



RADIOTRONICS

AMALGAMATED WIRELESS VALVE CO. PTY. LTD.

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NOTE

Owing to pressure of urgent work, it was not possible to issue a Radiotronics Bulletin for June, but it is expected that the following issue will be available about the middle of August.

Australian subscribers are reminded that subscriptions for the year 1939-40 are now due, and any who have not already done so are requested to forward the annual subscription of 2/- together with the card enclosed in a previous bulletin.

5-VALVE SIMPLE BROADCAST RECEIVER SPECIAL DESIGN WITH MINIMUM OF COMPONENTS

For certain classes of service it is required to design a receiver having the minimum number of component parts. Such a receiver need not necessarily be poorly designed; in fact, it is possible with good design, to make a simple receiver of this nature capable of giving good performance with long and trouble-free service. It is the purpose of this article to describe a receiver which has been developed to demonstrate what can be done with good design and the minimum number of components.

As a starting point, it was decided to use back bias throughout and to earth all cathodes where possible. As a second feature, the value of which became more obvious as the design progressed, grid leak bias was used for the second detector. Only a single tapping on the bias voltage divider was found to be necessary.

The Circuit

The circuit of the complete receiver is shown on page 40. Type 6A8-G has been selected for use in the converter stage on account of its low price, reliability and good performance on the broadcast band; it is also comparatively non-critical in its operation. It was found possible to omit the oscillator grid condenser without any detrimental effects. The anode-grid supply was taken from a 180 volt tapping on the voltage divider, this voltage being selected to avoid the necessity for any voltage dropping resistor.

The coupling to the I.F. stage is through a standard I.F. transformer. The intermediate frequency selected for this receiver is 465 Kc/s. Type 6U7-G was selected for the I.F. stage and combines high gain with a good super-control characteristic. The screen of this valve together with the screen of the 6A8-G are taken from a common 100 volt tapping on the voltage divider, suitably by-passed to earth. A.V.C. is applied to both the 6A8-G and 6U7-G control grids, and it will be noted that no decoupling resistor is used between them. This has been found permissible although it may introduce a slight amount of regeneration at intermediate frequency.

The coupling to the diode detector is through a second I.F. transformer of conventional design. Type 6B6-G was selected for the second detector stage so that grid leak bias could be used, resulting in simplicity and low cost.

5-VALVE SIMPLE BROADCAST RECEIVER (Cont.)

The usual resistance-capacitance filter was omitted from the diode load circuit, and the remaining condenser increased in capacitance from .0001 to .0005 μF . The resultant filtering is not as efficient as would be obtained by using the additional filter section, but any trouble due to large I.F. voltages reaching the grid of the 6F6-G is avoided by the plate bypass condenser on the 6B6-G.

Simple A.V.C. has been used, and a filter resistor of 1.75 megohms has been adopted owing to the fact that its cost is slightly lower than a 2 megohm resistor, while the difference in damping between them is negligible.

The coupling condenser from the volume control to the grid of the 6B6-G has a value of 1,000 $\mu\mu\text{F}$., and the grid leak resistance is 10 megohms. The additional R.F. voltage on this grid tends to increase the bias but does not appear to be detrimental to the performance of the receiver. Since a small voltage of intermediate frequency appears in the plate circuit, a condenser of 500 $\mu\mu\text{F}$. is connected between plate and earth. This is not sufficient to bypass the whole of the I.F. voltage at this point, but any much larger value would have a serious effect on the high audio frequency response. Further filtering is incorporated in the plate circuit of the 6F6-G. The plate load resistor of the 6B6-G has the conventional value of .25 megohm.

The coupling to the power stage is through a .005 μF . condenser with a .25 megohm grid resistor. It will be noticed that this value of grid resistor is equal to the value of the preceding plate load resistor, and the arrangement is therefore not an ideal one. Any increase of

grid resistor is, however, not permissible owing to the use of back bias, and the combination given is the one which gives the highest gain and best all-round performance.

Radiotron type 6F6-G was adopted for the output stage on account of its low cost, reliability, and good all-round performance. The loudspeaker load resistance to suit the 6F6-G valve should be 7,000 ohms, and a speaker having this nominal impedance is used. Since the impedance of a loudspeaker rises as the frequency rises, it is necessary to use some form of filter across the load to reduce the impedance at high frequencies. A condenser having a capacitance of .005 μF . has been connected between plate and B+, and this value, or one selected by trial, may be used in a receiver not employing a tone control.

The power transformer is a standard one rated at 385 volts each side, with a D.C. current of 80 mA. It was found under test conditions that a typical transformer of this rating gave 370 volts on load with an aerial input signal of 0.1 volt, and 365 volts with zero signal. A 5Y3-G rectifier valve was used with an 8 + 8 μF . filter and a 2,000 ohm field coil.

The back bias resistor of 250 ohms is inserted between the centre tap of the transformer and earth, and is bypassed by a 25 μF . electrolytic condenser of low voltage rating. A tapping on this back bias resistor is selected to give -2.6 volts, since this, together with the effects of contact potential in the diode and the bias developed by the noise voltage, provides an effective voltage of -3 volts between earth and control grids with a very weak signal. Any loss of sensitivity due to the use of simple

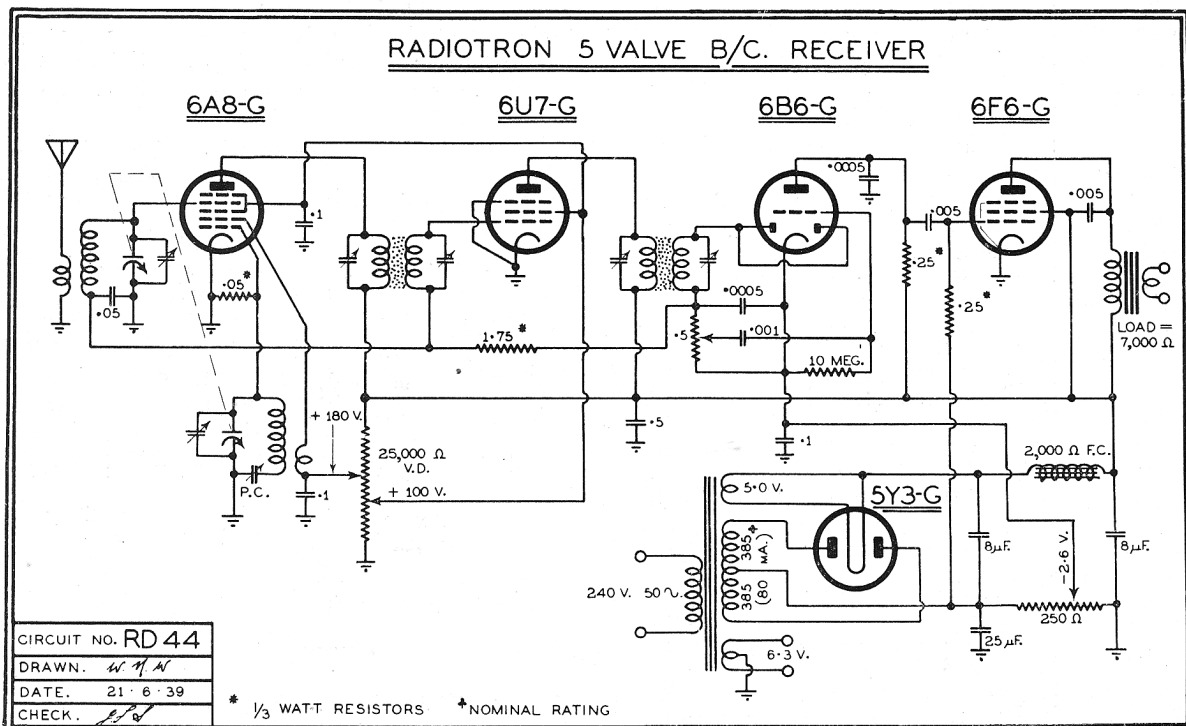


Fig. 1. Circuit diagram of complete receiver.

5-VALVE SIMPLE BROADCAST RECEIVER (Cont.)

A.V.C. is thereby eliminated. It might be found possible to omit the 25 μF . condenser across the grid bias resistance in a small table model receiver in which the bass response is poor or in which a slight hum could be permitted.

Tone Control and Pick-up

Fig. 2 shows an alternative arrangement with a three position tone control. A condenser of .005 μF ., as given in the circuit diagram of Fig. 1, is permanently connected in order to act not only as a tone filter, but also as a bypass for I.F. currents. The tapping switch adds capacitances of .02 and .05 μF . on positions two and three, but all these values could be adjusted to suit the taste of the designer.

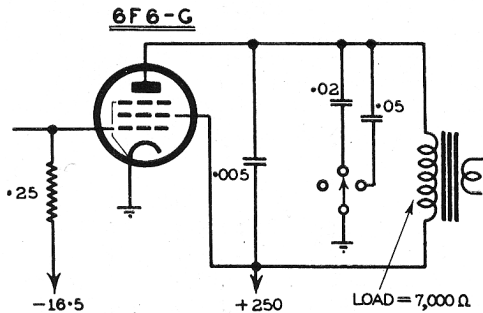


Fig. 2. Alternative three-position tone control arrangement.

A continuously variable tone control is shown in Fig. 3 in which the same .005 μF . fixed condenser is used from plate to B+, and a .05 μF . condenser in series with a .05 megohm variable resistor forms the tone control. Again in this case considerable flexibility is possible in the choice of component values.

A switching arrangement for including pick-up terminals and cutting out radio reception is shown in Fig. 4, which is self-explanatory.

Test Results

The results of tests on this receiver, as tabulated at the end of this article, indicate that the performance is reasonably satisfactory in all regards. An overall absolute sensitivity of 3.9 to 4.8 μV . is obtained over the band for an output of 50 mW. The noise level under these conditions is from 7.5 to 10 mW. for 50 mW. at maximum sensitivity. This is shown also as an "Equivalent - Noise - Sideband - Input" (E.N.S.I.) of .45 to .645 μV . Corresponding readings are also given for the standard I.R.E. test of 500 mW. output, and under these conditions the sensitivity varies between 11.4 and 13.5 μV . for 500 mW. output. As indicated by the theory of E.N.S.I. voltages, the values obtained do not differ to any appreciable extent from those obtained at lower input and output levels.

The noise level was also taken at inputs of 5 and 10 μV . to the aerial terminal with a 50 mW. signal output.

The overall distortion was measured with an input of 25,000 μV . to the aerial terminal at

1,000 Kc/s. modulated 30% at 400 c/s. An output of 2.1 watts was obtained for 5% total distortion and 3.25 watts for 10% total distortion. The American rating of "maximum output" for unlimited distortion was measured and gave 5.15 watts for 35% total distortion. All these tests were taken with a 7,000 ohm resistive load and an electrostatic voltmeter.

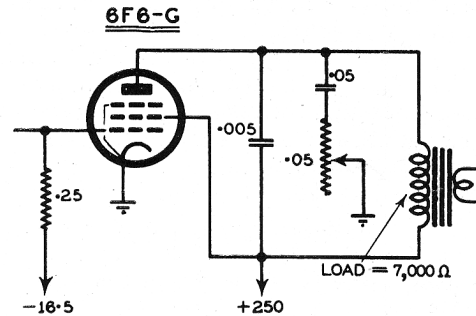


Fig. 3. Continuously variable tone control arrangement.

The A.V.C. curve was first drawn in the conventional manner and then it was plotted a second time according to the method suggested by M. G. Seroggie*, in which the output is extrapolated to give an equivalent curve to that which would be obtained if an audio amplifier of unlimited power handling ability were used. It is proposed to describe this system in greater detail at some later date, but the difference between the two curves is quite interesting. On each curve there has also been added the straight line corresponding to no control. The difference in decibels between the no control line and the A.V.C. curve represents the improvement in the receiver obtained by the use of A.V.C., while the difference between the A.V.C. curve and a horizontal line indicates the further improvement which would be required to obtain an ideal A.V.C. characteristic.

There has also been plotted, with the conventional A.V.C. curve, the bias applied to the controlled grids. It will be seen that the

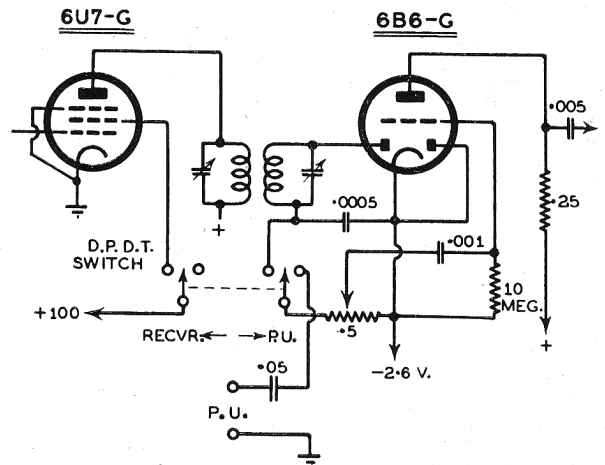


Fig. 4. Switching arrangement for including pick-up terminals and cutting out radio reception.

5-VALVE SIMPLE BROADCAST RECEIVER (Cont.)

control becomes effective only at an input of about 10 μ V., and that no appreciable loss in sensitivity occurs between 1 and 10 μ V. input. The total bias reaches a value of slightly over -30 volts with an aerial input signal of .5 volt. With an input of 1 volt the bias rises to -35 volts, but at this point the A.V.C. curve shows a rise indicating distortion in the I.F. amplifier due to modulation rise. The receiver is therefore capable of operating reasonably well with input signals up to 1 volt without serious distortion, although the maximum for ideal conditions should not exceed .5 volt. The rise in output from 1,000 μ V. to 1 volt is 17 db. on the conventional curve.

TEST RESULTS

Sensitivity and Noise Level

Position	Frequency Kc/s.	Sensi- tivity μ V.	Noise Level mW.	E.N.S.I. μ V.
(a) For 50 mW. Output.				
6U7G				
Control Grid	465	1250		
6A8G				
Signal Grid	465	16.0		
	600	19.0		
	1000	20.0		
	1400	18.5		
Aerial	600	3.9	7.5	.45
	1000	3.9	10.0	.525
	1400	4.8	10.0	.645
(b) For 500 mW. Output.				
Aerial	600	11.4	10.0	.485
	1000	11.4	12.5	.54
	1400	13.5	12.5	.640

Noise Level at 5 μ V. and 10 μ V. Input to Aerial 50 mW. Output.

Frequency Kc/s.	Input to Aerial	
	5 μ V. mW.	10 μ V. mW.
600	3.5	1.1
1000	5.0	1.7
1400	8.0	3.0

Overall Distortion

Input to Aerial Terminal: 25,000 μ V., 1000 Kc/s. modulated 30% at 400 c/s.

Total Distortion	Power Output
5%	2.1 watts
10%	3.25 watts

Max. Power Output: 5.15 watts (35% Distortion).

Above tests with resistive load (7,000 ohm) and output voltage measured with electrostatic voltmeter.

Hum

Residual hum (audio frequency amplifier only): 0.01 volt R.M.S. across 7,000 ohm resistive load = 83 db. below the nominal maximum power output of 3 watts.

Voltage Measurements

Zero Signal:	B+ to E	235 volts
100,000 μ V. signal, 3 watts output:	B+ to E	240 volts

BACK BIAS (250 ohm resistor).

Zero signal:	17.2 volts
100,000 μ V. signal, 3 watts output:	16.7 volts

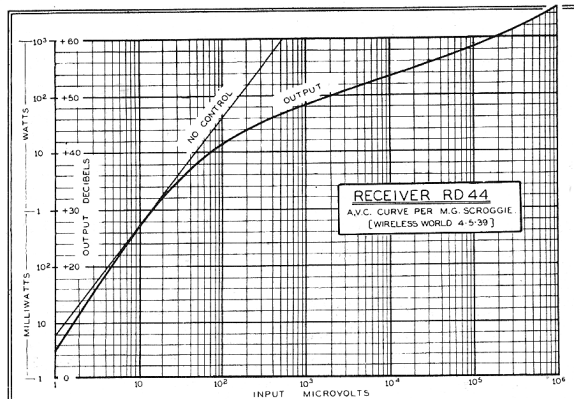
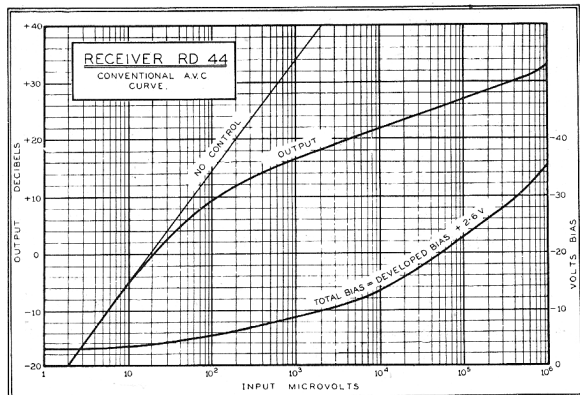
FIELD WATTAGE (2,000 ohms resistance).

Zero signal:	12.0 watts
100,000 μ V. signal, 3 watts output:	11.3 watts

Oscillator Grid Current

Frequency	Oscillator Grid Current
600 Kc/s.	390 μ A.
1000 Kc/s.	410 μ A.
1400 Kc/s.	420 μ A.

(continued on page 43)



NEGATIVE FEEDBACK OVER THREE STAGES

Possible Cause of Parasitics

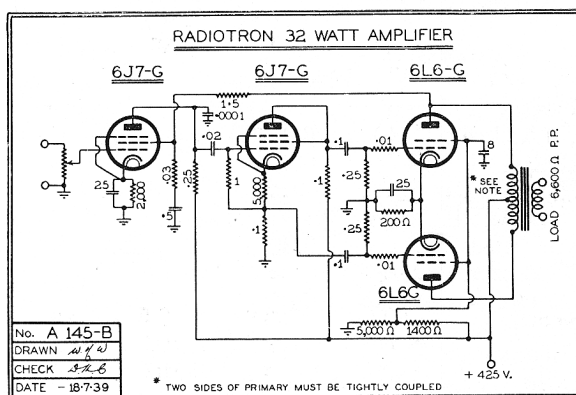
It has been found, with a circuit having negative feedback applied over three stages with a push-pull output, that supersonic parasitic oscillations may take place when an unbalanced output transformer is used. Three circuits of this description (A140, A145, A146) have been described in recent issues of Radiotronics, and all give excellent results when used with a properly balanced output transformer. An examination of this circuit will show that the feedback voltage is taken from one side only of the output circuit. This is permissible if the voltage on the opposite side of the output transformer is identical under all conditions. If unbalance exists in the output transformer it is obvious that instability may occur under certain conditions.

Measurements with some practical transformers have shown that parasitic oscillations may take place over approximately one-quarter of the cycle, and that these parasitic oscillations have a frequency in the region of 30,000 to 40,000 c/s. The effect can be demonstrated on a cathode-ray oscillograph by examining either the wave-form of the output voltage or the relationship between the input and the output voltages. The parasitic oscillations appear to be largely independent of the input signal frequency, but do not occur until the output power reaches a fairly high level, about half maximum power output under the conditions tested.

The effect of the parasitic oscillations is not very apparent on a listening test to music, but if a test is made on a single frequency input, as from a beat frequency oscillator, the sound shows a slight effect of "breaking up" when the parasitic oscillations appear. Even with a single frequency input the effect is not very

obvious and only a very critical ear will distinguish the effect. In view of this fact, it is advisable to make a check with a cathode-ray oscillograph if this trouble is suspected.

Although it is preferable to prevent the trouble from occurring by using a suitable output transformer, it is possible to effect a cure without reconstructing the output transformer by adding a small capacitance of 50-100 $\mu\mu\text{F}$. from the plate of the first (6J7-G) valve to earth. The effect of this small capacitance on the high frequency response is almost completely negligible, since the output at 10,000 c/s. drops by less than 1 db. Even if a good output transformer is used, this condenser may be connected as a safety precaution if it is not possible to make a test with an oscillograph.



A reprint of Circuit A145, with the addition of this small condenser as described, is given to assist readers to make the alteration. A similar alteration may be made with advantage in Circuits A140 and A146.

5-VALVE SIMPLE BROADCAST RECEIVER (Cont.)

Conclusion

In conclusion, it may be stated that this receiver, in spite of the fact that it incorporates only five fixed resistors apart from the volume control, voltage divider and back bias divider, has a reasonably good radio performance, while the tone is quite fair. The adjacent channel selectivity depends on the choice of I.F. transformers, while the tone is largely dependent upon the choice of loudspeaker. While it is admitted that the receiver could not be compared as regards certain fine points with a more elaborate receiver using the same number of valves, delayed A.V.C., and other circuit refinements, it is likely that the receiver would provide a standard of performance which is as high as that required by the average listener, and at the same time have the advan-

tages of low cost, extreme reliability, and simplicity both in manufacture and in servicing. Readers who require a higher standard of performance will find a wide range of the receiver combinations described in earlier issues of Radiotronics. This receiver has not the tonal quality which would be expected from a receiver with negative feedback and with more adequate filtering, nor is it suitable for short-wave operation. This receiver has been designed, however, as a service to readers of Radiotronics in the belief that it will do something to improve the standard of the simpler and cheaper receivers.

* M.G. Scroggie "The A.V.C. Characteristic; An Aid to Receiver Testing", Wireless World, 4th May, 1939, pp.427-428.

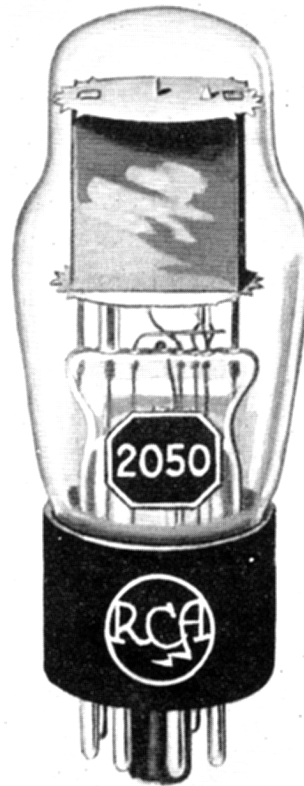
RADIOTRONS 2050, 2051

HOT-CATHODE GAS TETRODES

Radiotrons 2050 and 2051 are sensitive, gas-filled tetrodes of the indirectly heated, hot-cathode type, designed for grid-controlled rectifier service. Both valves have a steep control characteristic (high control ratio) which is independent of ambient temperature over a wide range. Because of the special electrode structure employed, the pre-conduction or gas-leakage currents to the anode are extremely small right up to the beginning of the conduction cycle. In addition, the grid current is very low (less than 0.1 microampere), so that a high resistance may be used in the grid circuit. This characteristic provides the valves with a high sensitivity and permits their operation directly from a vacuum-type phototube. Both the 2050 and the 2051 have a very low grid-anode capacitance and consequently are not appreciably affected by line-voltage surges.

Tentative Characteristics and Ratings

Heater Voltage (A.C. or D.C.)	6.3	Volts
Heater Current ..	0.6	Ampere
Heating Time* ..	10 min.	Seconds
Grid-Anode Capacitance	0.2	$\mu\mu\text{F}$.
Maximum Overall Length	4 $\frac{1}{8}$ "	
Maximum Diameter	1 $\frac{3}{16}$ "	
Bulb	ST-12	
Base	Small Shell Octal 8-Pin	



Grid-Controlled Rectifier Service

	Type 2050	Type 2051	
Peak Forward Anode Voltage	650 max.	350 max.	Volts
Peak Inverse Anode Voltage	1300 max.	700 max.	Volts
Shield Grid (Grid No. 2) Voltage	0	0	Volts
Peak Anode Current	500 max.	375 max.	Milliamperes
Average Anode Current†	100 max.	75 max.	Milliamperes
Valve Voltage Drop (Approx.)	8	14	Volts
Grid Resistor‡	{ 0.01 min. 10 max.	{ 0.01 min. 10 max.	{ Megohm Megohms

* The heater voltage preferably should be applied at least 10 seconds before anode current is drawn.

† Averaged over a period of not more than 30 seconds.

‡ When the valve is operated with an a-c anode voltage and a high value of grid resistance, the grid-anode capacitance should be made as small as possible by placing the grid resistor directly at the socket terminal, by connecting pins No. 4 and No. 8 together at the socket, and by using a close-fitting bulb shield connected to the cathode terminal.

Installation and Application

The **base** pins of the 2050 and 2051 fit the standard octal socket, which may be installed for operation of the valve in any position.

The **bulb** becomes hot during operation. Although sufficient ventilation should be provided to prevent overheating, operation of these valves is not critical to changes in bulb temperature.

The **heater** is designed for operation at 6.3 volts. The transformer winding supplying the

heater should be designed to operate the heater at its rated voltage under average line-voltage conditions. **It is preferable to apply the heater voltage at least 10 seconds before anode current is drawn.** Otherwise, the useful life of the valve will be shortened.

The **cathode** preferably should be connected to the mid-point or to one side of the heater circuit. Although the cathode may be made positive with respect to the heater, the poten-

tial difference between them should be kept as low as possible. It is recommended that the cathode never be made negative with respect to the heater.

The shield grid (grid No. 2) is normally connected to the cathode. It may, however, be used as a control electrode, because the control characteristic of grid No. 1 can be shifted by varying the potential of grid No. 2. As the shield grid is made negative, the control-grid characteristic is shifted positive. With minus four volts on the shield grid, the control-grid characteristic lies completely in the positive region (see Fig. 1).

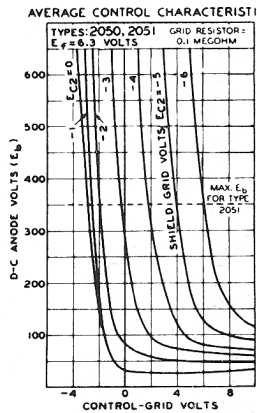


Fig. 1.

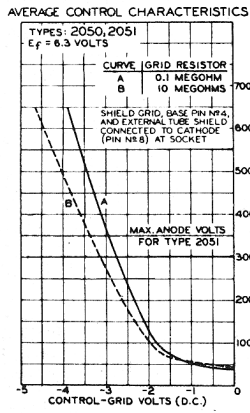


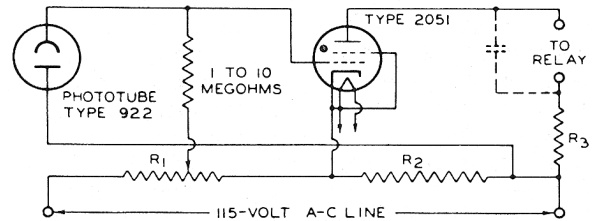
Fig. 2.

The 2050 and 2051 operate by virtue of the fact that, for any specific shield-grid potential and positive anode potential, there is a critical value of control-grid voltage. If the control grid is kept more negative than this critical value and the valve is not conducting, the anode current will remain zero. If the control grid is made less negative, the valve becomes conducting and the anode current assumes a value determined by the applied anode potential and the impedance in the anode circuit. In the conducting condition, the valve voltage drop is quite low and is substantially independent of the value of both anode current and control-grid bias. To extinguish the discharge and to allow grid No. 1 again to assume control, the anode potential should be reduced to zero or made negative. Typical curves showing relations between control-grid voltage, shield-grid voltage, and anode voltage are shown in Fig. 1.

Because the control-grid current is extremely low, a grid resistor having a value as high as 10 megohms can be used; thus, the 2050 and

2051 can be operated directly by a vacuum-type phototube. When a large grid-resistor value is employed, care should be taken to keep the valve base clean and dry, in order to make leakage currents between the control-grid and anode base pins as low as possible.

TYPICAL LIGHT-OPERATED RELAY CIRCUIT



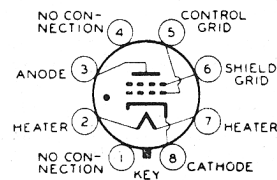
- R₁ = GRID-BIAS POTENTIOMETER
- R₂ = BLEEDER RESISTOR
- R₃ = ANODE-CURRENT-LIMITING RESISTOR

Fig. 3.

The electrode structure of the 2050 and 2051 provides a very low grid-anode capacitance with the result that the valves are insensitive to line-voltage surges. This characteristic also insures that only very low values of capacitive current will flow through the grid resistor. Such a characteristic is very desirable because the control-grid bias required to prevent conduction is increased by an amount equal to the peak IR drop across the grid resistor. In some cases, a neutralising circuit can be used to cancel the effect of this IR drop.

The 2050 and 2051 are designed primarily for grid-controlled rectifier service where the operating frequency is relatively low. In relay applications, the anode voltage may be supplied from either a D.C. or an A.C. source. When a D.C. supply is used, the circuit possesses a "lock-in" feature, because the anode potential must be removed momentarily in order to restore the valve to a non-conducting condition. When an A.C. supply is used, the circuit has no "lock-in" feature, but the average anode current may be controlled by the relative phase of the control-grid, shield-grid, and anode potentials. A typical light-operated relay circuit is shown in Fig. 3.

Bottom View of Socket Connections



SUPER-CONTROL CHARACTERISTICS

Limited Grid Input Voltage

It is sometimes thought that because an R.F. amplifier valve has a super-control characteristic, it is capable of giving satisfactory operation with a very high input voltage provided that the grid is made sufficiently negative. Unfortunately the maximum signal voltage which may be applied to the grid is very much less than the bias under all condi-

tions of operation. Even with extremely negative bias it is inadvisable to apply more than from 3 to 5 volts peak signal on the grid of most super-control valves. The peak signal voltage, at which cross modulation and modulation rise become serious, varies with the grid bias, but frequently has a minimum value at an intermediate bias voltage.

RADIOTRON 1Q5-GT BEAM POWER TETRODE

Radiotron 1Q5-GT is a Bantam beam power tetrode having a 1.4 volt filament. Its characteristics somewhat resemble those of type 1C5-G, but the 1Q5-GT operates with a considerably smaller grid bias and is therefore more sensitive. Type 1Q5-GT also has the advantage that it may be operated satisfactorily with over-biased conditions, giving an appreciable reduction in B Battery drain without serious increase in distortion. The characteristics are given below:—

Filament Voltage (D.C.)*	.....	1.4	Volts
Filament Current	.....	0.1	Ampere
Maximum Overall Length	.....	3 $\frac{5}{16}$ "	
Maximum Diameter	.....	1 $\frac{3}{8}$ "	
Bulb	.....	T-9	
Base	.....	Intermediate Shell Octal 7-Pin	

POWER AMPLIFIER—CLASS A.

Operating Conditions and Characteristics:

Plate Voltage	.....	90 max.	Volts
Screen Voltage	....	90 max.	Volts
Grid Voltage	.....	-4.5	Volts
Plate Current	.....	9.5	Milliamperes
Screen Current	....	1.6	Milliamperes
Transconductance	..	2100	Micromhos
Load Resistance	....	8000	Ohms
Total Harmonic Distortion	.....	7.5	Per cent
Power Output	.....	0.27	Watt

Pin Connections.

Pin 1—No Connection	Pin 5—Grid
Pin 2—Filament +	Pin 7—Filament—
Pin 3—Plate	Pin 8—No Connection
Pin 4—Screen	

(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.

RADIOTRON NEWS

The following new types have been announced but are not at present available from stock:—

Radiotron 1A7-GT, a Bantam equivalent of type 1A7-G, 1.4 volt pentagrid.

Radiotron 1D8-GT, a Bantam diode-triode-power-output-pentode with a 1.4 volt filament.

Radiotron 1H5-GT, a Bantam equivalent of type 1H5-G, 1.4 volt diode-high-mu-triode.

Radiotron 1N5-GT, a Bantam equivalent of type 1N5-G, 1.4 volt R.F. pentode.

Radiotron 1Q5-GT, a Bantam beam power tetrode having a 1.4 volt 0.1 ampere filament (see data elsewhere in this issue).

Radiotron 6AG7, a video beam power amplifier for television receivers.

Radiotron 50L6-GT, a Bantam beam power tetrode with characteristics identical to those of type 25L6-G, but having a 50 volt 0.15 ampere heater for series-heater operation.

Radiotron 893, a water-cooled triode having a plate dissipation of 20 KW. and a filament suitable for 3 or 6 phase operation.

Radiotron 1624, a transmitting beam power amplifier with a fast-heating (2.5 volt 2.0 ampere) coated filament, and a maximum plate dissipation of 25 watts, for use in mobile equipment.

Radiotrons 2050 and 2051, gas-filled tetrodes of the indirectly heated, hot cathode type, for grid controlled rectifier service (see description elsewhere in this issue).

Changes in ratings or operating data have been made in the following types:—

Radiotrons 1A7-G, 1G4-G, 1G6-G may now be mounted in any position.

The newly released types, **Radiotrons 1A7-GT, 1H5-GT, 1N5-GT, 1Q5-GT** may also be mounted in any position.

Radiotron 6Y6-G: The loose leaf Data Sheet (October, 1938) should be revised in the following particulars:—

The Plate and Screen Dissipation (total) should be changed from 8.5 to read 12.5 max. watts. The Harmonic Distortion (Total) for a bias of -13.5 volts and a load resistance of 2,000 ohms should be changed from 9.4 to read 12.0. The Second and Third Harmonic Distortion for a bias of -14.0 volts and a load resistance of 2,600 ohms should each read 8.5% (these values were omitted in the Data Sheet). Under these conditions the maximum signal D.C. Plate Current should read 64 mA.

New Designations

R.M.A. designations have been made for a number of cathode ray tubes and one rectifier for use with cathode ray tubes. It should be noted that although the tubes will in future bear the hyphenated designation for ready identification, it will be sufficient to refer to a specific type by the first (R.M.A.) portion of the designation; e.g., type 3AP1/906-P1 may be referred to as type 3AP1, but it will be understood that it is identical with the existing type 906-P1.

The list of types affected is given below:—

Radiotron 2X2/879	..	(Rectifier)
Radiotron 3AP1/906-P1		(Cathode Ray Tube)
Radiotron 3AP4/906-P4	..	..
Radiotron 5BP1/1802-P1	..	..
Radiotron 5BP4/1802-P4	..	..
Radiotron 9AP4/1804-P4	..	..
Radiotron 12AP4/1803-P4	..	..

In the new R.M.A. designation the first figure refers to the screen diameter in inches, the second symbol is taken in alphabetical sequence, and the third and fourth symbols give the phosphor number.

For example take type 3AP1. The first figure "3" gives the screen diameter as 3 inches. The second symbol "A" has been selected as the first tube of this class. If a second tube having the same screen diameter and phosphor number were released, it would be classed as type 3BP1. Lastly the symbols "P1" indicate that the phosphor number is P1.

RADIOTRON

COMPARATIVE VALVE CHART

For Power and Rectifier Valves

There is a Radiotron Transmitting Valve for every radio application. If a type number is desired which cannot be found on the Radiotron price list, refer to the following tabulation. Where a Radiotron type number is followed by an asterisk, this type is not directly interchangeable, but is in the same general power class.

Consult Radiotronics Technical Bulletins or the RCA TT-3 manual for complete details.

TYPE NUMBER	RADIOTRON TYPE	TYPE NUMBER	RADIOTRON TYPE	TYPE NUMBER	RADIOTRON TYPE	TYPE NUMBER	RADIOTRON TYPE	TYPE NUMBER	RADIOTRON TYPE
RK-10	10	RK-39	807*	ZB-120	838*	HK-255	—	T-805	805
BW-11	834	HY-40	—	T-125	810*	266-B	—	T-814	806*
RK-11	1623*	T-40	808*	150-T	806	267-B	—	T-822	806*
HV-12	—	TZ-40	808*	M-150-T	806*	C-300	—	825	1623*
RK-12	809*	RK-41	807*	HK-154	808*	HF-300	—	C-830-B	830-B
RK-15	46*	RK-42	30*	HK-155	—	300-T	—	C-833	833
RK-16	59*	RK-43	—	T-155	806*	303-A	203-A	C-838	838
RK-17	2A5*	RK-44	837	C-200	810*	303-U	—	C-841	841
HV-18	—	RK-45	837*	HF-200	—	304-A	204-A	841-A	808*
RK-18	800*	RK-46	804*	T-200	806*	WE-304-A	834	C-845	845
RK-19	—	RK-47	814	C-201	805*	308-B	—	R-845	845
FV-20	—	RK-48	813*	C-202	805*	310	801	T-845	845
RK-20	804	RK-49	6L6-G*	C-203-A	203-A	311	211	845-B	845
RK-20-A	804	50-P	—	HD-203-A	805*	311-C	835	C-849	849
T-20	1623*	50-T	—	203-B	203-A	311-CH	—	C-849-A	—
TZ-20	809*	RK-51	830-B*	HD-203-C	805*	311-CT	—	C-849-H	—
KY-21	—	HY-51A	—	203-H	805*	311-T	—	C-851	851
RK-21	836*	HY-51B	830-B*	203-Z	838*	315-A	—	C-852	852
RX-21	—	RK-52	808*	C-204-A	204-A	317-C	217-C	C-866	866
T-21	6L6-G*	RK-53	—	210	10	342-B	211	C-866-A	866-A
RK-22	—	HK-54	808*	C-211	211	C-350	—	866-B	866*
RK-23	802*	HK-55	—	211-B	211*	353-A	872	866-JR	—
HK-24	—	T-55	808*	211-C	835	HK-354	806*	C-872	872
RK-24	30*	RK-56	6L6-G*	HD-211-C	805*	HK-354-C	806*	C-872-A	872-A
HY-25	809*	HY-57	809*	211-D	211	HK-354-D	806*	905	805
RK-25	802	RK-57	805	211-E	835	HK-354-E	806*	911-CH	835*
RK-25-B	802	RK-58	838	211-G	—	HK-354-F	806*	930	830-B*
HV-27	—	RK-59	—	211-H	—	361-A	835	930-B	830-B
VG-27	—	HY-60	807*	212-E	—	376-A	835	938	838
RK-28	803	RK-60	5Z3*	C-214	214	450-TH	—	941	841
RK-28-A	803	HY-61	807	222-A	214*	450-TL	—	942	842
RK-30	800	RK-62	—	242-A	211	500-T	—	945	845
RK-31	—	RK-63	806*	242-B	211	575-A	—	949	849
RK-32	834*	HF-100	810*	242-C	211	HY-615	—	951	851
RK-33	—	RK-100	—	242-C	211	HK-654	831*	952	852
RK-34	6A6*	100-TH	852*	249-B	—	750-TH	—	966	866
RK-35	—	100-TL	852*	C-249-B	—	750-TL	—	966-A	866-A
35-T	808*	C-100D	—	250	50*	756	809*	972	872
RK-36	806*	C-100E	—	250-TH	806*	C-800	800	972-A	872-A
RK-37	808*	C-101	—	250-TL	806*	C-801	801	HK-11554	—
RK-38	806*	C-120	838*	HK-254	—	C-805	805	HK-3054	—