

RADIOTRONICS

AMALGAMATED WIRELESS VALVE CO. PTY. LTD.

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RADIOTRON 1.4 VOLT 5 VALVE DUAL WAVE RECEIVER Circuit No. RA51

The economy in battery consumption, which may be obtained by the use of the Radiotron 1.4 volt valves has led to a demand for their application in dual-wave receivers. The performance of the receiver to be described should be regarded as typical of what may be obtained with good circuit and coil design.

As a result of the inevitably lower available emission of the 1.4 volt valves, as compared with that of the A.C. types, the chief problem encountered in the design of a receiver incorporating a short-wave band and employing a pentagrid converter valve having similar characteristics to the 1A7-GT, is usually the difficulty in obtaining satisfactory and consistent oscillator performance over the wide tuning ranges demanded in present day receivers.

This is primarily due to the unsatisfactory values of L and C which must be used in the oscillator circuit of the converter valve to cover such wide ranges, particularly on the highest frequency range. This difficulty may be overcome in the case of the 1A7-GT (when used with the usual tuned grid-plate feedback oscillator circuit) by reducing the frequency coverage to a lower value, depending on the obtainable Q of the oscillator tuned circuit. Where this is not desirable, however, wider coverage may **only** be obtained by paying particular attention to circuit losses and the design of the oscillator coil. In this way, entirely satisfactory operation has been obtained in the receiver to be described, for a short-wave frequency coverage of 3.4 : 1.

Circuit Features.

The circuit arrangement of the 5 Valve Dual Wave Receiver (RA51) is essentially the same as that of the receiver (RB52), published previously in Radiotronics 104, except for the inclusion of the dual wave feature and modifications to the converter circuits.

The tuning ranges covered are:

Broadcast	}	550 — 1600 Kc/s
		545 — 187.3 Metres
Short-wave	}	6.5 — 22.05 Mc/s
		46.2 — 13.6 Metres

The same valve types are used throughout and are as follow:—

R.F. Amplifier	— 1P5-GT Super-Control Pentode
Frequency Converter	— 1A7-GT Pentagrid Converter
I.F. Amplifier	— 1P5-GT Super-Control Pentode
Detector and A.F. Amplifier	— 1H5-GT Diode, High-Mu Triode
Power Amplifier	— 1Q5-GT Beam Power Amplifier

It should be noted that all of these valve types are now manufactured in Australia and are available from stock.

In order to obtain satisfactory and consistent oscillator performance over as wide a short-wave frequency coverage as that stated, padder feedback is used in the oscillator circuit of the converter on both ranges, while the oscillator grid circuit losses are reduced to a minimum by the use of a trolitul former for the short-wave oscillator coil. With the constants given, the padder feedback circuit limits the variation of oscillator grid current over the short-wave band to a value (20-49 μ A.), which maintains the total cathode current within the recommended limit of 3 mA. maximum and enables a satisfactory value of conversion conductance to be obtained over the entire range.

On the broadcast band, however, the feedback obtained is excessive and results in a sharp rise of oscillator grid current as the high frequency end of the band is approached. This undesirable feature is considerably reduced and a relatively flat characteristic obtained by connecting a resistor of 25,000 ohms in parallel with the oscillator grid coil, as shown in the circuit diagram.

The coils for the broadcast band are mounted in coil cans and are similar to those specified for circuit RB52, with the exception of the oscillator primary, which now has 40 instead of 4 turns. The additional turns are necessary, owing to the alterations to the oscillator circuit constants to permit optimum

short-wave operation. The short-wave coils are of the interwound type and are designed to have minimum high-frequency loss. Leads are kept short by mounting the coils close to the wave change switch. The design of the short-wave oscillator coil to cover a wide range of frequencies presents the main problem of this type of receiver. If due regard is given to selecting the optimum wire gauge for the secondary, maintaining a length/diameter ratio approaching unity and using low loss construction (i.e., short leads, optimum winding turns per inch and a former of low high-frequency loss), a satisfactory short-wave oscillator coil should be obtained. The short-wave oscillator coil described in the coil data provides an oscillator grid current having the following values:—

Frequency (Mc/s.)	Wavelength (Metres)	Oscillator Grid Current (μ A.)
22.05	13.6	49
12.5	24.0	45
6.5	46.2	20

These values of oscillator grid current are above the recommended minimum value of 20μ A. so that the recommended maximum cathode current of 3 mA. is not exceeded at any point in the tuning range. Also, oscillation of the 1A7-GT is maintained on both ranges when the filament and plate supply voltages are reduced to 1.1 volts and 45 volts respectively (B battery internal resistance = 1000 ohms).

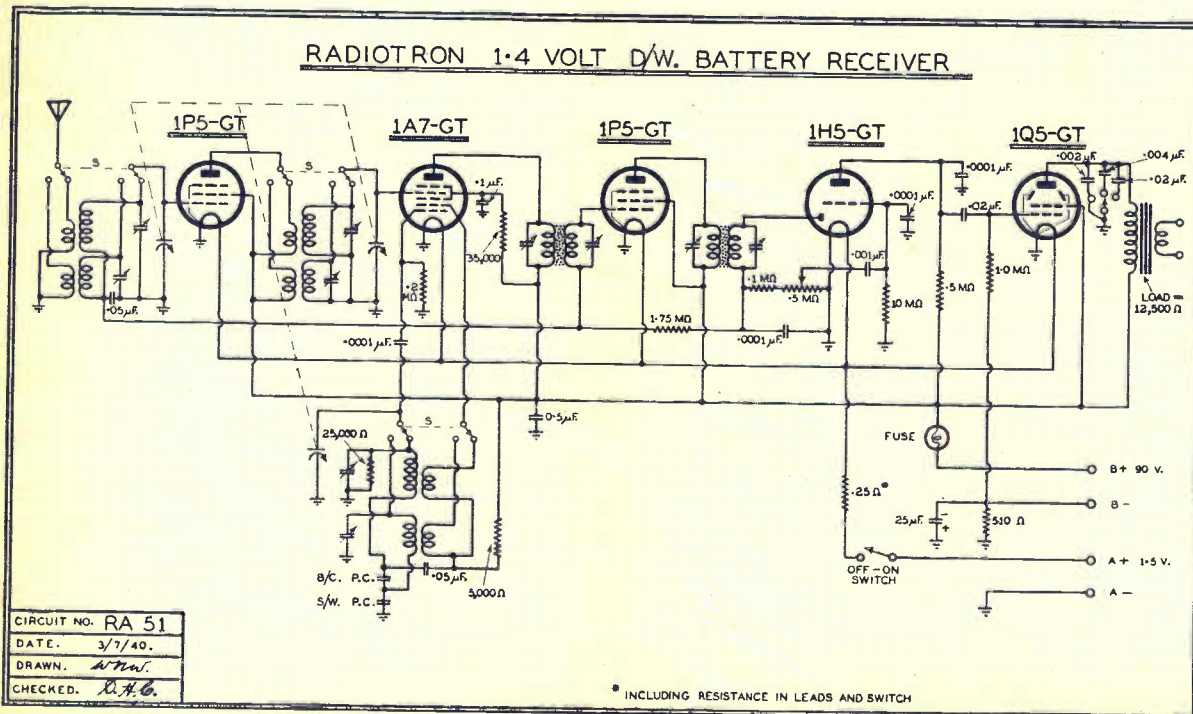


Fig. 1.

The coil switching arrangement for band-changing is simple, while providing for the separate switching of both primary and secondary of each coil on both bands.

The diode load filter arrangement is similar to that of circuit RB52, in that the second filter condenser is connected directly to the grid of the 1H5-GT. In this way improved filtering is provided at low volume control settings, together with a slight tone control effect when the volume control is advanced for receiving weak signals. Operation of the 1H5-GT with high resistance grid leak bias is used in order to permit the reduction of A.C. loading and distortion in the diode circuit.

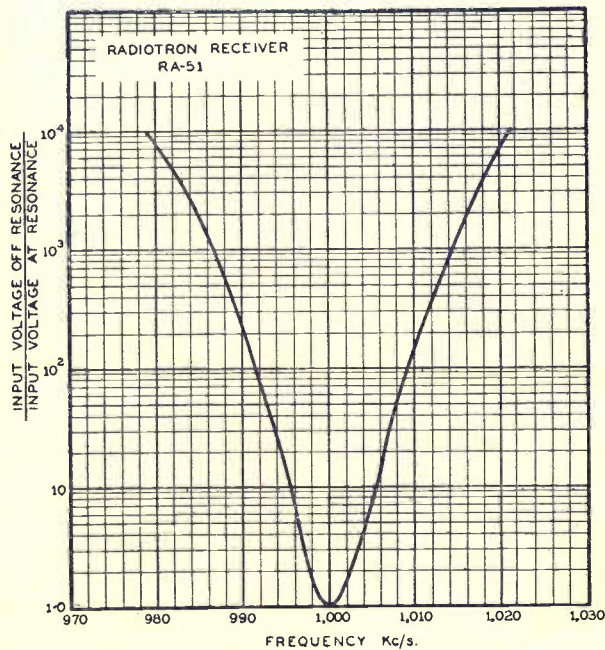


Fig. 2

The filtering of stray R.F. interference from the audio section of the receiver is achieved by the use of a pi-type filter in the diode circuit, together with a 0.0001 μ F. bypass condenser connected from the plate of the 1H5-GT to ground.

The three-position tone control circuit is shown in the circuit diagram connected across the primary of the speaker output transformer. In this simple system, the values of capacitance were selected by means of an aural test, so that some adjustment of these values may be required to suit different cabinets, loud speakers and individual taste.

The simple A.V.C. system employs the full D.C. voltage available from the diode circuit. After the usual resistive capacitive filter network, this voltage is used to control the grids of the 1P5-GT valves in the R.F. and I.F. amplifier stages. A.V.C. is not applied to the

signal grid of the 1A7-GT owing to the sharp cut-off characteristic of this converter valve. The effectiveness of the A.V.C. system on the broadcast band is shown by the A.V.C. characteristic in Fig. 3.

A more desirable A.V.C. characteristic may be obtained, but on the broadcast band only, by applying a fifth of the available A.V.C. voltage to the signal grid of the 1A7-GT. This requires, however, a more expensive and elaborate A.V.C. voltage-dividing-network. It is not recommended that A.V.C. be applied to the 1A7-GT at frequencies above 1600 Kc/s.

The power output of the 1Q5-GT in this receiver is limited to 168 mW.* (10% Total Harmonic Distortion). Self-Bias (-6 volts) is employed and thus avoids the necessity for a separate C bias battery since the remaining valves in the receiver are all operated at zero bias. In addition, a decrease in bias is assured as the B battery terminal voltage falls with use.

The total B battery drain on either wave band, under zero-signal conditions, is 12.35 mA. This is reduced to 10.7 mA. when the receiver is tuned to a modulated signal of 100,000 μ V. at the aerial terminal and the power output is adjusted to 168 mW.

The power output may be increased to 270 mW., if desired, but only at the expense of increased B battery drain and a separate C bias battery. In this case, 90 volts, instead of 84 volts, are available as plate and screen supply voltage for all the valves in the receiver, resulting in an increase in the total current drain. It is desirable, when the high tension voltage is so increased, that the 1A7-GT cathode current be checked and adjustments made to the oscillator plate and screen resistors, in order to prevent operation with a cathode current in excess of the maximum value recommended (3.0 mA.). Under this condition, the zero-signal B battery drain was found on actual test to be 20 mA., falling to 16 mA. under the signal input conditions previously defined, and with the output adjusted to 270 mW. (7% Total Harmonic Distortion).

The filament supply voltage is obtained from a 1.5 volt dry-cell, preferably of the block type specially designed for this class of service. It is strongly recommended that a series dropping resistor of 0.25 ohm resistance (inclusive of lead and switch resistance) be inserted between the 1.5 volt cell and the filament circuit, as shown in the circuit diagram. Further information concerning this precaution is given in Radiotronics 96, page 22. * See Radiotronics 102 page 1-2, and Radiotronics 103 page 21.

The plate and screen supply voltages are obtained from the usual 90 volt B battery block, of which, however, only 84 volts are available, owing to the loss of 6 volts in self-bias for the 1Q5-GT.

Performance.

Test results indicating the performance of this receiver are given in tabular form at the end of this article. The **absolute sensitivity** at the aerial terminal is better than $3 \mu\text{V}$. over the broadcast band and $15 \mu\text{V}$. over the short-wave band, for 50 mW. power output. The **noise level** under these conditions and with the volume control set at maximum, varies on the broadcast band, from 7 mW. at 1500 Kc/s. to 12 mW. at 600 Kc/s. On the short-wave band, under the same conditions, the noise level varies from 1.0 mW. at 20 Mc/s. to 0.5 mW. at 7.5 Mc/s. The noise level when expressed in terms of ENSI becomes $0.38 \mu\text{V}$. at 1500 Kc/s., and $0.43 \mu\text{V}$. at 600 Kc/s. on the broadcast band, and $0.42 \mu\text{V}$. at 20 Mc/s. and $0.53 \mu\text{V}$. at 7.5 Mc/s. on the short-wave band.

The **image ratio** at 20 Mc/s. is 30, increasing to 640 at 7.5 Mc/s. These values are higher than those which have been obtained in other receivers of similar design tested in this laboratory, and are due principally to the use of lower loss and higher Q aerial and R.F. coils. In this connection, it may be of interest to note that the Q of the short-wave secondary coils is of the order of 200 at 10 Mc/s. The bandwidth of the receiver was measured at 1000 Kc/s. on the broadcast band and the **selectivity curve** obtained is shown in Fig. 2. From the latter, the bandwidth of the receiver is seen to be 10 Kc/s. at 10 times down, 27.5 Kc/s. at 1000 times down and 42.5 Kc/s. at 10,000 times down.

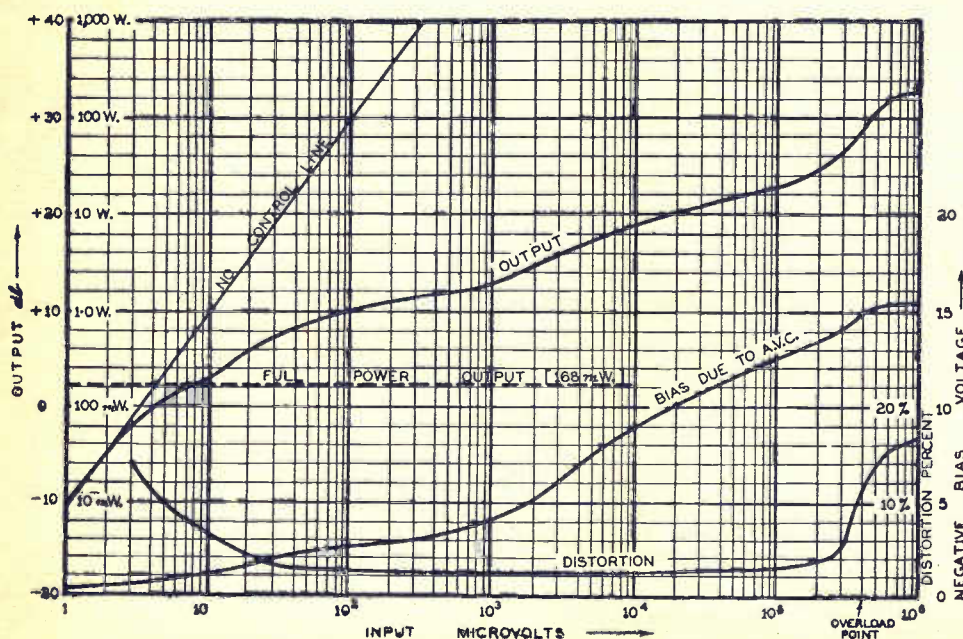
The **A.V.C. characteristic**, shown in Fig. 3, is representative of the receiver performance at 1000 Kc/s. and has been drawn according to Scroggie's method.*

It is seen that the 50 mW. output level is reached, on the broadcast band, at a point slightly above $2 \mu\text{V}$. input and the full power output (168 mW.) at $8 \mu\text{V}$. Although not shown on the diagram, at 12.5 Mc/s. on the short-wave range 50 mW. output is obtained with $7 \mu\text{V}$. input and full power output at $27 \mu\text{V}$. The mean slope of the A.V.C. characteristic from 20 to 200,000 μV . is 4.4 db for a 10 : 1 ratio of input voltage.

The overload point occurs at an input voltage of 400,000 μV . and is probably due to the limited grid base of the controlled valves; at this point the developed bias is -15 volts.

Distortion due to modulation rise is also apparent and is seen to increase rapidly at inputs above 100,000 μV ., with the 30% modulated signal with which the measurements were taken. The signal voltage, at which the receiver overloads, may be slightly increased by applying a fractional part only of the available A.V.C. voltage to the grids of the controlled valves. This results, however, in a less desirable A.V.C. characteristic being obtained, while appearing to be unnecessary under almost all listening conditions likely to be experienced.

It is interesting to note that the receiver operates without instability when the input voltage applied to the aerial terminals is as high as 2 volts, on either band, although the



* See—The Radiotron Designer's Handbook, Third Edition, pp. 177-178, 236-238.

Fig. 3.

distortion, of course, is correspondingly high. The "apparent" harmonic distortion, which is shown at low input levels, is largely noise combined with diode distortion. With an input exceeding 400,000 μ V. there is some tendency towards feedback when the internal resistance of the B battery rises. This may be substantially eliminated by connecting a 4.0 μ F. condenser directly across the B battery terminals, but in most cases this precaution is unnecessary. Without this capacitance the receiver is completely free from feedback at input voltages up to 400,000 μ V. even when the condition of the B battery is very poor.

ABSOLUTE SENSITIVITY AND NOISE LEVEL FOR 50 mW. OUTPUT.

Position	Frequency	Sensitivity μ V.	Stage Gain	Image Ratio	Noise Level mW.	Ensi μ V.
1P5-GT (I.F.)						
Control Grid ..	455 Kc/s.	7000	—	—	—	—
1A7-GT						
Signal Grid ..	455 "	90	—	—	—	—
	600 "	100	—	—	—	—
	1000 "	100	—	—	—	—
	1500 "	100	—	—	—	—
	7.5 Mc/s.	110	—	—	—	—
	12.5 "	110	—	—	—	—
	20.0 "	110	—	—	—	—
1P5-GT (R.F.)						
Control Grid ..	600 Kc/s.	10	10	—	4	—
	1000 "	11.5	8.7	—	3.2	—
	1500 "	15	6.6	—	2	—
	7.5 Mc/s.	33	3.3	—	.3	—
	12.5 "	22	5.0	—	.5	—
	20.0 "	30	3.7	—	.3	—
Aerial	600 Kc/s.	2.7	3.7	—	12	1.43
	1000 "	2.4	4.8	—	10	0.41
	1500 "	2.9	5.1	—	7	0.38
	7.5 Mc/s.	14	2.4	640	0.5	0.53
	12.5 "	7	3.1	275	1.6	0.44
	20.0 "	9	3.3	30	1.0	0.42

NOISE LEVEL AT 5 μ V. AND 10 μ V. INPUT TO AERIAL TERMINAL FOR 50 mW. ABSOLUTE OUTPUT.

Frequency Kc/s.	Input to Aerial	
	5 μ V.	10 μ V.
600	4.0 mW.	2.2 mW.
1000	3.5 mW.	1.8 mW.
1500	3.0 mW.	1.5 mW.

BAND WIDTH.

Frequency Kc/s.	Band Width (Kc/s.)			
	10	100	1000	10,000
Input Voltage off resonance				
Input Voltage at resonance				
600	—	—	25	—
1000	10	17.5	27.5	42.5
1500	—	—	30	—

DISTORTION.

At 25,000 μ V. input to aerial at 1000 Kc/s., 30% modulated at 400 c/s., and with 12,500 ohm resistive load in place of loudspeaker.

Output (mW.)	Harmonic Distortion (total)
50	2.7%
100	3.5%
168	10.0%

BATTERY CURRENT DRAIN AND BIAS

VOLTAGE.

	Current Drain	1Q5-GT Bias Voltage
A Battery	0.3 A.	
B Battery—No signal	12.4 mA.	6.3
0.1V signal unmodulated	10.7 mA.	5.45
0.1V signal 168 mW. output		
	10.8 mA.	5.50

OSCILLATOR GRID CURRENT.

Oscillator Grid Current in 0.2 megohm grid resistor for an average sample 1A7-GT having an oscillator $g_m = 600 \mu$ hos., over both bands, using the coils specified.

Frequency (Kc/s.)	Grid Current (μ A.)	Frequency (Mc/s.)	Grid Current (μ A.)
550	29	6.5	20
1000	53	12.5	45
1600	50	22.05	49

(For coil details see overleaf)

RADIOTRON 829

P-P Beam Power Amplifier

Radiotron 829 is a new, push-pull, beam power amplifier having a total maximum plate dissipation of 40 watts. This type has exceptional efficiency and power sensitivity, and a single valve operated in push-pull class C service is capable of handling a power input of 120 watts and requiring less than one watt of driving power. The 829 may be operated at maximum ratings at frequencies up to 200 Mc/s. and at reduced ratings to 250 Mc/s.

Physical features include a balanced and compact structure, excellent internal shielding, short leads and a terminal arrangement designed to facilitate symmetry of circuit layout. The heater is centre-tapped to allow operation from either a 12.6 or a 6.3 volt supply, the current drain being 1.125 amperes per section.

Type of cooling— Forced Air.
 Transconductance ($I_p = 60$ mA.)— 8500 μ hos (approx.)

AS PUSH-PULL CLASS C AMPLIFIER.

	Telephony Grid Mod.	Telephony Plate Mod.	Telegraphy
Plate Voltage (max.)	500	425	500 Volts
Screen Voltage (typical)	200	200	200 Volts
Grid Voltage (typical)	-38	-60	-45 Volts
Cathode Current (typical)	132	258	284 mA.
Driving Power (approx.)	0.5	0.8	0.7 Watt
Power Output (approx.)	23	63	83 Watts

COIL DETAILS.

Suitable for Radiotron Converter Type 1A7-GT.

COIL	PRIMARY	SECONDARY
AERIAL 550-1600 Kc/s.	375 turns 40 S.W.G. S.S.E.	120 turns 5/44 B. & S. Litz, in three equal sections.
R.F. 550-1600 Kc/s.	950 turns 40 S.W.G. S.S.E. with one turn over second section of secondary.	120 turns 5/44 B. & S. Litz, in three equal sections.
OSCILLATOR 550-1600 Kc/s.	40 turns 34 B. & S.E. wound# over bottom end of secondary.	105 turns 31 B. & S.E.
AERIAL 13.6-46.2 Metres	1.5 turns 34 B. & S.E. interwound from A.V.C. end of secondary.	8.37 turns 22 B. & S.E. wound in screw cuts 16 T.P.I.
R.F. 13.6-46.2 Metres	6.25 turns 34 B. & S.E. interwound from earth end of secondary.	8.37 turns 22 B. & S.E. wound in screw cuts 16 T.P.I.
OSCILLATOR 13.6-46.2 Metres	6.0 turns 34 B. & S.E. interwound from padder end of secondary.	8.0 turns 22 B & S.E. wound in screw cuts 16 T.P.I.

The first turn of the primary is wound immediately over the first turn of the secondary.

Band Coverage—

Broadcast Band: $\left\{ \begin{array}{l} 550-1600 \text{ Kc/s.} \\ 545-187.3 \text{ Metres} \end{array} \right.$
 Short-wave: $\left\{ \begin{array}{l} 6.5-22.05 \text{ Mc/s.} \\ 46.2-13.6 \text{ Metres} \end{array} \right.$

Tuning Condenser: 12-440 $\mu\mu\text{F}$. Other types of condensers may be used provided that suitable adjustment is made to the inductance of the coils.

Maximum Effective Stray Capacitances: 45 $\mu\mu\text{F}$., including valve input, trimmer, wiring and coil capacitances.

Padder Capacitance—

Broadcast band: 500 $\mu\mu\text{F}$.
 Short-wave Band: 3800 $\mu\mu\text{F}$.

Shield Can: Internal Diameter $2\frac{1}{8}$ in.

Note that these coil data apply only to particular conditions, and adjustment will normally be required in differing layouts. The effective inductance of the coils is affected by the lengths of leads, the shield can, and proximity to other components in the case of unshielded coils. The band coverage is affected by the total stray capacitances as well as by the minimum capacitance of the gang condenser. Any minor adjustments in the coils should be made in the same proportion to both primary and secondary. In the accompanying illustration the primary and secondary of each coil is wound in the same direction. The single capacity turn wound over the second section of the secondary of the R.F. coil is joined to the inner end of the high impedance primary winding which is connected to the plate of the R.F. Amplifier.

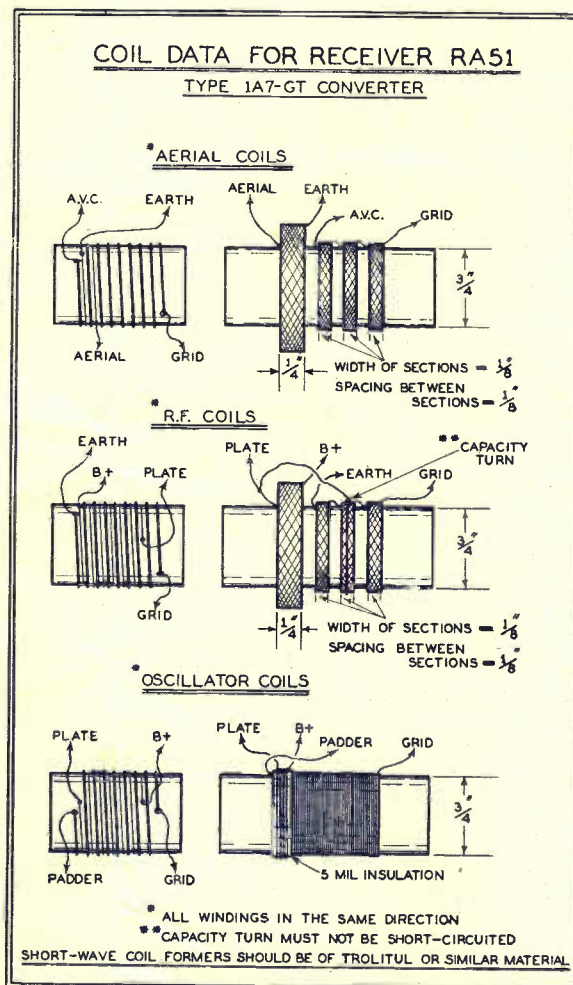


Fig. 4

REPLACING IMPORTED VALVE TYPES

In view of the desirability of reducing the drain on dollar exchange it is timely to remind set manufacturers and others that many imported types may, with only minor modifications, be replaced by Australian types. This applies not only to receivers now in use but, more particularly, to equipment now in process of design. The use of Australian-made types in new equipment has a special appeal to clients who can be assured of the certainty of obtaining replacements when necessary.

A complete chart of valve types and their nearest Australian-made equivalents is now in course of preparation and should be available within the next few weeks.

Reference should be made to the Chart "Valve Types which may be replaced by Radiotron Types of Australian Manufacture" issued several months ago. Copies of this chart may be obtained at one penny each, posted. This chart will, however, be superseded by the more detailed chart when available.

Special attention is drawn to the following types:—

Imported Type	Replace by Australian Type
1A5-G	1Q5-GT
1B7-G	1A7-GT
1C5-G	1Q5-GT
1A6	1C6
1D7-G	1C7-G
1F4	1D4
1F5-G	1L5-G
1F6	1K6
1F7-G	1K7-G
5Z4-G	5V4-G
6C5-G	6J7-G (triode connection)
6F5-G	6B6-G (triode section)
6J5-G	6J7-G (triode connection)
6K5-G	6B6-G (triode section)
6K6-G	6F6-G
6K7-G	6K7-GT
6Q7-G	6B6-G
6R7-G	6B8-G (triode connection)
41	42
56	57 (triode connection)
59	2A5
76	6C6 (triode connection)

All metal valves Equivalent glass types.

Note that 2.5 volt types (2A7, 2B7, 2A6) may be replaced by the 6.3 volt equivalents (6A7, 6B7, 75) without any change in circuit provided that a 6.3 volt filament transformer is added to the receiver. Special filament transformers for this purpose are expected to be available from transformer manufacturers.

If any difficulty is experienced in finding a suitable Australian-made equivalent you are invited to write to the Unified Sales-Engineering Service, Box 2516BB, G.P.O., Sydney, or to telephone BO 522, Extension 364.

RADIOTRON 6J8-G SPECIAL APPLICATIONS

Radiotron 6J8-G may be used in applications other than as a converter valve. For example, the mixer section may be connected as an R.F. pentode in the same manner as with type 6L7-G, and it may then be used as an I.F. amplifier. Under these conditions the A.V.C. voltage may be applied both to the signal grid (grid No. 1) and to grid No. 3, the ratio of the voltages applied to the two being so adjusted as to give negligible change in input capacitance as the bias is varied.* In a receiver designed for the reception of C.W., the mixer section may be used as a pentode I.F. amplifier and the triode may be used as a beat oscillator.

An alternative application is as an audio frequency amplifier. The pentode section may be used as a resistance coupled pentode amplifier, while the triode may be used as a phase splitter or for some other purpose. There is a certain amount of interaction between the two circuits, but in many cases this may be quite negligible. It is possible that the 6J8-G may also be used as an audio frequency mixer, although no experimental work has yet been done in this direction.

In some cases Radiotron 6J8-G may be substituted directly for type 6L7-G (or 6L7). The socket connections are similar except that pin 6, which is omitted in the case of type 6L7-G, is connected to the triode plate of the 6J8-G. Compared to the 6L7-G the 6J8-G has very much lower plate and screen currents, slightly lower mutual conductance and approximately twice the plate resistance.

* J. F. Farrington, "Compensation of Vacuum Tube input capacitance variation by bias potential control," R.M.A. Engineer, Vol. 4, No. 1, pp. 13-15, November (1939).

PARALLEL OPERATION SINGLE GRID "STOPPER"

When two or more high-slope power amplifier valves are operated in parallel it is advisable to use grid "stopper" resistances to prevent parasitic oscillation. When only two valves are used in parallel it is usual to make use of two "stopper" resistors. It may be found possible to omit one of these "stopper" resistances for greater economy without encountering trouble through oscillation.

ADDITIONS TO AUSTRALIAN RADIOTRON RANGE

1D8-GT, 6K7-GT, 47 and 1603

Four new valve types have recently been added to the range of Australian-made Radiotrons. Type **1D8-GT** is already well known as a combined second detector and power pentode for 1.4 volt receivers. **Radiotron 47** is a replacement type for old receivers, and is so widely known as to require no further description. **Radiotron 1603** is intended for use as a microphone amplifier valve, particularly for operation at low levels. It is described in greater detail elsewhere in this issue.

Radiotron 6K7-GT is a new type which merits special attention. It is electrically similar to type 6K7-G except that the mutual conductance has been increased to 1600 μ mhos under typical conditions (being in this respect similar to type 6U7-G) and that a slight modification has been made to the structure. In the 6K7-GT the internal screens are returned to the suppressor pin instead of to the cathode

pin as in Radiotron 6K7-G. This change has been made in order to make the 6K7-GT more adaptable for special circuit requirements. When the suppressor is tied to the cathode it is obviously immaterial which pin is used as an earth return. When the plate-to-cathode capacitance is required to be kept to a minimum, or when an impedance is required to be inserted between cathode and earth, the 6K7-GT is to be preferred to either 6K7-G or 6U7-G.

Although Radiotron 6K7-GT is particularly suitable, owing to its small size, for use in automobile or midget receivers, it is equally suitable for use in larger receivers and may take the place of type 6U7-G. The screen surrounding the plate in the 6K7-GT enables a less efficient shield-can to be adopted for the same degree of stability. Its other features may influence its application in special circuits.

AUSTRALIAN-MADE RADIOTRONS

COMPLETE LIST: 69 TYPES

The following Radiotron valves are now Australian-made, and are listed under three heads, Receiving, Miscellaneous and Transmitting.

RECEIVING TYPES.

1A4-P	1P5-GT	6V6-G
1A7-GT	1Q5-GT	19
1B5/25S	2A5	24A
1C4	5V4-G	30
1C6	5Y3-G	32
1C7-G	6A7	34
1D4	6A8-G	35
1D5-GP	6B6-G	42
1D8-GT	6B7	45
1H4-G	6B7S	47
1H5-GT	6B8-G	57
1H6-G	6C6	58
1J6-G	6D6	75
1K4	6F6-G	77
1K5-G	6G8-G	78
1K6	6J7-G	80
1K7-G	6J8-G	83V
1L5-G	6K7-GT	85
1M5-G	6K8-G	
1N5-GT	6U7-G	

MISCELLANEOUS TYPE.

1603

TRANSMITTING TYPES.

802	833
804	866
805	866A
807	872
809	6P6

RADIOTRON 2000

HALF-WAVE GAS RECTIFIER

Radiotron type 2000 is a half-wave gas rectifier of the filament type capable of supplying a high current at a relatively low voltage. It is suitable for supplying exciter lamps and arcs in motion picture projectors, for use in battery chargers or for plating, welding and similar applications.

Ratings are as follows:—

Filament Voltage	2.2 volts
Filament Current	18.0 amps.
Peak Inverse Voltage	350 (max.) volts
D.C. Output Voltage	90 (max.) volts
D.C. Output Current	6.0 (max.) amps.
Average Breakdown Voltage	13 volts
Average Valve Drop	8 volts

AUSTRALIAN MANUFACTURE

RADIOTRON 1603

Microphone Amplifier Valve

Radiotron 1603 has been widely used in low level amplifier stages in broadcast studios and in other applications requiring the use of low level microphones. It is an indirectly heated triple grid amplifier of low microphonic, low noise, design which may be used either as a pentode or triode. Its electrical characteristics are similar to those of type 6C6 and a similar base is used. It differs, however, from the 6C6 in that the electrodes are rigidly mounted so as to avoid any form of rattle or looseness. This rigid mounting is accomplished by reducing the diameter of the holes through the mica spacing pieces to what is virtually a "push fit". Care is also taken in other directions to avoid any looseness or any possible source

of noise.

These valves are not only carefully assembled but are rigorously tested both for noise and for microphony, and only those valves reaching the highest standard of performance are passed by the tester.

Radiotron 1603 is now Australian made so that continuity of supply can be assured. It is particularly recommended for use in the first stages of public address amplifiers as well as in broadcast studios. It may be used either as a triode or as a high gain resistance coupled pentode and in either application the fact that its control grid is taken to a top cap ensures that the grid circuit is free from any hum picked up from the heater wiring.

RADIOTRON 5Y3-G

TYPICAL OPERATING CONDITIONS

The publication of certain "Typical Operating Conditions" for type 5Y3-G with an A.C. maximum plate voltage per plate of 350 volts RMS has resulted in many enquiries as to whether this is the highest voltage which may be used. It was stated in Radiotronics 103, page 16, that "The valves may be operated in any manner which may be desired, provided that the Design Maxima are not exceeded." There is no need for the designer to be limited to the Typical Operating Conditions which apply only to specific conditions and are not intended to be absolute maxima. However, if the Typical Operating Conditions are not followed it is the duty of the radio designer to make sure that none of the Design Maxima is exceeded.

The "maximum" quoted in the Typical Operating Conditions for type 5Y3-G refer to

particular conditions with a total effective plate supply impedance of 10 ohms per plate, and a filter input condenser of 40 μ F. It is obvious that a higher voltage may be used provided that one or more of the following are put into effect:—

1. Decrease the capacitance of the filter input condenser below 40 μ F.
2. Increase the plate supply impedance.
3. Decrease the D.C. output current.

Tests which have been conducted in the A.W.V. laboratory indicate that an A.C. plate voltage of 400 volts RMS per plate is permissible with a filter input condenser of 8 μ F. and a total effective plate supply impedance of 10 ohms (minimum) per plate. The D.C. current under these conditions should not exceed 125 mA. for full wave rectification.

TRIODE OPERATION OF PENTODES AND TETRODES

Use of Screen Dropping Resistor

When pentodes and tetrodes are operated as triodes* it is usual to connect the screen directly to the plate. Under certain conditions it may be desired to operate them with a dropping resistor between screen and plate. In this case the voltage applied to the plate should not exceed the rated maximum, and the dropping resistor should be adjusted so that, with this applied plate voltage, the effective voltage on the screen does not exceed the rated maximum screen voltage. If special ratings have been given for triode operation with plate and screen tied together, the rated maximum screen voltage may be taken as for this condition.

The effect of the screen dropping resistor is

to decrease the mutual conductance and plate current, and to increase the plate resistance for a given grid bias voltage. The greater the value of the dropping resistor, the greater will be the effect on the characteristics, although not in proportion. Adjustment of the screen dropping resistor may be made experimentally, within the limits of the valve, to provide any desired characteristics in the direction indicated above.

A low resistance screen dropping resistor (say 500 ohms) may be used with high-slope tetrodes (e.g., type 6L6-G) or pentodes to prevent parasitic oscillation, should this be experienced.

* See Radiotronics 104, p. 35.

RADIOTRON 807

Transmitting Beam Power Amplifier

Radiotron, type 807, which is now Australian-made, was announced in Radiotronics 71. The ratings have subsequently been revised and comprehensive data in regard to ratings and typical operating conditions are now available. The data are printed in full for purposes of reference.

It should be noted that type 807 is similar electrically to type 6L6-G, and may be directly substituted for it, provided suitable modifications are made with regard to the base and top cap connection. If increased power output is desired this may be obtained by increasing the applied voltages within the ratings of the 807. Alternatively, if it is operated at appreciably less than maximum ratings extremely satisfactory service should be obtained.

CHARACTERISTICS and RATINGS.

Heater Voltage (A.C. or D.C.)	6.3	Volts
Heater Current	0.9	Ampere
Transconductance, for plate cur. of 72 ma.	6000 approx.	umhos
Direct Interelectrode Capacitances:		
Grid-Plate (with external shielding)	0.2 max.	μμf.
Input	11	μμf.
Output	7	μμf.
Bulb	ST-16	
Cap	Small Metal	
Base	Medium 5-Pin, "Micanol"	

MAXIMUM CCS and ICAS RATINGS with TYPICAL OPERATING CONDITIONS.

CCS = Continuous Commercial Service.
 ICAS = Intermittent Commercial and Amateur Service.

As Push-Pull Class AB₂ Modulator.

	CCS	ICAS	
D-C Plate Voltage ...	600 max.	750 max.	V.
D-C Screen Voltage ...	300 max.	300 max.	V.
Max.-Sig. Plate Curr.*	120 max.	120 max.	Ma.
Max.-Sig. Plate Input*	60 max.	90 max.	W.
Screen Input*	3.5 max.	3.5 max.	W.
Plate Dissipation* ..	25 max.	30 max.	W.

Typical Operation with Fixed Bias:

Unless otherwise specified, values are for 2 valves.

Plate Voltage	400	500	600	750	V.
Screen Voltage	300	300	300	300	V.
Grid Voltage	-25	-25	-30	-32	V.
Peak A-F G-G Volts	80	80	80	95	V.
Zero-Sig. Plate Curr.	100	100	60	60	Ma.
Max.-Sig. Plate Curr.	230	230	200	240	Ma.
Max.-Sig. Screen Curr.	10	10	10	10	Ma.
Load Res. (per valve)	950	1165	1665	1830	Ω
Eff. Load Res. (P-P)	3800	4660	6660	7320	Ω
Peak Grid Input°	0.35	0.6	0.4	0.5	W.
Max.-Sig. Output**	60	75	80	120	W.

As R-F Power Amplifier—Class B Telephony.

Carrier conditions per valve for use with a max. modulation factor of 1.0.

	CCS	ICAS	
D-C Plate Voltage ...	600 max.	750 max.	V.
D-C Screen Voltage ..	300 max.	300 max.	V.
D-C Plate Current ..	80 max.	90 max.	Ma.
Plate Input	37.5 max.	45 max.	W.
Screen Input	2.5 max.	2.5 max.	W.
Plate Dissipation ...	25 max.	30 max.	W.

Typical Operation:

Plate Voltage	400	500	600	750	V.
Screen Voltage	250	250	250	300	V.
Grid Voltage	-25	-25	-25	-35	V.
Peak R-F Grid Volts	30	30	20	27	V.
Plate Current	75	75	62.5	60	Ma.
Screen Current	4	4	3	3	Ma.
Grid Curr. (Approx.)	0	0	0	0	Ma.
Drive (Approx.)***	0.25	0.25	0.2	0.12	W.
Output (Approx.)	9	12.5	12.5	15	W.

As Grid Modulated R.F. Power Amplifier—Class C.

Carrier conditions per valve for use with maximum modulation factor of 1.0.

Tentative Ratings.

	CCS	ICAS	
D.C. Plate Voltage ..	600 max.	750 max.	V.
D.C. Screen Voltage .	300 max.	300 max.	V.
D.C. Grid Voltage ...	-200 max.	-200 max.	V.
D.C. Plate Current ..	60 max.	60 max.	Ma.
Plate Input	35 max.	45 max.	W.
Plate Dissipation ...	25 max.	30 max.	W.
Screen Input	2.5 max.	2.5 max.	W.

Typical Operation.

Plate Voltage	400	500	600	750	V.
Screen Voltage	250	250	250	250	V.
Grid Voltage	-65	-70	-70	-75	V.
Peak R.F. Grid Volts	-65	-70	-70	-75	V.
Peak A.F. Grid Volts	30	30	30	30	V.
Plate Current	45	45	42	50	Ma.
Screen Current	3	3	3	3	Ma.
Grid Curr. (Approx.)	0.5	0.3	0.5	0.5	Ma.
Drive (Approx.)***	.2	.2	.2	.2	W.
Output	6	7	9	12	W.

As Plate-Modulated R-F Power Amplifier—Class C

Telephony.

Carrier conditions per valve for use with a maximum modulation factor of 1.0.

	CCS	ICAS	
D-C Plate Voltage ...	475 max.	600 max.	V.
D-C Screen Voltage .	300 max.	300 max.	V.
D-C Grid Voltage ...	-200 max.	-200 max.	V.
D-C Plate Current ..	83 max.	100 max.	Ma.
D-C Grid Current ...	5 max.	5 max.	Ma.
Plate Input	40 max.	60 max.	W.
Screen Input	2.5 max.	2.5 max.	W.
Plate Dissipation ...	16.5 max.	25 max.	W.

Typical Operation:

Plate Voltage	325	400	475	600	V.
Screen Voltage of .	225	225	225	275	V.
From series res. of°°	10000	16000	25000	35000	Ω
Grid Voltage of +	-45	-50	-50	-78	V.
From combin. of Grid Resistor ... and Cathode ...	5000	10000	10000	15000	Ω
From combination					
Peak R-F Grid Volts	70	70	70	100	V.
Plate Current	80	80	83	100	Ma.
Screen Current	9	9	9	9	Ma.
Grid Curr. (Approx.)	3	3	2	3	Ma.
Drive (Approx.) ..	0.2	0.2	0.1	0.1	W.
Output (Approx.) .	15	19	24	37.5	W.

As R-F Power Amplifier and Oscillator—Class C

Telegraphy.

Key-down conditions per valve without modulation.†

	CCS	ICAS	
D-C Plate Voltage ...	600 max.	750 max.	V.
D-C Screen Voltage .	300 max.	300 max.	V.
D-C Grid Voltage ...	-200 max.	-200 max.	V.
D-C Plate Current ...	100 max.	100 max.	Ma.
D-C Grid Current ...	5 max.	5 max.	Ma.
Plate Input	60 max.	75 max.	W.
Screen Input	3.5 max.	3.5 max.	W.
Plate Dissipation ...	25 max.	30 max.	W.

RADIOTRON 929 Vacuum Phototube

The 929 is a new vacuum phototube with a new type of caesium photo-surface which has extraordinary high sensitivity for light sources predominating in blue radiation. Although this tube is not infra-red sensitive, it has a sensitivity of 45 microamperes per lumen to light from a tungsten filament operated at 2870°K. To daylight, its sensitivity is several times this value, and to an H-4 mercury arc, its sensitivity is many times the tungsten value. Other features of the 929 are its excellent stability and its consistent spectral response. Because of these features, the 929 is well suited for measurement and relay applications.

TENTATIVE DATA

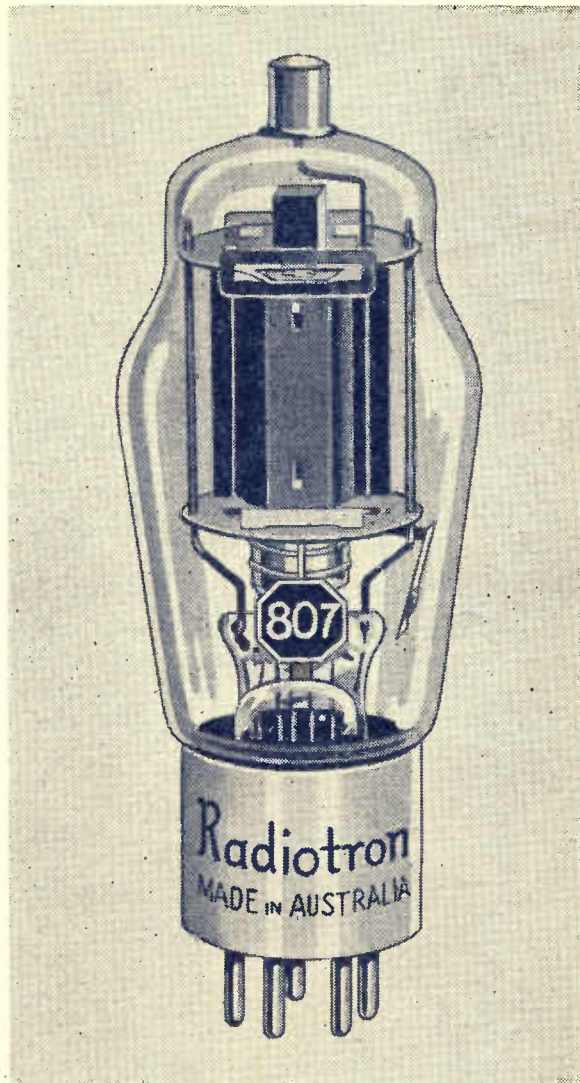
Cathode Photosurface	S-4
Cathode Window Area	0.6 sq. in
Direct Interelectrode Capacitance	2.5 $\mu\mu\text{f}$
Maximum Overall Length	3-1/16"
Maximum Seated Height	2-1/2"
Maximum Diameter	1-5/16"
Bulb	T-9
Base	Intermediate Shell Octal 5-Pin
Mounting Position	Any

MAXIMUM RATINGS AND CHARACTERISTICS. Anode-Supply Voltage (D.C. or Peak A.C.)—

	250 max. Volts
Anode Current*—	20 max. Microamperes
Ambient Temperature	100 max. °C.
Sensitivity**—	45 Microamp/lumen
Sensitivity at 3750 Angstroms	0.04 Microamp/micro-watt
D-C Resistance of Load—	1 min. Megohm

* On basis of the use of a sensitive cathode area 1/2" in diameter.

** Sensitivity value is given for conditions where a Mazda projection lamp operated at a filament color temperature of 2870° K is used as a light source. The method for determining sensitivity employed a 250-volt anode supply and included a 1.0 megohm load resistance. A light flux of 0.1 lumen on the cathode was used to excite the 929.



Typical Operation:

Plate Voltage	400	500	600	750	V.
Screen Voltage:					
From fix. supply of	250	250	250	250	V.
From series res. of	17000	28000	39000	55000	Ω
Grid Voltage†:					
From fix. supply of	-50	-50	-50	-50	V.
From cath. res. of	470	470	450	450	Ω
From grid res. of	20000	25000	16700	16900	Ω
Peak R-F Grid Volts	80	80	80	80	V.
Plate Current	95	95	100	100	Ma.
Screen Currnt	9	9	9	8	Ma.
Grid Curr. (Approx.)	2.5	2	3	3	Ma
Drive (Approx.) ..	0.18	0.14	0.22	0.22	W.
Output (Approx.) .	25	30	37.5	50	W.

||Subscript (2) indicates that grid current flows during a part of input cycle.

*Averaged over any audio-frequency cycle of sine-wave form.

°Driver stage should be capable of supplying the grids of the class AB₂ stage with the specified peak values at low distortion. The effective resistance per grid circuit of the class AB₂ stage should be

RADIOTRON 807 (contd.)

kept below 500 ohms and the effective impedance at the highest desired response frequency should not exceed 700 ohms.

†The total effective grid-circuit resistance should not exceed 25,000 ohms.

**With zero-impedance driver and perfect regulation, plate-circuit distortion does not exceed 2%. In practice, plate-voltage regulation, screen-voltage regulation, and grid-bias regulation, should be not greater than 5%, 5% and 3%, respectively.

***At crest of a-f cycle with modulation factor of 1.0.

°°Connected to modulated plate-voltage supply.

‡Modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115% of the carrier conditions.

RADIOTRON NEWS

Radiotron 1D8-GT is now Australian-made. See article elsewhere in this issue.

Radiotron 6K7-GT is now Australian-made. See article elsewhere in this issue.

Radiotron 6SR7 is a duo-diode general-purpose triode of single-ended metal construction. It is fitted with a wafer octal base and is electrically identical to the earlier types 6R7 and 6R7-G. This type is not at present available from stock.

Radiotron 47 is now Australian-made. See article elsewhere in this issue.

Radiotron 117Z6-GT has been modified and the heater centre-tap connection to pin 1 is now omitted. See note under article headed "Safety First."

Radiotron 804. Dual ratings for this type are now available on request.

Radiotron 807. Dual ratings for this type, together with additional data for grid modulation are given elsewhere in this issue.

Radiotron 829 is a push-pull beam power amplifier for use in transmitters. This type, which is described in greater detail elsewhere in this issue, is not at present available from stock.

Radiotron 901 is a gas-filled tube of the cold-cathode crater type for use in photographic recording equipment. This type is not at present available from stock.

Radiotron 909. The production of this type of cathode ray tube has been suspended for an indefinite period. There are no stocks of this type on hand.

Radiotron 910. The production of this type of cathode ray tube has been suspended for an indefinite period. There are no stocks of this type on hand.

Radiotron 929 is a high-vacuum phototube having high sensitivity to blue light. See data elsewhere in this issue. This type is not at present available from stock.

Radiotron 1603 which is a non-microphonic triple-grid amplifier, is now Australian-made. See further details elsewhere in this issue.

Radiotron 1611 is a power amplifier pentode similar to type 6F6-G except that it has a uniform cut-off feature. This type is not available from stock.

Radiotron 2000 is a half-wave gas rectifier capable of supplying a high current at a relatively low voltage. See description elsewhere in this issue. This type is not at present available from stock.

SAFETY FIRST

Attention is drawn to the fact that **No. 1 Pin of the octal socket may only be used for earthing purposes.** Under no circumstances should this pin be used to carry voltage above earth.

As an example of the danger involved to the set user, it may be stated that there are now available valves having metal-shell bases which are electrically connected to No. 1 pin. If the No. 1 pin of the socket is at a high voltage to earth, the whole of the metal shell will be "alive" and may result in a shock to an unsuspecting user.

Attention is also drawn to the reference in "Radiotron News" to the change made in the basing connections of type 117Z6-GT which is now being manufactured without heater mid-tap connection to No. 1 pin. This change avoids any necessity of connecting pin 1 of the socket to a high voltage and hence the possibility of shock to the user should a metal valve or a valve having a metal shell base be inadvertently inserted into the rectifier socket. Furthermore, it removes the possibility of applying line voltage to a receiver chassis should the 117Z6-GT be inserted in the wrong socket.

PRICE LIST OF AUSTRALIAN-MADE RADIOTRONS

A price list of Australian-made Radiotron receiving valves, issued on 1st July, 1940, is now available. Those who have not received a copy may obtain one by sending one penny to cover postage. Enquiries should be addressed to Amalgamated Wireless Valve Co. Pty. Ltd., Box 2516 BB, G.P.O., Sydney.

VALVE DATA SHEETS

Six Radiotron Loose Leaf Valve Data Sheets are being released concurrently with this issue. These are:—

Type 1A7-GT	1 sheet (data)
Type 1H5-GT	1 sheet (data)
Type 1N5-GT	1 sheet (data)
Type 1P5-GT	1 sheet (data)
Types 25L6, 25L6-G,		
25L6-GT	1 sheet (data)
Types 25Z6, 25Z6-G,		
25Z6-GT	1 sheet (data)

Existing sheets for types 1A7-G, 1H5-G, 1N5-G, 25Z5 and 25Z6-G should be removed from the Data Book.