RADIOTRONICS

AMALGAMATED WIRELESS VALVE COMPANY LIMITED

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In this issue:

MAGIC-EYE TUNING INDICATORS

Circuits for Correct Operation

HOW TO SECURE INDICATION ON WEAK SIGNALS AND SHORT-WAVES

The Radiotron "Magic-Eye" has become not only a luxury, but a regular feature of good radio sets. It has made possible, in an attractive manner, the correct tuning of a receiver fitted with A.V.C. Its usefulness extends not only to strong local signals, but also to the reception of weak signals, including short-wave signals. The 6E5 suffers from the disadvantage that "overlapping" of the fluorescent screen frequently occurs on strong signals, and if some form of desensitising is employed its operation is not very good on weak signals. Special circuits have been developed to enable the 6E5 to be applied without overlapping and without serious loss of sensitivity on weak signals, but these circuits introduce further complications or expense.

Radiotron 6G5 has been introduced in order to provide simple means for the avoidance of overlapping, together with *increased sensitivity on weak signals.* Up to a deflection of approximately one-third of the angle at which overlapping occurs the 6G5 is more sensitive than the 6E5. Beyond this point, if both types are operated from the same A.V.C. voltage, the 6E5 is more sensitive, but then suddenly overlaps. In order to avoid overlapping the 6G5 sensitivity must necessarily decrease, but even in the case of the 6G5 overlapping can occur on extremely strong local signals.

Radiotron 6G5 is identical in brilliance and performance to Radiotron 6E5, and the two types can be directly interchanged. Type 6G5 will generally be found to give the best all round performance unless special provision is made to eliminate overlapping in the 6E5.

FIG 1
SIMPLE A.V.C. NO CATHODE RESISTOR
PRACTICAL CIRCUIT
6G5 6E5

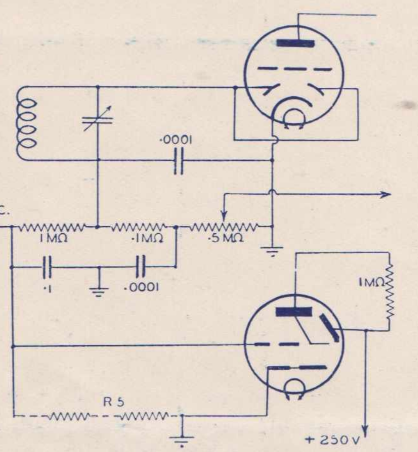


FIG 2
SIMPLE A.V.C. DUO-DIODE-TRIODE.
CIRCUIT NOT RECOMMENDED
6G5 6E5

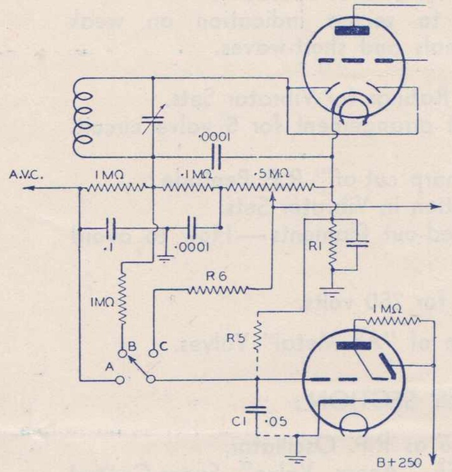


FIG 3
SIMPLE A.V.C. DUO-DIODE-TRIODE.
IMPRACTICAL CIRCUIT
6G5 6E5

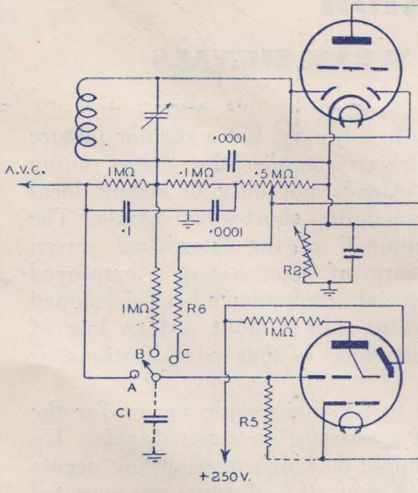
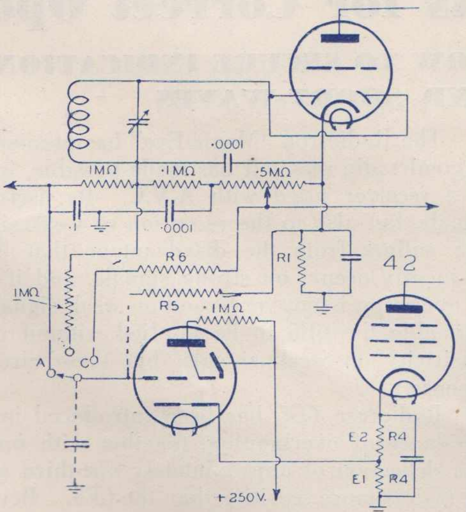


FIG 4
SIMPLE AVC DUO-DIODE-TRIODE
PRACTICAL CIRCUIT
6G5 6E5



I.W.

APPLICATION TO SIMPLE A.V.C. CIRCUITS

When simple A.V.C. is used in a receiver, and when the cathode of the diode detector valve is returned direct to earth, the Magic Eye may be applied without any complication.

As shown in Fig. 1, the grid of the Magic Eye is connected to the A.V.C. line at the filtered end while the cathode is returned direct to earth. If a 6E5 is used, the resistor R5 may be added to prevent overlapping on strong signals. If a 6G5 is used, R5 is generally unnecessary.

When a duo-diode triode or duo-diode pentode valve is used with self-bias there is difficulty, due to the cathode return of the Magic Eye. In Fig. 2, one arrangement is shown in which the cathode of the Magic Eye is returned to earth. This arrangement is simple and readily applied, but has the disadvantage that the grid of the Magic Eye is initially positive and grid current tends to flow, thereby affecting the A.V.C. system. If a 6E5 is used, overlapping may be prevented by various methods, as indicated by switch positions A, B and C. In position A, the addition of R5 will desensitise the 6E5, but at the same time, also decrease the A.V.C. voltage. Position B has a similar desensitising effect with R5, but avoids the effect on the A.V.C. Position C is a special arrangement whereby the voltage applied to the grid of the 6E5 is reduced as the volume control setting is reduced. With this arrangement overlapping is avoided so long as the volume control is set at a low level, and since the setting for strong stations is lower than for weak stations, a certain degree of desensitisation is given automatically. One disadvantage of this arrangement is, that the deflection of the Magic Eye is no indication of the signal strength. With position C as shown, it is not possible to obtain "silent tuning", since when the volume control is set at zero the indication will also be zero. If it is desired to have "silent tuning", it may be obtained in switch position C by connecting together points B and C. The value of R6 may be of the order of 1.0 megohm. The addition of R5 gives additional desensitisation. Condenser C_1 is required in switch positions B and C only.

In order to avoid the unsatisfactory operation of Fig. 2, self-bias may be applied to the Magic Eye. Unfortunately, due to variations of target current between valve and valve, this is not entirely satisfactory, although it is an improvement. If individual adjustment is possible, or if the voltage across R_1 is very small, this arrangement might be used.

Fig. 3 is similar to Fig. 2, except that a common self-bias resistor is used for both the duo-diode triode valve and the Magic Eye. This is not recommended since, if resistance coupling is used, any variations of target current of the Magic Eye will seriously affect the amplifying valve. With transformer coupling and valve types 55, 85 or 6R7, this objection is not very important, since the total cathode current is much higher and the bias much less critical. If R2 is made adjustable, as indicated in Fig. 3, this arrangement would be satisfactory. Fig. 4 shows a simple and readily applied means for avoiding the difficulties described in previous circuits. The cathode of the Magic Eye is returned to a suitable tapping point on the cathode bias resistor of the output valve, in this case, Type 42. E_1 is made equal to the voltage drop across R_1 in Fig. 2, so that the cathode of the Magic Eye is at the same potential as the Cathode of the Duo-diode-triode valve. R_3 and R_4 together provide the correct bias for the 42, and a total resistance of about 420 ohms. is quite satisfactory. Since E2 is 16.5 volts above earth, and E_1 is only about 1.3 volts above earth, there is very little effect on the 42, due to the small additional current flowing through R_3.

ELECTRON RAY TUNING INDICATORS (TYPICAL CIRCUITS)

FIG. 5
DELAYED A.V.C. DUO-DIODE-TRIODE
PRACTICAL CIRCUIT

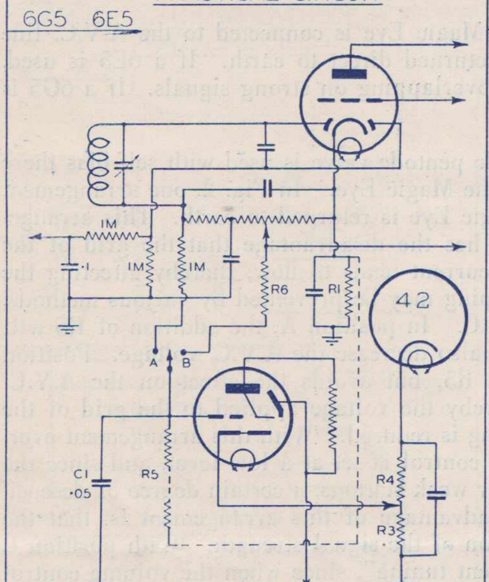


FIG. 6
DELAYED A.V.C. DUO-DIODE-TRIODE
RECOMMENDED CIRCUIT

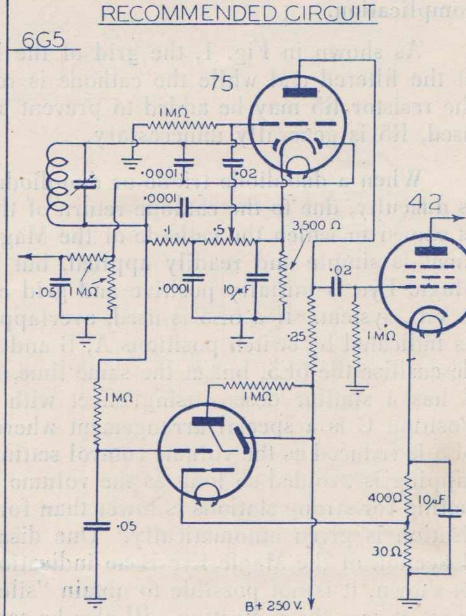
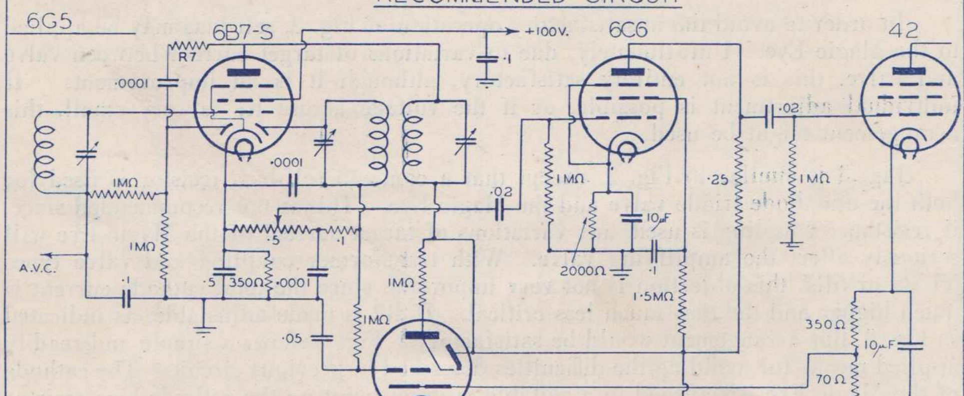


FIG. 7
6B7—S I.F. AMPLIFIER WITH DELAYED A.V.C.
RECOMMENDED CIRCUIT



DELAYED A.V.C. SYSTEMS

The discussion so far has been limited to simple A.V.C. systems. In Fig. 5 a circuit is given for a similar improved circuit applied to a delayed A.V.C. system. If the cathode of the Magic Eye in Fig. 5 is taken direct to earth, there is no effect on the A.V.C. system as there would be in Fig. 2, but there is an effect on the Magic Eye. It is obvious that no effect will be observed on the Magic Eye until the A.V.C. begins to operate, but due to the delay incorporated in the A.V.C., there is no change whatever until the signal is strong enough to overcome the delay. The result is that with such an arrangement the Magic Eye only operates on strong signals. This is particularly unfortunate, and largely detracts from the value of the Magic Eye as a tuning indicator. The effect of the delay voltage is present at all signal levels, and not only at voltages below the delay voltage. For example, take an A.V.C. voltage of 2 volts and a delay of 1.5 volts, this being the voltage across R1. With the usual arrangement, the voltage on the grid of the Magic Eye is 0.5 volt, but with the improvement shown in Fig. 5, the full 2 volts will be applied and will give a correspondingly greater deflection. One effect of the greater deflection is that the overlapping effect will be more pronounced, and some desensitising means may have to be adopted with the 6E5. In switch position A, the addition of R5 will give the desensitising effect. In switch position B another desensitising arrangement is shown. This has already been described under Fig. 2, switch position C.

When the circuit of Fig. 5 is employed, it is far simpler to use the 6G5 in switch position A with the omission of R5 and R6. This circuit, applied to Radiotrons 75, 6G5 and 42, is given in Fig. 6, complete with the necessary constants. In order to prevent distortion due to shunt diode loads, it is better to take the I.F. voltage from the plate of the I.F. valve instead of from the signal diode as shown in Fig. 5.

In Fig. 7, is shown a preferable arrangement using Radiotron 6B7S as I.F. amplifier. Diode shunt loads are avoided as far as possible through the A.V.C. diode being fed from the plate of the 6B7S. There is a certain amount of damping introduced through the diode load shunting the primary of the I.F. transformer. This can be minimised through the use of a resistance R7, which may be from 0.1 to 0.5 megohm, or alternatively by the use of a very small capacity C2. Either arrangement results in a smaller A.V.C. voltage, and consequently a less efficient A.V.C. action, and must be used with caution for this reason. The delay voltage in this circuit is 3 volts.

A 6C6 resistance coupled pentode is recommended as audio amplifier, and gives less distortion and approximately twice the gain of a 75. A 42 output valve is shown in the diagram, but if good fidelity is required, a 2A3 is much to be preferred. The gain of the 6C6 pentode is sufficient to drive the 2A3 quite comfortably.

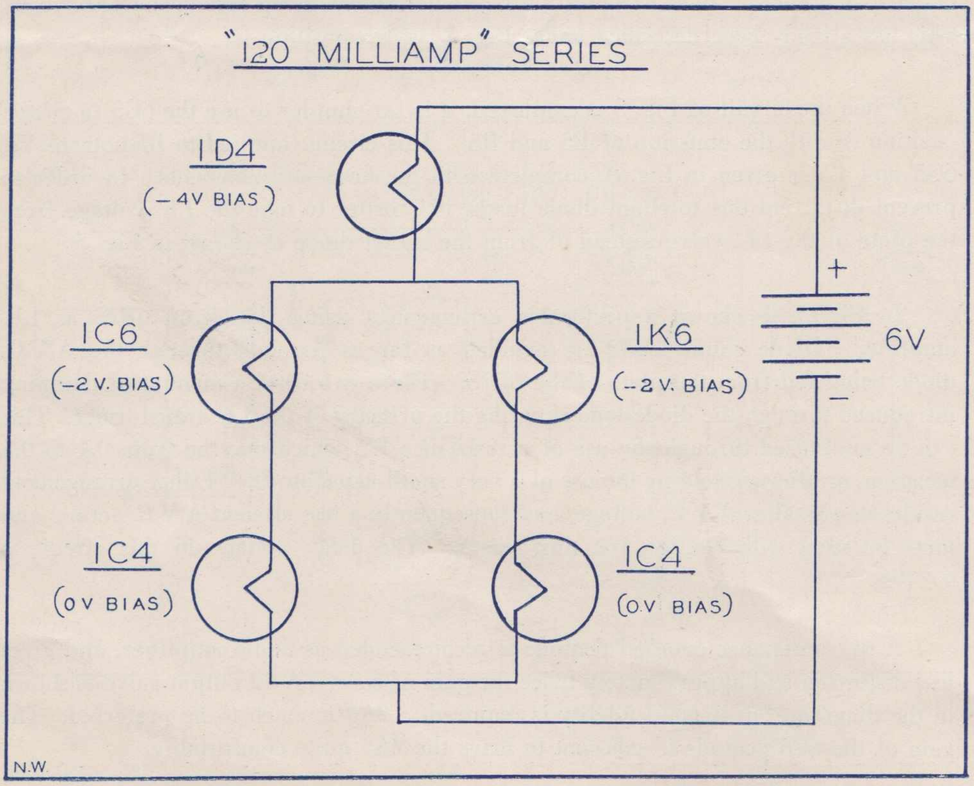
NEW RATINGS FOR RADIOTRON "120 MILLIAMP" BATTERY SERIES

Application to Vibrator Sets

The Radiotron "120 milliamp" Battery Series has been designed to suit either 2 volt or 6 volt A Batteries, and the filaments are suitable for connection in "series"—"parallel" without the use of any shunts or dropping resistors. The suggested arrangement of filaments given in the diagram refers to a popular 5 valve arrangement. It will be seen that the correct bias for each valve is given directly from the A Battery without the necessity for a separate bias resistor in the B– lead.

It has been found that most vibrator sets operate on effective voltages between 140 and 160 volts, so that a mean value of 150 volts has been chosen as the most typical, and grid bias voltages of 0, –2 and –4 volts have been selected so as to suit the conditions. It is pointed out that these voltages are very close indeed to the optimum values so that no appreciable advantage can be secured by the use of any other bias. On the other hand, if the B supply voltage is as high as 180 volts, the bias of the 1D4 should be increased to –6 volts, or alternatively, the screen voltage dropped to a maximum of 150 volts.

In the arrangement illustrated *no valve can be injured through any valve being inadvertently pulled from its socket whilst in operation.*



RADIOTRON "120 Milliamp" BATTERY SERIES. VIBRATOR SET RATINGS.

Type	1C4		1C6	1D4	1K6	
Description	Super-control R.F. Pentode		Pentagrid Converter.	Power Pentode.	Duo-diode Pentode.	
Application	R.F. & I.F. Amplifier		Converter.	Power Amplifier	Detector and R.C. Amplifier	
Filament	12A 2V.		12A 2V.	24A 2V.	12A 2V.	
Plate Volts	150		150	150	150	150
Screen Volts	67.5	45	60	150	Triode	60
Screen dropping resistor ohms	100000	200000	50000	—	Screen tied to plate	750000
Grid Volts	0 min.	0 min.	–2 min.	–4	–2	–2
Plate Current mA	2.5	1.25	1.45	9.5	0.8	0.33
Screen Current mA	0.9	0.5	1.8	2.3	—	0.12
Anode-grid Current mA	—	—	1.8	—	—	—
Anode-grid dropping resistor ohms.	—	—	50000	—	—	—
AC Plate resistance megohms	0.9	1.6	0.4	—	—	—
Mutual conductance micromhos	1000	780	conversion 400	—	—	—
Voltage Amplification Factor	900	1250	—	—	—	—
Ohms Load	—	—	—	15000	100000	250000
Power Output Watts	—	—	—	0.45	—	—
Effective Voltage Amplification	—	—	—	—	12	64

RADIOTRON 1K4
New "Sharp cut-off" R.F. Pentode
"120 milliamp." Battery Valve

A new "120 milliamp." battery valve has been added to complete the range of these popular valves. The 1K4 is substantially identical with the 1C4 in all features except that it has a sharp cut-off in place of the super-control characteristics of the 1C4. Detailed characteristics and curves are given in the loose leaf sheets being made available for your "Radiotron Valve Data" binder.

Radiotron 1K4 has a wide range of applications, among which are suggested —

(1) Leaky-grid detector with reaction.

(2) High-gain resistance-coupled audio amplifier.

(3) Fixed bias R.F. or I.F. amplifier (*e.g.*, second I.F. Amplifier). In this application the 1K4 is practically identical with the 1C4.

(4) Triode driver for Class B stage when a larger power output is required than that given by the 1K6 as a triode.

Due to the high gain and non-microphonic construction of the 1K4, it is particularly suited to portable microphone amplifiers. A two-stage amplifier incorporating 1K4's will give a gain of 72 db. The distortion given by such an amplifier for an output voltage of 4.5 volts peak is practically zero, while the frequency range may readily be designed to extend from 30 to 10,000 cycles within 1 db.

Radiotron 1K4 is available immediately from stock.

RADIOTRON 1K6 and VIBRATOR SETS

Radiotron 1K6 may be used as a resistance-coupled amplifier either as a pentode or as a triode. In the latter application the plate and screen are tied together. In circuits where high gain is required the "pentode" application is recommended. In other cases the 1K6 may be used as a triode, and will be found to give a gain very similar to that of other duo-diode-triodes.

In Vibrator Sets an extremely high audio gain is generally avoided on account of hum from the vibrator. In such applications the 1K6 as a triode is most suitable. Any appreciable increase of gain will increase the hum level in proportion.

CAUSES OF BURNED-OUT FILAMENTS

How to avoid accidents

It is not always realised that in multi-grid valves there are certain electrodes such as suppressor-grids which require to be earthed. In such cases the suppressor grid is connected to the *negative* end of the filament. It is obvious, then, that there is a correct and an incorrect way for the filaments to be connected in a receiver. *The negative end of the filament must always be earthed.* All returns such as from bypass condensers should be taken to the *negative* end of the filament — that is, directly to earth. The only returns to the positive end of the filament that can be approved are in the case of diodes or leaky-grid detectors in which the returns may be taken to the positive end of the filament for obtaining positive bias.

If the filaments are incorrectly wired it is possible for all the valves in a receiver to be burned-out through one defective valve or component.

As a convenient way of remembering which end is the negative, it may be taken that the negative end of the filament is the pin nearest to the *screen* pin, or in the case of triodes to the *grid* pin. This rule holds for most popular types, including 30, 31, 32, 33, 34, 1A6, 1C4, 1C6, 1D4, 1K4 and 1K6.

Alternatively it may be remembered that the positive end is next to the plate pin in all types.

25Z5 and 25Z6

New Ratings for 250 volts

An omission occurred in the ratings for Radiotron types 25Z5 and 25Z6 given in *Technical Bulletin* 69, Page 11. The maximum rating with the two halves connected in parallel should read "85 milliamps. *per valve*," that is, 170 M.A. total. These ratings apply with 100 ohms. resistor connected in series with each plate.

Complete range of RADIOTRON "ALL-METAL" VALVES now available

With the addition of the 6B8 (described in *Radiotronics Technical Bulletin*, No. 69) a complete range of "All-Metal" Radiotrons is available. For convenient reference the list is given below, together with a reference to the available data if not included in the Radiotron "All-Metal" Characteristic Chart.

Type.	Description.	Reference.
5W4	Full wave rectifier (directly heated)	Bulletin 63, P. 8
5Z4	Full wave rectifier (indirectly heated)	Chart
6A8	Pentagrid converter	Chart
6B8	Duo-diode-pentode	Bulletin 69, P. 12
6C5	General purpose triode	Chart
6F5	High mu triode	Chart
6F6	Power Pentode	Chart
6H6	Twin diode	Chart
6J7	Pentode	Chart
6K7	Super control pentode	Chart
6L6	Beam power tetrode	Chart
6L7	Pentagrid mixer	Chart
6N7	Twin triode (Class B)	Bulletin 63, P. 8
6Q7	Duo-diode high-mu triode	Chart
6R7	Duo-diode triode	Chart
6X5	Full wave rectifier (automobile)	Chart
25A6	Power pentode (A.C./D.C.)	Chart
25Z6	Full wave rectifier (A.C./D.C.)	Chart

EXPERIMENTERS SECTION

RADIOTRON 6L6 as R.F. OSCILLATOR

We have received from Mr. Don. B. Knock (VK2NO) a letter which should prove of the greatest interest to experimenters who aim at a stable high power job on 56 MC. In his letter Mr. Knock states that —

"Owing to the great popularity surrounding the type 6L6 'Beam' power amplifier valve, both in Australia and overseas, I am passing on information which may be of value to you in your circulars to experimental transmitters.

"For some time I have studied the problem of obtaining sufficient stable output from oscillators at ultra-high-frequencies with the object of obtaining a good R.F. output from a final stage with a minimum of intermediate or doubler stages. There is no technical objection to achieving this, even with crystal control initially, but when the final arrangement runs into a formidable array of stages, it is entirely beyond the average experimenter's pocket. The 6L6 presented opportunities for experimentation as an R.F. oscillator, and my findings are somewhat surprising. Using a 6L6, with 350 volts on the plate and a maximum of 250 screen volts; with grid circuit at 28 mc — the harmonic output in the plate circuit is somewhat amazing. In fact, there is as much output from the 6L6 at 56 MC used thus, as there is at 14 MC with a 53 using a 7 mc crystal. Here, then, is a splendid solution to the problem of designing *stable* ultra short-wave transmitters, and it is something that has long been needed. In my case, the 6L6 is followed by an 802 type valve, capacity coupled and un-neutralised. As an exciter at 56 MC, this combination in itself constitutes a useful u-s-w transmitter with considerable RF output. For those who cannot run to the 802, the well tried 6P6 is admirable. In fact, there is little difference from the 802 at 350 volts. The final stage of my modern 56 MC transmitter uses two 50 watt type triodes in push-pull with 150 watts input. With this transmitter and vertical dipole antennae, I am able to put R9 telephony into Holdsworthy military camp from Waverley. The equipment there is a simple transceiver with a super-regenerative receiver. The distance is not the point here; Holdsworthy is well screened from Sydney's Eastern Suburbs. This new transmitter is ideal for CW (Morse) transmission, and monitoring the signal reveals that it is T8 and rock steady. This would not have been possible by any means with only three stages, but for the 6L6, and I can strongly recommend this valve as an outstanding high frequency and ultra-high-frequency oscillator for experimenters.

"It certainly should seal the doom of the unstable form of push-pull 'unity-coupled' or 'TNT' oscillator used hitherto for ultra-short-wave communication in most parts of the world.

"The fact that the 6L6 generates considerable heat does not appear to be detrimental. I have had one running for several hours continuously for some weeks now, drawing 65 milliamperes at 350 volts, and although the valve gets so hot that it cannot be touched by hand, it appears to like it. The indication of extra heat is, of course, natural to the metal shell.

"With the 6L6 and 6P6 available to experimenters, there is now no reason why everybody interested in ultra-short-wave communication should not be able to put a perfectly stable signal on the air, even at 112 megacycles.

Yours faithfully,

(Sgd.) DON B. KNOCK (VK2N0),

Radio Editor, *The Bulletin.*"

NEW "ACORN VALVE" FOR U.H.F.
RADIOTRON 956

Super Control R.F. Pentode

Already the well known Radiotron Acorn Valves 954 and 955 have proved their ability to give extraordinarily good performance on the Ultra-High Frequencies (below 5 meters). A companion type is the 956, which is somewhat similar in construction and application to the 954, except that the 956 has super-control characteristics.

It is generally found that at wavelengths of 5 meters and above the performance of Radiotrons 6C6, 6D6, and the "all-metal" types 6J7, 6K7 and 6L7, is practically equal to that of the Acorn types. It is at the still higher frequencies that the Acorn Valves excel all others, and the 956 is particularly suited for operation between 0.7 and 5.0 meters.

At a wavelength of 1 meter, the 956 is capable of giving a gain (as an R.F. amplifier in circuits of conventional design) of four times or more, while at 3 meters the gain under similar conditions can be 13 times.

TENTATIVE CHARACTERISTICS

Heater Voltage (A.C. or D.C.)	6.3	Volts
Heater Current	0.15	Ampere
Plate Voltage	250 max.	Volts
Screen Voltage	100 max.	Volts
Grid Voltage (minimum)	–3	Volts
Suppressor	Connected to cathode at socket	
Plate Current	5.5	Milliamperes
Screen Current	1.8	Milliamperes
Plate Resistance	0.8	Megohm
Amplification Factor	1440	
Mutual Conductance	1800	Micromhos
Mutual Conductance (at –45 bolts bias)	2	Micromhos
Grid-Plate Capacitance (with shield-baffle)	0.007 max.	$\mu\mu$f.
Input Capacitance	2.7	$\mu\mu$f.
Output Capacitance	3.5	$\mu\mu$f.
Bulb	T-4½	

As a mixer in superheterodyne receivers, the 956 may be used under the following conditions:—Plate voltage, 250 volts; screen voltage, 100 volts; and grid bias, –10 volts approximately (with a 7-volt peak swing from the oscillator).