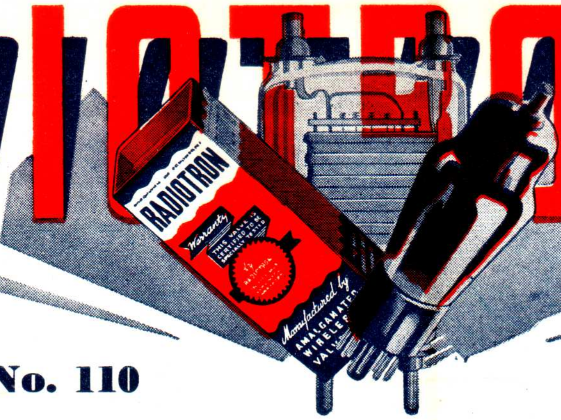
RADIOTRONICS



BULLETIN No. 110 March, 1941

EFFECT OF TEMPERATURE ON FREQUENCY OF 6J5 OSCILLATOR*

Oscillator frequency stability becomes increasingly important as utilization of short waves is increased. The reason is that while factors tending to change the frequency of an oscillator act for the most part to cause small percentage changes, the tolerable frequency variation in a receiver or transmitter is generally expressible as a definite number of kilocycles which is independent of the oscillator frequency. For example, the frequency band which is passed by the I.F. system of an "all-wave" broadcast receiver is the same whether the frequency of the receiver signal is 500 kilocycles or 20 megacycles. A five-kilocycle change in the frequency of the oscillator would have the same effect in either case. Since the oscillator frequencies for these two cases would be approximately 1000 kilocycles and 20 megacycles, a five-kilocycle deviation would represent 0.5 per cent. of the operating frequency for the 500-kilocycle signal, and 0.025 per cent. for the 20-megacycle signal. For equal effect, therefore, the frequency variation for the short-wavelength signal should be one-twentieth of that for the longer-wavelength signal.

Television and frequency-modulation services employ wide bands, and, consequently, do not require quite the high degree of oscillator frequency stability of the above example. The tolerance for frequency-modulation has been estimated to be five to twenty kilocycles, and that for television reception, twenty to fifty kilocycles. These tolerances, when applied to frequency-modulation signals at 50 megacycles and television signals up to 100 megacycles, indicate permissible oscillator-frequency deviations in the range of 0.01 to 0.05 per cent. Receivers for such services must be capable of tuning to this order of accuracy, and of maintaining their oscillator frequency, thereafter, within the tolerance considered to be acceptable.

Factors tending to change the oscillator frequency are:

1. Temperature variations affecting the mechanical and electrical properties of the oscillator circuit.
2. Voltage variations.
3. Structural changes of circuit elements produced by shock, vibration, etc.

Measurements of Temperature Rise and Frequency Drift.

This Note deals primarily with frequency change due to temperature variation. Preliminary results were obtained in a series of tests with a television receiver altered to use the oscillator circuit shown in Fig. 1-A. The change was made to facilitate testing procedure, and not because it offered any advantages in practice. These tests showed that:

1. With the oscillator operating at 58 megacycles, its frequency decreased 150 kilocycles in an hour, and was still decreasing slowly at the end of that period.
2. The temperature of the chassis at a point near the oscillator valve increased approximately 15°C during the hour. The temperature of the air increased about 13°C, and that of the top of the oscillator valve (6J5, a metal type) increased by approximately 50°C. The temperature between the base of the valve and the socket increased 30°C.
3. Changes in the socket material affected the amount of frequency drift appreciably, but the differences between the frequency drifts observed with wafer-type sockets and sockets of the molded ceramic type were small in comparison with the total drift. Curves showing frequency drift vs time are given on Fig. 2.

Further tests were made by first operating the receiver for at least an hour to allow the frequency to reach (approximately) its equilibrium value, then quickly changing the oscillator valve and observing the frequency change as the fresh valve heated. In these tests, the maximum fre-

(Continued overleaf, column 2.)

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*By courtesy of R.C.A. Manufacturing Co. Inc.

RADIOTRONICS

TECHNICAL BULLETIN, No. 110

MARCH, 1941

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CONTENTS

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AMALGAMATED WIRELESS VALVE CO.
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* * *

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HEATER-CATHODE CAPACITANCE

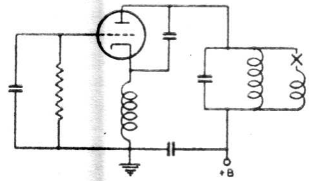
When the cathode is not at earth potential the heater-cathode capacitance is sometimes of importance. Although this is somewhat variable for the different valve types, the values given below may be taken as reasonably close.

Type	Chk.
6.3 volt 0.3 amp. (6J7-G, etc.)	10.5 $\mu\mu$F.
6.3 volt 0.45 amp. (6V6-G)	12 $\mu\mu$F.
6.3 volt 0.7 amp. (6F6-G)	10 $\mu\mu$F.

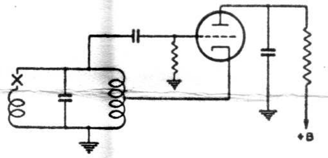
(continued from page 15)

quency change observed was never more than one-third of the change observed in the preliminary tests. When ceramic-type sockets were used, the changes were still less. The curves of Fig. 3 show results of tests made in this manner. An immediate conclusion is that for the receiver used the oscillator valve does not account for more than a third of the observed frequency change. Actually, the fraction chargeable to the valve is less than this, because insertion of a cold valve in a hot socket cools the socket to an undetermined degree. Thus, part of the observed frequency change is due to the change in socket capacitance as the socket temperature again rises to the equilibrium level.

OSCILLATOR CIRCUITS USED IN TESTS



(a) GROUNDED-GRID OSCILLATOR CIRCUIT



(b) GROUNDED-PLATE OSCILLATOR CIRCUIT

FIG. 1

It will be noted that the ordinates of Figs. 2 and 3 are given in terms of change in capacitance as well as in kilocycles. The capacitance corresponding to a given change in frequency can be determined readily when the operating frequency and the total capacitance of the circuit are known. The relation is

$$\Delta F/\Delta C = -500\ F/C$$

where F is frequency in megacycles
Δ F is frequency change in kilocycles
C is total circuit capacitance in $\mu\mu$f
Δ C is the change in circuit capacitance in $\mu\mu$f

The negative sign indicates that an increase in circuit capacitance causes a decrease in frequency, and vice versa. In the receiver used for the tests described above, the total capacitance was 58$\mu\mu$f and the operating frequency was 58 megacycles; consequently, a capacitance change of 0.002 $\mu\mu$f would cause a frequency change of one kilocycle, and the 150-kilocycle change observed (see Fig. 2) would correspond to a capacitance change of 0.3 $\mu\mu$f. It should be mentioned that the original oscillator circuit had twice the total capacitance of the circuit used in this test, and included a compensating condenser. For these reasons, the frequency shift of the unaltered receiver was very small in comparison with the 150-kilocycle change noted above.

Determination of equivalent capacitance is useful in two ways; first, it enables us to extend the interpretation of our results to other frequencies and other operating conditions, and second, it suggests the nature and magnitude of corrective measures to be applied.

The stating of frequency variation in terms of capacitance change does not necessarily imply that the frequency change is entirely due to a change in circuit capacitance. An increase in circuit inductance, caused by mechanical expansion of coils and leads with increasing temperature, also causes a decrease in frequency. Hence, it is possible that under some conditions an inductance change could account for a major part of the frequency drift.

Discussion of Drift Components.

A curve showing temperature rise vs time for the television receiver given is shown on Fig. 2. Only part of the heat causing increases in receiver temperature comes from the oscillator valve itself. Quite different temperature-rise curves should be expected with receivers of other design or application. Accordingly, in order to obtain a better determination of the performance of the valve itself, a special chassis containing only the oscillator circuit and a little auxiliary equipment to facilitate drift measurements was constructed. Drift measurements taken with this special chassis are shown on Figs. 4 and 5. With this chassis, the operating frequency was 52 megacycles, and the circuit capacitance was 26 μμf. Hence, a frequency change of one kilocycle corresponded to a capacitance change of 0.001 μμf.

Fig. 4 shows data obtained with each of the two oscillator circuits of Fig. 1 for a wafer socket. This socket was fastened directly to the chassis. Since a possible objection to this arrangement was that the aluminium chassis might conduct heat

TEMPERATURE RISE & FREQUENCY DRIFT OF COLD TELEVISION RECEIVER
WITHOUT FREQUENCY-COMPENSATING CONDENSER

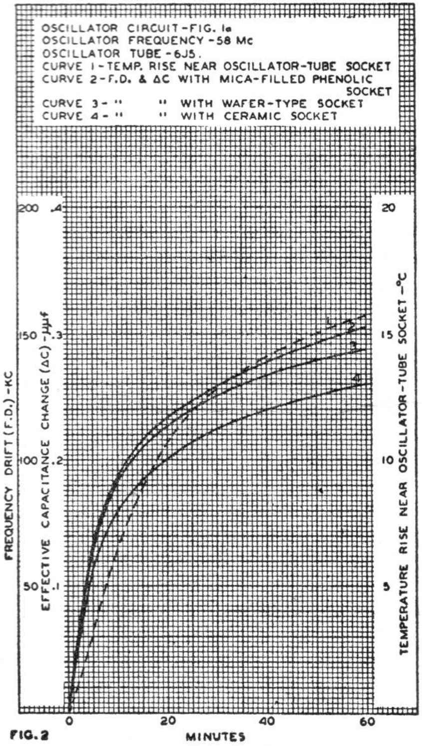


FIG. 2

FREQUENCY DRIFT OF WARM TELEVISION RECEIVER FOR COLD OSCILLATOR TUBE
WITHOUT FREQUENCY-COMPENSATING CONDENSER

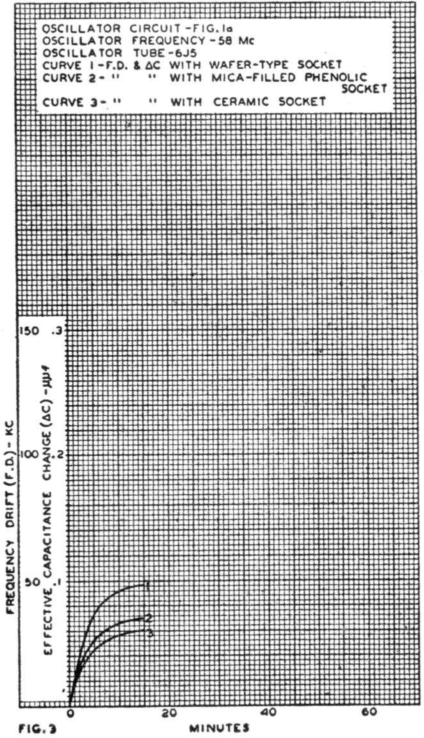


FIG. 3

EFFECTIVE CAPACITANCE CHANGE OF COLD OSCILLATOR TUBE IN WARM SPECIAL CHASSIS WITH WAFER-TYPE SOCKET MOUNTED ON CHASSIS

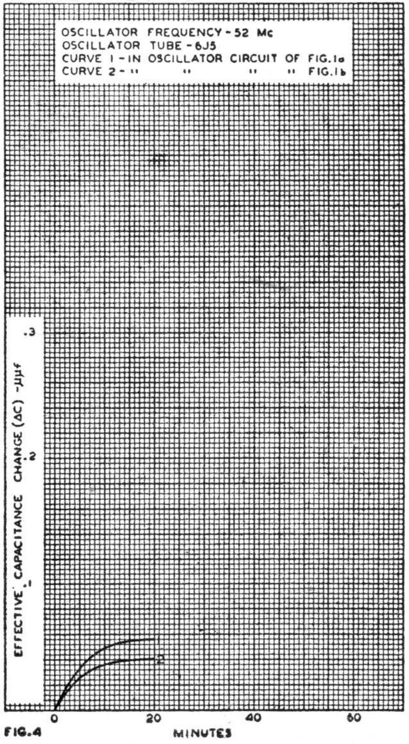


FIG. 4

away too rapidly, a special socket mount, consisting of a steel plate suspended from the chassis by rubber grommets, was also used for these tests. These results are shown on Fig. 5 for the "grounded-grid" circuit of Fig. 1-A.

It is at once apparent that the drift (expressed as capacitance change) is less under these conditions. The change in ten minutes, with a wafer socket, is 0.06 μμf for the special chassis with the rubber-mounted socket, and 0.095 μμf for the television receiver. The temperature rise between valve base and socket was approximately 30°C in the receiver ,and from 10°C (near the edge) to 20°C (near the centre) in the special chassis. These differences are of the correct order of magnitude to correspond to the differences in results. The temperature difference in the two cases corresponds roughly to the increase in air and chassis temperatures in the receiver. Consequently, it is reasonable to conclude that approximately two-thirds of the socket temperature rise in the receiver is due to heat from the valve, and that the remainder is due to heat from other sources. The temperature rise of other parts, which accounts for two-thirds of the total drift, is almost entirely the result of heat from other sources.

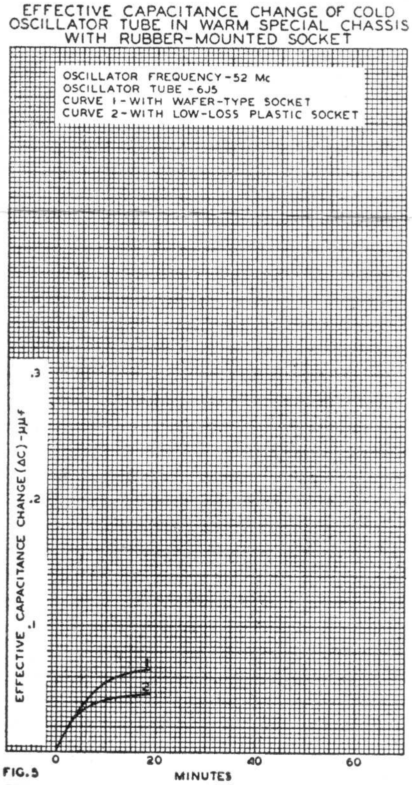


FIG. 5

A comparison of Figs. 2 to 5 leads to an approximate analysis of the sources of frequency drift, as shown in the following table.

Part	Temp. Rise (receiver) °C	Capacitance Change μμf	Temp. Coeff. μμf per °C
Valve (internal structure)	—	0.03	—
Valve base	30	0.03	0.001
Socket (wafer)	30	0.03	0.001
Other circuit elements . .	15	0.20	0.017
Total		0.29	

For the special chassis, the results on the basis of the same coefficients are as follows:

Part	Temp. Rise °C	Capacitance Change μμf	Temp. Coeff. μμf per °C
Valve (internal structure)	—	0.03	—
Valve base	15	0.015	0.001
Socket (wafer)	15	0.015	0.001
Total		0.06	

If it is assumed that the ceramic socket used in the receiver and the low-loss plastic socket used with the special chassis contribute negligible amounts to the frequency drift, the predicted changes with these sockets are 0.270 μμf for the receiver, and 0.045 μμf for the special chassis. Observed values are 0.261 μμf and 0.047 μμf, respectively. For these tabulations, the valve capacitance change has been separated into "internal structure" and base components, because it has been assumed that only the base is affected by changes in external temperature.

Over-all test results with a mica-filled phenolic socket indicate a temperature coefficient of 0.0017 μμf per degree C, but tests with a cold valve inserted in a hot receiver show less change than for wafer sockets. The explanation is probably that the wafer socket is cooled almost to room temperature by the insertion of a cold valve, while the mica-filled phenolic socket retains considerable heat because of its greater mass and different structure. The apparent differences in the performance of sockets under the conditions of Figs. 2 and 3 indicate the necessity for caution in the interpretation of all data obtained by the insertion testing method.

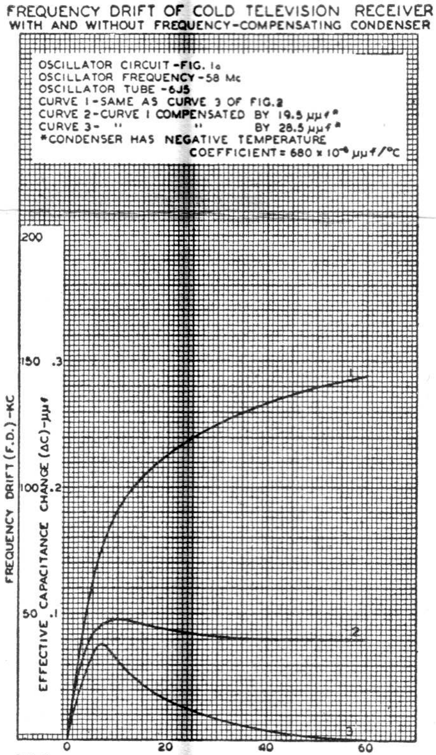


FIG. 6

No special significance should be attached to the use of the "grounded-grid" oscillator circuit in these tests. In this connection, the two types of circuit shown in Fig. 1 were tested on the special chassis and gave the data shown by curves 1 and 2 of Fig. 4. Since mechanical construction of both circuits was substantially alike and also typical, it is proper to point out that the difference between curves 1 and 2 (of Fig. 4) is small in comparison with the drift shown on Fig. 2.

Compensation for Drift.

Since the frequency drift is in the direction that would be caused by an increase in circuit capacitance with temperature, it is possible to decrease the drift by using a fixed capacitor having a negative temperature coefficient as part of the oscillator circuit. Capacitors employing ceramic dielectrics and having negative coefficients as high as 0.0007 μμf per degree C are available, and are frequently used for this purpose.

In the receiver used for the tests described in this Note, the temperature rise of the chassis is enough to produce a considerable change in the capacitance of such a condenser. It is interesting to compute the extent of compensation by substitution of a capacitor, with a negative coefficient, for part of the total circuit capacitance. An initial computation shows that in order to obtain a capacitance change of 0.29 μμf when the temperature rise is 15°C, the compensating condenser should have a negative coefficient of 680 x 10^{-6} μμf per degree C and a capacitance of 28.5 μμf. If the compensating-condenser temperature is assumed to be the chassis temperature, as shown on Fig. 1, the capacitance change at any time can be computed. The net capacitance change reaches a maximum value in eight minutes, and drops back to zero in an hour. However, a mode of compensation which would cause the frequency to reach an equilibrium value more quickly might be preferable. This result is obtained with a compensating capacitance value of 19.5 μμf, and is shown by curve 2 of Fig. 6.

Further improvement in compensation can be obtained by any means which would cause the temperature of the compensating condenser to rise more rapidly during the first few minutes of receiver operation. Location of the condenser in a position to receive more heat directly from the oscillator valve would tend to produce that result. Another possibility would be the use of a heating element, of suitable characteristics, in the vicinity of the compensating condenser. In the example considered above, the heater should cause an additional temperature rise of 6°C, and the heater and compensating condenser considered alone should reach equilibrium in ten minutes.

Conclusions.

High-frequency oscillator circuits of typical construction give rise to considerable frequency drift during the warm-up period of the receiver, if a compensating condenser is not incorporated in the oscillator circuit.

The amount of drift chargeable to the valve alone is likely to be small in comparison with the total drift of a complete receiver. Consequently, a comparison of drift data for different valve and socket combinations is not a matter of first importance. Such comparisons would be important only after a high degree of refinement had removed most of the drift not directly chargeable to the valve.

Available compensating condensers are adequate to minimize the frequency drift of typical oscillator systems to a satisfactory degree, insofar as television and frequency-modulation services are concerned.

BOOK REVIEW

"The Behaviour of Slow Electrons in Gases," by R. H. Healey and J. W. Reed (published by The Wireless Press for Amalgamated Wireless (Australasia) Ltd.).

This valuable monograph is a survey of recent work on the subject of slow electrons in gases and was written by two Australian engineers on the staff of Amalgamated Wireless Valve Co. Pty. Ltd. Dr. Healey is in charge of the Valve Works Technical Staff and Mr. Reed was on the Laboratory Staff.

The book is suitable for the use of Physics students in the final years of a degree course, but is also useful as a work of reference. It gives a brief, critical survey of the work on the behaviour of slow electrons in gases, much of which has been carried out during the last twenty-five years and is available only in the original communications. The investigations described deal with the determination of such quantities as the mean free paths, average energy losses and probability of attachment, of electrons moving through a gas with energies not exceeding a few electron volts.

Many different techniques have been used for the investigation of the various aspects of the motion of electrons in gases. Here the main attention is focussed on the diffusion methods developed by Townsend at Oxford and by Bailey at Sydney, as these lead to the widest variety of experimental results; particular attention is given to the study of the formation of negative ions by attachment.

An account of the diffusion methods is given in the earlier chapters, including a discussion of the formulae used and a summary of the experimental results obtained. There follows a brief survey of a number of other methods. An important application of the work described in the earlier portion of the book is given in the final chapter which is devoted to certain problems concerning the motion of electrons in alternating fields and the effect of radio waves on the ionosphere.

Essentially all of the results obtained by the diffusion methods are given by means of graphs and tables, and the bibliography relating to the whole field is comprehensive. The final chapter should be of interest to those concerned with the propagation of radio waves.

The authors are well qualified to undertake such a task. Dr. Healey has specialised in this branch of Physics for the past ten years. In 1937 he wrote a Thesis on the subject with which he gained his doctorate; this book is based on that Thesis. Six papers by Dr. Healey dealing with the ionosphere and other aspects of the subject have been published in recent years in Scientific Journals, mainly in England. Mr. Reed has assisted Dr. Healey in some of the work mentioned above; he has published with him a joint paper dealing with low pressure measurements by means of the ionization gauge; and he has written a paper, on the velocity-distribution of slow electrons in gases, which makes an important contribution to one of the main items dealt with in the book.

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Many different techniques have been used for the investigation of the various aspects of the motion of electrons in gases. Here the main attention is focussed on the diffusion methods developed by Townsend at Oxford and by Bailey at Sydney, as these lead to the widest variety of experimental results; particular attention is given to the study of the formation of negative ions by attachment.

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1603 PRE-AMPLIFIER

Amplifier circuits given from time to time in Radiotronics normally have sufficient gain to allow full output to be obtained with an input voltage of the order of .3 volt RMS. The sensitivity is therefore sufficient for use with most gramophone pick-ups and radio tuners. In certain cases the gain could be increased so as to operate from a lower input voltage but any attempt to increase the gain appreciably may introduce difficulties with hum or microphony.

Amplifier stages which are intended to operate with an input of less than say 0.1 volt peak should preferably be mounted on a chassis separate from that which accommodates the power supply. If this is not done precautions must be taken to avoid hum due to eddy currents induced in the chassis by the power transformer or power chokes. The effect is most noticeable with a steel chassis and cannot be overcome by using shielded leads. (See article entitled "Separate chassis for power pack" elsewhere in this issue.)

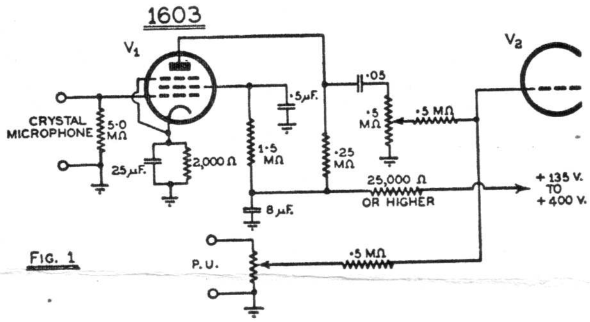


FIG. 1

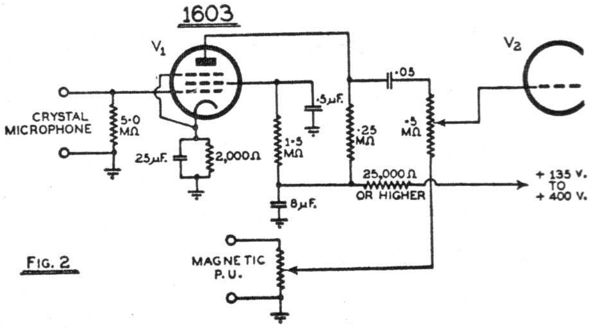


FIG. 2

Figure 1 shows a typical pre-amplifier stage using the Radiotron non-microphonic pentode type 1603. The second valve (V_2) is intended to represent the first valve in the main amplifier. Under normal conditions the two gain controls and the pick-up terminals would be mounted on the main chassis, the connection to the pre-amplifier being effected by means of a short length of shielded cable.

There is a certain amount of interaction in this mixing circuit, and the volume level from either source is affected by the setting of the other control. In practice, however, the effect is not unduly troublesome. The mixing circuit introduces a loss of approximately 6 db, but if mixing facilities are not required a simple change over switch may be used in the grid circuit of the second valve, selecting either input channel. With this arrangement the full gain of the 1603 stage is obtained, although a "thump" will be heard from the speaker as the switch is moved.

The stage gain of the 1603 under the conditions shown is 125 times (or 42 db) without the mixing circuit, and about 60 times (or 36 db) with the mixing circuit. Where the pick-up is a magnetic type having a comparatively low impedance an alternative arrangement may be used as shown in figure 2. With this arrangement the full gain of the 1603 pre-amplifier is retained and there is less interaction between the two controls.

The grid circuit resistance of the 1603 should not exceed 10 megohms unless the heater voltage is reduced. A grid circuit resistance of 5 megohms is suitable for most crystal microphones, but lower resistances may be adopted to suit other types of microphones.

The grid resistor of the 1603 should preferably be fixed and no attempt should be made to control the volume at this point in the circuit since it is almost sure to prove noisy. The valve itself will not be overloaded unless the input voltage exceeds about 0.5 volt. Type 1603 is Australian-made, the nett price being £1.

INCREASED RATINGS

RADIOTRONS 6B8-G AND 6J7-G

Radiotron 6B8-G as a pentode has, in the past, been limited to a maximum screen voltage of 125 volts although triode operation has been permitted with a plate and screen voltage of 250 volts. The maximum screen voltage is now increased to 250 volts provided that the maximum cathode current does not exceed 11.5 mA., and provided also that the existing plate and screen dissipation limits are not exceeded. The amended maximum ratings are therefore:

Plate Voltage	300	max. volts
Screen Voltage	250	max. volts
Screen Supply Voltage ..	300	max. volts
Grid Voltage	0	min. volts
Plate Dissipation	2.25	max. watts
Screen Dissipation	0.3	max. watt
Cathode Current	11.5	max. mA.

These increased ratings will enable type 6B8-G to be used as a small A.F. power pentode with a screen voltage of about 140 to 150 volts. The operating conditions should be adjusted so that the screen dissipation is not exceeded either at no signal or at maximum signal. With a bias of about −7.75 volts, a plate voltage of 250 volts and a load resistance of 25,000 ohms, a power output of about 650 mW. will be obtained. As a radio frequency amplifier there is normally no good purpose served by using a screen voltage in excess of 125 volts, the conditions for which are shown in the Radiotron Data Sheet for this type.

Radiotron 6J7-G as a pentode has previously been limited to a maximum screen voltage of 125 volts although triode operation has been permitted with a plate and screen voltage of 250 volts. The maximum screen voltage is now increased to 250 volts. With 250 volts on screen and plate the grid bias may be −8 volts as for triode operation, with a cathode current of 6.5 mA. This will enable type 6J7-G to be used as an A.F. power pentode with a power output in the region of 600 to 700 milliwatts.

Revised maximum ratings are now being prepared, and will be published when available.

HEARING TESTS

At the World's Fair at New York and San Francisco a large number of tests were made on the hearing of men, women and children. The results of these tests have recently been described* and it is thought that the subject is sufficiently interesting for one of the tables to be repeated. This table gives the mean hearing loss in decibels for various age groups of men and women for frequencies from 440 to 7,040 c/s.

Mean Hearing Loss in db.

	Age	Frequency					No. of
	Group	440	880	1760	3520	7040	Tests
Men	10-19	1.0	.3	–.3	–1.2	–.4	4132
	20-29	0	–.2	–.1	2.0	1.5	3287
	30-39	1.4	1.3	2.3	8.2	7.7	3197
	40-49	3.7	4.5	7.0	17.7	16.8	4528
	50-59	6.8	7.7	12.1	25.6	24.0	1935
Women	10-19	.5	.2	–1.1	–4.4	–3.6	3417
	20-29	0	.2	.1	–2.0	–1.5	4208
	30-39	2.6	2.6	2.9	2.4	4.8	3978
	40-49	6.0	5.8	6.7	7.8	11.9	4369
	50-59	10.3	9.8	11.0	13.8	19.7	2538

It will be seen that as the age becomes greater so the hearing loss at the higher frequencies becomes very much greater, being more so for men than for women. The hearing loss becomes appreciable after the age of 30 and is very serious at ages over 40 for men and over 45-50 for women.

It is obvious that older people require a higher level of high frequency response for the same clarity in speech and perception in music. If full compensation is to be made for the highest age group at a frequency of 7,040 c/s. the amount of compensation will be about 22 db as an average between that for men and that for women. At a frequency of 3,520 c/s. the compensation would require to be slightly under 20 db. for the same age group.

These results are interesting, not only from the point of view of telephone technique, but also in radio listening and communication.

*"Results of the World's Fair Hearing Tests," by J. C. Steinberg, H. C. Montgomery and M. B. Gardner, of the Bell Telephone Laboratories, New York, Journal of the Acoustical Society of America, volume 12, No 2, page 291, October, 1940.

SEPARATE CHASSIS FOR POWER SUPPLY

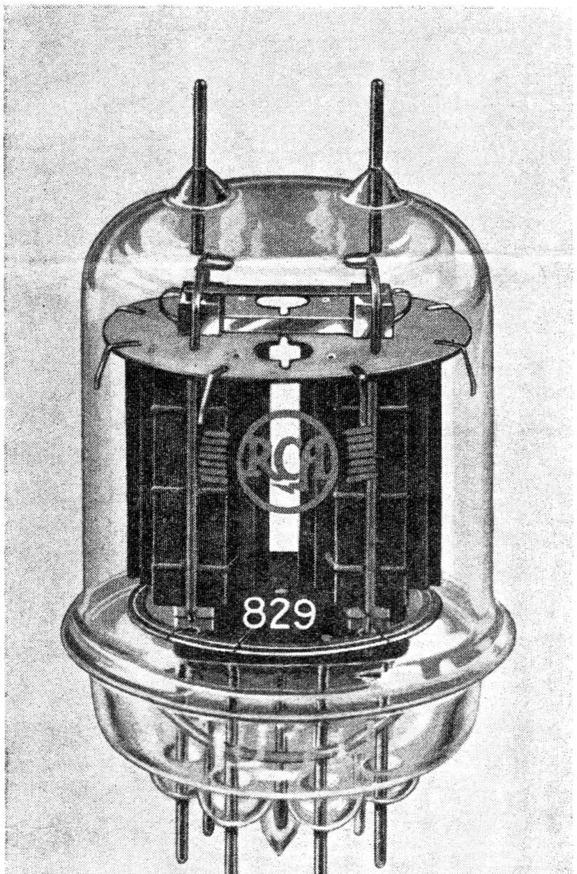
With high-gain amplifiers, especially in cases where a steel chassis is used, it is highly desirable for the power supply to be on a chassis separate to that on which the low level stages are mounted. Experience has shown that many home constructors fail to appreciate the trouble which may be caused through hum as a result of having too compact a construction. Although the use of two separate chassis is somewhat more expensive it is strongly recommended for all cases in which the input voltage to the first audio frequency amplifier stage is less than 0.1 volt RMS.

If two chassis are used it is generally most convenient to mount the power supply alone on the second chassis and the complete amplifier on the first chassis. This avoids the use of A.C. on the amplifier chassis except for the heaters. Hum due to this cause may be reduced to a negligible amount by using twisted leads well apart from other wiring. The output transformer is preferably mounted on the amplifier chassis although it could be mounted on or close to the loud-speaker if this is situated within a few feet of the chassis.

The only link necessary between the two chassis will therefore be a cable comprising a twisted twin flexible wire for the heaters and two or three flexible leads for the B supply and bias if necessary. If a voltage divider is used it can most conveniently be mounted in the amplifier chassis where any bypass condensers from the tappings will also be mounted. The power chassis will thus mount the power transformer, filter choke or chokes, filter condensers and possibly a back bias resistor or bleeder. Since electromagnetic and electrostatic fields are unimportant the power chassis may be compactly constructed provided that adequate ventilation is given.

The amplifier chassis should be constructed as far as possible with the succeeding stages in one straight line passing from the input at one end to the output at the other. Particular care should be paid to the first stage if this is operating at low level. Some precautions for avoiding hum will be found in Chapter 24 of the Radiotron Designer's Handbook.

RADIOTRON 829



Radiotron 829 is a push-pull, beam power amplifier having a total maximum plate dissipation of 40 watts which may be operated at maximum ratings at frequencies up to 200 mc/s and at reduced ratings to 250 mc/s. A Power output of 83 watts is obtainable with class C Telegraphy, 63 watts with plate modulation and 23 watts with grid modulation.

Further data on this type were given in Radiotronics 105, page 41.

RADIOTRON NEWS

The following new releases have been announced and are listed for reference, but are not at present available.

Radiotron Type.	**Description.**
1A5-GT	...1.4 volt power pentode*
1C5-GT	...1.4 volt power pentode*
2A4-G	...Gas triode
6A3	......Power triode (filament type)
6AC5-GT	..High-mu power triode*
6AD6-G	...Twin tuning indicator
6AE7-GT	..Twin input triode
6H6-GT	...Twin diode*
6K8-GT	...Triode-hexode converter*
6P5-GT	...General purpose triode*
6R7-GT	...Duplex-diode triode*
6SA7-GT	..Pentagrid Converter*
6SK7-GT	..Super-control R.F. pentode*
6SQ7-GT	..Duplex-diode high-mu triode*
6Y7-G	....Class B twin triode (similar 79)
7A4‡	.....General purpose triode (similar 6J5-G)
7A5‡	.....Beam power amplifier
7E6‡	.....Duplex-diode triode (similar 6R7-G)
7E7‡	.....Duplex-diode super-control pentode
7F7‡	.....High-mu twin triode
7G7/1232‡	.Television amplifier pentode
7J7‡	.....Triode-hexode converter
12B8-GT	..Triode-R.F. pentode
12SA7-GT	.Pentagrid converter*
12SK7-GT	.Super-control R.F. pentode*
12SQ7-GT	.Duplex-diode high-mu triode*
25B8-GT	..Triode-R.F., Pentode
32L7-GT	..Rectifier-beam power amplifier
50Y6-GT	..Full wave rectifier
117L7-GT	.Rectifier-beam power amplifier

*Types marked with an asterisk are GT equivalents of existing G types.
‡Locking-base type.

Radiotron 6B8-G: For increased screen voltage ratings, see article elsewhere in this issue.

Radiotron 6J7-G: For increased screen voltage ratings, see article elsewhere in this issue.

Radiotron 6X5-GT: The Australian-made 6X5-GT has been released.

Radiotron 807: See article elsewhere in this issue announcing the commercial release of the Australian-made 807. This type may be used in large amplifiers in place of types 6L6 or 6L6-G.

The following two types have been released but are not at present available from stock:—

RADIOTRON 1629 is a tuning indicator similar to type 6E5, except for the heater, which is rated at 12.6 volts, .15 ampere. It has been designed particularly for use in aircraft-radio equipment and is not intended for general use.

RADIOTRON 8000 is a transmitting triode, having a maximum plate dissipation of 125 watts CCS or 150 Watts ICAS. It may be used in self-rectifying oscillator circuits, such as are often used in therapeutic applications. Two type 800's are capable of delivering a useful power output of 550 watts and are rated for operation at full input at frequencies up to 30 Mc/s.; they may be used with reduced plate voltages up to 100 Mc/s.

RADIOTRON CHARACTERISTICS CHART

A new Radiotron Characteristics Chart is now in course of preparation and should be available shortly after the date of this issue. The new Chart is in book form and of the same overall dimensions as Radiotronics Bulletins. Of the total number of 20 pages, 3 pages are given to detailed characteristics of the Australian-made Radiotron Range, and the remaining pages give the characteristics of all Radiotron types, both imported and locally-manufactured. Socket connections are shown for each type.

This new Chart should prove very useful when used in conjunction with the "Radiotron Equivalent Type Chart" issued some months ago. Either chart may be had free on application or at a cost of threepence posted.

RATTLE IN VALVE BASES

Some octal-based valve types require insulation between leads coming down to the base pins, and in the past it has been usual to adopt "spaghetti" tubing as most satisfactory for this purpose. It has been found, however, that the high-frequency characteristics of the tubing now available are very poor and that serious losses may occur through its use. In order to improve the valve performance, some Radiotron types are now being fitted with glass tubing in place of "spaghetti". The high-frequency performance is thus improved, although there is a tendency for the valves to rattle when shaken. This rattle is in no way a sign of a defective valve, and should rather be accepted as an indication of a valve having a good electrical performance.

RADIOTRON 807

Radiotron 807 is a transmitting valve having electrical characteristics similar to those of Type 6L6-G, although having higher ratings and with the plate taken to a top cap. It may be used in amplifiers as a replacement for Type 6L6-G without any change in circuit constants.

The Australian-made Radiotron 807 is now commercially available at a nett price of £1/15/-, but a licence from the Senior Radio Inspector is required before the valves can be supplied. Licence forms are available from the Senior Radio Inspector of each State.

RADIOTRON DESIGNER'S HANDBOOK

The increasing popularity of the Radiotron Designer's Handbook is shown by the fact that a further 3,000 copies have been ordered for England and a total of 1,500 copies for U.S.A.

The total printing has now reached 18,000 copies and a further reprint is imminent.

It is interesting to note that the total quantity exported (7,000 to England and 1,500 to U.S.A.) is almost half of the total sales.

DATA SHEETS

Four loose-leaf data sheets are released concurrently with this issue. These comprise

Radiotron 1L5-G, Sheets 1, 2, 3.
Price List of Australian-made Radiotrons.

The new 1L5-G sheets give complete triode operating conditions, and 90 volt conditions for both triode and pentode operation. Plate characteristics are given for 90, 135 and 180 volts on the screen as well as for triode operation. Mutual characteristics are given for plate and screen voltages of 90, 135 and 180 volts, the plate and screen currents being shown separately. These comprehensive data sheets are intended to assist in the widest possible application of this Australian-made type.