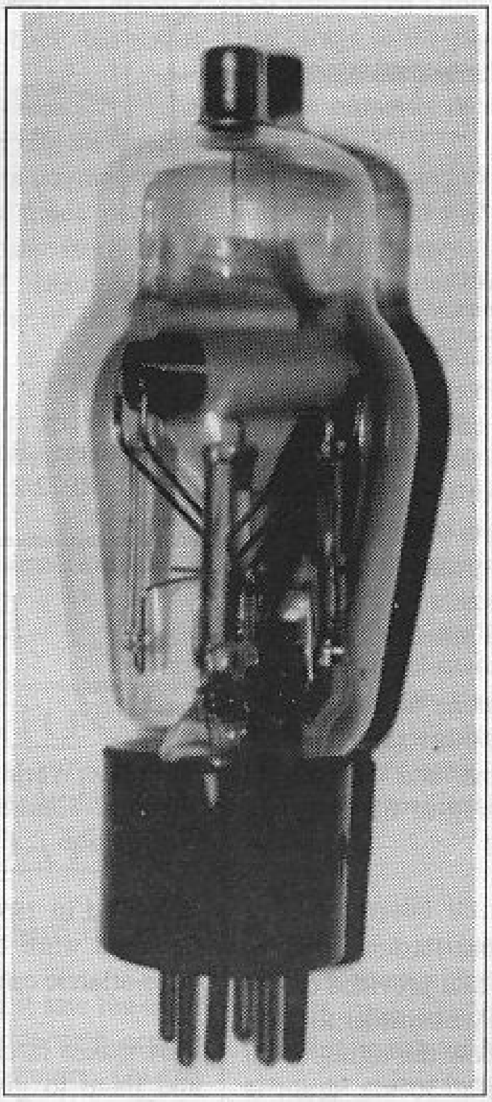
THE AWA AV11 RECTIFIER

By Colin MacKinnon
VK2DYM

During WW 2 Australia was left in a desperate situation. Having relied on England for most of its defence needs in the past, it now found itself isolated and unable to obtain military equipment, components or raw materials for local manufacture. Australian industries hastily converted to war production and the wireless and electronics industry was generally able to satisfy needs for telephones, radio transmitters and receivers etc. However, radar production which had commenced in 1940 after Australia was taken into the confidence of the UK scientists, looked like coming to a complete halt. Australian scientists of the Radiophysics Laboratory, or RPL, had obtained samples of the English ASV MK II radar set and were working to adapt it for ground use. This ASV radar used the VT90 triode in a push-pull oscillator, producing around 6 KW pulse output, but the RPL scientists wanted more power, around 10 KW, so they needed a high voltage rectifier to provide the 10,000 volt high tension.



By December 1940 the supply of suitable imported rectifiers was exhausted, and urgent efforts were being made to obtain more. Philips, which had a manufacturing plant in Australia for domestic valves, thought it could get a suitable valve from its US factory, but only in very small quantities. STC (Standard Telephones and Cables) also had a valve plant in Australia but it had to this point only made amplifier valves for telephone repeaters. STC suggested the imported 4059A, but couldn't get any from its UK parent company. AWV (the Amalgamated Wireless Valve Co., a subsidiary of the Australian company, AWA) had a large valve manufacturing plant already making a range of receiving and transmitting valves based mostly on RCA designs, but it had not made high voltage rectifiers before. Their best effort was a rectifier capable of 5000 volts at 60 ma. and they refused to do any research work until they received a contract and priority order from the government.

An order was hastily arranged and AWV commenced development of the Type AV11 half wave high vacuum rectifier. The tentative ratings were to be:

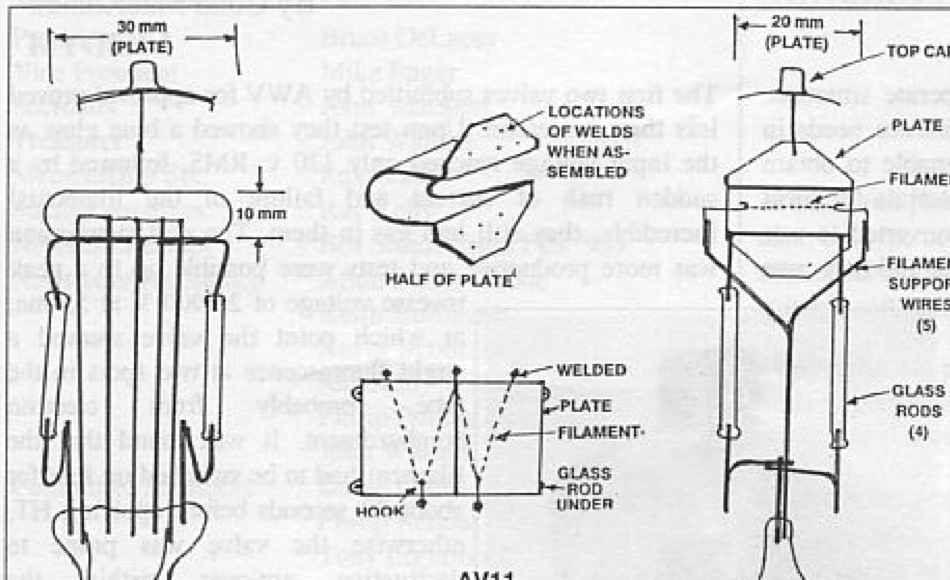
- Filament voltage: 2.5 volts
- Filament current: 1.75 amps
- Peak Inverse Voltage: 14,500 volts
- Maximum average plate current: 30 ma.
- Maximum peak plate current: 350 ma.

The first two valves submitted by AWV for approval proved less than successful. Upon test they showed a blue glow as the input voltage reached only 120 v. RMS, followed by a sudden rush of current and failure of the filaments! Incredibly, they still had gas in them. The next submission was more productive and tests were possible up to a peak inverse voltage of 25,000 V at 55 ma. at which point the valve showed a slight fluorescence at two spots in the tube, probably from electron bombardment. It was found that the filament had to be switched on first for about 30 seconds before applying HT, otherwise the valve was prone to destructive arc-over within the elements. These tests commenced in January 1941 and continued through to the end of February at which time tentative specifications for production valves were issued. Initially the RPL wanted each valve to be tested at a PIV of 25,000 v. and 50 ma. current for 5 minutes, without arc or glow, but AWV pointed out that such a test was like striking matches to prove they were acceptable. Therefore AWV was asked to guarantee 1000 hours operating life at ratings of 14,500 PIV and 30 ma. max. average plate current, plus a test of 21,000 PIV at 40 ma. for 5 minutes. The scientists suggested AWV could improve their manufacturing quality and in particular the degree and consistency of evacuation. To prevent switch-on failure a time delay relay was fitted to the radar equipment allowing a 30 seconds filament warm-up before application of HT. Incidentally the English ASV radar used a step switch with a caution to the operator to "Count five before switching to H.T."

To compare the AV11 with other valves a series of tests were carried out on samples of RCA 2X2(879) and Mazda V.1907 (military designation CV 1111) rectifiers. The relevant test results were:

	2X2	V.1907	AV11
Filament Voltage	2.5	4.0	2.5
Current (amps)	1.75	1.1	1.75
AC Plate Voltage RMS	4,500	5,000	5,000
Peak Inverse Voltage	12,500	12,000	12,500
Peak Plate Current	100 ma.	350 ma.	300 ma.
DC output current	7.5 ma.	50 ma.	30 ma.

"The AWA AV11 Rectifier" continued



AV11
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Under test the 879 (the indirectly heated cathode version of the 2X2) withstood 26,000 PIV. After other severe tests it was noted that "examination shows the cathode to be practically destroyed. However, the valve is still capable of giving 7.5 ma. at 3,000 v. with an ac input voltage of 2700 v RMS." In these tests the scientists had greatly exceeded the 10 Kv. ratings of their own test equipment so "thought it inadvisable to leave it on for more than 3 minutes."

Several of the V.1907's proved to be prone to flashover at around 17,000 volts at only 11 ma. but other samples were able to give 8,500 volts output at 12 ma. and withstand a PIV of 18,700 v. Simultaneous switching of filament and HT was a guarantee of valve destruction!

In their summary the scientists noted:
"The factor of safety against peak inverse flashover on the V.1907 seems to be somewhat less than that provided on the AWA valves type AV11, specially when we consider that the current drain, when tested, was well below the rating of 50 ma. The voltage drop across the valve at 30 ma. drain is nearly the same as that appearing across the AV11."

"It seems that the 2X2-879 has a rather greater factor of safety than the Australian made AV11. It is probable that this is largely due to the better evacuation of the American job. When the HT and filament voltages are applied simultaneously the glow appearing in the 879 is a light grey colour and that in the AV11 a bright blue, which seems to indicate a better vacuum in the former. Also due to its construction (a straight equipotential cathode surrounded by a concentric cylindrical anode) the 879 is a better tube to withstand very high peak inverse voltages than the AV11."

Physically, the AV11 is similar to the AWV produced 807, and uses the same envelope and top cap. The base is the USM4 and is branded "Radiotronics". Internally, the filament is a horizontal "W" supported by 5 wires, the outer two of which are connected to base pins, 1 and 4. The plate is a horizontal flattened cylinder supported on each corner by a glass rod, four in all. Wires inserted into each end of the glass rods connect them to the plate and to wires in the squeeze. The plate is made up of two U-shaped, flanged sheet pressings welded together. The top cap is connected to the top plate flange by a wire. The plate cylinder surrounds the filament, with a clearance of 5mm. Refer to the sketches and photo.

The AV11 was accepted for production and several thousand were produced during the war for a number of different designs of radar set, both ground and airborne. Specifications of the AV11 do appear in Babini's "International Radio Tube Encyclopedia" of 1949, along with many other wartime valves which faded into obscurity.

References: Radiophysics Laboratory Reports RP57/1, RP72/1, RP72/2, RP72/3.

BOOK REVIEW

by Ken England.

"How the World was One: Beyond the Global Village" by Arthur C. Clarke, Victor Gollancz Ltd. 289pp, about $32.95. Non-Fiction.

Published in 1992, the first part is a re-write or re-issue of his 1958 work celebrating the laying of the first working trans-atlantic cable a hundred years before.

This makes fascinating reading. Clarke goes off track here and there to give us an idea of some of the conflicting personalities and ideas behind the failures and eventual success. Curiously, the laying of one early cable was recorded by a reporter for the "Sydney Morning Herald". Some of the Atlantic cables laid in the later 19th Century were still in use in the 1950's. Curiously, submarine cable operators were slow to use solid state repeaters.

While Clarke tells a good story, and obviously has a good technical understanding, not over much of the technical side come through. I would like to have seen a little more of this, but Clarke, or his editors, might have felt that this would have frightened off the more general reader. It's still an education just reading it.

After dealing with telegraph cables, Clarke proceeds to telephones and radio. We meet Oliver Heaviside, a reclusive mathematician who contributed to both. There's not much