BY ROGER JOHNSON

Four-Valve Sets - Part 2

This month we're continuing our look at four-valve receiver designs of the late 1920s, moving to some of the more interesting designs of that era. Overall, four-valve radios would of course encompass just about half the radios ever made in the valve era, especially in Australia.

IN THE EARLY to mid 1920s both Britain and America seemed to have reduced numbers of four-valve radios in their range, but whereas America opted for five, six and seven-valve sets, Britain seemed to favour one, two and three-valve radios, with lesser numbers of designs with more valves. This is a fairly broad generalisation and any amount of exceptions can be provided, but anecdotally, it appears to be the case.

It's not that easy to find samples of British four-valvers in this country from the mid 1920s. However there are many Australian department store brands, and many were home built. In the latter 1920s, if the advertisements in the popular magazines are a guide, the preference was to America for imported radios of all descriptions.

When referring to electric sets, do we consider the rectifier as a valve? Up until the early 1930s, a 'valve' meant an amplifying valve, and so a rectifier was excluded in the valve count. But valve manufacturers and technical people pointed out that the criteria should be whether or not it is a thermionic vacuum tube, and not merely an 'amplifier'. Hence the rectifier became included in the valve count, no doubt to the delight of many a salesman.

For the purposes of this article, though, we will use the prevailing attitudes of the day and exclude the rectifier from the valve count.

Battery triode circuits

Even toward the late 1920s, circuits using battery triodes were still popular. One such circuit using the standard tuned RF and regenerative detector is the 'Bush 4 Valver' described in *The Listener In* for June 12th 1929.

As the name implies, this was the set for bush 'cockies' and efficient antenna coupling went a long way to achieving the best performance. So in this slightly different circuit (Fig.1) the antenna is connected via a two-position switch to either a tap towards the earthy end of the tuning coil, or to a vario-coupler.

The RF amplifier is coupled to the detector tuning coil via a small value capacitor, with an RF choke from the plate to HT. The text describes this as 'the choke-fed tuned anode system'. Regeneration is from what is a not-quite-oscillating Hartley circuit. The detector tuning coil (3) is centre tapped for the earth return, and the tuning capacitor (5) is connected across the entire winding. The anode of the detector stage is fed back into the bottom of the coil via a 100pF reaction capacitor (6).

Just in closing, this circuit really *was* intended for the 'cockies'. The text claimed that selectivity should give way to sensitivity, and that loudspeaker operation is obtainable from merely 90 volts HT in order to reduce costs.

Actually *The Listener In* for June 12th 1929 was a boon in preparing this column, for it contained three four-valve circuits, all different, and some incorporated new techniques.

Another circuit for the home constructor was described in the same issue, called the 'Home Four Valver'. This is another example of an 'all triode' circuit, but technically some features are somewhat dated. Although four valves are used, it is in reality a three-

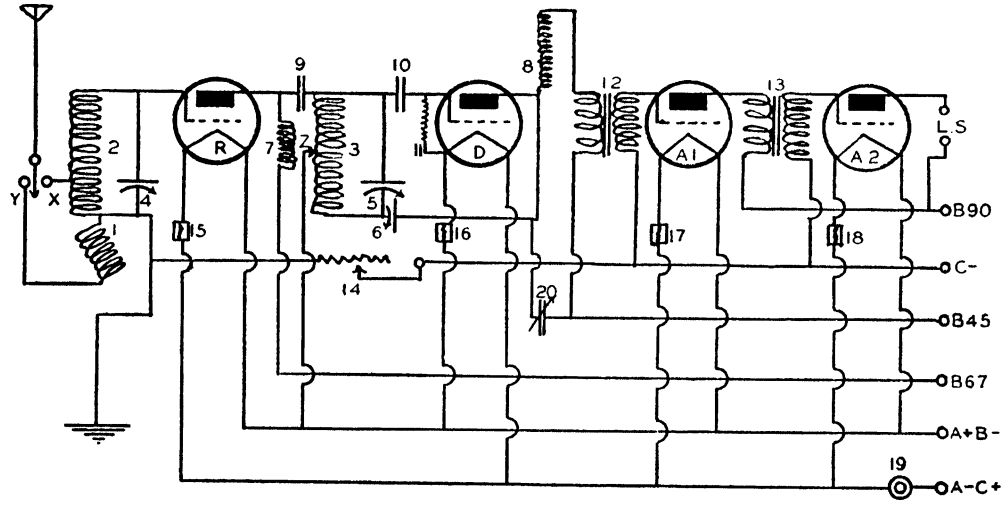


Fig.1: *The 'Bush Four Valver' described in The Listener In for June 12, 1929. It was designed to achieve high sensitivity for the 'man on the land'.*

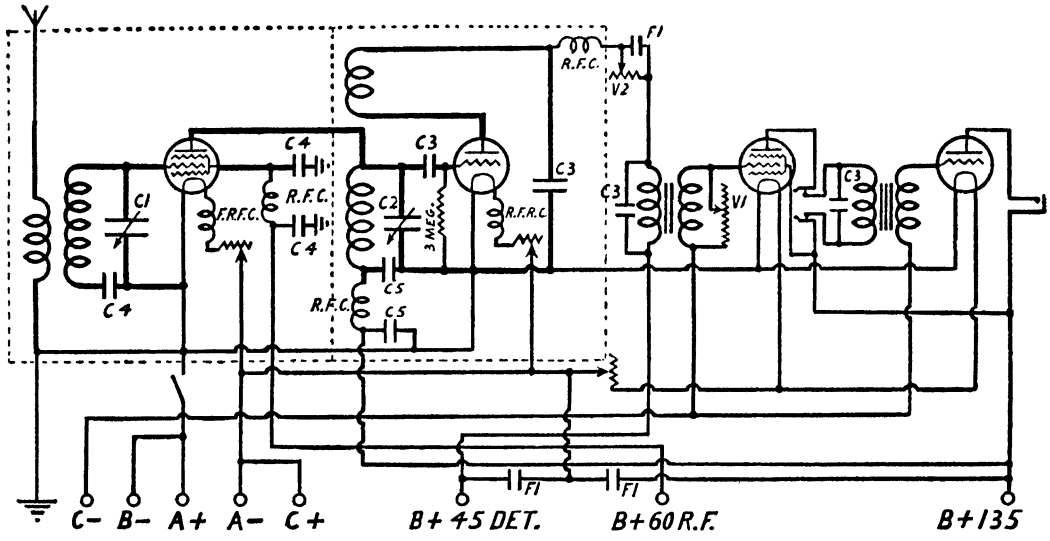


Fig.2: *A rather complex short wave set using screen-grid 'penthodes', also described in The Listener In for June 12, 1929.*

valve set consisting of a single stage regenerative detector and two transformer coupled stages of audio. The fourth valve is the dubious 'antenna coupler' seen in so many American sets from about 1925. It is an untuned RF amplifier intended to isolate the antenna loading effects from the tuned circuit. In this capacity it has a stage gain of not much more than unity.

The description of 'all triode' is given in quotation marks, for that is how the circuit appears. The two audio stages are shown as triodes, but reference to the parts list shows the audio stages as penthodes (sic). Even the wiring diagram shows UX sockets. So how are pentodes used?

The very earliest pentodes had a UX base, in which the pins were connected as a triode. But the 'extra' screen grid was connected to a grub screw mounted on the valve base. This was done to facilitate the incorporation of a 'power valve' i.e. a pentode into the final stage without modification to the existing wiring. You merely connected a wire from B+ to the screen terminal.

There are some refinements shown in this circuit. Reaction is controlled by a 6000 ohm pot in series with the 1st AFT and the B+ end of the reaction winding. It is used to vary the anode potential, and hence the stage gain, and ultimately the amount of RF fed back by the reaction winding to the tuned winding.

Another refinement is a 'volume control' R7 shunted across the secondary of AFT1. With a transformer coupled pentode, which incidentally is not the wisest thing to do, and a further pentode output stage, this set could beef out the best part of 1/4 watt, more than enough for a horn speaker. However, one would think that R7 is to prevent overloading and hence distortion of the output, rather than too much sound.

Screen grids and 'penthodes'

The term 'penthode' was the very early spelling of 'pentode'. Why the 'h' was included is anyone's guess. In any case the term was initially only used for audio or power valves. For RF applications, these valves were described as a 'screen grid'. This is an accurate description, because that is exactly what they were. They did not have a suppressor, either external or internally connected, which has been verified by examining dud specimens. So functionally they were really a tetrode, although that term only seemed to be adopted at a later time.

The final circuit from *The Listener In* for June 12th 1929 is for a short wave receiver (Fig.2). Now this is another interesting development — listening to short waves. The stations which were logged on this receiver were RFM Siberia on 70m, W2XAF New York and PCJ Eindhoven on the 31m band (amongst Australian hams of the day), and the American KGO and W2XG along with stations in the 'Dutch East Indies' (i.e. Indonesia).

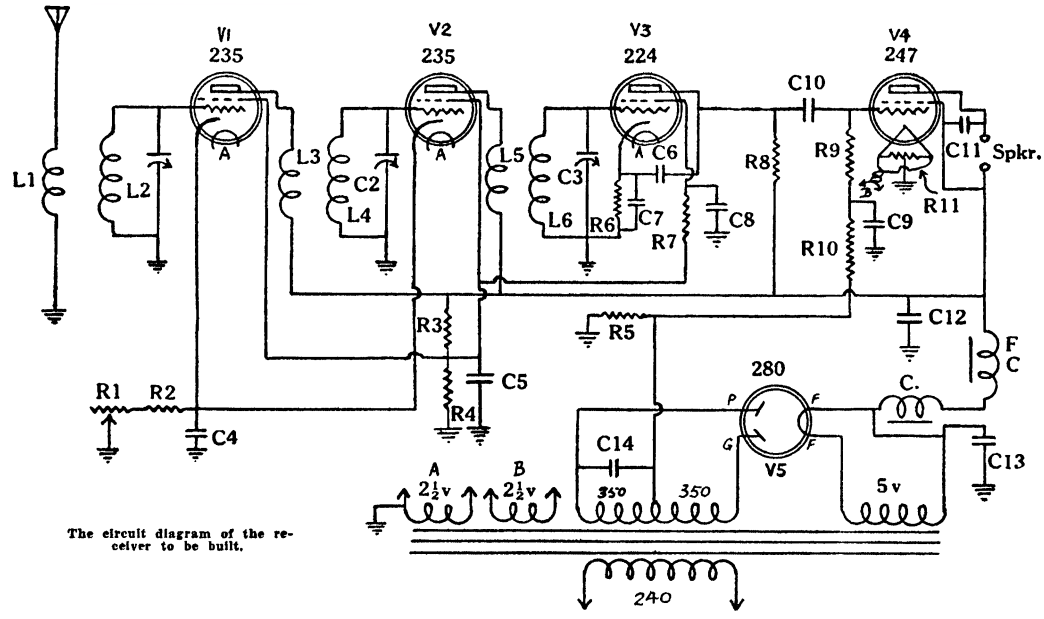
In this circuit a screen grid RF amplifier is used to dispense with the need for neutralisation (which could be difficult at higher frequencies), followed by a triode detector, then transformer coupled to a pentode audio stage, which is turn transformer coupled to a triode output stage! This was included so that the set could operate with either three or four valves.

Once again, reaction is achieved by means of a potentiometer (V2) instead of a variable capacitor, and a volume control is included by shunting the secondary of AFT 1 with a high value pot (V1).

The RF and detector stages are enclosed in separately shielded compartments, and RF chokes are included in the filament circuits. Both stages are also bypassed in the screen and anode circuits. One presumes that the elaborate shielding was insufficient, and that stray RF tended to be transmitted via the wiring to any or all of those various electrodes, causing instability.

Quite elaborate instructions are given on bending the aluminium sheet into the rectangular box and partition which forms the shielded sections, but the photograph would suggest that the compartment is definitely made by a sheet metal worker. The text also describes how to fix all this metalwork to the chassis: with 'Meccano' brackets (why not?). Although a chassis is described, most of the wiring is actually above the chassis, with just a couple of pots and the old 'rectangular can' type bypass capacitors mounted beneath. Baseboard wiring was still firmly entrenched.

The tuning capacitors have been modified for a maximum capacity of about 150pF to allow ease of tuning, and coil details are given for five tuning ranges



The circuit diagram of the receiver to be built.

Fig.3: The '1932 Advance' described in Wireless Weekly for January 8, 1932. It's fairly typical of the last generation of all electric four-valve TRF sets.

— covering from 84 metres down to 13 metres. However only the number of turns is given, and no details regarding the spacing of the windings or the spacing between the windings themselves. The coils are all wound on UX valve bases, which explains why there is no RF/detector primary.

Perhaps it was assumed that this was not a set for the novice constructor, and that the operator would have had some prior experience in winding the coils and constructing and operating it. The valve types are A442, A415, B443 and B405.

Early electric sets

Referring again to *The Listener In*, there was a four-valve electric set in the October 23rd issue. This circuit denotes the beginning of the brief interval of the 4/5 valve TRF configuration popular for two or three years up until 1931, when the autodyne superhet became very popular and dominated electric receivers until the introduction of the pentagrid converter.

The 1929 circuit is a little unorthodox in that it has a first stage RF amplifier in which there is no tuned circuit at the grid. The tuning circuits are a tuned anode/tuned grid (otherwise known as band pass tuning) in the second stage and again in the detector stage.

This receiver requires a four-gang tuning capacitor and coil details which are not given, but *are the same as the battery circuit described a couple of weeks ago* (terrific!). The circuit also includes reaction, which is a dubious inclusion in a set with four tuned stages. One would think that sensitivity and selectivity, even with home wound solenoid coils, would be more than ample in this circuit without reaction. The detector stage is a grid-leak triode, which is then transformer coupled to a pentode.

The article gives an explanation of how grid bias is obtained by cathode resistors which really has to be read to be believed. One could almost be forgiven for concluding that the author of the article didn't have a clue what he was talking about. Not only that but there's no cathode resistor in the output stage anyway, to give any bias at all.

The construction details are also remarkably scant. It seems that this set was to be built on a timber base, covered with copper sheeting to act as shielding and a convenient earth for the wiring. Again, the three RF stages are placed in compartments, and the power supply is not shown.

Later TRFs

The same criticism could not be made of the '1932 Advance' described in *Wireless Weekly* for January 8th 1932, and shown in Fig.3. This circuit must have been the very last of the all-electric TRFs, because there is a little block insertion in the column proclaiming 'Next week - special superhetrodyne number'.

The 1932 Advance circuit is very typical of many of the commercial TRFs of the day. There is not a lot of variation in these sets, with the possible inclusion of a voltage divider where the volume control, together with the detector screen, is taken from the 35 volt tap.

The circuit makes a very good guide to rebuilding an unidentified derelict chassis that has a few bits and pieces missing from it. Looking at the circuit, we see nothing complex or unusual. There are two stages of variable-mu RF amplifiers type 35, an anode-bend detector type 24A and a type 47 pentode output. The anode-bend method of detection is better than grid leak detection when the input voltages are high.

Notice that with this type of set there is no band-pass tuning or a four-gang tuning capacitor to complicate things.

One departure from the system used by many set manufacturers is the inclusion of a 250,000 ohm anode load resistor (R8) where an audio choke is more commonplace. The choke has a lower DC resistance, and hence the valve can operate at a higher anode voltage and thereby has a higher gain. The inductive reactance of the choke at audio frequencies forms the anode load, and not merely the DC resistance.

In conclusion, four-valve sets were plentiful and varied in Australia in the late 1920s and early 1930s. Those described here and last month will hopefully have given you a brief insight into the variety available. ea