RADIOTRONICS

AMALGAMATED WIRELESS VALVE CO. PTY. LTD.

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

TECHNICAL BULLETIN No. 84 **15th MARCH, 1938**

In this issue:—

THE RADIOTRON FIDELITY TUNER

Continuously Variable Selectivity

In Radiotronics 82, an earlier article covered the general problems in the design of variable-selectivity tuners. This article includes the description of a complete tuner together with details of coil adjustment and a suitable design of differential condenser for the control of selectivity. Additional information and performance curves will be given in the next issue of Radiotronics.

Having considered the design problems of variably selective tuners as given in Radiotronics 82, various circuit values for the I.F. filter may be calculated in the circuit diagram (M126). If the inductance of L_1 is considered to be 1500 μH and the coils to have Q factors of 93.5* the loss resistance (I^2R loss) is found to be 47.0 ohms. The tuned circuit following the buffer valve may have the same inductance and resistance, but must be damped by a resistance of .05 megohm or less in the following grid circuit. The last I.F. transformer (L_2, L_3) has coils having the same Q factors, in themselves, as the circuits having the inductance L_1, but their effective values of Q have been halved by making their own dynamic resistances equal to the loads imposed on the respective coils. It has been noted that such a condition allows maximum transfer of energy from valve to diode load. The primary is loaded by the A.V.C. network (0.25 megohm) and the plate resistance of the 6G8G. The secondary has the effective diode input impedance (0.3 megohm) shunted across it. Calculation showed the required inductances for L_2 and L_3 to be 686 μH and 1100 μH, and the resistances to be 21.4 ohms and 34.4 ohms respectively.

The fixed magnetic coupling in the filter had to be tight enough to preserve the stage gain, yet loose enough to have negligible effect on the selectivity curve. By making $KQ = 1$ in each case (where $K = M_1/L_1$ and $M_2/\sqrt{L_2L_3}$), the mutual inductances were found to be $M_1 = 16\ \mu H$ and $M_2 = 8.7\ \mu H$.

The problem of construction thus resolved itself into the making of coils with specified inductances and high frequency resistances. From the point of view of the engineer the simplest solution of a problem is the best, even if it may not be backed rigorously by science, provided that the result can be proved correct. The experimental method of coil making was preferred to an attempt to calculate their sizes and shapes, because the number of variables would make such a task extremely tedious.

Having to fix two variables, namely inductance and resistance, a system was devised whereby each could be adjusted in turn. Each coil was made in two lattice-wound sections of 250 turns of 7/41 B. & S. Litz, on a common ⅜in. dowel in a manner to allow one section to be slipped to or from the other. To adjust the resistances, each half coil was resonated in an oscillatory circuit connected as in Fig. 1, and an R.F. potential developed across it by passing the output of a signal generator through it. As a constant current was required, a 10,000 ohm resistance was introduced in series between the generator and the coil. The I.F. channel, detector, and audio stages of a receiver connected to an output meter were used to measure the voltage output. At resonance, the reactance of the coil R_x, was nullified by the negative reactance of the condenser, C, and the high frequency resistance remained. Resonance was indicated by a sharp dip on the cutput meter. When a non-inductive resistor having the required resistance was substituted for the re-

THE RADIOTRON FIDELITY TUNER (Continued)

sonance circuit, the output voltage from the signal generator was adjusted to provide standard output (50 mW). Turns were then removed from the half coil, until, at resonance, it provided the same output as the resistor had given. Thus the high-frequency resistance of the coil was equal to that of the resistor. When one attempts such a procedure, it is important that the harmonic output of the signal generator does not, to any extent, reach the detector in the receiver, as it would not be suppressed by an acceptor circuit tuned to the fundamental. When making the non-inductive resistors, if very fine wire such as 48 S.W.G. is used, they may be straight lengths on pieces of mica. A bridge with an accuracy of one part in one hundred may be used to fix them, or one may measure the voltage drop across them when a measured current is flowing. Having then obtained coils of the required high frequency resistance, it was necessary to adjust the mutual inductance between their halves to

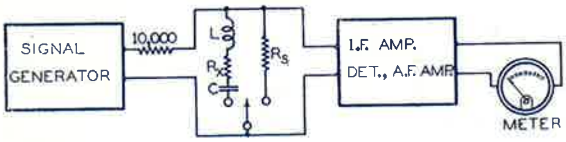


fig. 1

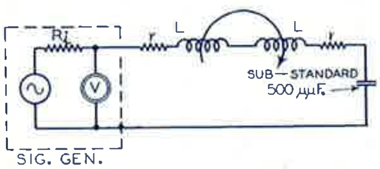


fig. 2

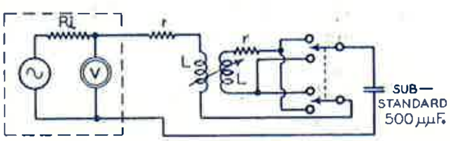


fig. 3

the value which gave them the required total inductance. In the A.W.V. laboratory the coil was resonated in series with a sub-standard (1%) 500 µµF condenser across the output terminals of a signal generator (Fig. 2). With the main (stepped) attenuator set to its maximum setting, the resistance of the circuit at resonance (r) was so much less than the internal resistance (R_i) of the generator that the output voltage fell sharply, indicating the frequency of resonance. The frequency of the generator was set to 184 Kc/s, 272 Kc/s and 215 Kc/s respectively for L_1, L_2 and L_3, and the spacings between halves of each were adjusted for minimum voltage output.

This method must not be used with signal generators having thermo-couple output meters, as the high current at resonance would probably damage the thermo-couple.

Alternatively, the coil could have been used in a parallel resonant circuit in the plate circuit of a 6J7 or 6K7, fed with 0.1 volt at its grid from a signal generator. Resonance may then be shown by a valve voltmeter connected across the tuned circuit. 500 µµF was chosen to reduce the effects of coil capacitance on resonant frequency, and to keep the frequencies within the range of the signal generator. With a smaller condenser, the stray capacities could have a greater (and less desirable) effect on the frequency of resonance.

The mutual inductance between the two coupled pairs was adjusted by varying the lateral distance between the coils, and measuring the frequency of resonance (Fig. 3) with the coils connected first in an assisting sense, and then in the opposing sense. The difference between the two total inductances is then four times the mutual inductance between the coils. The mutual inductance, M, may be calculated very easily from the approximate formula:—

$$M = \frac{f_1 - f_2}{f_1 + f_2}$$

Where f_1 = frequency with coils opposing,
f_2 = frequency with coils aiding,
and $f_1 - f_2 << f_1 + f_2$

Curves were plotted showing the mutual inductance M as a function of the distance between the coils. The correct distances were selected, the dowels were fixed to sheets of bakelite, and their mutual inductances were checked again.

The variable coupling condensers, C_c, remained the sole item for development. Calculation revealed that a differential condenser of special design could be made to spread the outer humps of the resonance curve symmetrically about the central hump. A dimensioned sketch of the condenser finally adopted is shown in Fig. 4. It is suggested that this design be copied faithfully if the engineer wishes to avoid tedious calculations. The mathematical treatment of this condenser will be forwarded on application to the Unified Sales-Engineering Service.

The choice of valves for the tuner is quite straightforward and the rest of the tuner needs little comment. The cathodes of all valves were connected to earth rather to simplify design and reduce cost than anything else. The 6L7G is operated with 80 volts on its screen to increase the plate resistance, since a high plate resistance is essential.

The purpose of this article is to show the engineer how his ordinary screened room equipment (signal generator, output meter, and resistance bridge) can be made to do his odd jobs, and how, with standard gear and a little ingenuity he may develop circuits a little out

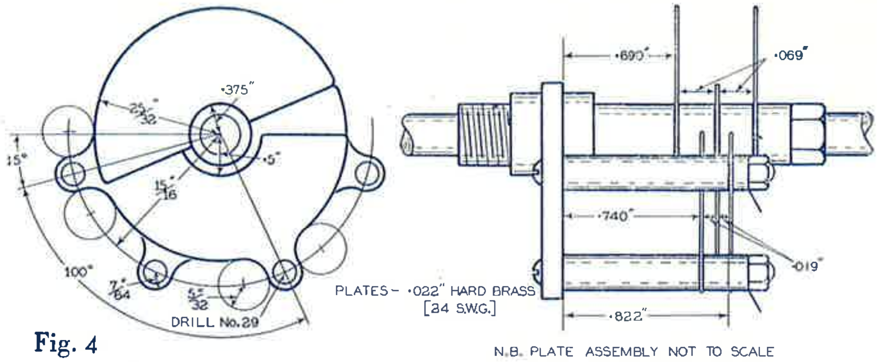


Fig. 4

of the ordinary. The tuner itself is an advance on any other which has come before our notice, in that while it has a band width at 1000 times down of 38 Kc/s in the selective position, when expanded it has a flat top (within 2 db) of 20 Kc/s and retains a bandwidth of 53 Kc/s at 1000 times down. This latter bandwidth is found quite frequently in peaked tuners having attenuation of about 5 db. for bandwidths of 10 Kc/s. As the earlier stages are doing little more than idling, and the final I.F. stage operates with fixed bias, the envelope distortion is negligible. The sensitivity is of the order of 1 microvolt absolute on broadcast and 3 microvolts on short-waves.

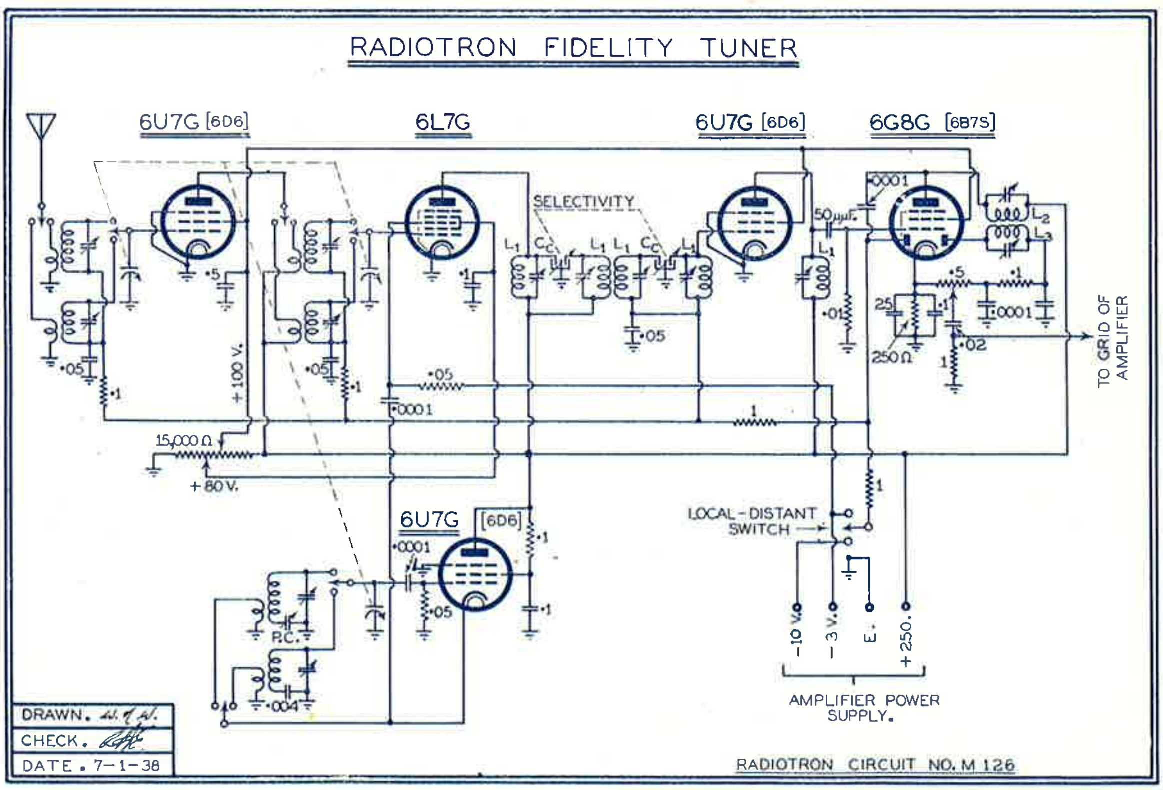
Mechanically the variable coupling condensers are sound, and not likely to require service. In the experimental model, air trimmers were used throughout, except for the plate circuit of the buffer stage where a ± 20% capacity drift is tolerable. It is recommended that this practice be copied.

Alignment presents no problem, as the tuner will be found to behave as a normal peaked amplifier when set to the selective position. Tuning should be carried out always with the selectivity at its maximum and the pass-band may be adjusted afterwards to the most desirable setting.

No particular amplifier is shown with the tuner, which may be used with any of those described in Radiotronics during the past twelve months. A single ended 6C6-2A3 arrangement will be found to satisfy most ordinary requirements, delivering 3.5 watts of undistorted output: Better still is the 7 watt amplifier (A115) shown in Technical Bulletin No. 77, page 45. The composite receiver would have then a frequency response flat within 5 db. from 30 to 10,000 c/s, with distortion less than 5% total at any frequency. The speaker for such a set is a problem for the individual engineer.

(To be continued.)

* W. T. Cocking; *Wireless Engineer*, Mar., Apr., May, 1936.



IMPROVED AUDIO A.V.C.

Radiotron 6L7G as Bias Controlled Audio Amplifier

Audio A.V.C. has been described more than once in previous issues of Radiotronics. Its function, when correctly applied, is to maintain the signal strength of a station constant, irrespective of fading. If the A.V.C. is applied only to the stages earlier than the second detector, it is not possible to obtain a perfectly flat A.V.C. characteristic since obviously some rise is necessary in order to actuate the circuit producing the increased negative bias. If a large delay voltage is used, and if control is exercised on a sufficiently great number of stages, it is possible to obtain a satisfactorily level A.V.C. response. In an ordinary small receiver, however, the A.V.C. characteristic is usually rather poor, so that, although some compensation is given for fading, the compensation is not complete. In such a receiver it is possible to add audio A.V.C. in such a way as to produce an A.V.C. characteristic which is level within the limits of audibility over a very wide range of signal strength.

Such an A.V.C. characteristic is particularly desirable in an automobile receiver where satisfactory operation is necessary under particularly adverse conditions. An incidental feature of the application of audio A.V.C. is that hum arising in the first audio stage is reduced while the receiver is tuned to a local station, the effect being due to the reduced audio gain under these conditions.

In previous circuits Radiotron 6B7S was used as a bias controlled resistance coupled audio amplifier, but the distortion obtained with this arrangement is sufficiently high to prevent its use in many cases. It is emphasised that the distortion obtained is dependent upon the output voltage from the controlled stage, and the distortion may be reduced to a negligible amount if the voltage to be delivered by the controlled stage is reduced sufficiently. For this reason the use of a more sensitive output valve such as Radiotron 6V6G will reduce the distortion due to the controlled valve. However, even under these circumstances, the distortion may not be admissible in every case.

An improved form of audio A.V.C. is available by making use of Radiotron 6L7G valve in which the controlling voltage is applied to the first grid and the input signal to the third grid. Under these circumstances satisfactory control may be obtained with less distortion, although the output voltage is still not enough under certain G_1 bias conditions to excite a triode output stage or to allow the use of negative feedback. As in the case with the 6B7S, the distortion may be decreased by reducing the output voltage from the controlled stage, and in a fidelity receiver a second audio frequency stage should be interposed between the 6L7G and the output stage. In such a case the maximum audio gain may be sufficient to cause trouble through microphonicity, and Radiotron 1612 is suggested in place of the 6L7G. In cases where a second audio stage is undesirable, it is necessary to employ a sensitive power valve and Radiotron 6V6G is particularly applicable, provided, of course, that negative feedback is not employed.

In order to investigate the possibilities of the 6L7G as an audio A.V.C. valve, a receiver was constructed, employing Radiotron *6U7G* as an R.F. amplifier, *6A8G* converter, *6G8G* I.F. amplifier, second detector and A.V.C. diode, *6L7G* resistance coupled audio amplifier and

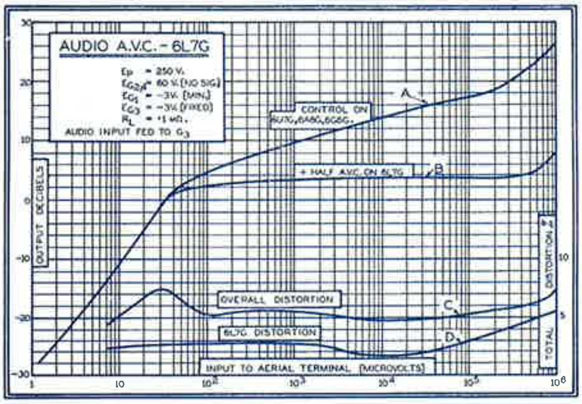


Fig. 5.

audio A.V.C. and *6V6G* power tetrode. The A.V.C. characteristics are shown plotted in Figure 5, in which curve A refers to the conditions in which control is placed on the three stages before the second detector, while curve B refers to similar conditions, but with the addition of half the A.V.C. voltage applied to the first grid of the 6L7G. It will be seen that for a change of input voltage from 100 μV. to 300 mV. there is an increase of 15 db. without audio A.V.C. and less than 2 db. with audio A.V.C. (Curve B).

The excellent control illustrated by curve B would not make it sufficient to justify the adoption of this arrangement unless the distortion were reduced to a reasonable level. The overall distortion was measured by adjusting the volume control to give an output of 100 mW. (zero db. level on the scale) with 1 mV. input to the aerial terminal, and the total percentage distortion was then measured with the receiver operating into a resistive load at an audio frequency of 400 c/s (curve C). Curve D shows the percentage total harmonic distortion with the 6L7G stage alone, being derived from measurements with 8 volts R.M.S. across its plate load. These curves reveal that the greater part of the distortion is due to stages other than 6L7G, the principal sources of distortion being the I.F. amplifier and output valve. The peak at 30 μV. input is due to the commencement of conduction in the A.V.C. diode, the voltage of which is adjusted so that it does not conduct until an input approaching 30 μV. is reached. The distortion occurs owing to the loading imposed by the diode load resistance under dynamic conditions being effective over part only of the cycle in the region of this input level. It will be noticed that the distortion rises to a peak and then falls as the aerial signal voltage is increased. This is a phenomenon which always occurs in a receiver fitted with delayed A.V.C., but in this case it is rendered less serious, since the delay voltage is

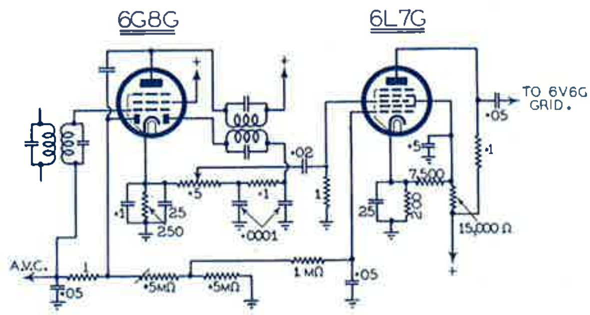


Fig. 6.

so small (—3 volts) that no appreciable distortion from this cause is found with input signals of 100 μV. or above. All normal listening on local stations would be carried out with an input signal well above this value, and therefore the peak of distortion will not be noticed except in the reception of very weak signals. Even under the worst conditions the total percentage of overall distortion is about the same as that of most commercial receivers employing a similar output stage. Owing to the presence of this distortion peak it is desirable to keep the delay voltage at a low value so that the distortion only occurs at low input signals.

The rising distortion as the input voltage approaches 1 volt is largely due to "modulation rise" in the 6G8G valve. This "modulation rise" is due to the curvature of the characteristic and its presence indicates that the valve is being operated with too high an input signal. This points out one of the weaknesses of audio A.V.C. which, although it is able to produce a very flat A.V.C. characteristic, still leaves the earlier stages prone to suffer from overloading. This could be avoided by the use of amplified A.V.C. or of two I.F. stages, the second being operated at fixed bias. Since both of these methods necessitate the use of an additional valve, they are not widely adopted and the distortion which occurs with high input signals is tolerated.

The screen voltage of the 6L7G is rather critical and should vary between 60 and 65 volts as the bias of the first grid is changed. The resistor network shown in the circuit diagram of Figure 6 provides a screen voltage for the 6L7G, which gives the necessary adjustment in screen voltage as the bias is varied. This circuit diagram shows the 6G8G I.F. amplifier with its two diodes employed for detection and A.V.C., together with the 6L7G audio controlled valve. This combination may be applied to many receiver arrangements. If the degree of A.V.C. applied to the first grid of the 6L7G is increased above half, it is possible to obtain a falling A.V.C. characteristic, while if less than half be used the characteristic will rise slightly. The half A.V.C. bias voltage used in this circuit applies to the conditions in which three stages are controlled, but if more or less controlled stages are employed, the tapping may be varied so as to give greater or less control to the 6L7G audio amplifier.

Summarising the operating conditions for Radiotron 6L7G valve as a bias controlled audio amplifier we have:—

- Applied supply voltage, 250 volts.
- Plate load resistance, 0.1 megohm.
- Screen voltage obtained from voltage divider with 15,000 ohms between the screen and B+, and 7,500 between the screen and cathode.
- Cathode bias resistor, 200 ohms.
- Maximum gain approximately 45 times.

The signal input grid (No. 3) is operated at fixed bias due to the self-bias in the cathode circuit, the actual bias being approximately —3 volts. The No. 1 grid, which is used for control purposes, is supplied through a suitable resistor which serves to prevent too severe a shunting effect on the A.V.C. system.

NEW RADIOTRON RELEASE

Radiotron 6G6G Power Pentode

Radiotron 6G6G is a power pentode of the indirectly heated type with a heater operating at 6.3 Volts 0.15 Amp. Its principal application is in battery receivers and the advantage is largely in the possibility of using self-bias. The 6G6G is very suitable for the power stage of receivers using a 6 volt accumulator, but it is not recommended for automobile use. With plate and screen voltages of 135 volts, plate and screen currents of 11.5 and 2 mA. respectively, an output of 0.6 watt is obtainable. With 180 volts, with plate and screen currents of 15 and 2.5 respectively the power output is 1.1 watt maximum. The Australian list price of the 6G6G is 18/-, and stocks are expected before the end of March.

RADIOTRON 50 WATT TRANSMITTER

Application of New Type 809

A circuit for a transmitter has been designed in the laboratory of Amalgamated Wireless Valve Co. Pty. Ltd. to take full advantage of the new 50 watt limit of input now existing on experimental transmitters. This transmitter is suitable for operation on either or both phone and C.W. and should be found extremely satisfactory from all points of view.

The first stage is Radiotron 6V6G used as a crystal oscillator. This valve has been found to be very satisfactory in such a position and since it has a high second harmonic in the output, it is preferable to pentode types for frequency doubling. The valve operates either as a straight crystal oscillator at crystal frequency or as a tritet oscillator on the second harmonic. Consequently by the use of a 40 metre crystal, it is possible to obtain operation on both 40 and 20 metre bands.

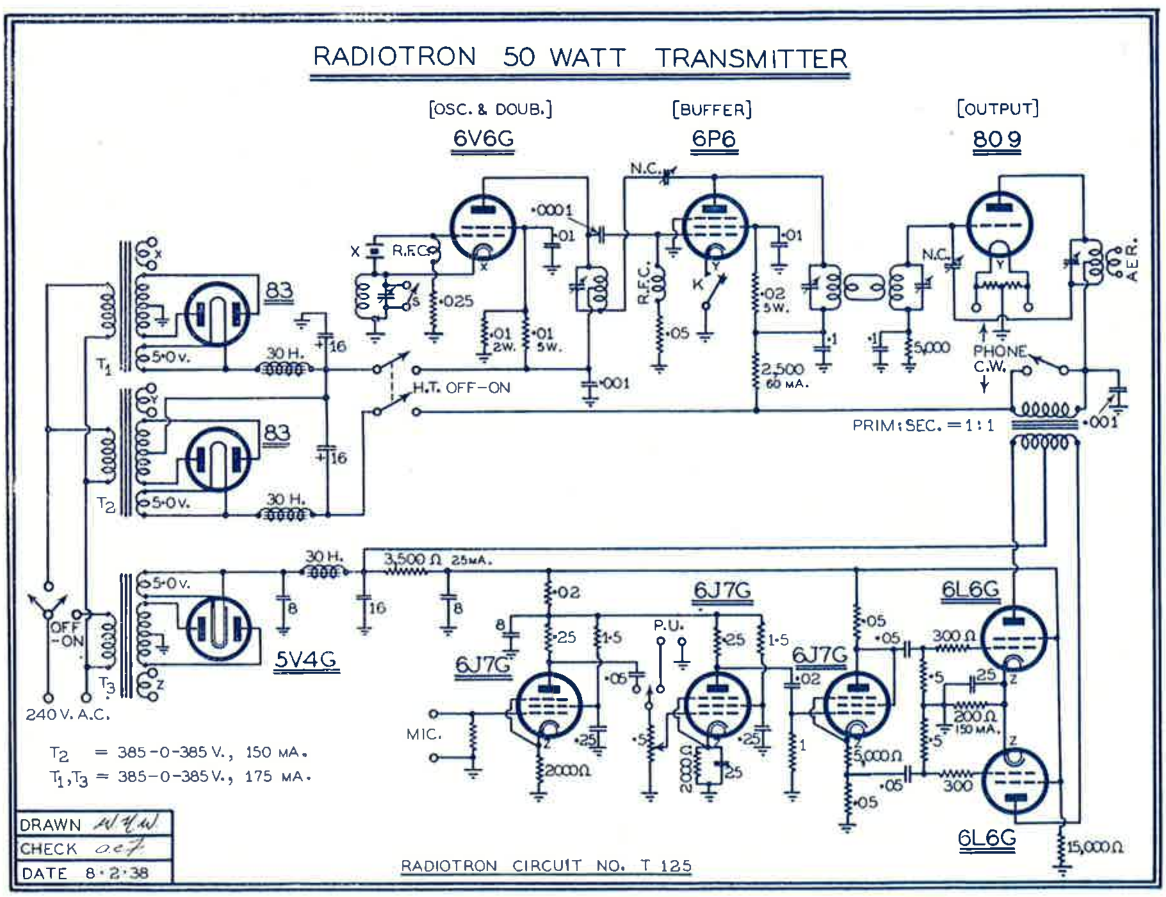
The output of the 6V6G oscillator gives ample drive to the grid of the 6P6 buffer which operates under maximum class C conditions to deliver a power output of approximately 12 watts. This stage is shown with a neutralising condenser in order that maximum stability may be obtained even with somewhat limited screening. The neutralising arrangement may be omitted in cases where screening is sufficiently complete, although it is a desirable feature in all cases. The neutralising condenser itself is constructed merely by twisting a short length of wire around the plate lead and adjusting the capacity by the number of turns.

The final amplifier is a Radiotron 809 high mu triode operating on both phone and C.W. under its maximum Class C telephony conditions, which are:—

Plate volts, 600 volts.
Plate current, 83 mA.
Power Input, 49.8 watts.
Typical Power Output, 38 watts.

When operated on C.W., the valve has ample reserve of power handling ability, although this cannot be used owing to the limitation of power input. The adoption of a constant supply voltage on both C.W. and phone simplifies the circuit arrangement.

The voltage which is required by the transmitter is much higher than that available from any rectifier used for receiving purposes, so



that a pair of Radiotron 866 mercury vapour rectifiers would normally be necessary. However, as will be seen from the circuit diagram, by combining in series the outputs from two standard power packs, the required voltage is obtainable at a lower cost. In this circuit two Radiotron 83 valves are used as rectifiers, each having its own separate transformer and filter. Due to the series connection, a convenient source of low voltage for the crystal oscillator is obtainable by tapping to the junction of the two units. This power supply arrangement is, however, merely a suggestion and may be replaced by any other power pack delivering the correct voltage and current, provided that the regulation is sufficiently good.

In order to modulate an input to the final stage of about 50 watts, it is necessary to have available at least 25 watts of audio power. A suitable modulator is shown in the diagram and will be seen to consist of two Radiotron 6L6G valves in push-pull Class AB1, giving an output of slightly over 25 watts. The earlier stages in the modulator consist of a 6J7G pre-amplifier, 6J7G voltage amplifier and 6J7G phase splitter. This latter operates under conditions of very low gain and is used merely in order to avoid the use of a transformer. The overall fidelity of this arrangement is excellent and since the 6L6G valves operate into a nearly constant load, the harmonic distortion is very low. This modulator is not recommended for use on a loudspeaker load owing to the danger of high voltages being present in the plate circuit due to the rise of impedance of the loudspeaker at high frequencies.

The pre-amplifier valve, which is shown as Radiotron 6J7G, could with advantage be replaced by the non-microphonic Radiotron 1603, which is specially intended for use in this application. If it is desired to use the 6J7G valve in this position, it may be necessary to select a suitable valve having the least tendency towards being microphonic.

Provision for a pick-up is shown on the input to the second stage of the modulator. If a sensitive microphone is used, with an output of over 0.2 Volt R.M.S., the pre-amplifier stage may be omitted and the input taken to the pick-up terminals. The power supply for the modulator is obtained from a separate transformer rated at 385-385 volts 175 mA. The rectifier is Radiotron 5V4G and the filtering arrangement is shown in the circuit diagram.

A suitable modulation transformer could be constructed as follows:—

- Cross sectional area of core—1.25 sq. inches.
- Length of magnetic path—11 inches.
- Length of air gap—.015 inches.
- Primary turns—3,000 turns 30 SWG. enamel (centre tapped).
- Secondary turns—3,000 turns 30 SWG. enamel.

For best results, the windings should be wound in sections in the following order:—

- Winding 1— 750 turns primary.
- Winding 2—1500 turns secondary.
- Winding 3—1500 turns primary (centre tapped).
- Winding 4—1500 turns secondary.
- Winding 5— 750 turns primary.

A similar construction is used in transformer T7 described in Radiotronics No. 76, page 43.

If operation on C.W. only is desired, the modulator and modulation transformer may be omitted and a very simple type of transmitter is the result. This could easily be built up as a unit and the modulator added at a later date without losing any efficiency with either arrangement and without any necessity for alterations in the transmitter.

NEW RADIOTRON RELEASE

Radiotron 814 Transmitting Beam Power Tetrode

Radiotron 814 is a beam power tetrode, having a plate dissipation of 50 watts maximum, which is capable of operating under maximum input up to a frequency of 30 megacycles while with 75% input operation is permitted up to 50 megacycles and with 50% input up to 100 megacycles. The filament is thoriated tungsten and is rated at 10 volts 3.25 Amps. The use of directed electron beams results in very little power being absorbed by the screen while ample suppressor action is supplied by the space charge effects produced between the screen and the plate. It may be used as R.F. amplifier, frequency multiplier, oscillator, and plate modulated or grid modulated amplifier. The plate is brought out to a cap at the top of the bulb and a 5 pin medium ceramic base is fitted.

The transconductance for a plate current of 39 mA. is 3,300 micromhos, and the direct interelectrode capacitances are 0.1 $\mu\mu$F. grid to plate (with external shielding), 13.5 $\mu\mu$F. input and 13.5 $\mu\mu$F. output capacitance. The maximum plate and screen voltages are 1250 and 300 respectively, and at these voltages a typical output for Class C telegraphy is 130 watts. The driving power for this output is only 1.5 watts. As a plate modulated amplifier, a typical carrier output is 87 watts, while as a grid modulated amplifier the power output is 29 watts. As a Class B linear amplifier on telephony, the output is 25 watts approximately. The maximum overall dimensions of the 814 are $7\frac{5}{8}$in. by $2\frac{1}{16}$in. diameter. The beam forming plates are brought out to a separate base pin, but are normally connected to the filament.

NEW RADIOTRON RELEASES

Radiotron 6K8 All-Metal Triode-Hexode

Radiotron 6K8 is a type of frequency changer new to the Australian market. It incorporates a hexode (four grid) mixing valve and a separate triode oscillator in the one envelope, and is therefore capable of being used in substitution for pentagrid converters such as the 6A7, 6A8 or 6A8G. The conversion conductance of the 6K8 is 400 micromhos and the plate resistance 0.6 megohm. Australian list price, 18/-. Further information will be given in the next issue of Radiotronics.

Radiotron 6J8G Triode-Heptode

Radiotron 6J8G is similar in many respects to the 6K8, but the mixing valve incorporates an additional grid, making it a heptode (or pentagrid) mixer in conjunction with a triode oscillator. The 6J8G is only available in the "G" series. The conversion conductance of the 6J8G is lower than that of the 6K8, but the plate resistance is considerably higher, so that the conversion gains of the two types are comparable. The Australian list price of the 6J8G is 18/-.

Stocks of the 6K8 and 6J8G valves are expected shortly and further information will be given at a later date.

Radiotron 6C8G Twin Triode

Radiotron 6C8G is a twin triode having two low consumption heaters, each drawing 0.15 Amp. giving a total heater consumption of 0.3 Amp. at 6.3 Volts. The two cathodes are brought out to separate base pins, and very flexible arrangements of the valve are possible as a consequence. Due to this feature, it is possible to use a load in the cathode circuit; in one suggested application the first unit may operate as a voltage amplifier, exciting the second unit, which may be used as a phase splitting valve with equal resistors in plate and cathode circuits. Other special circuits are also practicable. The 6C8G is only recommended to be used in cases where types 6A6 or 79 are not practicable, owing either to the heavier heater current or to the link between the two cathodes. The Australian list price of the 6C8G is 18/- and stocks are expected before the end of March.

Radiotron 6Z7G Class B Twin Amplifier

Radiotron 6Z7G is a twin triode intended for use as a Class B amplifier in automobile or battery receivers, but it may also be used with A.C. on the heater. The heater operates at 6.3 Volts 0.3 Amp., the maximum plate voltage is 180, while the maximum plate dissipation is 8 watts. With 135 volts on the plate an output of 2.5 watts is obtainable with a plate to plate load of 9,000 ohms and a driving power of 320 mW. in the grid circuit. If the plate load is increased to 15,000 ohms, the power output drops to 1.5 watts, but the driving power drops to 80 mW. With 180 volts on the plate, the power output with 12,000 ohms plate to plate is 4.2 watts with a driving power of 320 mW. With 20,000 ohms plate to plate, the output is 2.2 watts and driving power 80 mW. Zero grid voltage is used under all conditions and the zero signal plate current per plate is 3 or 4.2 mA. for plate voltages of 135 or 180 respectively.

The 6Z7G is fitted with a small shell octal 8 pin base and the maximum length is $4\frac{1}{8}$in. by $1\frac{9}{16}$in. diameter. The Australian list price is 18/-.

Type Modifications

Radiotron 1F7G will in future be designated as type *1F7G-V*. The letter "V" refers to the fact that the two diodes are situated vertically in relation to one another, both being at the negative end of the filament. In the past, some manufacturers have supplied valves having diodes situated one at each end of the filament, and confusion has arisen through the non-interchangeability of these two types in certain circuits. In future the type number 1F7G will refer to valves having diodes at each end of the filament, while type 1F7G-V will refer to types having both diodes at the negative end of the filament. All Radiotron valves of either type number have had and will continue to have the two diodes at the negative end of the filament, and for this reason the type number 1F7G will be changed to read 1F7G-V. Although in the case of existing stock the letter "V" may not be shown on the valve, it may be taken that all Radiotron valves branded 1F7G are identical with Radiotron valves now being branded 1F7G-V. The change is, therefore, merely one in type designation and does not *indicate any change whatever in valve characteristics or construction.*

Certain types of valves, which were introduced first as tetrodes and then later by certain manufacturers as pentodes, have been found not to be interchangeable under all circumstances. The R.M.A. has standardised these conflicting types under separate type designations, a final letter T or P indicating that the construction is tetrode or pentode respectively. Since Radiotron valves of these types are all of the pentode construction, the final letter P will be added to these types. The addition of this letter does not in any way indicate a change in valve construction or characteristics, being merely a change of symbol to differentiate between them and others having a tetrode construction. These pentode valves may be used in place of the tetrode valves under all normal circumstances, although the reverse is not always the case, particularly with low B battery voltages. The valve types referred to are the 1*A*4, 1*B*4, 1*D5G* and 1*E5G*, which will in future be known as Radiotron types 1*A*4-*P*, 1*B*4-*P*, 1*D5G-P* and 1*E5G-P*. Equivalent valves of the tetrode construction are not obtainable in the Radiotron range.

Published by The Wireless Press for Amalgamated Wireless Valve Co. Pty. Ltd.