RADIOTRONICS

BULLETIN No. 114 July, 1941

FREQUENCY COMPENSATION IN AUDIO AMPLIFIERS

Radiotronics 107 contained a note to the effect that an article on a special tone control stage was to be published in a future issue. Since this note appeared there have been numerous inquiries from readers interested in the subject. For various reasons the publication of the article has been unduly delayed and even now is less comprehensive than was at first planned.

During the past three or four years quite a number of audio amplifiers have been described in Radiotronics technical bulletins. Without exception, these were designed to have an overall frequency response as nearly level as possible. For example, in the case of amplifier A504 (described in Radiotronics 112) the response between 50 c/s and 13,000 c/s was within the limits of +2db and —1db and at 30 c/s was only down by 3db.

An amplifier of this nature is capable of excellent reproduction when used under favourable conditions and is far in advance of the audio amplifiers incorporated in most broadcast receivers.

However, it does not necessarily follow that the original sound is faithfully reproduced when the amplifier itself has perfect or nearly perfect characteristics. Quite frequently the subsidiary apparatus has marked deficiencies in regard to frequency response. These deficiencies are not necessarily due to lack of care in the design but are brought about by the necessity to compromise between cost, convenience and performance.

FACTORS LIMITING FREQUENCY RESPONSE

Radio Tuners:

Owing to the shape of the selectivity curve most radio tuners attenuate the higher modulation frequencies to a greater or lesser degree. If the selectivity curve is broadened to obviate this undesirable effect the tuner may not be capable of separating stations on adjacent channels. The ideal selectivity curve is one having very steep sides and a flat top approximately 20 Kc/s. wide. Unfortunately, the production of a radio receiver having a selectivity curve approaching this ideal is attended with numerous difficulties and as a rule wide-band reception is only provided in the most expensive receivers. In less elaborate receivers it is necessary for the designer to compromise between selectivity and treble attenuation. In a typical 4/5 valve superheterodyne receiver* the attenuation due to "side-band cutting" is 4db at 2,000 c/s, 14db at 5,000 c/s and 37db at 10,000 c/s.

Lateral-Cut Recordings:

For constant acoustic power the amplitude of the movement of the cutter increases as the frequency decreases. In order to override noise it is essential to record at a certain level and under these conditions the amplitude at the lowest frequencies would be considerable and adjacent grooves would require to be widely separated; this would seriously reduce the playing time.

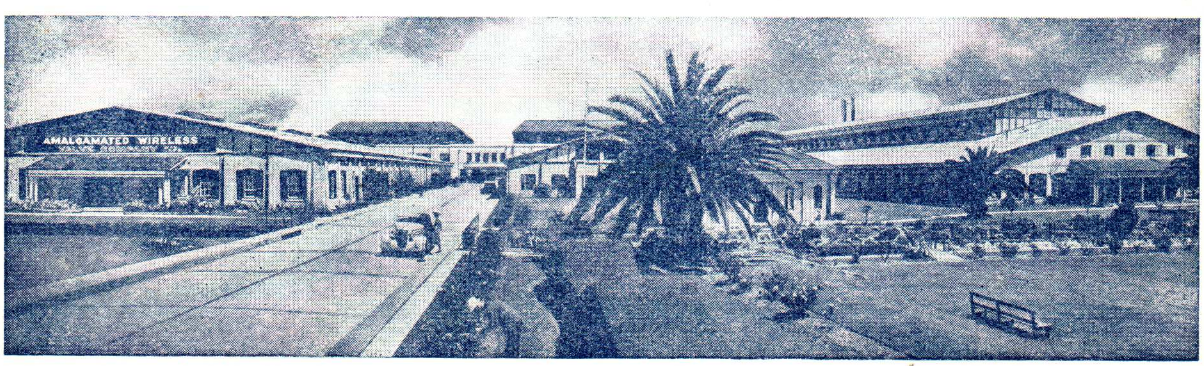
In order to avoid some of these difficulties it is conventional to arrange matters so that for frequencies below 250 c/s the recording follows a "constant amplitude characteristic" which means that the same amplitude holds for a given applied acoustic power at any frequency within this range. This is equivalent to a drop of 6db per octave in the output of the reproducer. In other words at a frequency of one half of 250 c/s the output voltage of the reproducer is likewise reduced to one half for a given acoustic power.

Although it is conventional to regard the changeover as taking effect at 250 c/s, this practice is not always followed and the changeover is sometimes effected at frequencies as high as 900 c/s.

The practice is not followed in vertical cut or "hill and dale" recordings but these are not generally available to the public.

* Radiotronics 72, page 3, figure 2.

(Continued overleaf, column 1.)



RADIOTRONICS

TECHNICAL BULLETIN, No. 114

JULY, 1941

* * *

Radiotronics Technical Bulletins are available by annual subscription to the Head Office of the Company:

AMALGAMATED WIRELESS VALVE CO.
PTY. LTD.
"Wireless House," 47 York Street,
Sydney, N.S.W. (G.P.O. Box 2516 BB).

Subscriptions are accepted for the full 12 months (January-December) ONLY and preceding numbers are supplied subject to stocks being available. Subscribers are requested to remit money by Postal Note.

Subscription—two shillings (2/-) per year.

* * *

* * *

Published by The Wireless Press for Amalgamated Wireless Valve Co. Pty. Ltd. Wholly set up and printed in Australia by The Cloister Press, 45-49 George Street, Redfern.

(Continued from page 43.)

Gramophone Pickups:

Designers of gramophone pickups have to effect a compromise between many conflicting factors. The characteristics of individual types differ widely, but it is possible to consider pickups in certain groups.

The cheaper crystal pickups are, as a rule, fairly free from objectionable sharp mechanical resonances and have a considerable amount of bass boost: However the response curve may not coincide with the desired curve and the net result may be undue accentuation of the frequencies between 100 and 500 c/s.*

The cheaper types of magnetic pickups usually have a certain amount of bass compensation, but this is seldom sufficient to compensate fully for the losses during recording. In many cases, sharp peaks are apparent in the response curve due to mechanical resonances. Such peaks make it difficult to obtain level overall frequency response.

In the case of more expensive pickups of all types the general practice appears to be to aim at a level frequency response without any attempt at achieving bass compensation. In such cases it is necessary to provide the full compensation of 6db per octave by means of electrical circuits.

Other Sources of Input:

Individual types of microphones naturally have different frequency response characteristics and in general there is a relationship between the shape of the response curve and the price of the microphone. There is, however, no question of compensating for a common deficiency in frequency response as is the case with pickups or radio tuners.

When reproducing sound recorded on film there is usually considerable attenuation of the higher frequencies which requires compensation in the electrical circuits.

Loudspeakers:

In the chain of equipment required for the reproduction of sound the loudspeaker is very often the weakest link. This is not in any way due to the incompetence of loudspeaker designers but is the result of having to compromise between many conflicting factors.

It is not proposed at this stage to enter into a discussion regarding the relative merits of various types of loudspeakers but, in general, the performance bears a close relationship to the cost price. It is sufficient to say that the majority of loudspeakers have marked deficiencies over one portion or another of the audible range.

FREQUENCY COMPENSATION.

In the design of an amplifier it is quite permissible to introduce frequency compensation to make up for the shortcomings of the subsidiary apparatus. For very small amounts of compensation the required result may often be obtained by suitable modification to the main amplifier, but this method is seldom satisfactory for large amounts of compensation.

If a frequency "a" is to be accentuated with respect to another frequency "b" the desired effect may be produced either by holding "b" constant and amplifying "a" or by holding "a" constant and attenuating "b". For example, if the response at 30 c/s requires to be raised 18db with respect to that at 250 c/s, the result can be achieved by amplification of voltages at 30 c/s or attenuation of voltages at 250 c/s. The former method would require the use of a special amplifying stage and the latter would only be possible if the amplifier had a large reserve of gain. The final result would, however, be the same.

When using frequency-discriminating circuits in an amplifier it is most important to study the a-c loading on the input source or on the valves concerned. If the loading conditions on a valve are unfavourable the valve will be unable to deliver the normal output voltage without severe distortion; if the distortion is to be kept small the output voltage must likewise be small.

Again, frequency discriminating circuits frequently involve the use of a voltage-divider network and the effective output voltage from a stage may only be a small fraction of that actually delivered by the valve.

When the higher frequencies are boosted with respect to the lower frequencies it is most im-

* See "Radiotron Designer's Handbook", p. 76, fig. 2.

portant that the distortion preceding the point of "boost" be kept small. If this is not done the harmonics will be amplified more than the fundamental with a serious increase in the distortion percentage.

In view of these and other considerations it is suggested that a tone-compensating stage is best connected directly ahead of the main amplifier, without an intermediate volume control, in which position it will not be required to deliver an output greater than about 0.5 volt. The volume control would be part of the input circuit to the tone-control stage. The stage may have a gain at middle frequencies of unity or thereabouts, the gain at high or low frequencies being increased or decreased as required.

or lowering the bass or treble response. Amongst other things this will allow compensation to make up for the peculiarities of individual recordings, for the acoustic properties of rooms with audiences of different size, or for reproduction at different levels.

Ideally a tone-compensating stage for this purpose should be quite distinct from other circuits included to offset some **permanent** deficiency in the apparatus. If the variable network is used to correct such a deficiency its potentialities are immediately restricted.

In the Radiotron Designer's Handbook a complete chapter (Chapter 9) is devoted to the general subject of "Tone Compensation and Tone Control." Some of the circuit arrangements shown in

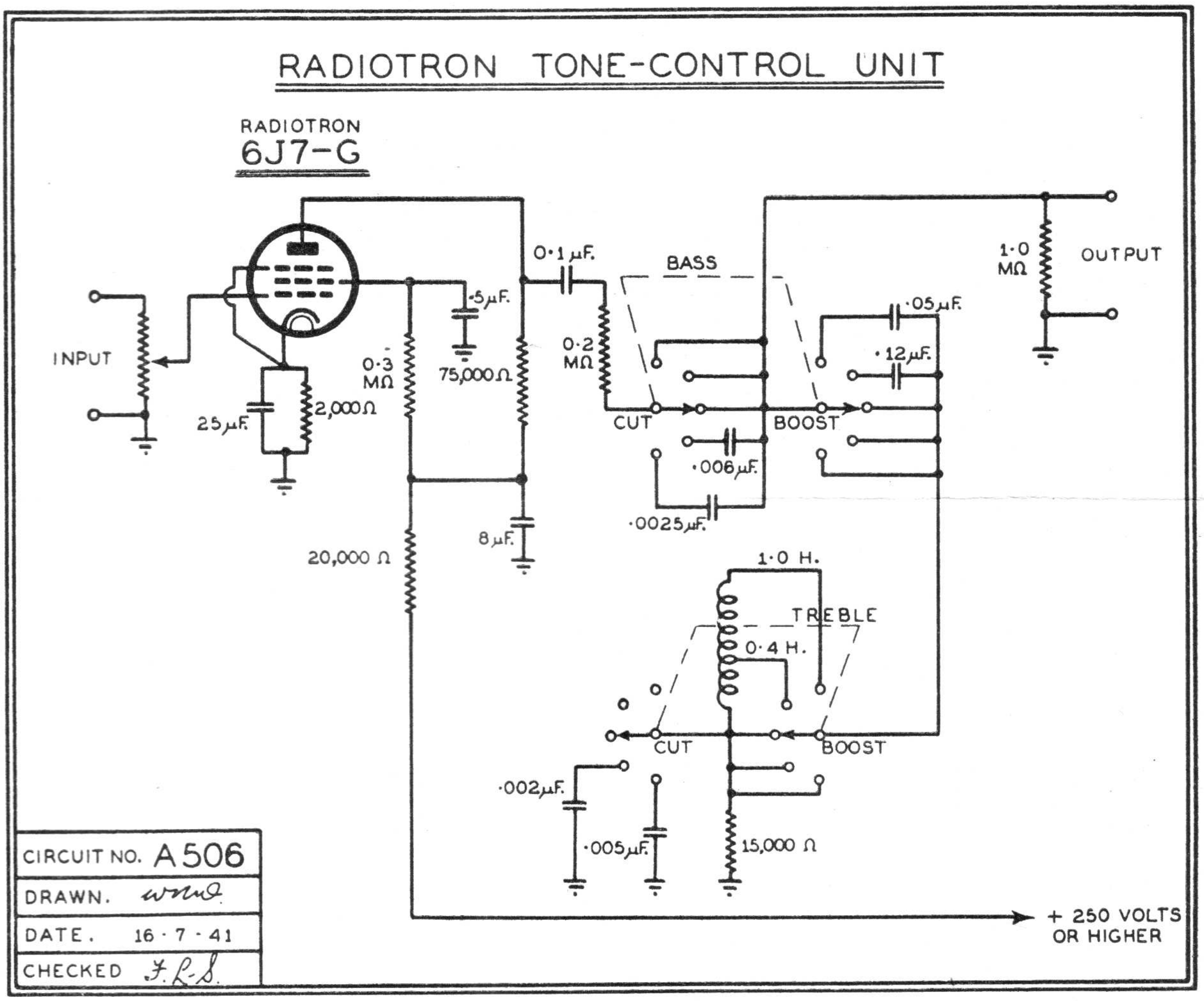


Figure 1.

Fixed and Variable Tone Compensation:

When it is desired to compensate for a considerable and **permanent** deficiency in the subsidiary apparatus (e.g., loss of bass in recording) it is usually most satisfactory to include a fixed tone compensating stage, having the desired characteristics, ahead of the main amplifier. This will then ensure that the overall characteristics from recording to loudspeaker will be as near to level as possible **under average conditions.**

However, when it is desired to achieve the utmost realism in the reproduction it is most helpful to have a means of independently raising

this chapter may be useful when devising fixed tone-compensating circuits.

Variable Tone-Control:

There has been quite a deal of controversy on the question of tone-control and most designers have their own ideas in regard to the subject. However, certain conclusions are fairly obvious:

(1) It should be possible to vary individually the bass and treble response.
(2) The control should not affect the response at middle frequencies. Manipulation of tone control will thus not materially alter the apparent volume.

(3) The control should be sufficient to have a very obvious effect on the tonal balance.

Bearing in mind these basic requirements the circuit shown in figure 1 is presented. It follows along the general lines of a number of circuits published some time ago in the English "Wireless World".*

The circuit makes use of a Radiotron 6J7-G connected as a pentode voltage amplifier. The grid of the following valve is fed through a divider network and switching is incorporated to vary the characteristics of the divider.

The circuit calls for the use of two double-pole five-position switches, which are readily obtainable. In addition to the level characteristic, the circuit provides for two degrees of attenuation or accentuation of both bass and treble. At middle frequencies the gain of the stage from input to output is approximately four times and the accentuation or attenuation at the rate of approximately 3db or 6db per octave for frequencies below 250 c/s and 3db or 6db per octave for frequencies above 2000 c/s. (See figure 2.) A continuously variable system may have certain advantages but would be much more complicated.

Examination of the circuit shows that the resistance of the plate load resistor is 75,000 ohms and that the parallel load can never be less than 200,000 ohms. Under these conditions and with low output voltage the distortion introduced by the 6J7-G would be very small indeed and would probably be very much less than that occurring in the input source.

The maximum peak output from the valve with supply voltages of 250 and 400 volts are respectively 65 and 105 (approx.) volts for a total harmonic distortion of 3%. Allowing for the reduction due to the voltage divider network, the output at middle frequencies will be respectively 4.5 and 7.3 volts peak. Operation under conditions requiring an output voltage approaching this figure is not recommended, however, since the harmonic distortion with treble boosting would be unduly high.

The components specified in the circuit are quite standard except for one or two condensers and the tapped choke. Where difficulty is experienced in obtaining single condensers having the specified values of capacitance, two condensers may be connected in parallel. The tapped choke is a non-standard unit which will have to be specially wound. It may be iron-cored or air-cored as desired and is not required to carry any d-c. A suggested design is given at the end of this article. It will be noted that specifications are given for inductances of 0.4, 1.0 and 1.4 henries. The curves in figure 2 are drawn only for 0.4 and 1.0 henries, but the additional inductance may be useful if a little more treble boosting is desired.

A choke of this nature is very prone to pick up hum and it is almost essential for the choke to be mounted on a chassis distinct and well separated from that which carries the power supply equipment. Where the choke and power supply must be mounted on a single chassis, careful shielding and orientation would be necessary.

In cases where it is impracticable to use a choke, the treble boost may be obtained by switching suitable capacitances in parallel with the 0.2 megohm series resistor. This method is not recommended, however, since it has the effect of reducing seriously the loading on the valve at the higher frequencies.

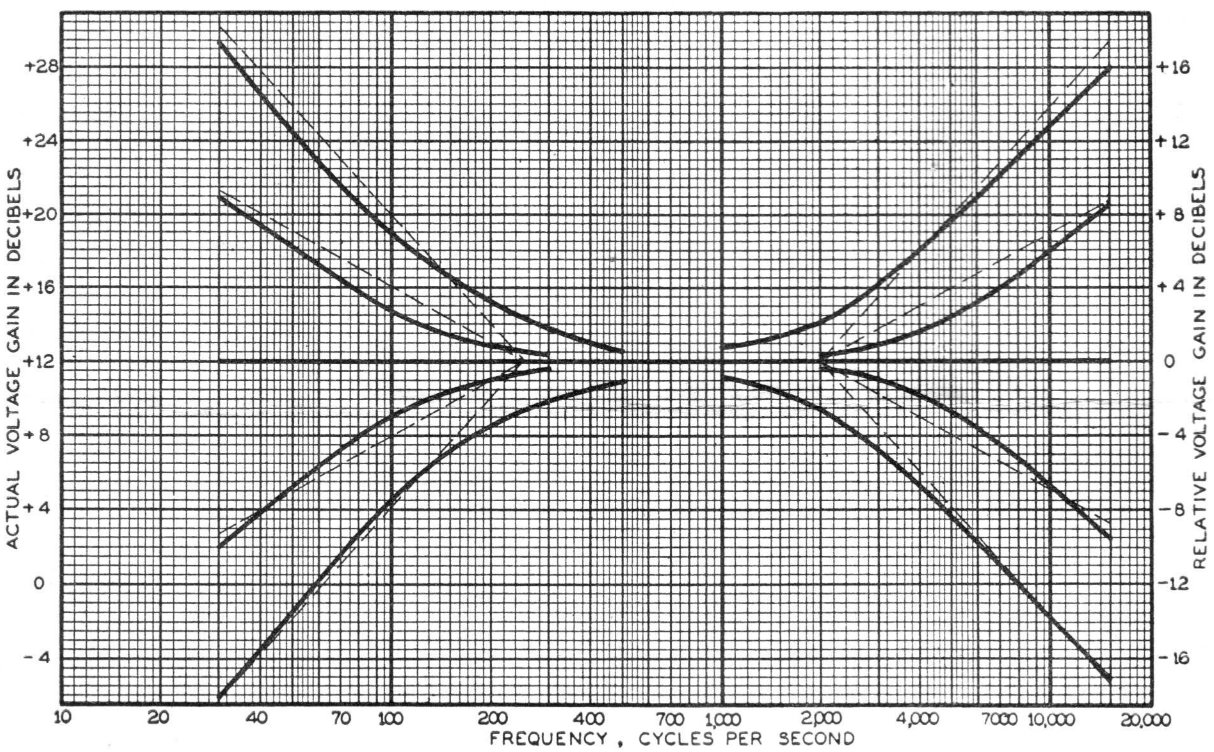


Figure 2.

* January 6th, 1938. September 22nd, 1938. May 11th, 1939.

In battery-operated equipment the 6J7-G valve may be replaced by type 1K5-G under the following conditions.

Plate supply voltage	135 volts
Plate load resistor	.075 meg.
Screen supply resistor	0.2 meg.
Grid bias	–1.5 volts
Overall gain (approx.)	1.7 times
Peak output voltage (approx.) ..	2.5 volts

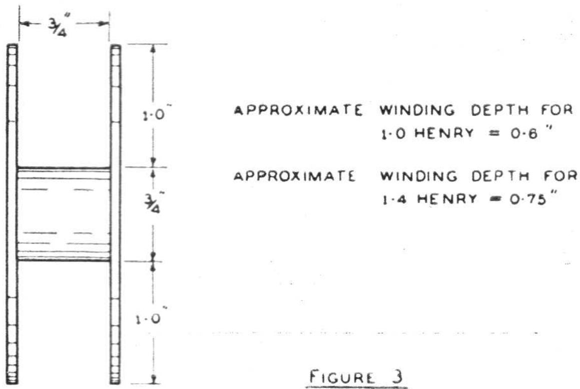


FIGURE 3

CHOKE DESIGN.

The following design is based upon the formula given on page 148 of the "Radiotron Designer's Handbook".

The bobbin is made up to the inside dimensions shown in figure 3. It may be turned entirely from wood or may be assembled from a wooden dowel and bakelite end cheeks. A suitable winding wire is 40 S.W.G. SSE or 40 S.W.G. DSC. Ordinary enamel wire of similar cross-sectional area may be used but greater care will be required to avoid short-circuiting turns, particularly if the coil is to be hand wound.

For the purpose of design it was assumed that the coil would be layer wound by hand and that, compared to exact winding, there would be a loss of approximately 25% in the total number of turns which could be wound into a given cross sectional area. Thus if exact winding is used the depth of the coil will be somewhat less than the calculated figure, but for small variations in depth the variation in inductance will not be great.

For the 0.4 henry section the number of turns required is 4520 and for 1.0 henry 6740 turns. If a slightly greater amount of boost is desired the total inductance may be increased to 1.4 henries and the number of turns to 7570. The total weight of wire required will be about .25lb.

OPERATION WITH LOWER GRID BIAS

Radio Frequency Stages

Although a grid bias of –3 volts is normally standard for all indirectly-heated radio frequency amplifiers and converters, it is sometimes possible to use a lower voltage with advantage. If the grid bias is decreased while the screen voltage is maintained at the full value of 100 volts, it is likely that the screen and plate dissipations will exceed the maximum ratings, so that in general a decrease in the minimum grid voltage should be accompanied by a decrease in screen voltage.

In general it will be found that if the grid voltage is decreased, the screen voltage being continuously adjusted so as to maintain constant plate current, the trans- (or conversion-) conductance will increase slightly as the grid voltage is decreased. Similarly, if the screen voltage is continuously adjusted so as to maintain constant transconductance, the plate current will decrease slightly as the grid voltage is decreased.

Under normal conditions any decrease in the minimum bias below –3 volts is not recommended, but if any worthwhile improvement in performance can be obtained by so doing, it will merit further investigation. This investigation should cover the plate and screen dissipations, the effect on the A.V.C. characteristic, and the possibility of running into positive grid current.

The shape of the A.V.C. characteristic will change as the minimum grid bias and screen voltage are changed. A reduction in screen voltage will cause cut-off to be reached at a lower grid voltage, and cross modulation troubles may be increased. Distortion due to "modulation rise" in the I.F. amplifier may also be increased, although both effects may be minimised by using a high resistance divider network for the screen supply.

There is a distinct risk of running into grid current when the grid bias is made less negative, particularly in the case of an I.F. amplifier valve. This may occur at any point up to a signal voltage sufficient to give a grid voltage of 8 or 10 volts, and should be checked with the aid of a signal generator and a microammeter in the grid circuit of the I.F. amplifier valve.

Decreased grid bias and screen voltages may be found beneficial in the case of converter valves, for example, type 6J8-G. The improvement will be shown by an increase in the signal-to-noise ratio, and the operating point should be selected experimentally with due regard to the points outlined above. Any reduction of grid bias will increase the likelihood of running into positive grid current, and if this should occur it will result in poor performance. The bad effects of positive grid current may be largely avoided by using a grid return circuit of low d-c resistance, omitting A.V.C.

"THERMIONIC TUBES AT VERY HIGH FREQUENCIES"

An excellent book with this title has just appeared in England, written by Dr. A. F. Harvey, who is a leading authority on the magnetron. It is well worth the attention of all those interested in the ultra-high frequencies. The publishers are Chapman and Hall.

NEGATIVE TRANSCONDUCTANCE OSCILLATOR

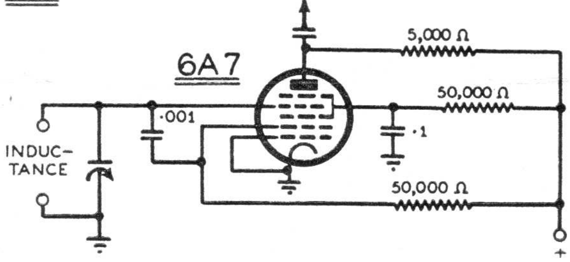
— A Useful Circuit

On page 106 of the "Radiotron Designer's Handbook" (third edition) it was pointed out that there is a pronounced negative transconductance characteristic between the control grid (G_4) and the oscillator anode (G_2) of pentagrid converter valves such as type 6A8-G. This is brought about by the fact that when the control grid is made more negative, electrons on their way the plate are turned back towards the inner screen (G_3) and the oscillator anode. Thus the effect of a negative voltage on the signal grid is to cause an increase in the current to both these electrodes.

The increase in the current to the inner screen (G_3) is more or less balanced by a decrease in the current to the outer screen (G_5) and as a result the total screen current for a pentagrid converter valve remains fairly constant with wide variations in signal grid voltage. On the other hand, the variation in the oscillator anode current is equivalent to a transconductance of about −400 micromhos.

Owing to this negative transconductance characteristic it is possible to create an oscillatory condition simply by coupling the oscillator anode to the signal grid by means of a condenser, providing, of course, that the remainder of the circuit is suitably arranged.

FIG. 1



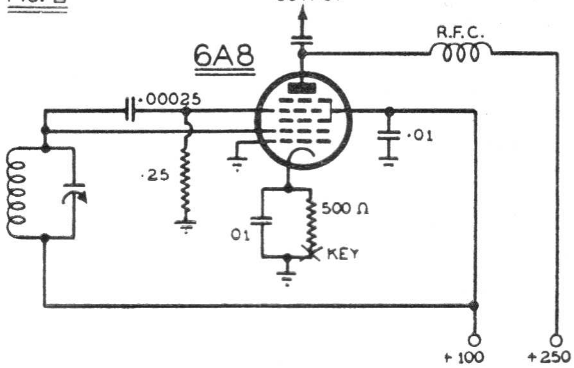
The "R.M.A. Engineer" for May, 1940, contained an article by Henry R. Heese entitled "R.F. Inductance Measurements Using Beat Frequency Test Equipment." One of the features of an instrument described under this heading was the use of a pair of negative transconductance oscillators using type 6A7. The circuit employed is shown in figure 1. Describing the results, the author states:—

"Output may be taken from the plate circuit without affecting the oscillation frequency. The circuit has oscillated reliably with a 138 μH. coil and a 7,000 μF. condenser shunted by a 10,000 ohm resistor at about 162 kilocycles. It has also operated dependably at about 18 megacycles, the highest frequency tried."

In "Q.S.T." for May, 1941, D. F. Metcalf, under the heading "An Improved Electron-Coupled Oscillator," describes a transmitter employing a 6A8 as a master-oscillator and using this principle. The circuit recommended by Metcalf is shown in figure 2.

The circuit of figure 1 is notable in the omission of the usual oscillator grid resistor and condenser. The reason for the omission is not immediately apparent and a hurried test seemed to indicate that these components were necessary. The circuit shown in figure 2 includes a grid resistor and condenser. The condenser and resistor in the cathode circuit are apparently not for the purpose of obtaining bias as might appear at first glance, but are included rather as a precaution against key-clicks. One feature of this circuit which might be a disadvantage in certain circumstances is the presence of H.T. in the tuning circuit.

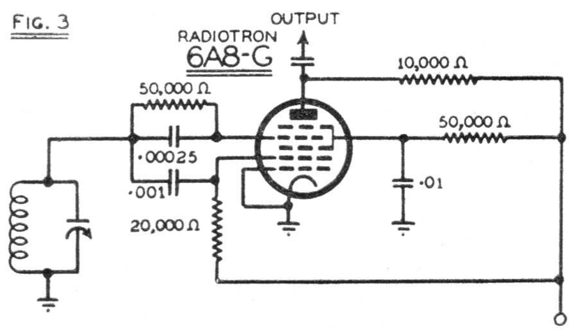
FIG. 2



The circuit shown in figure 3 does away with this objection and permits the rotor of the tuning condenser and one side of the coil to be earthed. The anode supply resistor is effectively across the tuned circuit but this appears to have no detrimental effects and the oscillator will operate consistently under a variety of conditions. When used with band-switching only a single-pole switch is required.

Two terminal oscillators are extremely useful for certain applications, particularly in measuring instruments, and this circuit seems to have interesting possibilities. It should be noted that the remarks do not apply to other converter valves such as type 6J8-G or type 6K8-G but hold only for types having electrode structures similar to that of the 6A7 or 6A8-G.

FIG. 3



Other types of valves exhibit a negative transconductance characteristic between various electrodes, but in most cases it is of a much lower order and cannot be used so conveniently. For example, an ordinary pentode has a negative transconductance characteristic between suppressor (G_3) and screen (G_2) and in the case of type 6J7-G it is of the order of −250 micromhos. However, the 6A8-G variety of valve has the advantage of screening between the control electrode and the output plate which is very helpful when the output is to be derived from the latter.

REPLACING TYPE 1B5/25S

In Radiotronics 113 it was announced that production of type 1B5/25S had been temporarily suspended. It was suggested that, in the meantime, the octal-based equivalent, type 1H6-G, could be used as a replacement by changing the socket to suit.

In certain cases a change of socket may be inconvenient and under these circumstances it may be preferred to use type 1K6, which requires the same socket as type 1B5/25S. However, the wiring would need to be rearranged slightly.

The filament connections (pins 1 & 6) and the diode connections (pins 3 & 4) need not be disturbed, but the control grid connection must be removed from pin 5 and taken to the top-cap preferably through a shielded lead. Pin 5 connects to the screen of the 1K6 and if pin 5 is joined to pin 2 the 1K6 will operate as a triode. In almost all receivers the 1B5/25S has been used as a resistance-coupled audio voltage amplifier and a triode-connected 1K6 will usually operate satisfactorily under the same electrical conditions.

Alternatively, the 1K6 may be connected as a pentode, in which case the audio gain of the receiver will be increased by about seven times. The recommended operating conditions for type 1K6 as a resistance-coupled pentode amplifier are as follows:—

Plate supply voltage	90 to 180 volts
Plate load resistor	0.25 megohm
Screen dropping resistor	1.0 megohm
Grid bias	–1.5 volts

In many cases, to effect this changeover, it will only be necessary to transfer the control grid from pin 5 to the top-cap and to add a 1.0 megohm dropping resistor and a 0.1 μF. screen bypass condenser.

Type 1K6 draws a filament current of 0.12 A. as compared to 0.06 A. for type 1B5/25S, but this will be of little consequence in ordinary 2.0 volt battery receivers. In the case of receivers having the filaments in series-parallel, some rearrangement may be necessary.

SUBSTITUTING RADIOTRON 1P5-GT FOR TYPE 1N5-GT

The production of type 1N5-GT has been suspended for an indefinite period and it will therefore not be available either for equipment or replacement purposes. It is suggested, however, that type 1P5-GT will be a satisfactory replacement in almost all cases. The two types are identical as regards basing, overall dimensions, interelectrode capacitances and filament rating, and the only differences are in regard to other electrical characteristics. Type 1P5-GT has a super-control characteristic and draws somewhat higher plate and screen currents than the 1N5-GT. This causes no difficulty where both electrodes are fed directly from B+. In rare cases, where a screen dropping resistor is used, the higher screen current of type 1P5-GT may cause the screen voltage to be reduced unduly with some loss of sensitivity. In such cases it may be advisable to decrease the value of the screen dropping resistor.

SUBSTITUTING RADIOTRON 1A4-P FOR TYPE 34.

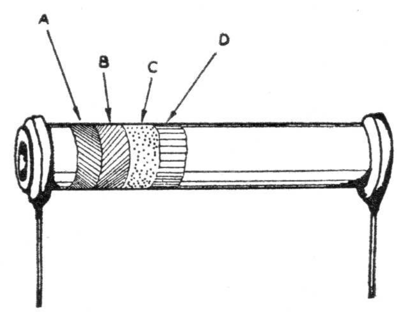
In order to expedite production of more essential types the production of type 34 has been suspended. This type will thus cease to be available when existing stocks are exhausted.

However, in almost all cases type 1A4-P may be plugged into the same socket without any change whatever in the wiring or circuit constants. The 1A4-P draws slightly lower plate and screen currents and has a slightly higher mutual conductance. The overall dimensions of the 1A4-P are smaller than those of the 34, but this should cause no difficulty. The interelectrode capacitances of the two types are practically the same and there should not be any need to realign the tuning circuits.

NEW COLOUR-CODE FOR RESISTORS

Advice has been received to the effect that the R.M.A. has adopted a new colour code for resistors.

Resistors manufactured in America at the present time are being coded in this manner. The Australian manufacturers may not adopt this standard for some time, and this will mean that the two codes will be in use.



In the new code, four colour bands are shown at the end of the resistor. The resistor should be placed with the bands at the left-hand end. Reading from the left in order call the bands A, B, C, D.

Band A is first figure.
Band B is second figure.
Band C is number of cyphers.
Band D is tolerance (silver 10%, gold 5%).

The colours retain their original significance.

Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Grey	8
White	9

RADIOTRON NEWS

Radiotron 1N5-GT: Production of this type has been suspended for an indefinite period. In most cases, however, type 1P5-GT may be used as a direct replacement without any noticeable effect on the performance of the receiver. See article elsewhere in this issue.

Radiotron 6K7-GT: Slight alterations have been made in the maximum voltage ratings and in the plate and screen currents to bring them into line with those of type 6U7-G. A new data sheet incorporating these changes is released concurrently with this issue.

Radiotron 6U7-G: The plate and screen dissipation figures have been increased respectively from 2.25 and 0.25 max. watts to 2.75 and 0.35 max. watts. A new data sheet incorporating these changes is released concurrently with this issue.

Radiotron 34: Production of this type has been discontinued and it will therefore cease to be available after present stocks are exhausted. However, in almost all cases type 34 may be replaced directly by type 1A4-P. See article elsewhere in this issue.

AUSTRALIAN-MADE RADIOTRONS

Complete List

In Radiotronics 105 a complete list of Australian-made Radiotron valves was published. Certain changes have been announced from time to time in Radiotron News and the following is a complete and up-to-date list:—

RECEIVING TYPES.

1A4-P	1M5-G	6K8-G
1A7-GT	1P5-GT	6U7-G
1B5/25S	1Q5-GT	6V6-G
1C4	2A5	6X5-GT
1C6	5V4-G	19
1C7-G	5Y3-G	24A
1D4	6A7	30
1D5-GP	6A8-G	32
1D8-GT	6B6-G	35
1H4-G	6B7	42
1H5-GT	6B7S	45
1H6-G	6B8-G	47
1J6-G	6C6	57
1K4	6D6	58
1K5-G	6F6-G	75
1K6	6G8-G	77
1K7-G	6J7-G	78
1L5-G	6J8-G	80
	6K7-GT	83V

TRANSMITTING TYPES.

802	813
804	833
805	866
807	866A
809	872
810	872A

MISCELLANEOUS TYPE.

1603

VALVE DATA SHEETS

Six valve data sheets are released concurrently with this issue of Radiotronics. These are as follows:—

1N5-GT	Sheet 1	data
6K7-GT	Sheet 1	data
6U7-G	Sheet 1	data
6U7-G	Sheet 2	curves
34	Sheet 1	data
35	Sheet 1	data

Each of these contains minor modifications and supersedes an earlier sheet. The earlier sheets should be removed from the Valve Data Handbook.

AUSTRALIAN-MADE TRANSMITTING VALVES

262,000 Watts Per Month

The production of transmitting valves in the Australian Radiotron factory has developed from a very small part of the factory to a section having an output of several valves per minute. Individual handling has in many cases been replaced by automatic machinery so that the valves are even more consistent and uniform.

An idea of the immense output from this section of the factory is obtained if we calculate the number of watts output obtained from each valve as a Class C amplifier and add together the total for one month. During the last complete month for which figures are available, this totalled 262,000 watts or 262 kilowatts. The annual output at this rate is equivalent to a power output of 3,150,000 watts or 3,150 kilowatts.

The monthly output of 262,000 watts is the equivalent of the power output given by 58,200 type 6F6-G valves operating in Class A_1.

VALVE BASES

Now Made in Australia

All bases used on Radiotron Australian-made receiving valves are now manufactured in the factory of Amalgamated Wireless Valve Company Pty. Limited at Ashfield. A very high grade of plastic is used and tests which have been conducted show that the electrical properties are in every way equal or even superior to the imported bases which have been used up till recently.

Fully automatic machinery inserts the pins into the bases and rivets them in place at a speed which would be impossible with manual operation.

Certain large moulded bases for transmitting valves are also being manufactured in Australia from special low-loss high frequency plastic.

RADIOTRON TECHNICAL PUBLICATIONS

July Posting

Early in July, a copy of the new "Radiotron Replacement Guide" was posted to all subscribers to Radiotron technical publications. Six valve data sheets were also included, as follows:—

1C6, 1C7-G	Sheet 1	data
1M5-G	Sheet 1	data
1M5-G	Sheet 2	curves
6B6-G	Sheet 1	data
6B6-G	Sheet 2	curves
85	Sheet 1	data

The data sheet for type 1C7-G includes a number of minor modifications and corrections, and supersedes the earlier sheet issued in November, 1940. The curves given for type 1M5-G are substantially the same as those published earlier for type 1C4, but are rather easier to read. The 6B6-G data sheet includes additional information on the use of the valve as a resistance-coupled amplifier and supersedes the previous 6B6-G data sheet issued in November, 1940. Information on the new 85 data sheet is substantially the same as that given in the earlier sheet, which it supersedes, but additional information is included regarding the replacement of type 85 by a triode-connected type 6B8-G. Existing sheets for the 1C7-G, 1M5-G, 6B6-G and 85, should be removed from the Data Handbook.