Vintage Radio

by PETER LANKSHEAR

A decade of radio development — 1

Electronics technology has never remained static for long. Personal computers, home video recorders, compact disc players and satellite TV are some examples of considerable development in this last decade. In the 1920's and early 30's, there was a similar period of rapid evolution in domestic radio receivers.

In 1925, American radio manufacturing was expanding rapidly, to satisfy a huge demand for receivers for the booming new broadcasting industry. And despite the stock market crash and the following depression, a rapid rate of technical progress was maintained during the following decade.

By 1935, domestic receivers had evolved from dependence on battery powered triodes and with major problems in stable RF amplification, into high performance and reliable equipment that underwent little further basic development right to the end of the valve era. To get some idea of the extent of the changes in technology during this decade, in this and next month's column, we will compare a typical 1925 receiver with its 1935 counterpart from the same manufacturer.

Although during this period radio equipment was produced in many parts of the world, American developments were foremost — a result of the sheer size of their market, competition, purchasing power, the number of makers and economic influences. Because they were therefore 'state of the art', I have selected a pair of typical US-made receivers for comparison.

Despite our geographical remoteness and small populations, Australia and New Zealand receiver design was often in advance of Britain's and not far behind America's. For example, by 1933 the superheterodyne accounted for only 50% of British models, whereas here it had already become the standard. Philips did not produce a superheterodyne until 1934, the same year that AWA produced the first edition of the internationally published series of the *Radiotron Designer's Handbook*.

Pairs of 1925 and 1935 receivers from the one maker are not plentiful. Although literally hundreds of American firms joined the rush into radio manufacturing in the mid 1920's, the majority did not survive the crash and the depression. Similarly, few of the pioneer Australian companies were still making receivers in 1935. Furthermore, after 1930, tariffs restricted US imports into Australia and to a lesser extent into New Zealand.

One make that *was* available in both 1925 and 1935 was Stewart Warner. Like the better-known Atwater Kent organisation, before entering the radio business Stewart Warner was a well established maker of automobile accessories. In 1925, they produced their first radio, the model 300 TRF. This will be compared with their R-136 of 1935.

Over 1000 models

McMahon's *Radio Collector's Guide* lists 1173 identifiable American models for 1925. Three main classes of receiver were being produced, comprising 15 superheterodyne, 70 neutrodyne and an incredible 695 tuned-radio-frequency (TRF) models.

The remaining receivers were a miscellany ranging from crystal sets, through simple regenerative to reflexed receivers. Many were low performance or obsolete types that would not have sold in large numbers.

Of the three major types, most advanced was the expensive, and, for the time, very complex superheterodyne to which RCA had the monopoly for complete receivers.(They did, however, licence AWA to make an Australian version). The neutrodyne, usually with two neutralised tuned RF stages, was the industry's answer to the superhet. Neutralising stabilised and optimised gain from the triode valves used as RF amplifiers, but was avoided by most manufacturers as it was subject to Hazeltine Corporation royalties. Accordingly, the majority settled for the TRF receiver. This usually consisted of two RF amplifier stages, a grid-leak detector and two transformer-coupled audio amplifiers. As there was no ganging of the tuned circuits, the TRF, like the neutrodyne, generally had three tuning controls — which had to be adjusted more or less simultaneously.

The TRF was so simple that many makers did not bother to supply circuit diagrams. The chief variations were in the means of stabilisation of the triode RF stages to prevent oscillation, none being as efficient as neutralisation. One popular method was to connect resistors in series with the grids of the RF valves.

For their model 300, Stewart Warner used an earlier method that reduced the gain sufficiently to damp any tendency towards oscillation by positively biassing the control grids of the RF valves.

Fig.1: In 1925, domestic receivers had not become pieces of furniture. With its metal panel and lack of ornamentation, the Stewart Warner 300 was strictly functional in appearance.

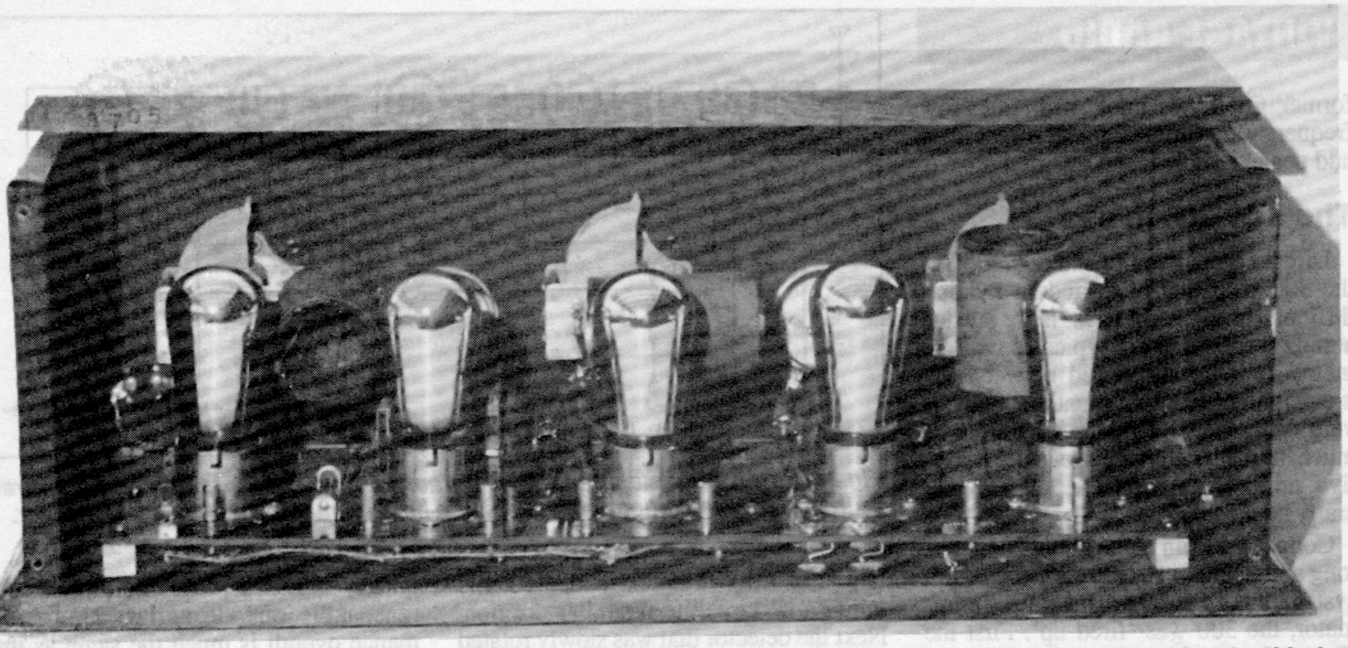

Fig.2: The rear of the Stewart Warner 300 with the wooden back and its attached lid removed. Directly under the lid, the all-important UV201A valves were readily accessible. From the right, they are 1st RF, output, 2nd RF, 1st audio and detector.

Many 1925 receivers had wooden cabinets and polished black front panels. For the 300, Stewart Warner chose a wraparound brown crackle painted steel panel instead, but retained the mandatory hinged wooden lid and base.

Few components

Inside, the few components are laid out symmetrically on a baseboard. To minimise coupling, the large tuning coils, wound with green silk-covered wire, are mounted so as to be mutually at right angles. Between them are two audio transformers. An engraved strip of bakelite at the rear carries the five UV201A valve sockets, minor components and terminals.

There are only two fixed capacitors, both mica, and one fixed resistor — a 1 megohm grid leak. Two wirewound potentiometers and an on/off switch, complete the parts list.

The circuit in detail

Stewart Warner's model 300 is about as simple as a five valve radio can be. There are three variable capacitors, each carrying its associated tuning coil. The aerial terminal is connected to a tapping on the first coil — an efficient coupling method, but aerial capacitance affects the tuning capacitor setting, preventing ganging. Two RF amplifier stages follow, their anodes being fed through flat wound primary windings positioned inside the coil formers.

The 250pF grid capacitor for the detector is made of sheets of mica and tinfoil clamped between two pieces of fibre. There are two clips for the 'plug in' grid leak resistor, which may be anywhere between 0.5 and 5.0 megohms. Early grid leak resistors were made much like automotive fuses, with brass caps at each end of a glass tube protecting a carbonised element. The detector anode RF bypass capacitor is similar to the grid capacitor.

Following the detector is the audio amplifier, consisting of two identical transformer-coupled stages. With a transformer turns ratio of 1:3, each stage has a gain of about 25. In 1925, fidelity was not an issue, and like the associated horn loudspeakers, the small simple audio transformers have a very restricted response. More serious is the lack of power output. Even with optimum bias, a 201A with an anode supply of 90V is rated at providing only 15 milliwatts.

The two variable resistors provide interactive control of the receiver gain and stability. R1, called 'Battery Control' with a total resistance of 3 ohms, is connected in series with the negative filament lead, and is used to reduce the 6.0 volt battery supply to the rated 5.0 volts for the 201A valves.

The correct use of negative grid bias was not always fully understood in 1925, and a casual glance at the circuit gives an impression that the audio valves have none. In fact the voltage drop across the battery control does provide some bias, but only about 1V, which is less than RCA's recommended 4.5 volts for correct operation of a 201A at 90 volts HT.

Bias can be increased by reducing the filament voltage with the battery control, but the performance of the output valve is restricted even more. The Stewart Warner 300 is strictly low powered and low fidelity!

RF amp 'volume control'

'Volume Control' R2 is a 300-ohm potentiometer connected across the filament supply line, enabling the grid returns of the two RF valves to be varied continuously between the positive and negative leads. This effectively allows the grid bias to be varied from negative to positive. Valve operation is more or less normal with the wiper at the negative end of the control, but at the positive end, grid bias is cancelled and grid current flows, loading down the tuned circuits sufficiently to prevent oscillation.

The term 'volume control' is a misnomer, as it is more of a stability control. Significantly, positive grid operation was abandoned and grid bias batteries were used in the following year's models.

The third tuned circuit is connected to the grid-leak detector. Simple, sensitive and suited to transformer coupling, grid-leak detectors were used universally in early receivers. They effectively used the grid and cathode of the valve as a diode detector, with the resulting audio developed across the grid-leak resistor and then amplified by the valve in the normal way, as an audio amplifier.

Two transformer-coupled audio stages follow. They provide adequate gain, but as mentioned previously, the valves for these stages are under biased with inadequate power output even for a horn speaker. By later standards, audio transformer fidelity is poor, with little low frequency performance, and a restricted and peaked treble response.

The S-W 300 in use

Direct comparison of the operation of the 300 with that of a modern radio is difficult. In the early days, large outside aerials were standard, typically with 30 metres of wire suspended between 12-metre poles; but the situation today is very different. Signal strengths are now much higher, receivers are more sensitive, and internal ferrite aerials are generally adequate.

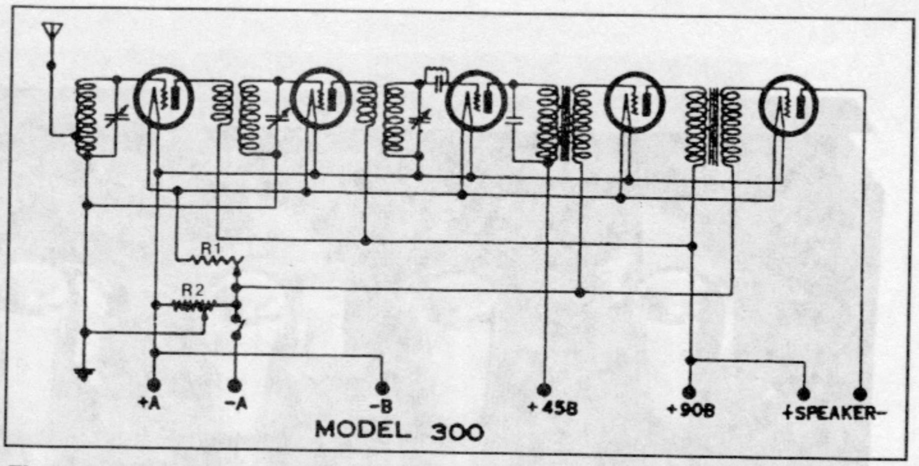

Fig.3: At this early stage, those manufacturers who did provide circuits rarely bothered to give component values. It's hard to imagine a simpler five valver.

Connected to an aerial about 20 metres long and rising to 10 metres, a good earth system, a horn speaker and battery eliminator, the 300 was 'fired up'. First the 'Battery' control was set to give 5.0 volts at the filaments and then the 'Volume' control set at mid scale. A gentle tap on the detector valve produced a healthy 'pong' from the loudspeaker, showing that so far, all was well.

Tuning in a station ideally requires three hands! Unless all three tuned circuits are in fairly close alignment, these unganged receivers are quite 'dead'. An essential aid is a station log, giving individual settings for the dials. Unlike most of its contemporaries, the middle dial of the 300 has a wavelength scale in addition to the normal 0-100 scale, making station finding easier.

Initially, this dial was set to the wavelength of a local station and the aerial tuning dial turned to a similar position. Next the detector dial was slowly rotated until a faint signal was heard. All three dials were then adjusted for resonance.

With the first station logged, the settings for other stations became easier to find. At the lower frequencies, where RF gain is low, the 'Volume' control has little effect, but at the upper half of the tuning range, it is needed to prevent oscillation. Receiver gain is best controlled by detuning of one of the variable capacitors.

Selectivity is more than adequate to separate local stations, and below about 700kHz is comparable to that of a simple superhet. But it falls off at the upper end of the band. On the other hand, sensitivity becomes noticeably greater as the frequency is raised. When connected to a reasonable outside aerial, RF performance overall is much the same as that from a modern receiver using a small ferrite aerial.

With the restricted audio fidelity and power output, listening quickly becomes tiring. However, in 1925, radio in the home was a miracle, and receivers such as the Stewart Warner 300 brought much pleasure and opened new horizons for literally millions of listeners, who were unconcerned about any technical limitations. These could be dealt with later.

During the following decade they were in fact overcome, and in addition there was a tremendous number of new developments — many of which were incorporated in Stewart Warner's R-136, to be described next month. ■

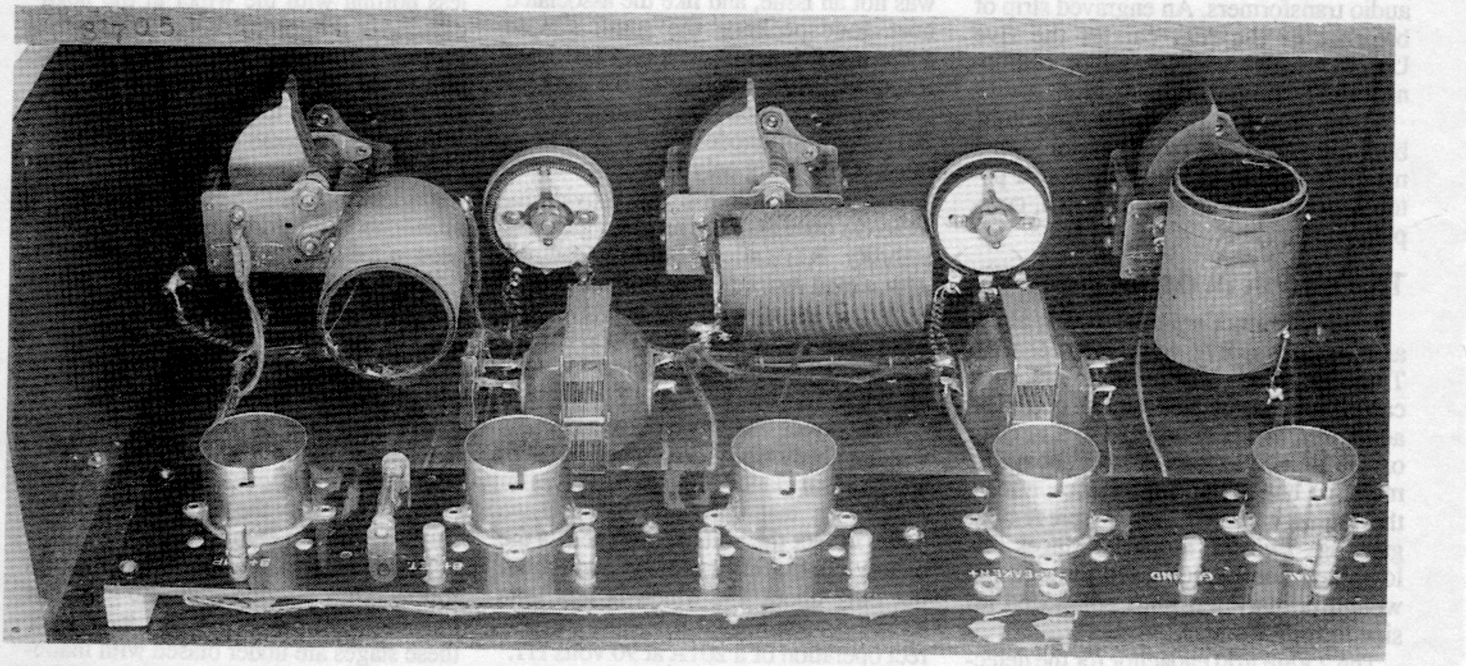

Fig.4: As this closeup shows, the construction was simple and not far removed from the 'breadboard' method popular with amateur builders of the time. TRF receivers used little if any shielding.