# Vintage Radio

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# The AWA Radiola B29 8-transistor radio with battery eliminator

## Manufactured in the 1960s, the AWA B29 is an interesting 8-transistor radio that could be run from batteries or an external power adapter.

TRANSISTOR RADIOS came in three basic sizes during the period that Australian manufacture still existed: small (little bigger than a large pack of cigarettes), medium (about the size of a house brick) and large (about the size of a medium-sized valve portable).

During this period, a lot of work was done to reduce the size of the sets while still maintaining good sensitivity and audio output. For example, in medium-sized receivers, 200mm x 12mm-diameter ferrite rods were used to ensure good sensitivity, while the batteries were kept small to keep the size and weight to a reasonable level.

Unfortunately, using small batteries also meant that they had to be replaced frequently at some cost. Many of these portables spent more time in the kitchen than outside, although they were also often used for entertainment at the beach.

### Saving batteries

In order to conserve the batteries, manufacturers had to look at ways of minimising or even eliminating battery drain in some circumstances – eg, when the radio was used in the kitchen. The answer was to provide a small external power supply that would allow the set to run off the mains. A switching contact on the set's power socket isolated the battery when the external supply was plugged in.

The AWA B29 8-transistor radio is one such set that can be used with an external power supply (or "battery eliminator"). It was a medium-sized receiver weighing 1.6kg without a battery, or about 1.85kg with its 2364 battery fitted. By contrast, the larger AWA B32 8-transistor receiver (which has an RF stage) weighs 3.2kg without a battery and just under 4kg with its quite sizable battery fitted.

The two sets draw around the same current. However, the battery in the B32 is more than three times heavier than the B29's 2364 battery (800g versus 250g) and it provides nearly four times the operating life.

Although hardly a lightweight at 4kg, the B32 weighed much less than the mains-powered valve portables from the 1950s and 1960s. These weighed as much as 8kg, which made them rather heavy to move around.

Generally, a high current drain relative to battery size means a short operational life. For example, some small sets used a 216 battery (weighing less than 40g), which meant that operating times were down to just a few hours. By contrast, those sets using four AA cells (52g) did have a longer operational life.

There were other options, however. For example, the Kriesler 41-27 used a 286 battery which was reputed to give around 1000 hours of operation. It is a weighty portable (approximately 3.6kg with the battery fitted), although it was lighter than the AWA B32.


Although still functional, the old AWA Radiola B29 was somewhat worse for wear. It's a fairly conventional 8-transistor set from the 1960s.

The B29 is more conveniently sized and is an effective portable receiver when using its internal battery. However, it's still best to use an external mains adapter to power the set if it is to be used in the home.

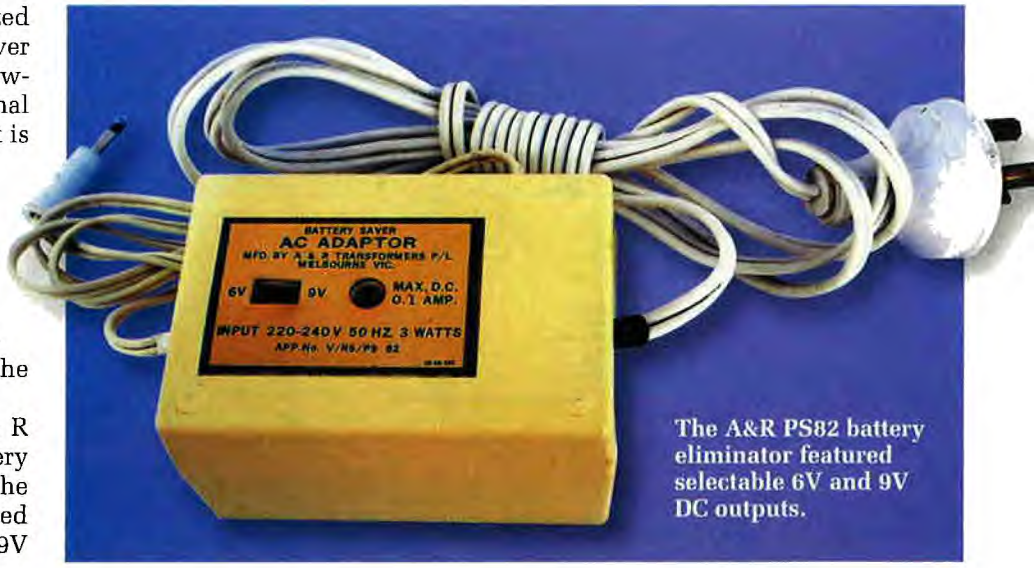
## The A&R PS82

Probably the first manufacturer to provide a battery eliminator was Philips with their circular shaped unit. However, other manufacturers soon climbed aboard the bandwagon.

One such company was A & R Transformers and their PS82 battery eliminator was very popular at the time. This unit was double-insulated and featured switchable 6V and 9V (100mA) DC outputs.

One advantage of the PS82 is that it is easily dismantled for service, requiring just one screw to be removed to split the case in half. As shown in Fig.1, the circuit is really quite simple and uses diode D1 as a half-wave rectifier. The 6V and 9V settings are selected by switching taps on the transformer secondary, while two electrolytic capacitors and a 10Ω resistor filter the output from D1.

Fitting four diodes in a bridge rectifier circuit would have achieved better voltage regulation under load, so why wasn't this done? The reason is probably to do with cost. Silicon diodes were much more expensive then than they are now and so this would have sharply increased the cost.




The A&R PS82 battery eliminator featured selectable 6V and 9V DC outputs.

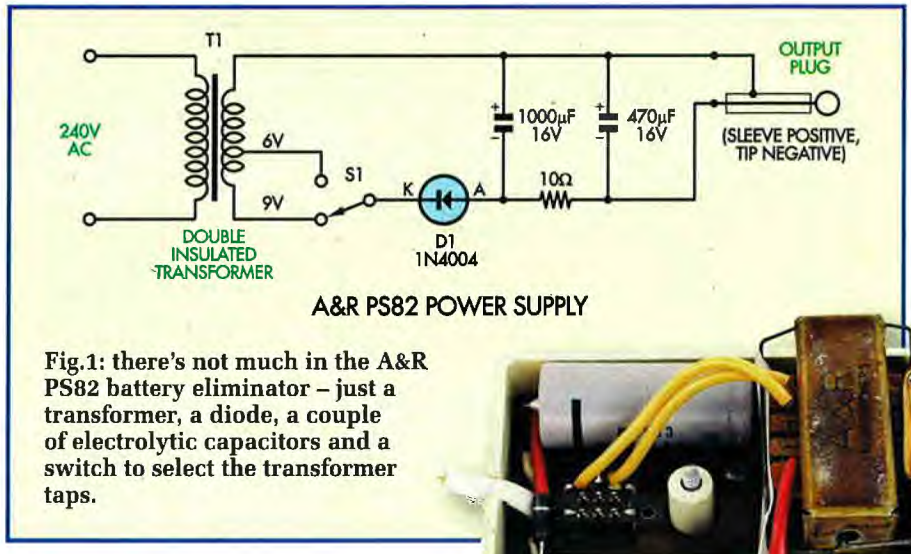



**Fig.1: there's not much in the A&R PS82 battery eliminator – just a transformer, a diode, a couple of electrolytic capacitors and a switch to select the transformer taps.**



## AWA B29 circuit details

The circuit of the AWA B29 is conventional for the era – see Fig.2. First, there is a large ferrite antenna rod and this has three windings: (1) a tuned winding for RF signal pick-up; (2) a transistor base feed winding; and (3) a winding that can be interfaced to an external antenna. Coil L1 connects to this third winding and acts as a loading coil to boost the receiver's performance with a relatively short antenna (eg, a car radio antenna).

The autodyne converter stage uses a 2N1639 or a 2N1636 germanium transistor. Following this is a 2-stage neutralised intermediate frequency (IF) amplifier using either 2N1638 or 2N1634 transistors. The neutralising capacitors are C11 and C17. Note that the IF transformers (TR3-TR5) each have only one tuned winding, their low impedance coils coupling to either the next transistor base or, in the case of TR5, to the detector diode (MR1).

The automatic gain control (AGC) voltage from the detector diode is applied to the base of the first IF transistor (VT2). For medium strength signals, AGC control only occurs in the first IF stage. As the AGC voltage increases, the transistor draws more current rather than less as in a valve circuit.

This also means that as the AGC voltage rises, the voltage on VT2's collector drops and this changes the bias on VT3 (2N406) such that it begins to draw current. As a result, VT3 functions a variable shunt across the tuned circuit in TR3, which reduces the signal applied to the first IF amplifier.

It's no exaggeration to say that this type of AGC circuit is foreign to most who have only been involved with valve AGC circuits. Note too that the circuit is drawn with a positive earth, which makes it just that much harder to follow.

The detector stage is followed by a conventional 4-transistor amplifier circuit, with transformer TR6 driving a push-pull class B output stage (VT7 & VT8). There is no output transformer, the output transistors directly driving a centre-tapped 80-ohm loudspeaker. Because the speaker is so unusual, you need to keep your fingers crossed that it never needs replacement!

By the way, germanium transistors are rather sensitive to temperature and voltage variations. If these factors increase, the output stage draws

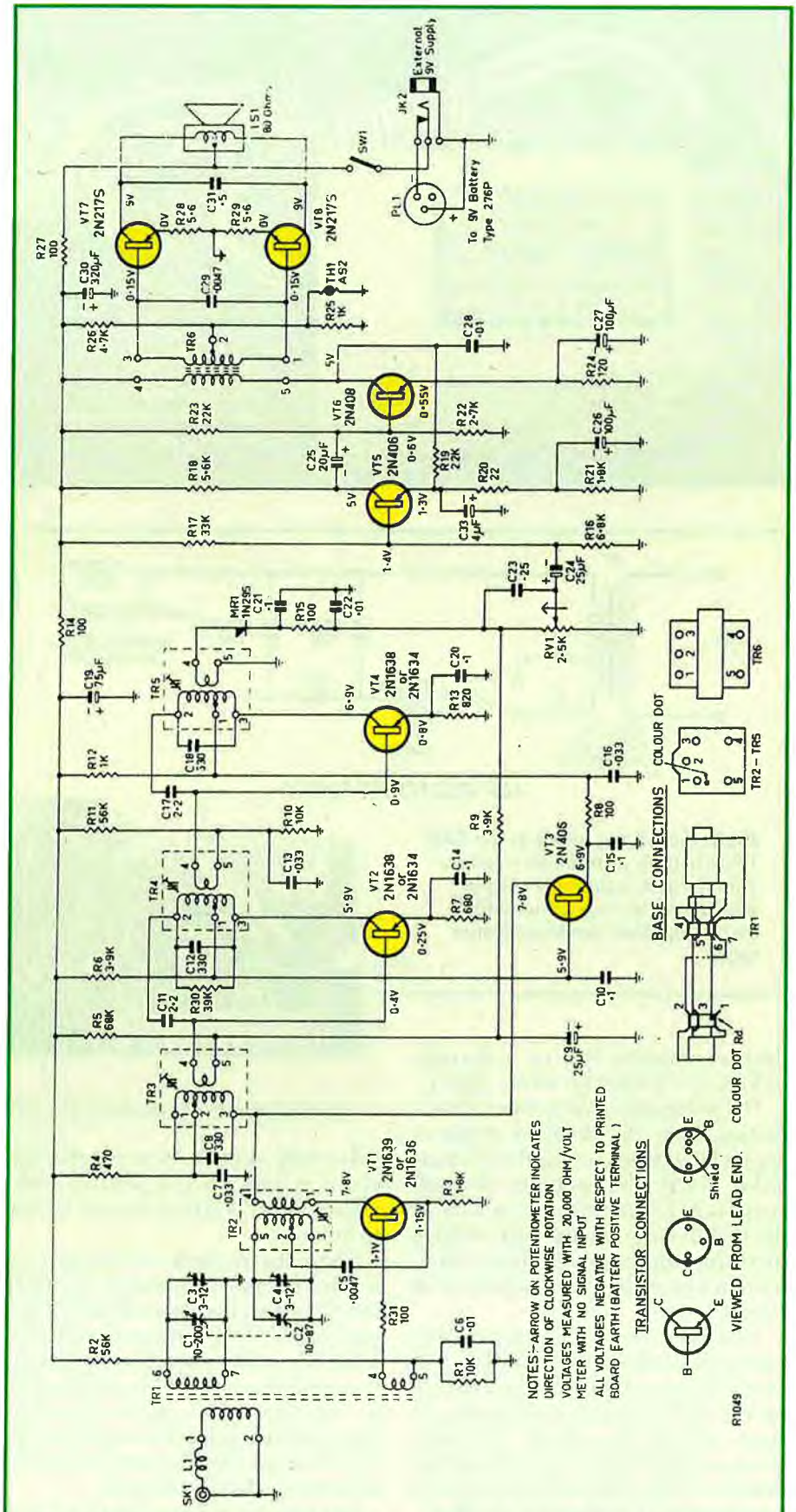



**Fig.2: the B29 receiver uses a fairly conventional superheterodyne circuit with eight transistors. The audio output stage is a little unusual though, as it drives a centre-tapped loudspeaker coil – see text.**

more current, which increases the temperature, which leads to a further increase in current and so on. Unless precautions are taken, this can lead to a condition known as thermal runaway and result in the destruction of the output transistors.

In this circuit, the current through the output stage is stabilised by a network consisting of R25, R26, R28, R29 and thermistor TH1 (AS2). In operation, TH1 monitors the temperature of the output transistors. As the temperature goes up, the thermistor's resistance goes down and this reduces the forward bias on the output transistors. As a result, they draw less standing current and so the current through them is kept to a safe limit.

Finally, note that because the set has a positive earth, the plug from the external power source must have its centre pin (tip) as the negative output. Most external supplies (including plugpacks) have the centre pin wired as the positive rail, so take care here.

## Repairing the cabinet

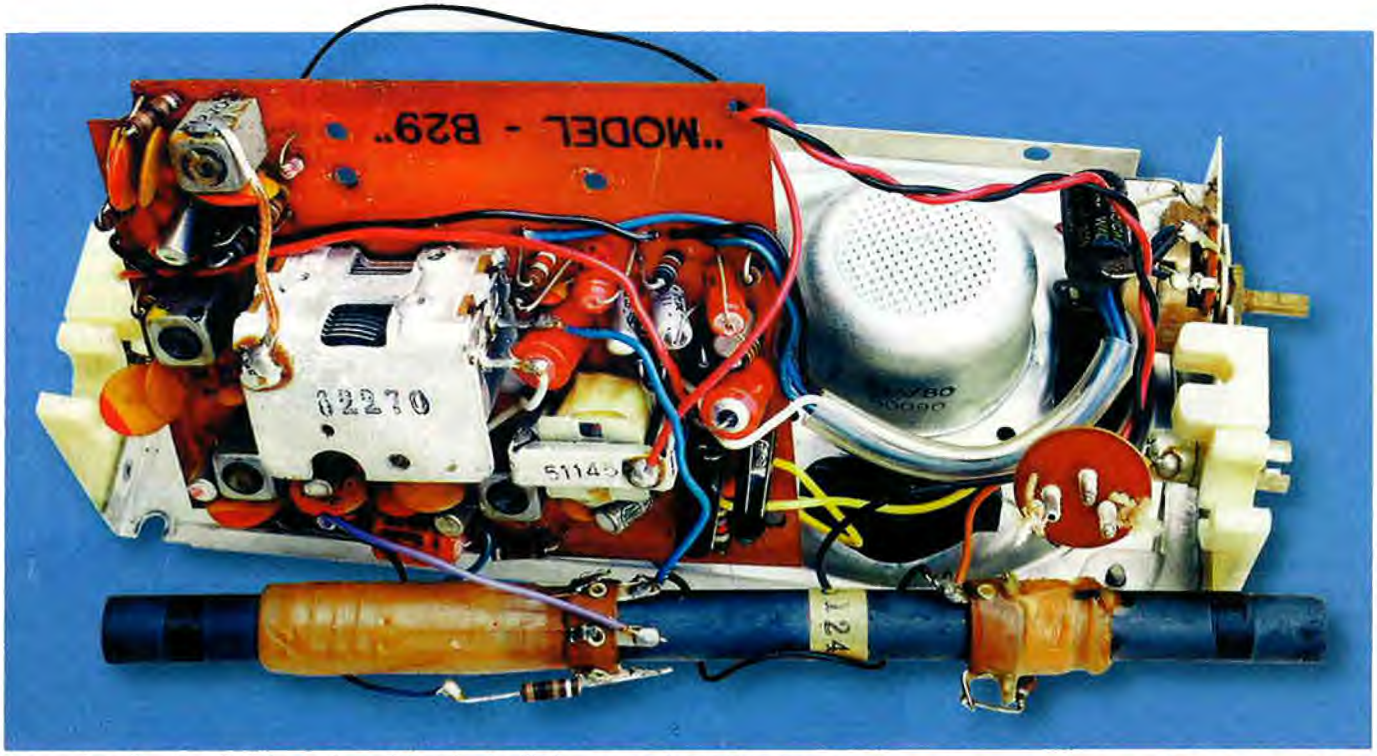
The B29's case measures 235mm x 120mm x 70mm and is made from brown leather, cardboard and plastic, with a metal front. The front of the set is similar to the B79 described in the December 2004 issue.

As can be seen in one of the photographs, the carrying handle had come adrift from the lugs on the top of the case. This method of attaching the handle was obviously inadequate, so I looked at making some improvements here. Unfortunately, this involved dismantling the set and that wasn't all that easy.

First, the handspan tuning knob and the on-off-volume control knob were removed. However, I couldn't persuade the dial pointer to come off – it is a tight friction fit to the tuning gang shaft.

Next, working from the back of the set, the five screws that secure the PC board in place were removed. That done, the loopstick antenna was eased out of its clips and the four nuts (one at each corner of the cabinet at the front) were removed using a small socket wrench (spintite) on an extender shaft

By this stage, everything was "flopping" around inside the case and so the dial-scale was now worked backwards and forwards while I tried to remove the PC board assembly. It eventually




**Removing the "works" from the cabinet isn't all that easy, the entire process taking around 20 minutes. Note the large loopstick antenna which contributes to the set's good sensitivity.**

came free and I was able to extract the PC board, the chassis and the rod antenna from of the case.

This gave access to the four bifurcated rivets that hold the handle in place. These rivets (along with the handle) were then removed.

That done, I cut some light-gauge galvanised flashing (try your local hardware store) into two small rectangles. These were then bent into semi-circular straps, after which two holes were drilled in each strap to match the holes in the leather handle assembly.

The idea behind these metal straps is that they would take all the pressure off the leather handle. The accompanying photographs shows the basic scheme.

Re-attaching the handle assembly to the case took a little while but the scheme worked well. It may not look 100% due to the damage that has been done to the various parts over the years but it's a lot better (and stronger) than it was.

The case was also looking a bit shabby, so the next step was to give it a good clean. First, the leather was washed with soapy water on a cloth and then put aside until it was completely dry. It was then polished using silicone wax and came up rather nicely.

The front panel of the set was also cleaned using soapy water, this time with the aid of a nail brush. However, this job had to be approached with a good deal of caution, to avoid splashing water onto the paper dial scale. The front panel was then polished, by which time the receiver was starting to look rather good, even in its disassembled state.

The knob and handspan dial were also given a wash, ready for the final assembly. However, that would have to wait until the circuit had been checked out.

## Getting it going

It was time for the smoke test. After making sure that the PC board was properly isolated, I connected a power supply and switched the set on. It immediately showed signs of life but the volume control was very noisy.

A quick spray with a suitable cleaner solved that particular problem. I then twisted the tuning control shaft with my fingers and a number of stations were heard. I closed the tuning gang and found to my amazement that the set was tuning down to around 495kHz. And with the gang fully open, it tuned all the way up to about 1700kHz.

However, the set was never really designed to cover this tuning range. Someone in the past had adjusted the various coils and trimmers so that it covered this range and then flooded the coil cores with beeswax. I was able to readjust the IF coils but the oscilla-


**The handle assembly on the old B29 was repaired and strengthened using two small metal brackets (above and right). The restored receiver looks good and gives reasonable performance.**

tor coil is well and truly sealed and so there is no way of adjusting the bottom end of the tuning range. When I obtain a surplus coil from another similar set, I'll replace it.

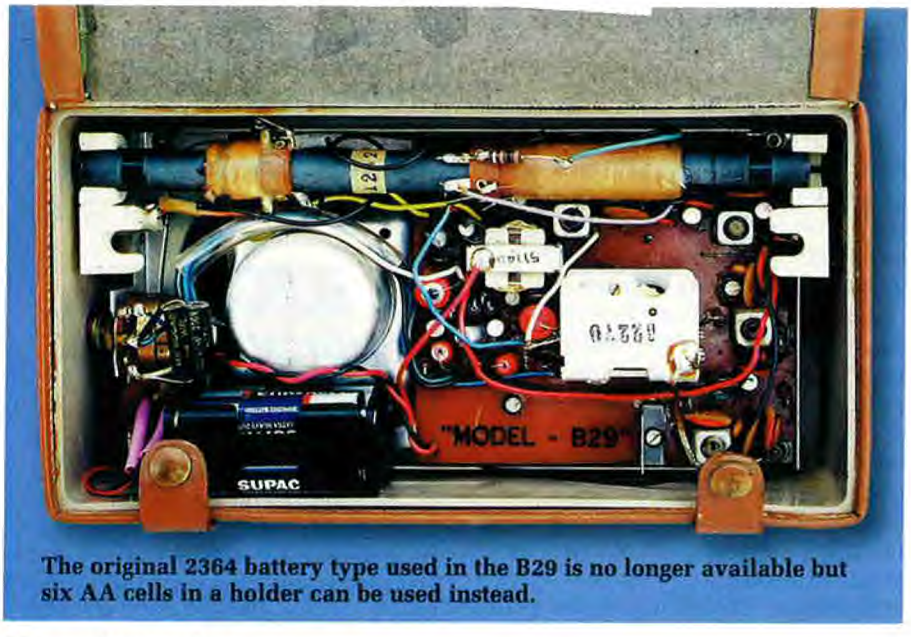
At the other end of the scale, the top frequency was adjusted to around 1640kHz with the tuning gang fully open. I then peaked the antenna coil near the bottom end of the dial (at about 600kHz) by sliding the tuned winding along the ferrite rod for best reception, after which the set was tuned to about 1500kHz and the antenna trimmer adjusted for best reception.

The set was now performing quite satisfactorily although like most sets of that era, the RF transistor isn't exactly quiet. As a result, the set is a bit "hissy" on the weaker stations.

The next problem was that the audio sounded rather distorted at high volume, so I starting checking out the audio amplifier. I soon found that the supply rail dropped with increasing volume, getting down as low as 7V. This is lower than I would have liked to have seen and indicates that a full-wave bridge rectifier in the power supply would have been a good idea.

As an experiment, I tested the set with a small regulated supply set to 9V. This gave greater output and less distortion but I still felt that there was something wrong with the output stage.

Next, I checked the voltages on the collectors of the 2N217S and they were nearly identical (ie, with the set delivering a reasonable volume). I then fed a 1kHz modulated signal from a signal generator into the set and checked the voltages across R28 and R29. They varied equally with increased volume but there was still noticeable distortion.




**The original 2364 battery type used in the B29 is no longer available but six AA cells in a holder can be used instead.**

## The old CRO

It was time to bring out the heavy artillery, so I fired up my CRO to track down the source of this distortion. This showed that the audio was a beautiful sinewave up to the bases of the 2N217S output transistors but when I put the probe onto either collector, I got a horrible looking waveform.

I had expected to see a half sinewave but that wasn't the case. I then tried disabling one half of the output stage

by getting rid of the signal alternatively to each base but it still looked terrible and I was getting nowhere fast!

My next step was to use the dual inputs of the CRO. By placing a probe onto each section of the output, I could observe the phasing of the output stage. It still looked terrible but at least the two waveforms showed that the problem occurred in each transistor output on each half wave. I then decided to use the add function and what did I see? – a beautiful sinewave.

I'd been trapped by the rather unusual nature of the circuit. If the speaker had been fed from a centre-tapped transformer, the CRO would have shown a sinewave on the voice coil. However, the system used in this set is different, as the output goes to a centre tapped choke (ie, the speaker) and the waveforms are different.

So what was causing the distortion? If I'd thought about it, I would have realised what the answer was – this is a personal portable with low-output transistors feeding the speaker so I was really expecting too much of the audio stage.

## Putting it back together

Having solved that problem, it was now time to reassemble the receiver. I won't go into all the problems I ran into but it took me no less than 20 minutes to do the job.

By contrast, I remember when the local film processing laboratory was giving a radio away with each film developed. These radios must have cost them next to nothing but they were still rather nice little 5-transistor sets. And they could be dismantled and reassembled in about one minute!

That said, the fully assembled B29 now looks good and performs quite credibly. And with an external antenna and earth, it really works very well indeed.

## Substitute battery

Type 2364 batteries are now unobtainable, so I decided to see if six C-cells could be fitted into the receiver's case. Unfortunately, the holder was just a little too large but a pack of six AA-cells in a holder can be fitted and will give reasonable life. It is only necessary to solder a battery snap lead to the 2364 battery plug and the B29 is ready to use as a portable.

To prevent any shorts, a couple of pieces of plastic tubing were placed over the exposed lugs on the 2364 battery plug. The 6-cell pack fits snugly inside the case, as can be seen in the photograph.

## Summary

The B29 is quite a nice little set, rather typical of many sets of the same era. Its performance is good (although the audio suffers as the battery voltage drops) and the handspan dial system works well.

In summary, it is a pleasant little transistor set which I'm quite pleased to have in my collection. **SC**

## Photo Gallery: Precedent 5-Valve Receiver

**Designed and manufactured by Firth Brothers, Melbourne, the Precedent c1933 was a stylish table model receiver that tuned the medium-wave band. The valves fitted were as follows: 57 autodyne mixer; 58 IF amplifier; 57 anode bend detector; 2A5 audio output; and 80 rectifier. Photo: Historical Radio Society of Australia, Inc.**

## A Few Gremlins

A few gremlins crept into the April 2005 column, as follows:

(1) Page 80, third column, end of paragraph four should read: "This feeds one section of a 6SN7-GT as the second stage, while the second section acts as a phase splitter . . ."

(2) The AGC bypass capacitor at the extreme left of the circuit (Fig.1) should be 47nF not 47µF.

(3) The asterisks marking the components replaced were omitted. The components replaced were: all the electrolytic capacitors, the AGC and audio coupling capacitors (except the coupler to the grid of V7), the screen dropping resistor feeding the 6U7-G valves and the accompanying screen bypass capacitor.

(4) V4's cathode should be earthed and not connected to the 25kΩ resistor, volume control or the 100pF capacitor. The same error is on the amended AGC circuit (Fig.3).