so it was left alone. That's close enough to the designed 455kHz anyway. The RF and oscillator sections are not so easy to get at, particularly for the 2 to 4MHz band.

The slugs are horizontal, going into the large below-chassis shielded enclosure and are well down in the chassis amongst a lot of components.

Great care is needed to avoid shorting anything. I couldn't even get a screwdriver onto them and had to use a pair of long-nosed pliers to laboriously rotate the slug cores; a bit of butchery but the only way of adjusting these coils. The 4 to 8 MHz cores are accessible for use with a screwdriver.

Surprisingly the adjustments were quite close, only requiring a touch-up.

The alignment of the transmitter involves making sure that the receiver and transmitter tuned circuits, particularly the respective oscillators, all track one another.

I won't go into all the procedure necessary to achieve this, suffice to say the alignment and adjustment details are straight-forward and unambiguous.

As some of the tuned circuits are common to both the receiver and the transmitter, it is necessary to make sure that the compensating networks within the equipment are adjusted correctly too, otherwise the transmitter and receiver do not operate on quite the same frequency under some circumstances.

Note that the transmitter variable frequency oscillator (VFO) (receiver equivalent is the local oscillator) runs at half the output frequency. This prevents the transmitter output getting back into the VFO (if it was on the same frequency) and causing instability.

On receive, I found the 122 would quite effectively detect CW signals down to around a microvolt – it's not as sensitive as modern day sets.

The transmitter came up very well. On low power the radio frequency output was around 3W. On high power AM and MCW, the output was around 7W and on CW, 13W.

The modulation waveform was not marvellous as observed on the oscilloscope but 100% modulation was quite easily obtained.

Summary

Many vintage radio buffs who collect military equipment, find this set very interesting and well worth having.

The 122, like virtually all military sets, will not win any beauty contests but then they were never intended to. It is a credit to Radio Corporation (Eclipse) that this set, old as it is, is still capable of doing work to the same standard as when it was made.

While its facilities and circuit techniques are now obsolete, it was a very advanced military transceiver in its day and it has a number of facilities that were not incorporated into amateur radio equipment until the 1960s. **SC**

Vintage radio feedback

As an old radio man who cut his teeth on valve radios, I always enjoy Rodney Champness' "Vintage Radio" feature. But Rodney, my un-met friend, something you said in the June 2002 issue is driving me bananas because I don't understand it.

In describing the Tasma M290 superhet radio, you point out that the local oscillator padder capacitor works best if placed where the Tasma M290 has it, in series with the oscillator tuning gang rather than in series with the earthy side of the oscillator coil.

What's the difference? In either case, the oscillatory circuit consists of the oscillator coil with two capacitors in series across it. Seeing that the oscillator is not "tickled" into activity by phase changes across the parallel resonant circuit (it has a separate tickler coil), what does it matter to circuit operation where the earth point is placed in the circuit? That's the only physical difference I can see, the effective placement of the earth point.

The only technical difference I can see is that the padder placement you call "best", in fact puts the dynamic Miller capacitance of the valve grid across the whole oscillator circuit instead of (with the other padder placement position) across just one of the series capacitors (the tuning gang). For circuit constancy, wouldn't it be better to put the padder capacitor in series with the earthy side of the oscillator coil to slightly improve the dynamic stability of the oscillator circuit?

Stan Hood,
Christchurch, NZ.

It is always good to get comment from readers and I appreciate Stan Hood of New Zealand for taking the time to do so. At the outset I certainly don't claim to be the font of all knowledge on vintage radio or design. These are my thoughts on why the local oscillator does work better when the padder capacitor is in series with the capacitor and not the earth end of the oscillator coil. One side of the original padders was earthed, therefore using them in the earthy end of the coil was convenient and it worked. When fixed padders became common most manufacturers carried on the convention. However, some put the padder in series with the tuning capacitor.

I used to wire all my receivers with the padder to earth just as "Radio & Hobbies" had done. I accepted is as "the" way to do it and never questioned it. However, I ran into trouble with a receiver that would drop out of oscillation on the low frequency end of the dial. All I did was to shift the padder to be in series with the tuning capacitor and the problem vanished. I've since done this modification to a few receivers and the results have all been favourable.

It may be remembered that 2A7s and 6A7s were prone to drop out of oscillation on the low frequency end of tuning ranges. This modification has cured any sets that I've had this problem with. It also seems to improve the sets' sensitivity.

I do believe that either the phase of the feedback is changed or the amount of feedback is reduced or maybe both. The effect may also vary depending whether the feedback winding is near the grid end of the tuned winding or near the so-called earthy end. Looking at the typical circuit redrawn, it does look like a cross between a Colpitts and a "tickler" feedback type circuit.

With the tuning capacitor fully meshed, the coil would appear to be "centre tapped". When tuned to the high end, the electronic tapping point has moved down near to the padder capacitor. With the padder in series with the tuning capacitor the coil always has the bottom of the coil referenced to earth and therefore the feedback would be more predictable.

All I can say it works better with the padder in series with the tuning gang.

Rodney Champness,
Mooroopna, Vic.