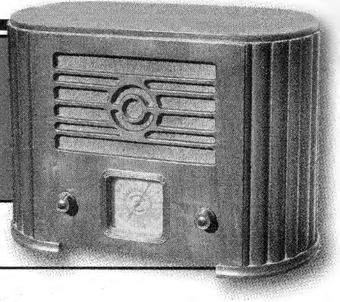


By RODNEY CHAMPNESS, VK3UG

Outback communications: the Flying Doctor radios

Radio communications played a vital role in bringing the Flying Doctor service to the outback. Here's how the outback radios were developed.

Back in 1912, the Reverend John Flynn became acutely aware of the needs of people living in outback Australia. The community facilities that we now take for granted in our cities – ie, good roads, rapid transport, good medical services, communications (including telephones), entertainment and supermarkets, etc – simply did not exist in the outback back then (and often still don't today).

Alfred Traeger posing with the first pedal radio in November 1928. This consisted of a 2-valve regenerative receiver using space charge tetrode valves (A141) and a 1-valve triode (B205) crystal-controlled Morse code (CW) transmitter. The transmitter operated with an output of 1-1.5W on a frequency of 2230kHz.

Admittedly, many of these facilities were rudimentary – and in some cases non-existent – in city areas in 1912. However, the people of the outback had none of these conveniences. How would we like to live in a world like that?

In reality, the infrastructure in outback Australia is quite poor and, given the sparse population, will remain that way.

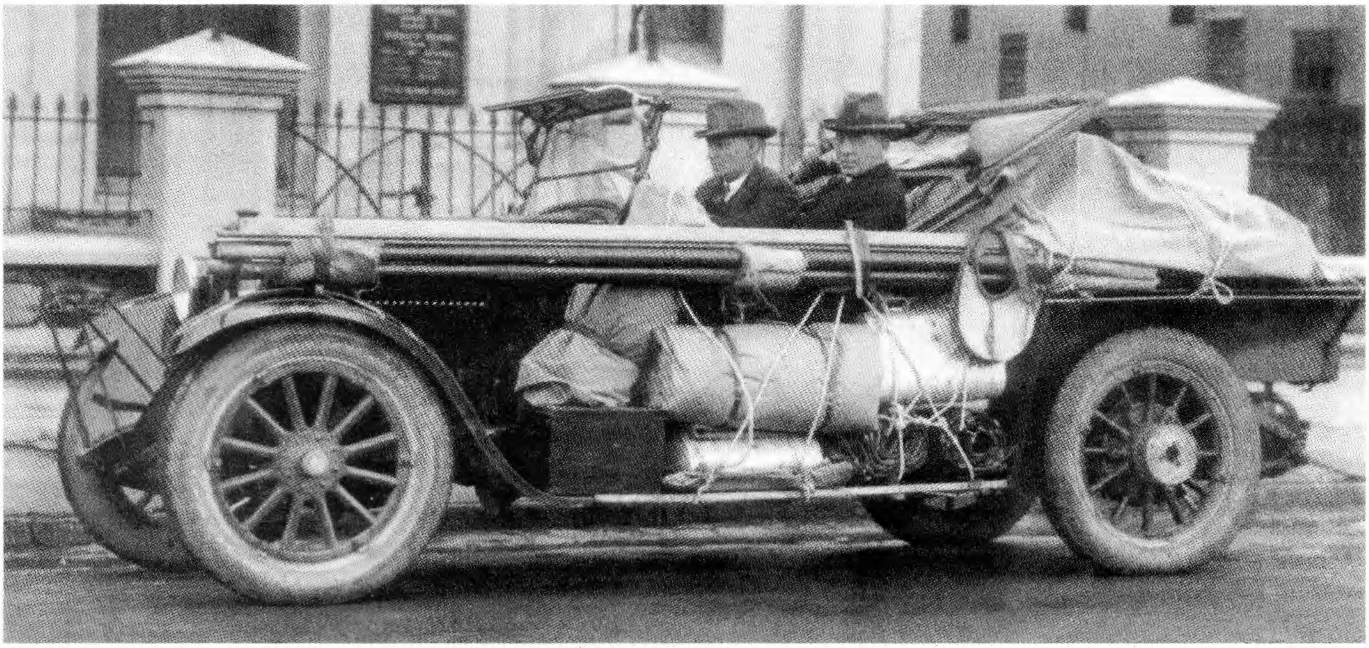
Flynn, through the Australian Inland Mission (AIM), an arm of the Presbyterian Church in Australia, began looking at ways to address the plight of people in isolated outback areas. In particular, he saw that people needed medical facilities (hospitals, doctors and nurses), the means to obtain speedy access to these facilities, and a means of calling promptly for this assistance.

The few medical centres that did exist at that time were thinly spread throughout remote areas. A single nurse (or perhaps two) and – if they were lucky – a doctor within a few hundred miles were about the best that people in the outback could expect nearly a century ago.

Transport to and from these centres was also a very real problem in those days, as the best roads were often little better than two wheel ruts through the scrub. Flynn was convinced by 1917 that aircraft could ultimately provide the needed transport in emergency medical cases. The cost of landing strips was much lower than providing roads and aircraft were speedier than land-based vehicles.

Bush radio

Another problem was that a means of quickly summoning aid was not



John Flynn (nearest to camera) and George Towns setting off from Adelaide on their 1925 trip to test radio communications equipment in outback central Australia.

available. There were no telephones back then, as the cost of providing a telephone service to outback cattle stations was prohibitive. In addition, cattle drovers were never in one place for long, so a telephone service would have been useless for many people anyway.

By 1919, Flynn hit on the idea of using radio communications to summon aid in an emergency. However, he could see that radio was still in its infancy and not really suitable at that stage for the job.

The world was just recovering from the ravages of World War I and many things were still in a state of confusion. Spark wireless transmitting and crystal receiving equipment was totally unsuitable for use between outback cattle stations and the nearest town where medical facilities were available, such as Cloncurry or Oodnadatta. The government had also placed some restrictions on the use of valves by radio experimenters, although this was gradually being relaxed.

In fact, by 1919, valves were being used in an increasing number of transmitters and receivers and valve-equipment was showing promise as a possible solution to his problems. But even the most advanced cutting-edge radio technology of 1919 was still totally unsuitable for the work that Flynn envisaged.

As a result, Flynn encouraged both individuals and groups involved in wireless communications – such as the Wireless Institute of Australia – to develop an easy-to-operate, portable or semi-fixed radio transmitter and receiver for use in the outback. This equipment was to be used on remote cattle or sheep stations to communicate with a central base station.

Many tried and failed and even the military, despite all the facilities they had at their disposal, had nothing like the equipment Flynn required. Was he asking the impossible?

Early experiments

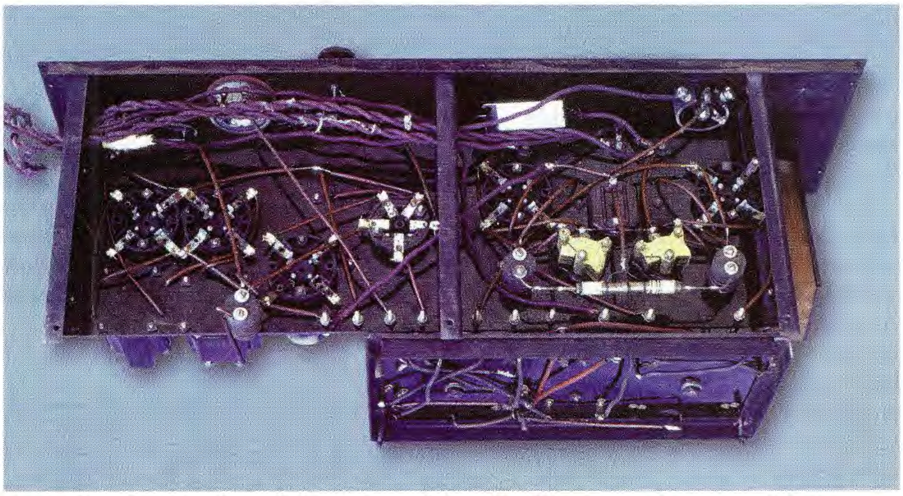
Despite those early setbacks, Flynn continued to encourage experimenters to develop suitable radio communications equipment. In 1925, he obtained help from Harry Kauper to develop equipment to test various ideas on outback communications. Kauper was the chief engineer of radio station 5CL and arguably the most competent radio experimenter in Adelaide at that time.

Under his guidance, Flynn and George Towns (an ex-WWI digger with experience in wireless) built the equipment. The amount of equipment involved can be seen in the accompanying photograph of Flynn and Towns leaving Adelaide in the overloaded Dodge buckboard.

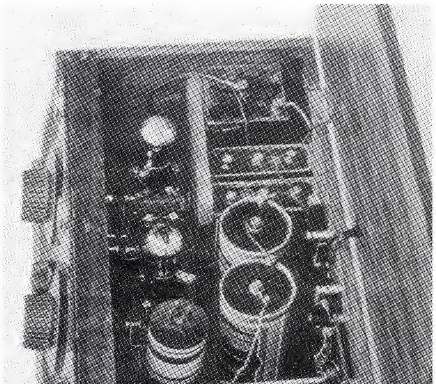
This equipment was tested by Flynn and Towns throughout the outback and they were able to contact Kauper and other experimenters. The experiments were successful in that some ideas were definitely worth incorporating into a portable transmitter/receiver, while others required further development. And of course, some ideas proved to be failures.

However, the overall development

The 1930 pedal radio was built into a heavy metal cabinet and used two transmitters – one on 2020kHz and the other on 8630kHz. This set was the Augustus Downs pedal radio and is now at John Flynn Place, Cloncurry.



An under chassis view of the 1930 pedal radio. The transmitters used A615 valves (or A415s) and had an RF output power of just 1.5W.



Inside view of the first pedal radio, complete with all the batteries. Note that the transmitting valve (B205) is missing from its socket at the bottom left of the photograph.

direction was slowly evolving. For example, it quickly became painfully obvious that voice communications were out of the question with the portable equipment envisaged. However, Morse code transmission from portable stations would be practical within a few years, once a range of problems had been overcome.

In 1926, Kauper built three transmitter/receiver sets for use in experiments between Arltunga, Hermannsburg and the AWA-supplied base station at Stuart (Alice Springs). These were tested by Flynn and Alfred Traeger (the pedal radio man) and proved successful, the unit operating for several months before breaking down.

The birth of pedal radio

With the design criteria sorted out, Flynn gave Traeger the job of developing a suitable transmitter/receiver under the watchful eye of Harry Kauper (Traeger's mentor), who contributed his considerable skills to the design. After many experiments, Traeger built the first pedal radio and unveiled it to Flynn in November 1928. This was a magnificent achievement, as it was the first portable high-frequency (HF) transmitter/receiver in the world that could be used by non-technical people.

According to its operating licence, the transmitter was crystal-locked on 2230kHz. It used a B205 valve which was operated in class "C" mode as a Morse code (CW) transmitter. Now the efficiency of small battery valves was quite low in class "C", so an input of about 4W gave just 1.5W of output power – ie, it was only 40% efficient.

The low-tension "A" battery supply came from two No.6 cells in series, while the high-tension "B" supply was nominally 180V but depended on how quickly the operator pedalled the generator (hence the name pedal radio) which supplied this power.

The transmitter was coupled to a quarter-wave wire aerial and a tuned counterpoise system. This proved to be an extremely effective antenna system, which it needed to be, considering the low transmitter power and the long distances over which the equipment was required to operate. In fact, this type of system was used up until relatively recent times.

The receiver was a simple 2-valve unit. It consisted of a regenerative detector and a transformer-coupled audio output stage which fed a pair of headphones. It tuned the broadcast band and one shortwave band, which included 2230kHz.

The valves used were two A141 space charge tetrodes which required 1.5V ("A") for the filaments and 9V ("B") – from two 4.5V bias batteries – for the high tension. The very low voltage on the "B" supply was sufficient for the A141 valves, which were designed to operate effectively on voltages from 2-20V.

Kauper selected the A141 valves because they drew very little current at low voltages. High voltage dry batteries of the era deteriorated very quickly in sub-tropical environments where these sets were to operate, such as Cloncurry in Queensland.

Six such sets were installed during 1929 within a radius of 600km of the

Cloncurry base. They quickly proved their worth when it came to saving lives, by summoning aircraft to carry patients to the hospital at Cloncurry.

Base transmitter

The Cloncurry base transmitter was much more powerful than the pedal radios, having an output power of 50W on (AM) voice. Of course, fixed base transmitters of reasonable power drew considerably more electrical power than a pedal radio transmitter. However, this wasn't a problem in this case, as a 32V lighting plant had been installed at Cloncurry to power the base station (despite the expense).

The base station receivers were also more elaborate than the pedal radio receivers, mainly because they had to be more sensitive.

Teething problems

Despite quickly proving their worth, practical experience with the new radios during the first few months also revealed some shortcomings. In particular, the sets were not always able to achieve reliable communications. To achieve that goal, it was evident that a frequency near 10MHz was needed in addition to 2MHz.

It was a case of going back to the drawing board and making the necessary improvements so that the pedal radios would be effective. Although the pedal generator had proved quite satisfactory, the receiver lacked gain and stability, and it seems that the transmitter valve may not have been rugged enough to stand the physical abuse of being bumped around in the outback.

As a result, these first six sets were scrapped over a period of time and their parts used in later improved sets, which is why there are no examples of the original sets in existence. However, there are two photographs which do show what they looked like.

The 1930 pedal radio

Harry Kauper decided to move to Melbourne in 1930, which meant that he was now able to provide only limited assistance to Alfred Traeger. Left largely to his own devices, Traeger used the best design aspects of the original sets and worked on methods of overcoming the weaknesses.

The replacement sets were built into a heavy metal case (to thwart termites) and the original single

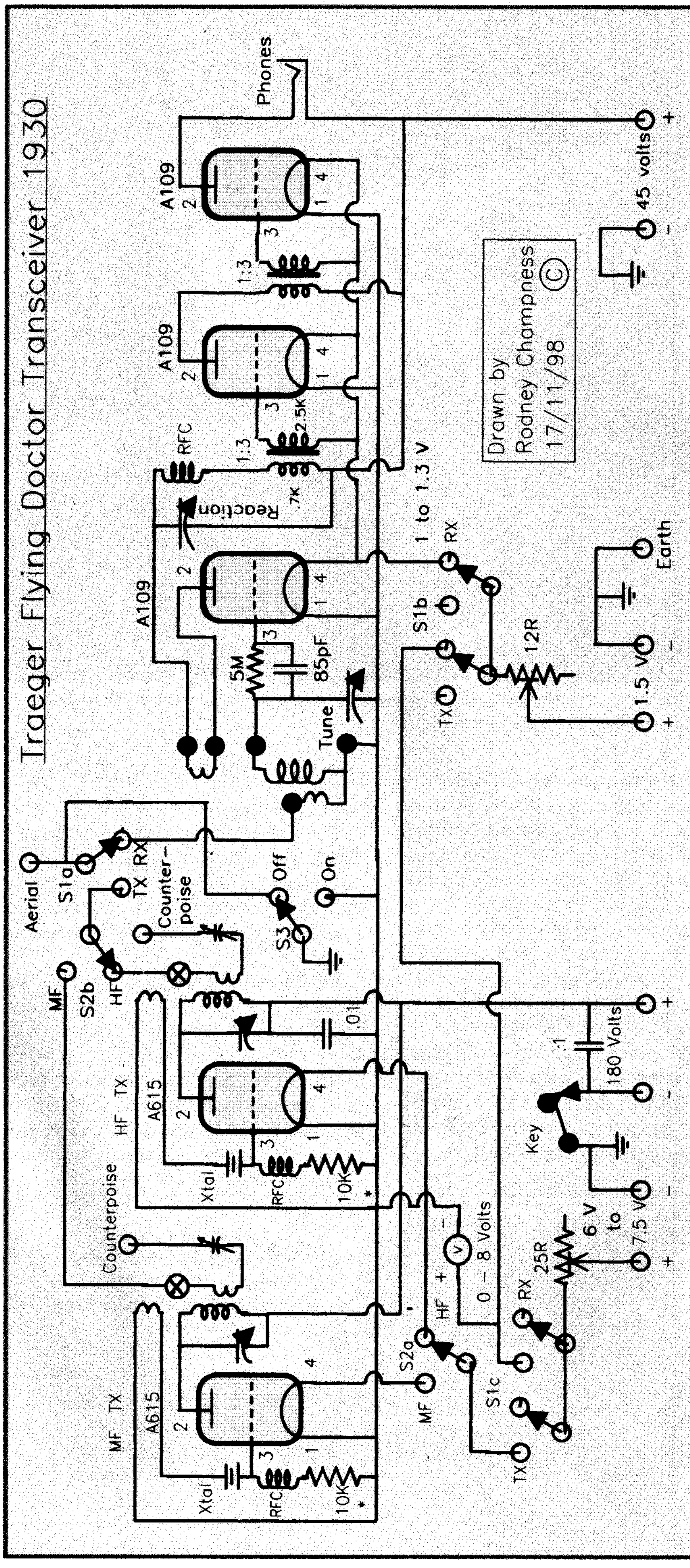
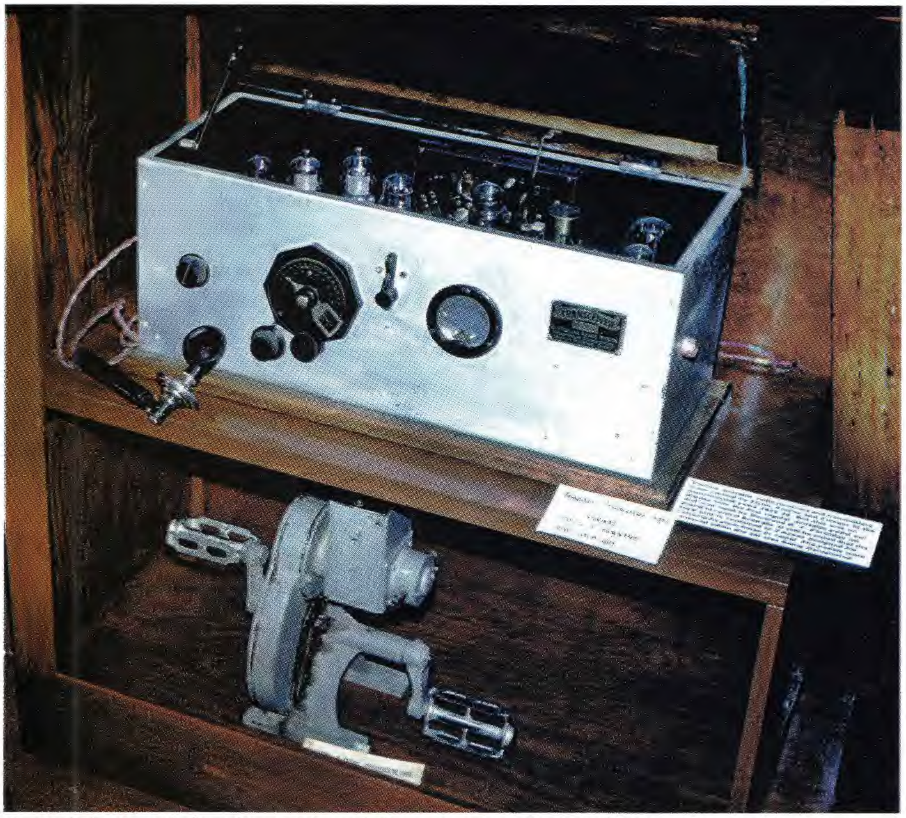


Fig.1: this is the circuit for the 1930-model pedal radio. Note the two almost identical transmitter stages based on A615 valves (one for 2020kHz and the other for 8630kHz). The receiver used three A109 triode valves – a regenerative detector and two transformer-coupled audio stages. The receiver tuned the broadcast band and up to around 10MHz, using plug-in coils.



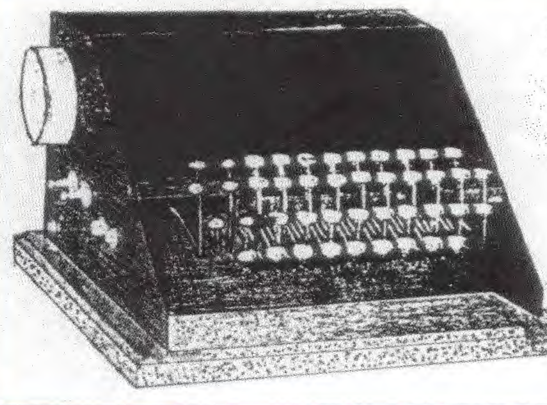
A model 36 pedal radio with pedal generator mounted below it, on display at "Adelaide House" in Alice Springs.

transmitter became two transmitters – one on a frequency of 2020kHz (night frequency) and the other on 8630kHz (day frequency). Exactly when these frequencies were issued is uncertain but it was definitely by 1931.

Traeger reasoned that by having two transmitters, communications with Cloncurry could be achieved either on the night frequency or the day frequency, even if one broke down. The transmitter design remained essentially the same as before, except the valves used were now A615s (or even A415s), which required four or five No.6 cells in series to power the filaments. The radio frequency (RF) output power remained at about 1.5W.

The antenna design also remained much the same as for the original set but it was now expected to operate on the two frequencies. As a result, two separate counterpoises were used in these units.

Initially, they were tuned in the same way as the original pedal radios, by laboriously adjusting the length of each counterpoise. Later on, they were modified so that the electrical length (and hence the tuning) of each counterpoise could be adjusted within the set itself.



Developed in 1931, Traeger's Morse typewriter sent perfect Morse code, regardless of the skills of the operator.

No meters were used in the transmitters to indicate the correct tuning. Instead, tuning was carried out by watching a small pea lamp and adjusting the transmitter and counterpoise controls for maximum lamp brightness.

It was said that if you got a glimmer out of the pea lamp, you had succeeded in tuning the transmitter!

The receiver, although also basically the same as the original, now boasted three conventional A109 triode valves. There was a regenerative detector and two transformer-coupled audio stages, with the output stage feeding a pair of headphones or, if the signals were really strong, a loudspeaker.

The receiver was able to tune the broadcast band and up to around 10MHz using plug-in coils. It was a much better performer than the original but now required a 45V HT battery in lieu of the 9V HT battery used in the original receiver.

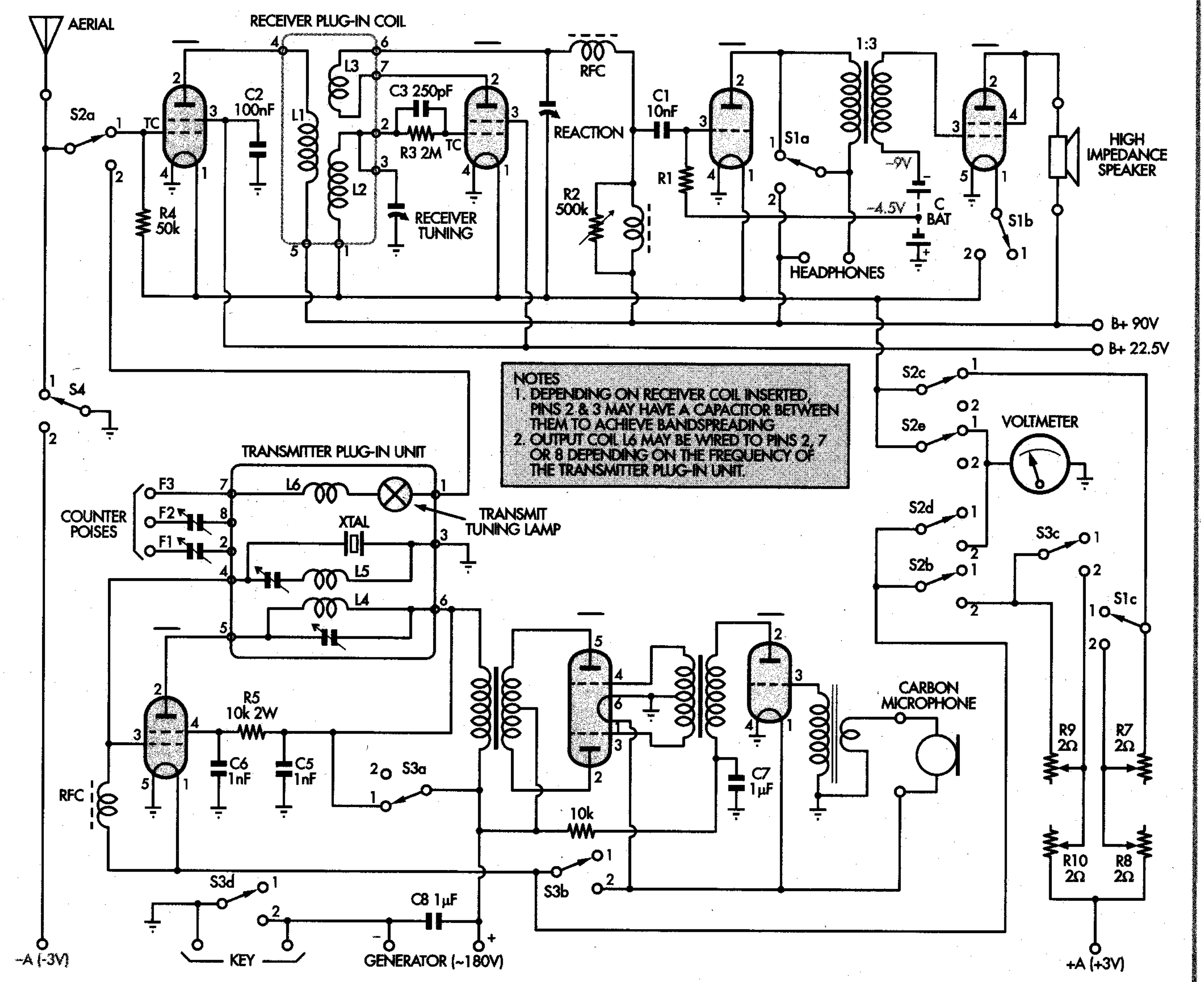
To the best of my knowledge, there is only one example of this model in existence and it is housed at John Flynn Place in Cloncurry. Another set that appears to be the same is at the RFDS base in Alice Springs. However, this is a model 34, which was made around three years later and uses different valves – three 30s in the receiver and two 33s in the transmitters.

Gaining access to these sets is difficult but I was able to see them some years ago thanks to the late Reverend Fred McKay. Unfortunately, I was unable to test them but I did build replica transmitters similar to the sets at John Flynn Place and in Alice Springs, in order to assess their performance (the receivers were conventional for their era, so I didn't build any replicas of these).

The accompanying photographs show the construction of the set at Cloncurry. The "chassis" is ebonite and components are mounted on it as shown. The wiring is in dark red spaghetti-covered single conductor wire.

The transmit/receive switch is the very large and relatively complex unit in the centre back of the set. Its operation can be traced in the circuit diagram. It's also worth noting that Traeger made any special switches himself.

The meter on the front panel was used when adjusting the filament voltages on the transmitter and the receiver valves. In practice, the receiver valves



S1: 1 = HEADPHONES; 2 = SPEAKER S2: 1 = RECEIVE; 2 = TRANSMIT S3: 1 = CW (MORSE); 2 = AM (VOICE) S4: 1 = OFF (ANTENNA SHORTED TO EARTH); 2 = ON

Fig.2: the model 36 was the first AM/CW pedal radio to be produced in any quantity. It was supplied with three plug-in transmitter assemblies (one for each frequency) and also used plug-in coils in the receiver.

were adjusted for a voltage of 1-1.3V and the transmitter valves for 6V.

The Morse typewriter

The next improvement in outback communications came with the development of the ingenious Morse typewriter by Traeger in 1931. As might be expected, the Morse code skills of the operators at the cattle stations were generally quite poor and it was often quite difficult for the base station operator to understand what was being sent.

By contrast, the typewriter sent perfect Morse code and even had a mechanical interlock which prevented more than one key from being pressed at a time. The exact sending speed was adjusted by an oil-filled dashpot and this was usually set to give a transmission speed of 10 words per minute.

The first voice pedal radios

Voice communication was still the goal as far as Flynn was concerned, however.

By 1934, the type 19 valve was available in reasonable quantities in Australia. This valve was originally designed for use as a class "B" push-pull audio output stage and was capable of around 2.2W with 135V of plate voltage. With this valve, battery receivers were capable of audio outputs that rivalled many mains-operated sets.

Traeger could see that this valve could also perform as a push-pull class "B" modulator for the plate and screen

Photo Gallery: General Electric 1934 Duette (Made by AWA)

Manufactured under licence in 1934 by AWA, the GE "Duette" was a 5-valve reflexed superhet receiver that was electrically equivalent to the AWA Radiolette Model 27. The valve line-up was as follows: 78 RF amplifier, 6A7 frequency changer, 6B7 reflexed IF/audio amplifier/detector/AVC rectifier, 42 audio output and 80 rectifier. Photo: Historical Radio Society of Australia, Inc.

of the transmitter output valve (33). This was tried and proved successful, even with 180V on the 19 valve – well above its design ratings. Its standing current was 20mA instead of 10mA in this situation, with zero bias.

This mistreatment seems to have been tolerated by the valve because of the intermittent nature of transmitting. The base station operators also used to do routine visits to the various outstations and replaced any weak valves in the transmitters on a regular basis to keep failure rates down

Perhaps one point needs to be made quite clear – the pedal generators did not produce more than 220V (when pedalling hard) and supplied between 160V and 200V (depending on the version of the pedal generator used) at normal pedalling rates. If they had produced the 350V some texts suggest, transmitting valves such as the 19 (with a maximum design rating of 135V) and the 33 (rated at 180V) would have failed spectacularly within seconds.

The model 36

The model 36 was the first AM/CW pedal radio to be produced in any quantity – perhaps 10-20 sets in total. However, from my research, it would appear that a model 35 was the first of the AM/CW sets and there may have only been one or two of these produced. It had a 3-valve receiver similar to the early CW-only receivers and a transmitter similar to the later 36 set.

The 36 set, which was produced in late 1935 or early 1936, had a totally new receiver. Some of the new low-filament current tetrode RF valves found favour with Traeger and the new receiver had a 32 as an untuned RF amplifier, followed by a 32 as a regenerative detector. A 30 triode was used as an audio stage and this was transformer-coupled to a triode-connected 49 audio output stage.

This set had an advantage over the earlier regenerative receivers in that the regeneration was not affected by the style of antenna connected to it. As a result, the regeneration control was much smoother.

A design similar to this receiver was published in the April 1929 issue of "QST", the official magazine of the American Radio Relay League. However, it used valves with higher filament current drains, which were unsuitable for the pedal radio designs of 1929.

Plug-in coils

The 36 also included an innovation that had started to appear in the last of the CW transceivers – ie, plug-in transmitter assemblies for each frequency (this in addition to plug-in coils for the receiver). Changing the transmitter frequency was simply a matter of changing the pre-tuned plug-in assembly.

Three plug-in assemblies were supplied with each transmitter, as only three frequencies were allocated to each network. The wiring of each plug-in was such that the correct counterpoise was automatically connected for the frequency in use. As for the frequencies used, in 1935 the base station at Wyndham was allocated 1600kHz, 5300kHz and 8830kHz (the broadcast band only extended to 1500kHz at that time).

The receiver's tuning range remained nominally the same as previous models, with enough plug-in coils to cover from 550kHz to around 10MHz. The higher frequency coils were wired in such a way that bandspreading was achieved for easier tuning, as can be seen in the model 36 circuit diagram.

For those unfamiliar with band-spreading, it is a mechanical or electronic means of spreading the tuning out across a band, which makes for easier tuning. A typical dual-wave receiver tunes from 6-18MHz in one sweep, which makes it hard to tune accurately. By contrast, a set with band-spreading splits that range up into multiple bands and is therefore easier to tune accurately – eg, an AWA 7-band set has seven bands which tune from 550kHz to 22.3MHz.

Once again, I built replica transmitters to check their performance. They performed pretty much as predicted. In the model 36 set, the 19 valve is overloaded and some standing bias would have been a good idea. I did not build a replica 36 receiver, as Graham Pitts, VK6GF – the Base Director at Alice Springs from 1944 to 1953 – assured me that these receivers performed satisfactorily.

Summary

The early development of the Flying Doctor pedal radios is fascinating. In this article, I've given you but a glimpse of what happened over the years from 1912 to 1936. It progressed from nothing to Morse code transmissions from the out-stations (homesteads) and voice transmission from the base station at Cloncurry in 1929, and then to voice transmissions from the out-stations and the base stations in 1935/6.

Due to the low power of the out-station pedal radios, the reception at the base stations was, more often than not, very poor. By contrast, base station transmissions were clearly heard most of the time as the transmitter power was much greater than the 1.5W output of the early pedal radios.

In late 1945 (after the end of WW II), out-station transceivers of up to 20W became available which improved communications performance markedly. Depending on the circumstances, the base transmitter powers varied between 20W and 400W output when AM transmissions were at their peak use.

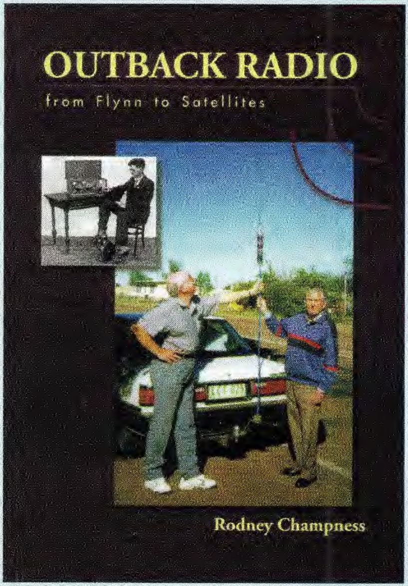
For those who wish to know a lot more about the development of communications in the outback, my book "Outback Radio – from Flynn to Satellites" will be helpful – see adjacent panel. **SC**

BOOK REVIEW

By Leo Simpson

History of Outback Radio

Outback Radio, from Flynn to Satellites, by Rodney Champness. Published 2004. Soft covers, 210 x 296mm, 186 pages. ISBN 0 646 43674 0. $39.95.



Just by coincidence, this month's Vintage Radio column happens to cover some of the subject material in this book, involving the pedal radio developed by Alf Traeger. Rodney Champness has put a great deal of research into this book, going as far as to reproduce some the early radios to check their performance.

In total, there are 17 chapters and eight appendices and the story goes right back to the beginnings of European settlement. The first chapter is largely devoted to the Overland Telegraph which began to be installed around Australia in the 1850s. In the days before the 1920s, the Telegraph and the various state railways represented the only ways to get messages quickly over vast distances and those methods left vast areas of Australia totally isolated. Few people had telephones and so there was a vast challenge which was taken up by John Flynn. John Flynn and Alf Traeger are the two heroes of this book.

Rodney Champness proceeds to describe the development of early radio communications in minute and exhaustive detail, covering not only the various transmitters and receivers but also the innovative pedal generators, designed by Alf Traeger and Henry Kauper. An incidental detail is that the pedal generators designed by Traeger only supplied the transmitter's high voltage while the remaining filament and other supplies were provided by batteries.

While the main thrust of the book is the pioneering radio work to complement the Royal Flying Doctor Service, a good portion is devoted to more recent developments since the 1950s, right up to the use of satellite communications, EPIRBs and GPS.

The eight appendices are of particular interest. Appendix one is a synopsis of the 17 chapters of the book while appendix two is a collection of early transmitters and transceivers and reviews of their performance. This will probably be the most closely read section of the entire book. Appendix three is a detailed discussion of aerial and counterpoise systems – critical to early radio communications.

Appendices four and five are collections of miscellaneous information, significant dates, valve data and radio frequencies. Appendix six contains brief profiles of outback radio pioneers and appendix seven is a comprehensive glossary. Appendix eight is the bibliography.

In summary, this is a thoroughly researched history of outback radio which will be of value to anyone interested in early Australian radio.

The book is available from the author, Rodney Champness, 6 Mundoona Court, Mooroopna, Vic 3629. The price is $39.95 plus $8 postage. Payment may be made by cheque or money order. (L. D. S.)