RADIOTRONICS

AMALGAMATED WIRELESS VALVE CO. PTY. LTD.

BOX No 2516BB, G.P.O., SYDNEY

TECHNICAL BULLETIN No. 100 **30th AUGUST, 1939**

In this issue:—

The 100th issue of "Radiotronics" is, in itself, both a milestone in the progress of the valve industry in Australia and a symbol of the Amalgamated Wireless Valve Company's policy of consistently developing the application of the radio valve.

It is, moreover, a source of extreme gratification to note that, whilst retaining its original subscribers year after year, "Radiotronics" circulation is continually expanding.

This fact not only provides adequate testimony to the value attached to the publication by its readers but also encourages the Company to spare no effort to sustain its high standard.

Our best wishes and appreciation for the many gestures of goodwill so frequently received are extended to all readers of our technical bulletins.

Faithfully yours,

SALES MANAGER,
Amalgamated Wireless Valve Co. Pty. Ltd.

A NEW 2A3 AMPLIFIER — 13.5 WATTS OUTPUT

In Radiotronics 78 a full description was given of a 13.5 watt amplifier using a pair of 2A3 valves in the output stage. Although this amplifier has proved very satisfactory, there has been a consistent demand for one providing similar power output, but with fewer valves. Such an amplifier is described in this article.

The Output Stage:

The characteristics of Radiotron 2A3 are such that two valves, operating in push-pull Class AB1 can, under fixed bias conditions, deliver a power output of 15 watts with 2.5% total harmonic distortion.

Since the plate current varies with the input signal, from 80 mA. at no signal to 140 mA. at maximum signal for two valves, there is obvious difficulty in applying self-bias. If the cathode resistor for self-bias is designed to provide the correct bias with no signal input, the bias developed at maximum signal input will be greater than the optimum. On the other hand, if the cathode bias resistor is designed to give the optimum bias at maximum signal input, then the bias with no signal input will be so low that the maximum plate dissipation will be exceeded. The procedure which is adopted is therefore to design the cathode bias resistor to give the same plate current at no signal input as is given under fixed bias conditions, and to adjust the value of the load resistance to give maximum power output for limited distortion without exceeding the plate dissipation at maximum input. The reduction in power output is not due to the variation in plate current over the cycle, for it is assumed that the cathode bias resistor is adequately by-passed, but to the restricted choice of operating conditions. Even if the valves were operated at a fixed bias equal to that produced by the self-bias resistor at maximum signal, and with a load resistance as for self-bias, the performance as regards power output and distortion would be the same as for self-bias.

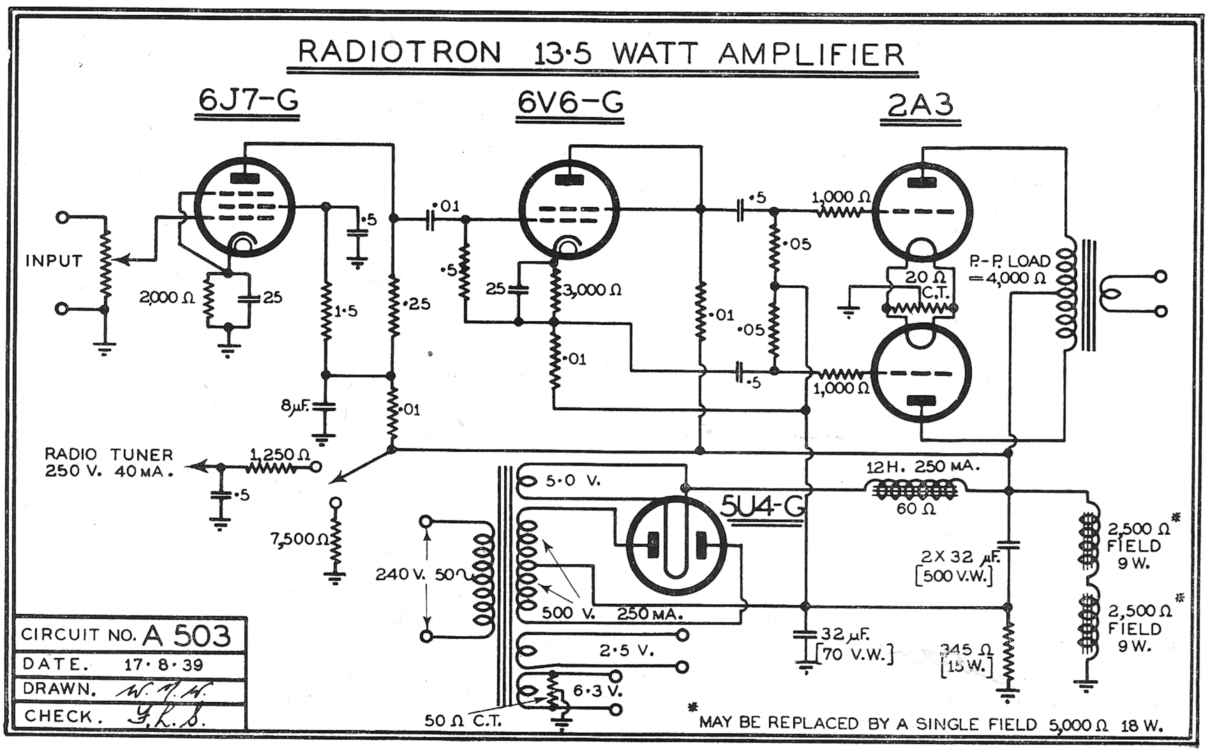
The maximum power output for self-bias operation of 2A3's in Class AB1 is 10 watts with 5% total harmonic distortion; for 2.5% distortion, the output is necessarily less than 10 watts.

Although the higher power output is desirable, it is usually difficult in a practical amplifier to provide a convenient source of fixed bias. However, by arranging the circuit so that the bias is not entirely dependent on the plate current, it is possible to effect a compromise between the two conditions and to realise a power output of approximately 13.5 watts.

In this circuit (A.503) the required bias voltage is developed across a back bias resistor by the plate current of the output valves, the energising current of the speaker, and by the supply current of the radio tuner.

The back bias resistor should preferably be adjustable, so that due compensation may be made for normal variations in load current. The no signal bias should be set to –62 volts, preferably with the radio tuner set to a local station and drawing normal current.

In the experimental amplifier, zero signal current through the resistor was 181 mA. which rose to 209 mA. at full output.



When no tuner is used, an equivalent amount of current should be drawn from the power supply by connecting a 7500 ohm, 15 watt resistance between B+ and earth.

Under semi-fixed bias conditions, the maximum permissible resistance in the grid circuit of a 2A3 valve is intermediate between .05 and .5 megohm, but in this amplifier it was found possible to maintain the grid resistors at .05 megohm without compromising the performance. The 1000 ohm resistors in series with each grid lead serve to relieve the severity of the distortion when the output valves are momentarily driven into the grid current zone.

For full power output, the valves require a peak input voltage of 144 volts (grid to grid). The rated power output is measured across the primary of the output transformer. The power which can be taken from the secondary is, of course, dependent upon the efficiency of the transformer.

Phase Splitter:

In order to reduce the number of valves, it was necessary to find a phase splitter which was capable of fully exciting the output valves without an intermediate stage of amplification.

Investigation showed that, of the valves available, type 6V6-G connected as a triode is most suitable, and may be used to provide the necessary output voltage when connected across the full 360 volts available from the power supply. Accordingly, the cathode return is made to the centre tap of the power transformer instead of to earth. The connection is unorthodox, but quite in order, and provides an additional 60 volts for the valve. Tests showed that the 6V6-G commences to draw grid current as the output of the amplifier reaches 14 watts.

In this application, the plate current of the 6V6-G is approximately 7 milliamps, and the 10,000 ohm load resistors may therefore be of 1 watt rating. The self-bias resistor in the cathode circuit is comparable in value to the load resistor and is by-passed to avoid unnecessary degeneration. In cases where the value of the bias resistor is very small in comparison with that of the total load resistance, such a precaution is unnecessary. With the by-pass condenser in position, the gain of the stage from input to either grid is 0.78.

Further information on the triode operation of type 6V6-G is given elsewhere in this issue.

General:

The remainder of the amplifier is straightforward and does not call for special comment, being generally similar to the original amplifier featured in Radiotronics 78.

The general characteristics are tabulated below and are self-explantory. Figures 2 and 3 show respectively the linearity and response curves, which were taken with the amplifier operating into a pair of typical 10 inch speakers. The curves can therefore be taken as indicative of the performance which can be expected under normal service conditions. It will be seen that the curves for linearity, response and distortion compare favourably with those given for the earlier amplifier.

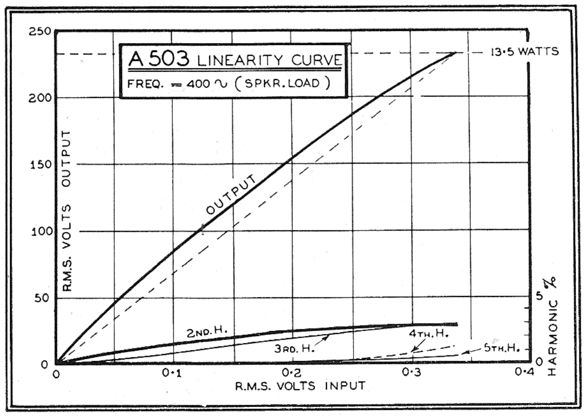


FIG. 2

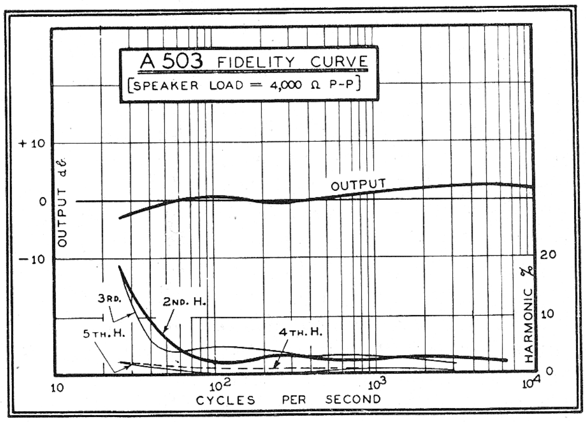


FIG. 3

Figure 4 shows a typical tuner which would be suitable for use with this amplifier. The supply voltage should not exceed 250, which is 50 volts less than that delivered by the amplifier. It will therefore be necessary to include a dropping resistor of 1250 ohms in series with the tuner supply. Complete coil data for this tuner will be found in Radiotronics 92, page 173, or in Radiotron Service Lecture No. 2.

Characteristics:

R.M.S. Input Voltage for Full Output	0.34 Volt
2A3 Plate to Fil. C.T. Voltage (no sig.)	300 Volts
2A3 Plate to Fil. C.T. Voltage (max. sig.)	280 Volts
2A3 Grid Bias (no sig.)	−62 Volts
2A3 Grid Bias (max. sig.)	−72 Volts
2A3 Plate Current (2 valves no sig.)	80 mA.
2A3 Plate Current (max. sig.)	112 mA.
Total Amplifier Current (no. sig.)	188 mA.
Total Amplifier Current (max. sig.)	216 mA.
Hum Level Below Full Output	−60 db
R.M.S. Plate to Plate Output Voltage (full output)	232 Volts

NOTES ON A.V.C.

It is sometimes forgotten that even a perfect A.V.C. system does not compensate for variations in modulation depth between different transmitters. Since considerable variations in average modulation depth occur between different broadcast stations, it is evident that those stations modulating more deeply will sound louder than those modulating less deeply.

Owing to the likelihood of distortion and interference through cross modulation in the R.F. stage and modulation rise in the I.F. stage, it is advisable to limit the maximum carrier input voltage applied to the grid of the R.F. stage. If no R.F. stage is used, the same limitation should be applied to the converter valve except that the signal voltage should be still further reduced. An aerial coil giving excessively high gain is sometimes undesirable in districts where very high signal strengths occur. Even with a normal aerial coil it is advisable to limit the maximum signal to the aerial terminal to 0.5 volt maximum in order to avoid these troubles. With large aerials situated close to powerful transmitting stations, this limit of input voltage may frequently be exceeded and under these circumstances some form of local-distant switch may be connected between the aerial terminal and the grid of the first valve. An alternative arrangement is to reduce the size of the aerial so that overloading does not occur with the strongest signal and cross modulation is no longer troublesome. This will have the effect of reducing the effective sensitivity of the receiver and increasing the noise level on distant stations and is therefore not so satisfactory as the use of a local-distant switch.

6V6-G TRIODE OPERATION

Radiotron 6V6-G may be operated as a triode with plate tied to screen without any danger of excessive screen dissipation, provided that the "maximum plate and screen dissipation (total)" does not exceed the rated maximum of 12.5 watts. The characteristics and 250 volt operating conditions, with screen tied to plate, are:—

Heater Voltage	6.3 Volts
Plate Voltage	250 Volts
Grid Voltage	–15 Volts
Amplification Factor	9.6
Plate Resistance	2400 Ohms
Transconductance	4000 μmhos
Plate Current	37.5 mA.
Load Resistance	3500 Ohms
Power Output*	1.0 Watt

* For 5% second harmonic distortion.

The plate voltage may be increased to 300 volts maximum, and under these conditions with a grid bias of –20 volts, load resistance of 4800 ohms and plate current of 39 mA. the power output for 5% second harmonic distortion is 1.65 watts.

Push-pull operation of 6V6-G triodes is also practicable.

The 6V6-G as a triode is thus very attractive for applications requiring an indirectly heated valve giving a fairly large power output. It is particularly suited for use as a driver valve for a Class B stage, or for a low impedance phase-splitter (see article on the 13.5 watt amplifier elsewhere in this issue). It has greater sensitivity, greater power output, lower plate resistance, higher amplification factor and greater mutual conductance than type 6F6-G operated as a triode.

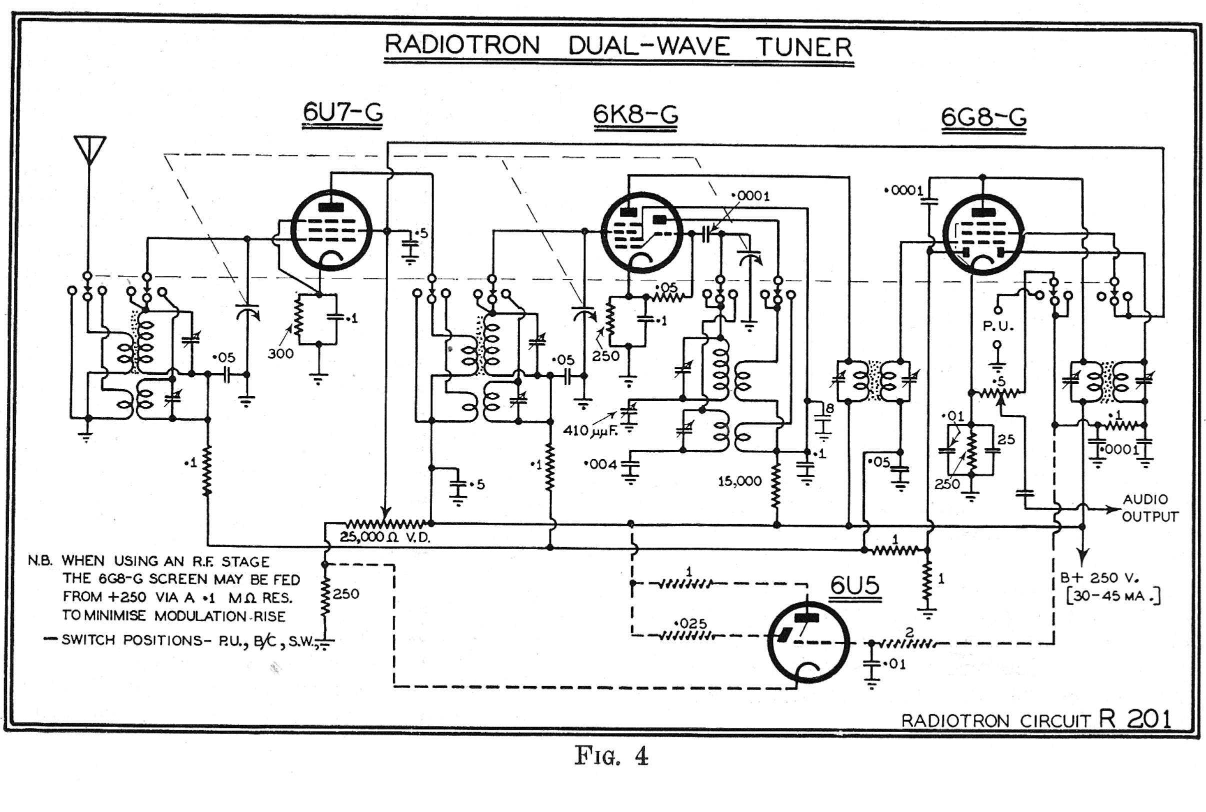


Fig. 4

R.C.A. APPLICATION NOTE "THE 6SK7 AS AN I.F. AMPLIFIER"

Although type 6SK7 is not used to any extent in Australia, the following article should prove of wide interest since it deals with the questions of gain, selectivity and I.F. transformer design. In this article, a comparison is drawn between valve types 6K7 and 6SK7, and it will assist the reader to remember that these types have characteristics which are very similar except that the transconductance of the 6K7 is 1450, while that of the 6SK7 under the same conditions is 2000 micromhos. The transconductance of type 6U7-G, which is very widely used in Australia, is intermediate between these values (1600 micromhos). Type 6SK7 is "single ended", with the grid lead taken to one of the base pins, and in this respect differs from both types 6K7 and 6U7-G.

An important advantage of the 6SK7 is its high transconductance. When the design of an i-f stage is changed to use the 6SK7 in place of the 6K7, the increase in transconductance enables the designer to increase gain, or it enables him to improve selectivity, or it may enable him to reduce i-f transformer cost. It is the purpose of this Note to show how these improvements can be made.

Increase of Gain

When it is desired to obtain an increase in gain from the change in valves, it is important that wiring be arranged so as to cause as little feedback as possible. It has been found good practice, in i-f stages using the 6SK7, to locate the avc filter resistor close to the diode load resistor. The reason is illustrated by Fig. 1 which shows a widely used avc circuit. In this circuit, if the avc filter resistor R were close to condenser C, there would be considerable i-f voltage between lead XY and ground. Because this lead, and the lead to the 6SK7 grid, are both under the chassis, the large i-f voltage on lead XY might cause objectionable feedback to the 6SK7 grid. This feedback is

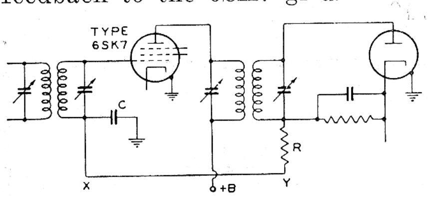


FIG. 1

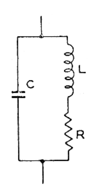


FIG. 2

greatly reduced when resistor R is placed close to the diode load, as in Fig. 1, because this placement reduces the i-f voltage on lead XY. Also, it has been found good practice to place the 6SK7 screen by-pass condenser across the 6SK7 socket so that the condenser will shield the grid terminal from the plate terminal. In some cases, it is advisable to place "hot" i-f leads close to the chassis so as to utilize the shielding effect of the chassis. By means of these and similar precautions against feedback, it is possible to change many 6K7 i-f stages over to use the 6SK7 without the necessity for alteration of i-f transformer design. When the change in valves is made in this way, the gain of the stage is increased in proportion to the increase in transconductance. For a stage operated at 250 volts plate voltage and 100 volts screen voltage, the increase in gain is 38%.

Alteration of I-F Transformer

In some i-f stages, however, the change to the 6SK7 causes instability in spite of well-arranged wiring. The reason is that feedback through grid-plate capacitance reflects into the grid circuit a negative resistance which is proportional to the product of the resonant impedance of the plate load, the transconductance of the valve, and the capacitance between grid and plate. The stability of the stage depends on the sum of this negative resistance and the positive resistance due to losses in the grid circuit. The change to the 6SK7 increases the reflected negative resistance because the transconductance of the 6SK7 is higher than that of the 6K7, while the grid-plate capacitances of the two valves are equal. The change to the 6SK7 may, therefore, cause instability in a stage where the resonant impedance of the plate load is high. A convenient way to eliminate this instability is to alter the output transformer of the i-f stage so as to reduce the plate-load impedance.

In a transformer where the primary and secondary can have different numbers of turns, the reduction of load impedance can be so made that the change in valves gives an increase in gain with no decrease in stability. When both valves are operated at 250 volts plate voltage and 100 volts screen voltage, the increase in gain which can be obtained in this way is 17%. However, i-f transformers in receivers are generally required to have primary and secondary coils of equal numbers of turns because this equality simplifies coil winding. When an i-f stage using such a transformer is to be changed over from the 6K7 to the 6SK7, and the stability of the stage is to be held constant by a reduction of load impedance, the reduction of load impedance must be large enough to hold gain constant. Hence, in such cases, the change from the 6K7 to the 6SK7 will not yield any increase in gain. The change, however, can be made to yield other improvements. The nature of these improvements depends on the method by which plate-load impedance is reduced. There are three different methods which give different results.

Single-Circuit Analogy

The discussion of these methods can be simplified by considering first the single tuned circuit shown in Fig. 2, where R represents the series resistance of the coil. As is well known, the resonant impedance of this circuit, when the coil Q is reasonably high, is L/RC, and the selectivity of the circuit is determined by the coil Q. It can be seen that one way to reduce the resonant impedance of the circuit is to reduce the ratio of L/C, with the ratio of L/R held constant. The reduction of L/C is, of course, to be so made as to leave the resonant frequency unchanged. This method of reducing impedance does not affect the coil Q, and, therefore, does not affect the circuit's selectivity. However, when the circuit is used as plate load in an amplifier, this method of reducing impedance increases the selectivity of the amplifier. The reason is that this method increases the conductance of the tuned circuit and, therefore, reduces the shunting effect on the circuit of the driving valve's output conductance and the following valve's input conductance. For example, let the conductance of the coil be g_c and the sum of the valve conductances be g_t. The total conductance is $g_c + g_t$, and the ratio of susceptance to total conductance, the Q of the circuit as a whole, is to a good approximation

$$\frac{1}{\omega L(g_c + g_t)}$$

It is this Q which determines the selectivity of the amplifier. If the inductance of the coil is multiplied by a factor 1/A, with coil Q held constant, the Q of the circuit as a whole becomes

$$\frac{A}{\omega L(A g_c + g_t)}$$

If A is greater than 1, this Q is larger than the former Q. It follows that selectivity is increased when L/C is reduced with coil Q and resonant frequency held constant.

A second method of reducing impedance is to decrease both L/C and L/R. As has been shown, the reduction of L/C tends to increase the selectivity of an amplifier stage using the circuit, while the reduction of L/R reduces Q and, therefore, tends to decrease selectivity. It follows that a reduction of both L/C and L/R can be so made as to leave selectivity unchanged. Because the cost of a coil usually depends to a large extent on the Q of the coil, this second method may be used to reduce circuit cost without affecting selectivity.

Improvement of Selectivity Curve

This discussion of a simple tuned circuit indicates how load impedance can be reduced when the load is a conventional double-tuned i-f transformer. The curves of Fig. 3 show the results obtained when load impedance is reduced by a decrease in the L/C ratio, with coil Q held constant. Curve I shows the selectivity of a typical i-f transformer coupling a 6K7 to a diode. The primary and secondary both have a coil Q of 120, coupling is critical, and gain at resonance is 200. Curve II shows the

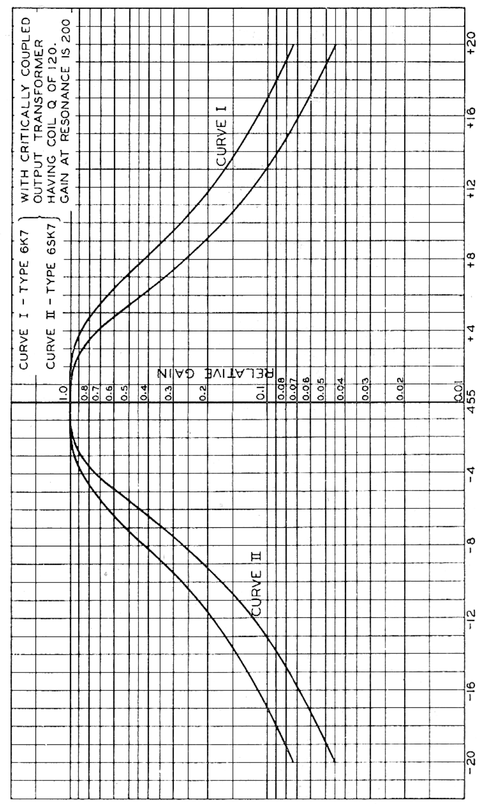


FIG. 3

selectivity obtained when the 6K7 is replaced with a 6SK7, the L/C ratio is reduced sufficiently to maintain gain at 200, the Q of the coils is held constant, and coupling is again critical. It can be seen that the response of the 6SK7 at 10 kc off resonance is down to 18% of maximum, as compared with 28% for the 6K7. The reason for this improved selectivity is the same as that mentioned in connection with the single tuned circuit. The reduction of the L/C ratio increases the conductance of the primary and secondary and, therefore, decreases the shunting effect on the transformer of the diode circuit and of the i-f valve's output conductance. The result is that, even though coil Q has not been changed, the Q of the circuit as a whole has been raised and, therefore, selectivity has been increased.

In some receivers, the side-band response of Curve II may be less than is desired. Side-band response can be improved by an increase in the coupling of the transformer, as illustrated by Fig. 4. In this figure, Curve I is for the 6K7 stage which has been described. Curve III shows the selectivity obtained when the 6K7 is replaced with a 6SK7, the Q of the coils is held constant, the L/C ratio is reduced, and the coupling is increased sufficiently to give the same gain at resonance and at 10 kc off resonance as shown in Curve I. Curve III shows that the change from a 6K7 to a 6SK7 can be made to provide better side-band response, with no change in gain or in coil Q, and with no increase in interference from stations on adjacent channels. The negative resistance reflected into the grid circuit in the stage represented by Curve III is practically the same as that of the stage represented by Curve I; the two stages, therefore, have the same stability.

Reduction of Coil Cost

The second method of reducing the impedance of a single tuned circuit, the method in which both L/C and coil Q are reduced so as to maintain selectivity unchanged, can also be applied to a double-tuned i-f transformer. For example, computations show that Curve I, which is for a 6K7 and a critically coupled transformer having a coil Q of 120, can be provided by a 6SK7 and a critically coupled transformer having a coil Q of 94. In other words, the stage represented by Curve I can be changed over to use the 6SK7 with a 20% reduction in coil Q and no change in gain or selectivity. This reduction in coil Q may make it possible to reduce the cost of the transformer.

COMPUTATION OF CURVES

Curve I

Curve I is computed for a 6K7 i-f stage driving a diode detector. Both the primary and secondary coils of the i-f output transformer have an inductance of 1.62 millihenry and a Q of 120. The total capacitance across each coil is 75.5 $\mu\mu$f. The primary is shunted by conductances of 1.25 micromhos due to the plate resistance of the 6K7, and 0.3 micromho due to losses in the 6K7 base and socket. The secondary is shunted by conductances of 1.8 micromhos due to a diode load of 1 megohm and a rectification factor of 90%, and 0.3 micromho due to losses in the diode base and socket. Coupling is critical. Plate voltage is 250 volts, screen voltage is 100 volts, and grid bias is –3 volts. The transconductances of the 6K7 is 1450 micromhos and gain at resonance is 200.

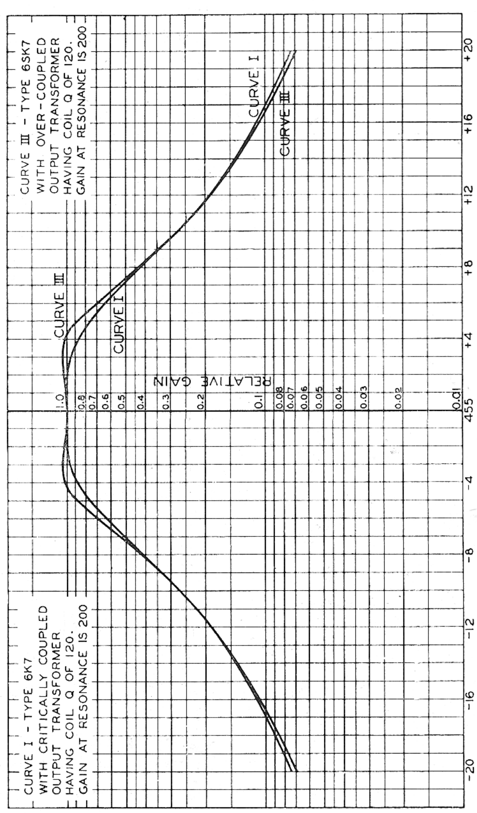


FIG. 4

Curve II

Curve II is computed for the i-f stage of Curve I after the 6K7 has been replaced with a 6SK7 and the primary and secondary have been changed to 0.918 millihenry and 133 $\mu\mu$f so as to hold gain at 200. Coil Q, the loading conductances, and electrode voltages are the same as for Curve I, and coupling is critical. The transconductance of the 6SK7 is 2000 micromhos.

Curve III

Curve III is computed for a 6SK7 and an overcoupled output transformer giving the same gain at resonance, and at 10 kc off resonance, as the stage represented by Curve I. Primary and secondary inductances are 1.00 millihenry, capacitances are 122 $\mu\mu$f, and coupling is 1.37 times the critical value. Coil Q, electrode voltages, and the loading conductances are the same as for Curve I.

Transformer giving response of Curve I with 6SK7

The critically coupled output transformer giving the response of Curve I with a 6SK7 has a primary and a secondary inductance of 1.17 millihenries, a primary and a secondary capacitance of 104 $\mu\mu$f, and a coil Q of 94. This coil Q is 20% less than the coil Q of the transformer with which Curve I was obtained using a 6K7. The loading conductances and electrode voltages used in computing the transformer for the 6SK7 are the same as those specified for Curve I.

RADIOTRON 2X2/879

REVISED RATINGS

Radiotron 2X2/879, a half wave high-vacuum rectifier for use with cathode ray tubes, has recently been given higher maximum voltage ratings. The new ratings are:—

Filament Voltage (A.C.) .	2.5 Volts
Filament Current	1.75 Ampere
A.C. Plate Voltage (RMS)	4500 max. Volts
Peak Inverse Voltage ...	12500 max. Volts
Peak Plate Current	100 max. mA.
D.C. Output Current (contin.)	7.5 max. mA.

Apart from the increased maximum plate voltage ratings, the characteristics remain as for the older type 879.

THE EFFECT OF SHUNT CAPACITANCES

In the article under the above heading which appeared in Radiotronics 94 (23rd January, 1939), it is regretted that an error occurred in the derivation of the formula for triodes which affected the relevant portion of the table. The complete derivation of the formula is given in the following article, together with the corrected table. The treatment for pentodes remains as given in the earlier article.

The gain (M) of a valve with no shunt capacitance is given by:—

$$M = \frac{\mu R_L}{r_p + R_L}$$

The gain (M′) of a valve with a capacitance (C) shunted across the load resistance is given by:—

$$M' = \frac{\mu R_L}{r_p + R_L + j\omega C r_p R_L}$$

$$\therefore \frac{M'}{M} = \frac{1}{1 + j\dfrac{\omega C r_p R_L}{r_p + R_L}}$$

This is in vector form, and the modulus $\left(\left|\frac{M'}{M'}\right|\right)$ is given by:—

$$\left|\frac{M'}{M}\right| = \frac{1}{\sqrt{1 + \dfrac{\omega^2 C^2 r_p^2 R_L^2}{(r_p + R_L)^2}}}$$

$$= \frac{1}{\sqrt{1 + \dfrac{R^2}{X_c^2}}}$$

where $R = \dfrac{r_p R_L}{r_p + R_L}$

and $\dfrac{1}{X_c^2} = \omega^2 C^2$

Equation (1) has been used in the derivation of the following table, which gives the relative gain with and without a shunt capacitance.

TABLE

Gain with capacitive shunt as a fraction of gain without shunt.

X_c/R_L	M′/M			
	$R_L/r_p = 10$	$R_L/r_p = 5$*	$R_L/r_p = 2$**	Pentodes
.05	.48	.29	.15	.05
.10	.74	.51	.29	.10
.20	.91	.77	.51	.20
.30	.957	.87	.67	.29
.40	.974	.92	.77	.37
.50	.983	.95	.83	.45
.60	.988	.96	.87	.51
.80	.994	.98	.92	.63
1.0	.996	.986	.95	.71
2.0	.999	.997	.986	.90
5.0	.9999	.9995	.998	.98
10.0	.99996	.99986	.9995	.995
20.0	.99999	.99997	.99986	.999

* Suitable for most general purpose triodes.
** Suitable for most high-mu triodes.

AUSTRALIAN-MADE TRANSMITTING VALVES

Four types of transmitting valves are now in current production at the Ashfield Works of Amalgamated Wireless Valve Company Pty. Limited. The Australian production of type 802 was announced in Radiotronics 93 (12th December, 1938), and since that date types added to the range include the 805, 807 and 866. The largest of these is type 805, having a plate dissipation of 125 watts, and an output of 215 watts under Class C telegraphy conditions. It is expected that further additions to the range of Australian made Radiotrons will be announced within the near future.

RADIOTRON 1D8-GT

DIODE-TRIODE-POWER PENTODE

New Type For 1.4 Volt Receivers

Radiotron 1D8-GT is a multiple valve intended especially for operation in battery portable receivers. It combines in one envelope the performance of two separate valves, and thereby saves space as well as having other outstanding advantages.

The diode-triode unit is somewhat similar to type 1H5-G except that the amplification factor is lower. The gain is still, however, ample for portable receivers since excessive audio frequency gain is undesirable on account of microphony. Zero bias operation is permissible as with the 1H5-G. The circuit arrangement and values of components may therefore be the same as for type 1H5-G.

The pentode unit may be compared with type 1A5-G so far as the filament current is concerned, but the power output is 200 milliwatts as compared with 115 milliwatts for the 1A5-G. This increase in power output has been achieved at the cost of a very slight increase in plate and screen currents. The cathode current is only 6.0 mA. compared with equivalent values of 9.1 mA. for the 1C5-G and 11.1 mA. for the 1Q5-GT. The grid bias is higher than for these types, thus causing some loss of sensitivity and also a loss of effective plate voltage when back-bias is used.

The whole unit is mounted in a T-9 bulb having overall dimensions $3\frac{5}{16}''$ in length and $1\frac{5}{16}''$ in diameter, and is thus shorter than type 1A5-G.

Stocks of this type are expected to be available early in September.

RADIOTRON 1D8-GT

DIODE-TRIODE-POWER AMPLIFIER PENTODE

(TENTATIVE DATA)

Filament Voltage (D.C.)*	1.4	Volts
Filament Current	0.1	Ampere
Maximum Overall Length	$3\frac{5}{16}''$	
Maximum Diameter	$1\frac{5}{16}''$	
Bulb	T-9	
Cap	Skirted Miniature—Style C	
Base	Intermediate Shell Octal 8-Pin	

PENTODE UNIT — CLASS A_1 AMPLIFIER

Operating Conditions and Characteristics:

Plate Voltage	45	62.5	67.5	90 max.	Volts
Screen Voltage	45	62.5	67.5	90 max.	Volts
Grid Voltage	–4.5	–5	–6	–9	Volts
Plate Resistance	0.3	0.2	0.2	0.2	Megohm
Transconductance	650	875	875	925	Micromhos
Plate Current	1.6	3.8	3.8	5.0	Milliamperes
Screen Current	0.3	0.8	0.8	1.0	Milliamperes
Load Resistance	20000	16000	16000	12000	Ohms
Total Distortion	10	10	10	10	Per cent.
Power Output	35	90	100	200	Milliwatts

TRIODE UNIT — CLASS A_1 AMPLIFIER

Operating Conditions and Characteristics:

Plate Voltage	45	67.5	90 max.	Volts
Grid Voltage	0	0	0	Volts
Amplification Factor	25	25	25	
Plate Resistance	77000	55500	43500	Ohms
Transconductance	325	450	575	Micromhos
Plate Current	0.3	0.6	1.1	Milliamperes

DIODE UNIT

The diode is located at the negative end of the filament, and is independent of the triode unit and pentode unit except for the common filament.

PIN CONNECTIONS

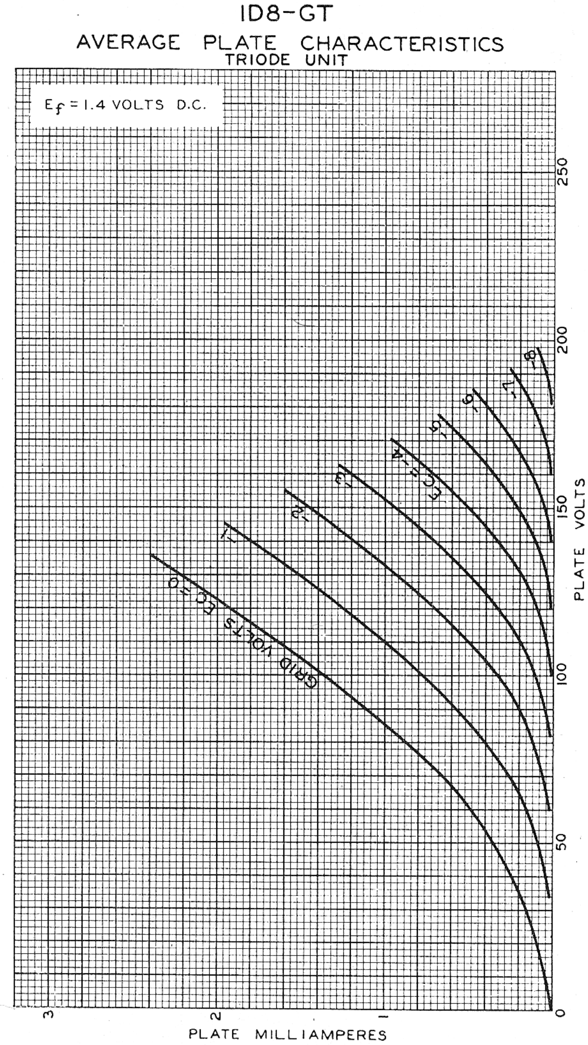
Pin 1—No Connection
Pin 2—Filament +
Pin 3—Pentode Plate
Pin 4—Pentode Screen
Pin 5—Pentode Grid
Pin 6—Triode Plate
Pin 7—Filament –
Pin 8—Diode Plate
Cap —Triode Grid

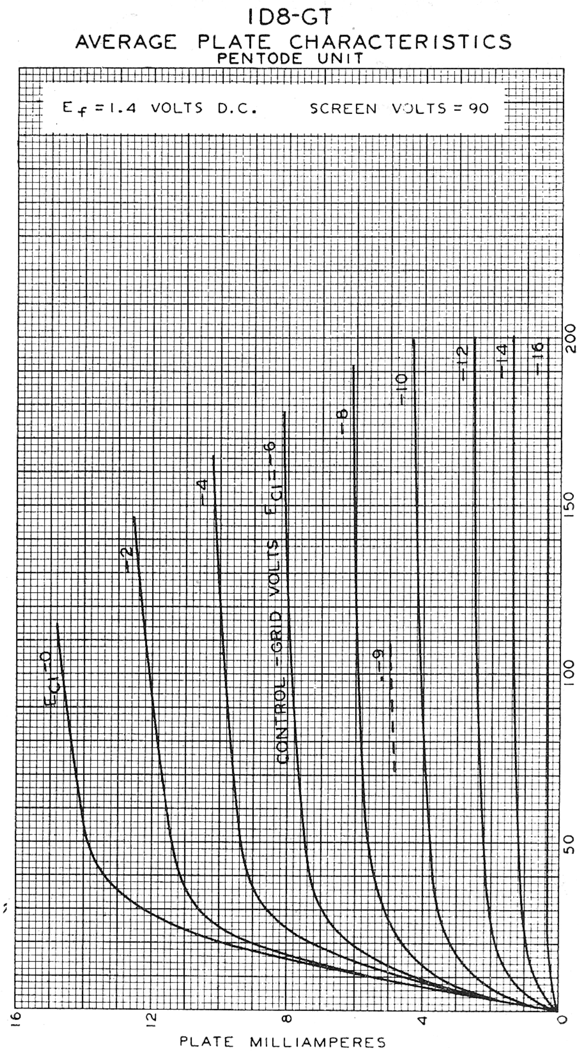
(Pin numbers are according to RMA system)

OPERATING POSITION

Vertical or Horizontal — No restrictions.

* The filament is designed for operation from a dry battery of which the voltage on load does not exceed 1.54 volts.





1.4 VOLT GT VALVES

BANTAM TYPES

The first releases in the 1.4 volt series were G types in a T9 bulb. Their overall maximum dimensions are $1\frac{3}{16}''$ diameter by $4''$ length (without top cap) or $4\frac{5}{16}''$ with top cap. The more recent releases such as types 1Q5-GT and 1D8-GT have been released as GT types, while some of the earlier types have been also made available in the GT construction. A valve type number bearing the suffix GT has the same electrical characteristics as one bearing the suffix G but has a shorter overall length and is mounted in a T9 bulb. The T9 bulb is one having a maximum diameter of $1\frac{3}{16}''$, and is cylindrical throughout its length instead of having a dome top, as is the case with a number of G types.

In the case of the 1.4 volt series, the only difference between the G and GT types is that the latter are shorter by $\frac{5}{16}''$ and have slightly larger base diameter ($1\frac{5}{16}''$). The GT types may therefore be used as replacements for the G types in all cases except where the grid clips will not reach down to the shorter valves.

It is expected that all future releases in the 1.4 volt series will be of the GT type, and that this type will become standardised on account of the advantages for portable receivers. As soon as stocks of types 1A7-G, 1N5-G and 1H5-G become exhausted, it is proposed to supply the equivalent GT types in place of the G types.

RADIOTRON 1624

TRANSMITTING BEAM POWER TETRODE

Radiotron 1624 is a Beam Power Tetrode Transmitting valve with a fast-heating, coated filament to permit quick off-on operation, especially in mobile equipment. Designed with high power sensitivity, this new valve is especially suited for use as an A.F. or R.F. amplifier, modulator, frequency multiplier, or oscillator.

Type 1624 has an application somewhat similar to that of type 1619, with an identical filament rating, but with increased plate voltage, plate input, plate current and plate dissipation ratings.

RADIOTRON 1624

TRANSMITTING BEAM POWER TETRODE

Tentative Characteristics and Ratings

Filament Voltage (A.C. or D.C.)	2.5	Volts
Filament Current	2	Amperes
Transconductance, for plate cur. of 50mA.	4000 approx.	Micromhos
Direct Interelectrode Capacitances: Grid-Plate (With external shielding)	0.25 max.	$\mu\mu$F
Input	11	$\mu\mu$F
Output	7.5	$\mu\mu$F
Bulb	ST-16	
Cap	Small Metal	
Base	Medium 5-Pin	

Maximum Ratings

As Push-Pull Class AB_2 Audio Amplifier.

D.C. Plate Voltage	600	Volts
D.C. Screen Voltage	300	Volts
Max.-Signal D.C. Plate Current*	90	Milliamperes
Max.-Signal Plate Input*	54	Watts
Screen Input* ...	3.5	Watts
Plate Dissipation*	25	Watts

As Grid-Modulated R-F Power Amplifier — Class C Telephony (Carrier conditions per valve for use with a max. modulation factor of 1.0).

D.C. Plate Voltage	600	Volts
D.C. Screen Voltage	300	Volts
D.C. Grid Voltage	–200	Volts
D.C. Plate Current	75	Milliamperes
Plate Input	37.5	Watts
Screen Input	2.5	Watts
Plate Dissipation	25	Watts

As Plate-Modulated R-F Power Amplifier — Class C Telephony (Carrier conditions per valve for use with a max. modulation factor of 1.0).

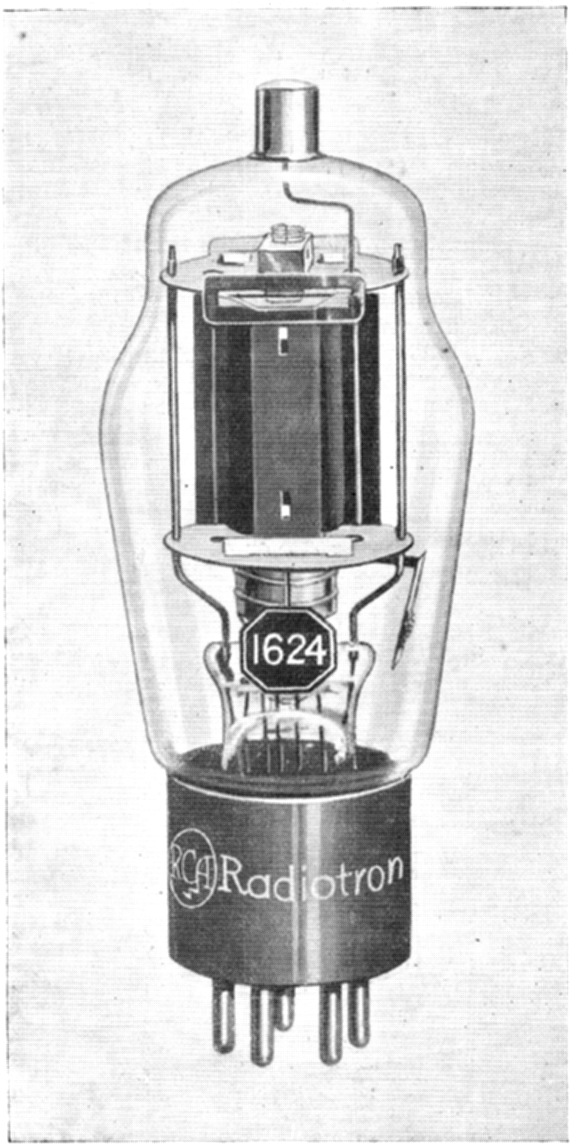
D.C. Plate Voltage	500	Volts
D.C. Screen Voltage	300	Volts
D.C. Grid Voltage	–200	Volts
D.C. Plate Current	75	Milliamperes
D.C. Grid Current	5	Milliamperes
Plate Input	37.5	Watts
Screen Input	2.5	Watts
Plate Dissipation	16.5	Watts

As R-F Power Amplifier and Oscillator—Class C Telegraphy (Key-down conditions per valve without modulation †‡).

D.C. Plate Voltage	600	Volts
D.C. Screen Voltage	300	Milliamperes
D.C. Grid Voltage	–200	Milliamperes
D.C. Plate Current	90	Watts
D.C. Grid Current	5	Watts
Plate Input	54	Volts
Screen Input	3.5	Volts
Plate Dissipation	25	Watts

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

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



Transmitting Beam Power Tetrode—Plate dissipation 25 watts maximum.

IMPROVED STABILITY
RADIOTRON 6U7-G

Stability in an I.F. Amplifier is of paramount importance, as will be appreciated by all radio engineers. One of the factors tending to result in instability is the value of the capacitance from control grid to plate of the I.F. amplifier valve. Some considerable time ago, the published grid-plate capacitance for Radiotron 6U7-G was reduced from 0.010 to 0.007 μμF **maximum.** It should be understood that this **maximum** rating does not give any indication of the value for an average valve, but only a maximum which the valves are guaranteed not to exceed. Occasionally, comparison is made between type 6U7-G with a published maximum value of 0.007 μμF, and other types such as the 6K7 with a published maximum of 0.005 μμF. Such a comparison is inclined to be misleading since, although no change has been made in the published maximum value, the average grid-plate capacitance of Radiotron 6U7-G is well below 0.005 μμF, and is practically identical to that of type 6K7. This improvement has been brought about by a modification of design, and this change has been in effect on our production for several months past.

In a high gain I.F. amplifier incorporating type 6U7-G, it is desirable to employ either a correctly shaped shield to fit closely to the dome of the valve at the level of the internal shield, or a form-fitting shield, in order to make full use of the low inter-electrode capacitance of the valve. Care should also be taken with the wiring and layout, and the shield-cans of the I.F. transformers should not be relied upon for complete screening. With attention to detail of this kind, high gain I.F. amplifiers using Radiotron 6U7-G may be designed to have excellent stability.

Radiotron 924, gas phototube for relay operation.

RADIOTRON NEWS

Radiotron 1D8-GT is a Bantam diode-triode-power-output-pentode with a 1.4 volt filament which has recently been released. Stocks are expected to be available early in September. Data appear elsewhere in this issue.

Radiotron 2X2/879, half-wave high vacuum rectifier for use in connection with cathode-ray tubes, which was mentioned in Radiotronics 99 among other new hyphenated designations, has increased ratings compared with those previously published for type 879. See data elsewhere in this issue.

Radiotron 5AP4/1805-P4, is a 5″ Kinescope having electrostatic deflection, white phosphor, and a short bulb, which has recently been released. It has an application somewhat similar to that of type 5BP4/1802-P4, but has different electrical characteristics in addition to the different bulb. Data are available on request.

Radiotron 6AG7 is a video beam power amplifier for television receivers which was first announced in Radiotronics 99. Data appear elsewhere in this issue.

Radiotron 6V6-GT is a recently announced Bantam equivalent of type 6V6-G.

Radiotron 924 is a recently released gas phototube of compact design with a circular cathode facing the end of the bulb. It is fitted with a screw type lamp base and is intended only for applications in which space is of the utmost importance. See illustration elsewhere in this issue.

Radiotron 925 is a recently released vacuum phototube of similar construction to type 923 but having smaller longitudinal dimensions and an octal base, intended for general phototube relay use.

Radiotron 926 is a recently released vacuum phototube having a construction identical to that of types 921 and 922, but having a rubidium cathode surface which makes it suitable for colour matching applications, since the spectral sensitivity characteristic approaches that of the human eye.

Radiotron 927 is a recently released gas phototube adaptable to 16 mm. sound reproduction equipment owing to its small size ($2\frac{5}{8}$″ max. overall length by $\frac{11}{16}$″ max. diameter).

For further details on all Radiotron phototubes, see the Radiotron Phototube Chart.

Radiotron 1624, a transmitting beam power amplifier with a fast-heating 2.5 volt filament, was announced in Radiotronics 99; complete data are given elsewhere in this issue.

Limited quantities of the following types of valves, recently announced in Radiotronics, are now available from stock: 1G4-G, 1G6-G, 1Q5-GT, 6K6-GT, 12A8-GT, 12K7-GT, 12Q7-GT, 35Z4-GT, 50L6-GT.

RADIOTRON PHOTOTUBE CHART

TYPE	NAME	PRINCIPAL USE	DIMENSIONS SOCKET CONNECTIONS		CATHODE		SENSITIVITY µAMP./LUMEN			SPECTRAL SENSITIVITY CURVE	GAS AMPLIFICATION FACTOR▲	DIRECT INTER-ELECTRODE CAPACITANCE µµf	MAX. AMBIENT TEMPERATURE °C	MAX. ANODE SUPPLY D-C OR PEAK A-C VOLTS	MAX. ANODE CURRENT● µAMP.	MIN. D-C LOAD RESISTANCE (MEGOHMS) FOR					TYPE
																UP TO 75-V SUPPLY	90-V SUPPLY		250-V SUPPLY	500-V SUPPLY	
			DIMEN.	S.C.	SURFACE	WINDOW AREA SQ. IN.	0 CYCLES	1000* CYCLES	5000* CYCLES							BELOW 3.5 µAMP.	BELOW 2 µAMP.	ABOVE 2 µAMP.			
868	GAS PHOTOTUBE	Sound Reproduction	D-1	A	Caesium	0.9	55	50	48	C-1	Not over 7	2.4	50	90	20	0	0.1	2.5	-	-	868
917	VACUUM PHOTOTUBE with Anode Cap	Relays and Measurements	D-2	B	Caesium	0.9	20	20	20	C-2	-	2.2	50	500	30	0	0	0	1	10	917
918	GAS PHOTOTUBE	Sound Reproduction	D-1	A	Caesium	0.9	110	102	93	C-2	Not over 10	2.4	50	90	20	0	1	4	-	-	918
919	VACUUM PHOTOTUBE with Cathode Cap	Relays and Measurements	D-2	C	Caesium	0.9	20	20	20	C-2	-	2.1	50	500	30	0	0	0	1	10	919
920□	TWIN PHOTOTUBE (Gas Type)	Sound Reproduction	D-3	D	Caesium	0.3	75	70	63	C-1	Not over 10	1.5#	50	90	10	0	1.0	4	-	-	920□
921	GAS PHOTOTUBE (Cartridge Type)	Sound Reproduction	D-4	-	Caesium	0.4	100	97	90	C-2	Not over 10	1.1	50	90	20	0	1	4	-	-	921
922	VACUUM PHOTOTUBE (Cartridge Type)	Relays and Measurements	D-4	-	Caesium	0.4	20	20	20	C-2	-	0.6	50	500	30	0	0	0	1	10	922
923	GAS PHOTOTUBE	Sound Reproduction	D-5	A	Caesium	0.4	100	93	84	C-2	Not over 10	2.1	50	90	20	0	1	4	-	-	923
924	GAS PHOTOTUBE (End Type)	Relays	D-6	-	Caesium	0.2	55	Less than 55	Less than 55	C-1	Not over 8.5	2.6	50	90	15	0	0.1	2.5	-	-	924
925	VACUUM PHOTOTUBE	Relays	D-7	E	Caesium	0.4	15	15	15	C-1	-	1.0	50	250	20	0	0	0	1	-	925
926	VACUUM PHOTOTUBE (Cartridge Type)	Colorimetry	D-4	-	Rubidium	0.4	6.5	6.5	6.5	C-3	-	0.6	50	500	20	0	0	0	1	10	926
927	GAS PHOTOTUBE	Sound Reproduction	D-8	F	Caesium	0.4	55	50	48	C-1	Not over 7	2.0	50	90	10	0	0.1	2.5	-	-	927

* These sensitivity values are measured with a light input varied sinusoidally about a mean value from zero to a maximum of twice the mean. The sensitivity values shown are the ratio of the amplitude of variation in the current output to the amplitude of variation in the light input. The light source was a Mazda projection lamp operating at a filament color temperature of 2870°K. Sensitivity of the gas phototubes was measured with a 90-volt supply, a 1-megohm load, and a mean light input of 0.015 lumen. Sensitivity of the vacuum phototubes was measured with a 250-volt supply, a 1-megohm load, and a mean light input of 0.1 lumen.

▲ Ratio of sensitivity at maximum anode voltage to sensitivity at a voltage sufficiently low (approximately 25 volts) to eliminate gas ionization effects.

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

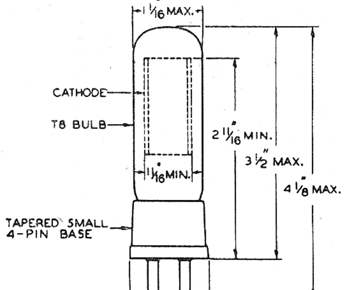
□ Values are for each unit.

Between cathode and anode of each unit. Capacitance between cathodes = 1.6 µµf, between anodes = 0.4 µµf.

AMALGAMATED WIRELESS VALVE CO. PTY. LTD.

(By courtesy of RCA Manufacturing Co. Inc.)

August, 1939



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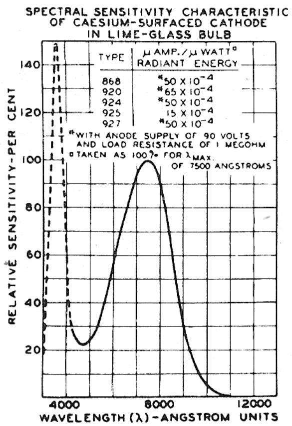

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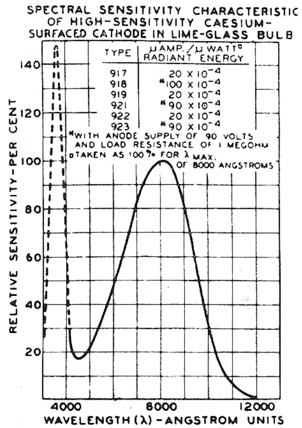

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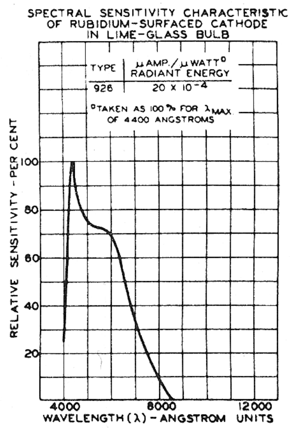

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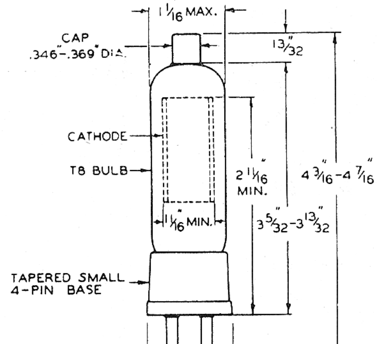

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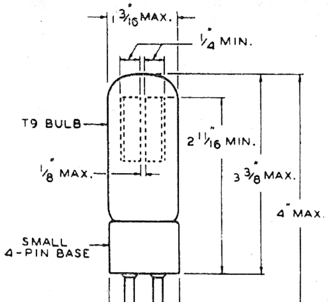

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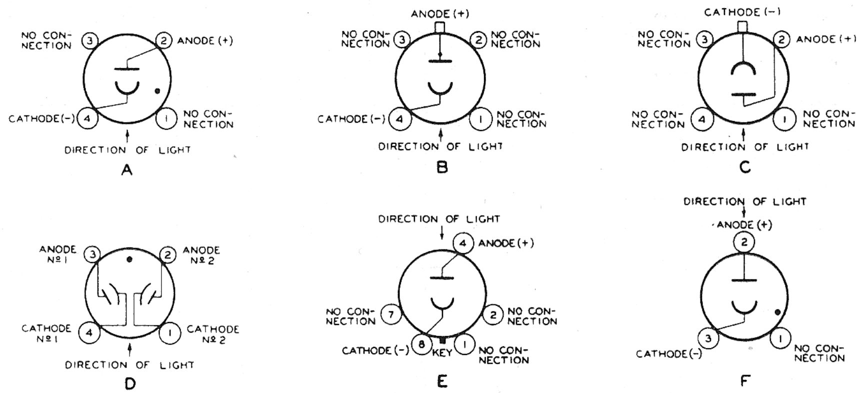
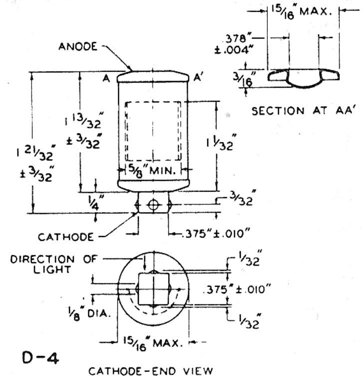


TOP VIEWS OF SOCKET CONNECTIONS ARE SHOWN●
●GAS TUBE TYPE



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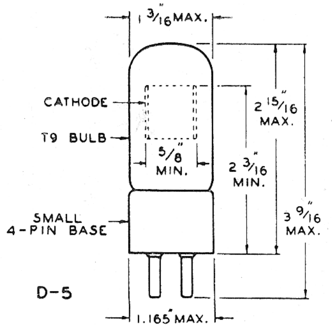

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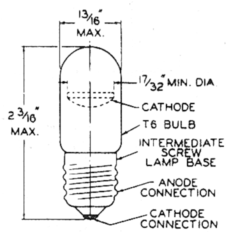

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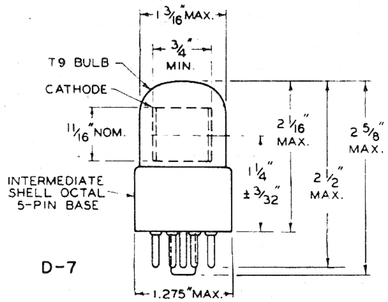

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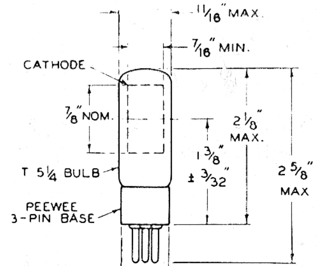

D-8