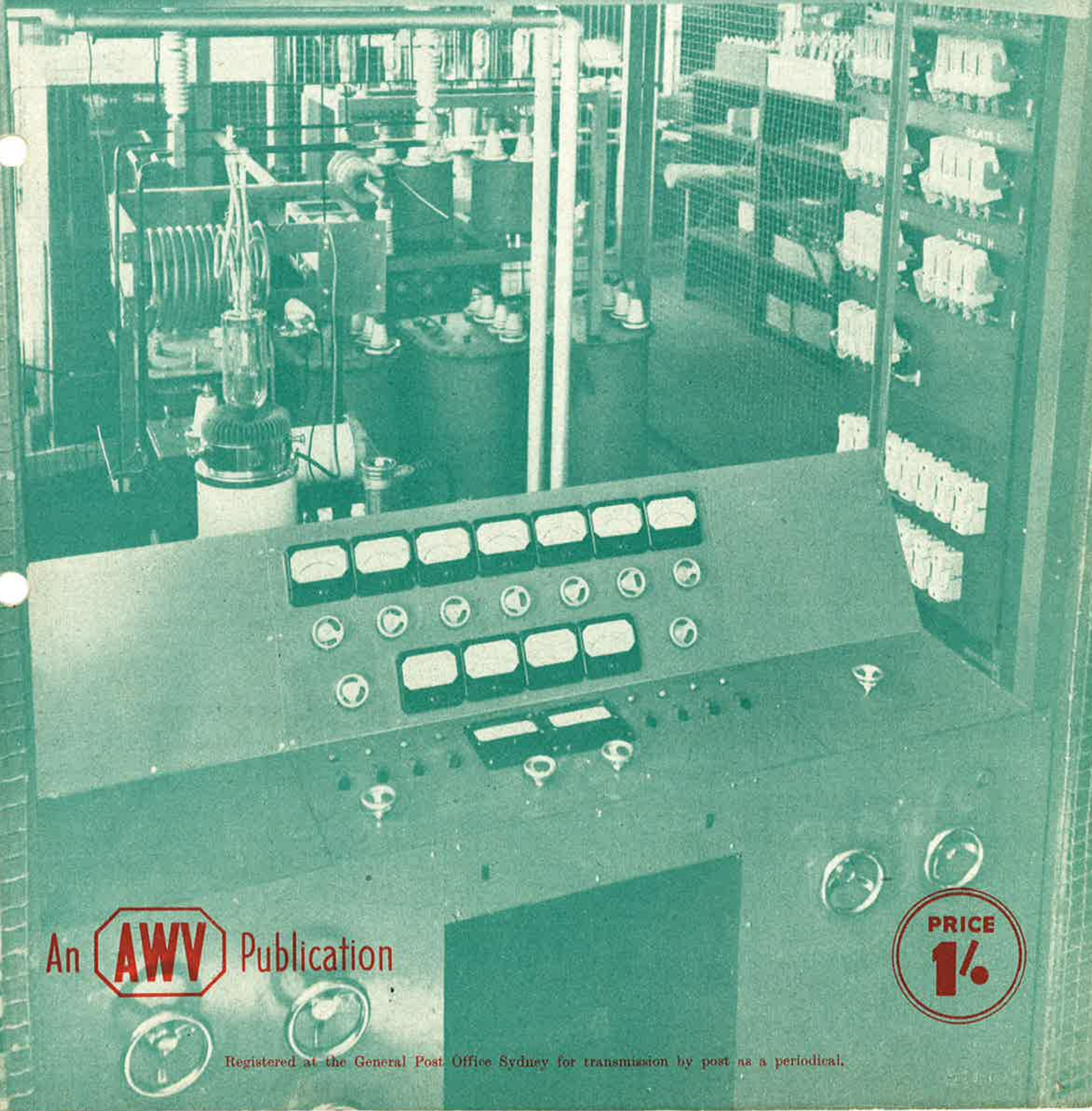
RADIOTRONICS

Volume 17 September 1952 No. 9



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By the way—

The cover of this issue shows the AWV high-power transmitting valve test set-up. On test is an 892-R; the largest air-cooled transmitting valve made at the Ashfield factory of Amalgamated Wireless Valve Company Pty. Ltd.

An article we printed some time ago dealt with the subject of electronic keying of transmitters. The interest that was aroused has prompted us this month to include a more thorough treatment of the same subject by the original RCA author.

Additional technical data together with typical Characteristic curves has become available on the GEX series of germanium crystals and is reprinted herein.

The high slope metal power pentode, 6AG7, has long been popular. Now RCA introduces its counterpart, the 6CL6, in miniature construction. It is expected that this new valve will be used in lieu of the 6AG7 for all new equipment designs. Full data appears in the rear of this issue.

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A MODERN STRAIGHT RECEIVER

By W. H. Allen, M.B.E.

One of the most persistent of all controversies in amateur circles is the question of "straight v. superhet." receivers. With modern advances in valve and circuit design, there is little doubt that where utmost sensitivity and selectivity are required, and where complication and cost are of secondary consideration, the superheterodyne circuit is the answer. For many amateurs — particularly those who are enjoying the varied interests of Amateur Radio for the first time — cost and complexity may well be the stumbling blocks. It is primarily for them that the straight receiver described in this article has been designed.

The straight receiver, upon which the pioneers of Amateur Radio depended, can still do a good job to-day provided its fundamental limitations are recognised. These include an inherent lack of selectivity, the inability to resolve weak modulated transmissions, and a tendency towards "swamping" by high-powered signals on adjacent frequencies. Nevertheless, it can hold its own with all but the best superhets. in the realm of c-w reception, provided that extreme selectivity is not a first requirement.

Many of the advances in technique which have so benefited the superhet. may be pressed into service to improve the performance of the straight receiver, as an examination of this design will show.

Specification

Three modern miniature valves are employed, in a t.r.f. circuit, as r-f amplifier, reaction detector and high slope power pentode output. As the circuit is conventional and well-tried, no difficulty should be experienced in obtaining comparable results with other valves of similar characteristics.

The 1.7, 3.5, 7, 14, 21 and 28 Mc/s amateur bands are covered, bandspread being provided on each. Although the receiver is designed primarily for reception on headphones, provision has been made for the connection of a loudspeaker when desired.

The circuit

There is ample room on the chassis for all the components, so that a fairly open lay-out is possible, with consequent ease of construction. Besides giving a worth-while amount of gain, the r-f stage isolates the detector from the aerial, preventing that valve from radiating interference to nearby receivers. Also, by ensuring a more constant loading of the detector tuned-circuit, smoother control of regeneration and constancy of calibration are obtained.

Reprinted with acknowledgements to R.S.G.B. Bulletin.

Provision is made for the connection of either a long wire aerial, or one having a balanced feeder (such as a dipole). When using the former, one of the two aerial terminals should be connected to chassis.

The r-f gain may be varied by means of a potentiometer in the cathode circuit of the first valve, while *R*2 ensures that the minimum bias for the valve is always present. Regeneration is obtained from the anode of *V*2 via the blocking condenser *C*8 and coil *L*3, control being effected by varying the screen voltage by means of *R*11. The secret of smooth control of regeneration is to run the valve in a low gain condition, with no more than 25 volts on the screen grid. A higher voltage would result in greater stage gain, but regeneration would then tend to start with a "plop", making it impossible to hold the receiver in its most sensitive condition — i.e., on the threshold of oscillation. With the component and coil values given, the receiver may be made to slide almost imperceptibly into oscillation at any point on its six frequency ranges.

No difficulties were encountered in using only one r-f choke in the anode circuits of *V*1 and *V*2, despite the wide frequency range over which they have to operate, but as this can be a troublesome point it is strongly recommended that the types specified be used in these positions.

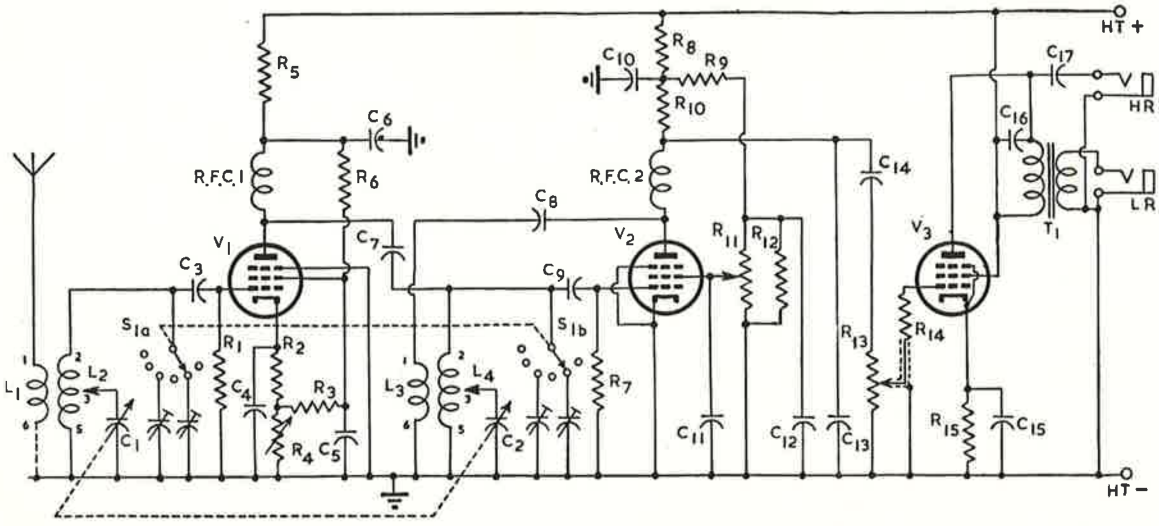
Smoothness of regeneration is improved by connecting *C*12 across *R*11, and not from the screen grid to earth, as is sometimes done. *R*12 is connected in parallel with the potentiometer *R*11, limiting the voltage developed across the latter.

The a-f stage follows normal practice, and is adequately decoupled for r-f by *C*13 and the grid stopper resistance *R*14. To be effective it is essential that one end of the latter be connected directly to the grid tag on the valve-holder.

The primary winding of the output transformer acts as a choke for the connection of high-resistance headphones or a loudspeaker having its own output transformer. The step-down ratio between primary and secondary is chosen to suit the impedance of a low-resistance speaker or headphones.

Power supply

The mains power supply is of conventional design and should deliver approximately 250 volts of h-t on load. The rectifier valve is also a miniature type, designed with high insulation between heater and cathode so that the former may be run from the same 6.3 volt supply as the other valves in the receiver.



CONDENSERS
C1, 2 45 μμF variable.
C3, 8, 9 100 μμF silver mica.
C4, 5, 6, 10, 11 0.05 μF.
C7 15 μμF ceramic disc.
C12 2μF paper.
C13 200 μμF.
C14 0.01 μF.
C15 25 μF, 50V working.
C16 500 μμF.
C17 0.5 μF.
C18 16 μF.
C19 8 μF.

RESISTORS
R1, 3, 10 100,000 ohms, ½-W.
R2 57 ohms, ¼-W.
R4 25,000 ohms potentiometer.
R5 10,000 ohms, 1-W.
R6 33,000 ohms, ½-W.
R7 2.2 megohms, ¼-W.
R8 50,000 ohms, 1-W.
R9 220,000 ohms, ½-W.
R11 50,000 ohms potentiometer.
R12 50,000 ohms, ½-W.
R13 470,000 ohms potentiometer.
R14 5,000 ohms, ¼-W.
R15 125 ohms, 1-W.

INDUCTANCES, ETC.
RFC1 R-F choke.
RFC2 R-F choke.
T1 Output transformer. 7,000 ohms to voice coil.
T2 Power transformer. 225-0-225V. 60 mA. 6.3V. 3A.
CH Smoothing choke. 15H. 60 mA. 300 ohms.

VALVES
V1 6BA6.
V2 6AU6.
V3 6BV7.*
V4 6X4.
* Diodes strapped to cathode.

MISCELLANEOUS
Ten 50 μμF mica compression trimmers.
Two 3-30 μμF air-spaced concentric trimmers.
One two-pin mains plug and socket.
One international octal valve holder.
One international octal plug.
Three 7-pin miniature ceramic valve sockets and screens.
Three insulated terminals.
One 6-way 2-wafer ceramic switch and fittings.
One double-pole fuse-holder and fuses.

Fig. 1.—Circuit of the modern straight receiver.

Bandspread

In this receiver only one tuning gang is required, made up of two 45 μμF variable condensers joined by a flexible coupler. A connection from the stator plates is made to a tapping on the coils *L*2 and *L*4 so that the effective capacity variation is just sufficient to cover the desired band. Bandsetting is accomplished by trimmers associated with the two coils of each frequency range. These trimmers are brought into circuit by a six-way ceramic wafer switch. This may seem to be an unnecessarily complicated arrangement, but by keeping the trimmers inside the receiver, they cannot be subjected to unwanted alteration in handling as would happen if they were mounted in or on the coil formers. Apart from it being poor practice electrically to have the trimmers in the field of the coils, the mechanical difficulties encountered would be considerable. Any losses which may be introduced by the switching system are negligible in practice, even on the highest frequencies covered by the receiver.

Construction

The receiver was built into an Eddystone type 787 cabinet and chassis, the latter measuring 16in. by 7¼in. by 3in. deep. As metal supplies are very uncertain at the present time, it is unlikely that an exact replica will be obtainable, but this is relatively unimportant as only the r-f and a-f sections of the receiver matter from the point of view of layout, and these can be accommodated on a chassis 9½in. long of the above-mentioned width and depth, with a separate power supply. Provided that the lead from the anode circuit of the detector valve is run in screened wire to the a-f gain control (*R*13) and thence by a further screened lead to the grid of *V*3 this valve may be mounted on either side or at the rear of the coil screens, the chassis dimensions being chosen accordingly. If the power supply is on the same chassis, however, it would be inadvisable to mount the output transformer in close proximity to either the mains transformer or the smoothing choke, without first ascertaining whether mains hum is being introduced. The disposition of the r-f components should not be changed radically unless the constructor is prepared to re-design the receiver and coils.

Any good slow-motion dial may be used in place of the Eddystone type 598 specified, but if this is done, the height of the chassis must be considered, and the mounting brackets for the ganged condensers adjusted accordingly. The positioning of the band-switch in relation to the tuning condensers and coils is important, so that leads can be kept short, but the regeneration and r-f gain controls, being in d.c. circuits only, may, if desired, be placed elsewhere.

The dimensions of the coil-box and the mounting brackets for the tuning condensers are given in Fig. 2. The wiring is arranged so that no leads pass through the coil box, which may, therefore, be placed in position after all other components on the top of the chassis have been fixed and wired in place. The holes in the brackets, through which the single-hole fixing bushes of the condensers pass, may with advantage be filed slightly oval in a vertical direction to facilitate lining up of condenser and dial shafts.

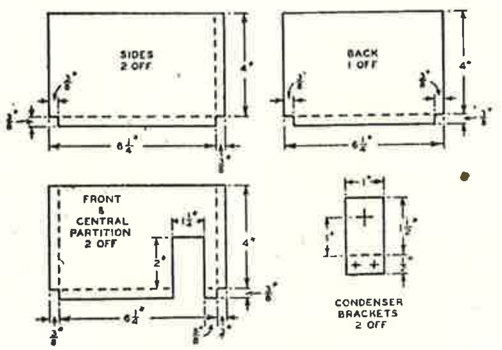


Fig. 2.—The screening box for the coils and tuning condensers is made from No. 20 s.w.g. aluminium. All lower edges are bent towards the inside of the box and secured to the chassis with 6 B.A. bolts and nuts. The apertures in the front and central partition provide clearance for the condenser shaft couplers. No. 16 s.w.g. aluminium is used for making the condenser brackets.

The two wafers of the six-way ceramic switch should be spaced 3in. apart, centre to centre, the switch spacers being adjusted so that the wafers are in the same relative positions in respect of the two coil bases. Thus the wiring in both r-f and detector circuits will be of similar length. This will bring the rear switch-wafer approximately 3in. from the front panel.

The five ceramic and mica-compression trimmers for the 1.7 to 21 Mc/s bands inclusive are soldered at one end of their respective switch contacts and at the other end *bolted* to a piece of sheet brass mounted on the side members of the switch. The spacers on the latter must be adjusted in length so that this becomes possible, washers being inserted, if necessary to preserve the correct distances. The trimmers for the 28 Mc/s band are 30 $\mu\mu$F concentric types; one of the tabs on the stator is soldered to the sixth switch contact and the rotors are connected to the brass plates by about ½in. of No. 20 s.w.g. wire. To preserve a low-impedance earthing contact, the brass plates are each joined to pin 5 on their respective coil bases by short lengths of copper braid.

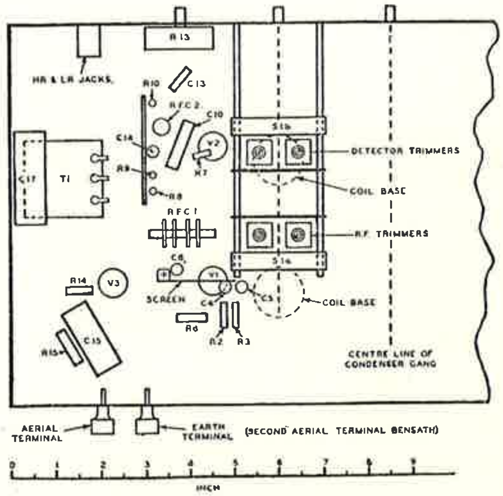


Fig. 3.—Scale drawing of part of the under-side of the chassis showing the location of the main components. For clarity only two trimmers are shown attached to the switches.

A piece of thin brass sheet, 1½in. high by 1¾in. long, is mounted across the valveholder of *V*1, which is arranged so that the grid tag is to the rear of the chassis and the anode tag is on the opposite side of the brass screen. A lead is taken from this screen to the earthy pin (No. 5) of the first coil base, all earth-return leads for the stage being made either to this lead, or directly to the brass screen.

All components should be firmly anchored to prevent movement and vibration, which would adversely affect the performance of the receiver. The time and trouble spent in arriving at a satisfactory layout, using group boards where necessary, and cabling lengthy supply leads together with twine, improve both the appearance and performance of the receiver. A group board holding *RFC*2, *C*14 and *R*8, 9 and 10 may be mounted vertically about one inch from the detector valve-holder, between that component and the output transformer.

The coils

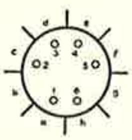
The six pairs of coils are wound on Eddystone type 537 six-pin plug-in formers, each pair of coils being of similar construction. Full details of the windings and the spacing between them are contained in the coil data table. A diagram showing the relationship between the position of the pins and the eight faces of the formers is also given. In all cases the aerial coupling and reaction windings start and finish through the same hole in the former on face "h". In the case of the 21 and 28 Mc/s coils, which are wound with stout wire, it is easier to take the earthy — or lower — end of the coil through the central hole in the base of the former, and solder it to the top of pin 5, rather than attempt to take it *down* the pin from the inside as was done with all other coils and windings. All L2 and L4 coils have an additional half turn of wire, to enable the windings to start and finish on opposite sides of the former so that leads do not cross inside.

COIL DATA

Band	L1–L3				L2–L4		
Mc/s	Turns	Length	Wire s.w.g.	Tap	Turns	Wire s.w.g.	Spacing L1/L2
1.7	67½	1⅝"	24 (enam.)	51¾(d)	5	26 (d.c.c.)	5/16"
3.5	35½	1"	24 (enam.)	14¾(d)	4	26 (d.c.c.)	⅛"
7	20½	1½"	24 (enam.)	6(f)	2	26 (d.c.c.)	¼"
14	9½	1"	20 (enam.)	2⅛(g)	2	26 (d.c.c.)	5/16"
21	5½	1"	20 (tin)	1¼(h)	2	26 (d.c.c.)	⅛"
28	3½	¾"	20 (tin)	1¼(h)	2	26 (d.c.c.)	⅛"

When viewed from the pin end of the formers, L2 and L4 are wound clockwise, starting at the earthy end on face "f" of the former. L1 and L3 start at pin 1, and are wound clockwise to finish at pin 6. Tapping points are counted from the earthy ends of the windings. The letters in the "Tap" column indicate the face of the former on which the tapping is made. Other pin connections are:

Pin	R.F. Coils	Detector Coils
1	aerial	to C8
2	grid	grid
3	tap	tap
4	blank	blank
5	chassis	chassis
6	aerial	chassis



The figures against the ends of *L*1, 2, 3 and 4 in Fig. 1 indicate the connections to the coil formers and coil bases. The dimensions given for the lengths of the coils are the distances between the holes drilled in the former for the start and finish of the winding, the turns being arranged evenly in the space indicated. The hole for the windings of *L*1 or *L*3 is located ½in. from the base of the former in all coils except those for the 21 and 28 Mc/s bands where the distance is ⅜in. The hole for the earthy ends of the coils (pin 5) is drilled ½in. from the base of the former (on face "f") in the case of the 21 and 28 Mc/s coils, ¾in. for the 3.5, 7 and 14 Mc/s and ⅝in. for the 1.7 Mc/s coils. The tapping is brought through the former at a suitable point and connected to the main winding in all coils except those for 1.7 and 3.5 Mc/s. Since the latter are close wound, the tapping passes through the wall of the former between the two windings, and is then brought to the required point outside of the turns, a piece of sleeving being slipped over the tapping wire for insulation purposes.

Aligning and calibration

After the circuit has been completed and checked, a pair of coils should be inserted, the range switch turned to the appropriate band, and the detector trimmer set at about half capacity. With the r-f gain at minimum, the regeneration potentiometer should be slowly advanced until the detector goes into oscillation with a faint "breathing" sound. If this point is reached when the control is about one third or half-way round, all is well. Should oscillation commence much earlier, the reaction winding should be slid slightly away from the grid winding and another test made, or *vice versa* as necessary. If the r-f portion of the receiver conforms with the layout of the original model, no difficulties should arise in this respect, otherwise it may be necessary to increase or reduce the number of turns on *L*3. Before doing so, however, a careful check of the entire circuit and its values should be made.

The next step is to adjust the detector trimmer so that the desired band is covered in approximately four-fifths of the tuning scale. This will require a frequency meter, or the use of another receiver, the scale accuracy of which is known, calibration being carried out by listening for the signal from the oscillating detector, and adjusting the trimmer on the latter accordingly.

Having lined up the detector stage the aerial should then be connected, the r-f gain control advanced (but not to maximum) with the dial set towards the h-f end of the band, and the trimmer on the r-f stage slowly adjusted. At one point it will be found possible to reduce slightly the setting of the regeneration control and still maintain oscillation. This is the point where the tuning of the r-f stage corresponds with that of the detector; it is sharp on all ranges, and care should be taken to ensure that the correct point has in fact been reached. The receiver is next tuned to the l-f end of the band, and the r-f trimmer adjusted again. Provided that the coils have been properly constructed, and are exactly alike, and that the wiring in the two stages is of similar length, there should be no appreciable change necessary in the r-f trimmer capacity. If the circuits are found to be seriously out of line at the l-f end, the position of the aerial coupling coil (*L*1) relative to the r-f stage grid coil should be altered slightly, and another attempt made to align the circuits.

No difficulty was experienced in aligning the prototype, and the process takes considerably longer to describe than to perform. In all cases the final adjustment to the r-f trimmers should be made at or near to the h-f end of each band.

Conclusion

It is hoped that the foregoing description will assist many readers to construct a satisfactory straight receiver capable of efficient and reliable service. The finished product need bear little outward resemblance to that described, but provided the layout of the first two stages is not radically altered no difficulty should be encountered.

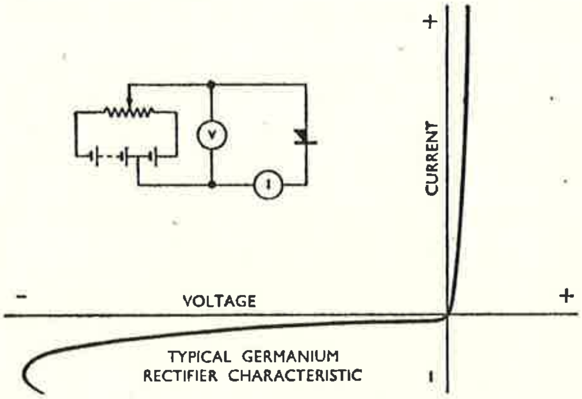
Summary of Information on Germanium Diodes

Germanium diodes consist of a small piece of germanium and a point contact or catwhisker, the whole being sealed into a glass capsule.

The advantages of this type of rectifier include very small size, robustness, low capacitance and ability to be soldered directly into the circuit. In addition, since a heater is not required, no hum is introduced.

Compared with other non-thermionic rectifiers, germanium is outstanding in its H-F performance and its ability to handle relatively high voltages.

A typical characteristic curve is given below from which it will be noticed that when the reverse voltage exceeds a certain figure the reverse resistance suddenly decreases and then becomes negative. The potential at which this occurs is known as the "turnover" voltage.



Other curves show variations between different types and variation with temperature.

Germanium rectifiers are divided into two categories, the first being the high back voltage types made from germanium of great purity and the other being the special low resistance types using germanium containing deliberately introduced impurities. The high back voltage types are differentiated mainly by their turnover voltage and back resistance figures which are the most important factors when considering their applications.

Colour code

In the colour coding system, red is an indication of the negative end of the rectifier. Thus, when compared with a thermionic diode the red end of the rectifier corresponds to the cathode.

The second and third colours give the type number according to the R.T.M.A. standard code used for resistors. Where a suffix is used e.g. GEX45/1 this is indicated by a colouring of the wire at the red end.

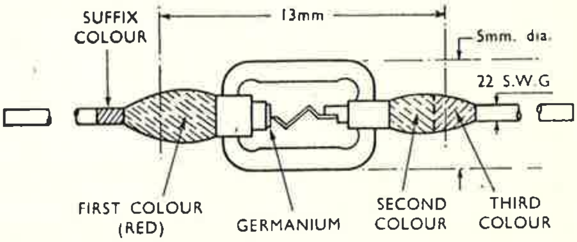
GENERAL

Temperature range

The rectifiers will function satisfactorily in the range –100°C to +120°C.

Humidity

The rectifiers are hermetically sealed and it is impossible for moisture to penetrate to the working surfaces. They may be immersed in boiling water or exposed to low temperature steam without detriment to their characteristics.



Vibration

All rectifiers are subjected to severe vibration test after manufacture.

Connection

Soldered joints may be made directly to the wire leads. No special precautions are necessary when carrying out this operation since they will withstand the 10 second test required by R.I.C. component specifications.

Expectation of life

Shelf life is expected to be greater than 10 years. Operating life is greater than 10,000 hours.

HIGH BACK VOLTAGE TYPES

Common Ratings (at 20°C.)

Forward current (continuous) ..	50 mA max.
Repetitive peak (sinusoidal)	100 mA max.
Repetitive peak (brief, recurrent)*	200 mA max.
Occasional one-second overload ..	0.5A max.
Dissipation with reverse voltage ..	120 mW max.

* On-off ratio 1/1000.

The above ratings are for operation at an ambient temperature of 20°C. and for higher ambient temperature must be reduced in the proportion $\frac{120-t}{100}$ where t is the new ambient temperature in degrees centigrade.

Capacitance

0.2 $\mu\mu$F min.
0.7 $\mu\mu$F average.
1.0 $\mu\mu$F max.

Individual characteristics

GEX00
Colour code: Red/Black/Black.
Detector. Suitable for inputs up to 5V r.m.s. with efficiency a little lower than GEX35. Intended for inexpensive crystal sets or video work where utmost sensitivity is not required. Functional test only.

GEX34
Colour code: Red/Orange/Yellow.
Lower efficiency version of GEX44/1.

GEX35
Colour code: Red/Orange/Green.
Video rectifier type. Turnover voltage greater than 30V. Tested for efficiency in the television frequency range at an output of 5.5V across 7,000 Ω as equal to an average low-impedance diode.

GEX44/1
Colour code: Red/Yellow/Yellow with Brown wire.
T.V. sound detector, noise limiter and spot limiter. Turnover voltage greater than 60V. Current at +1V greater than 1 mA. Current at –10V less than 100 μA. Current at –50V less than 2 mA.

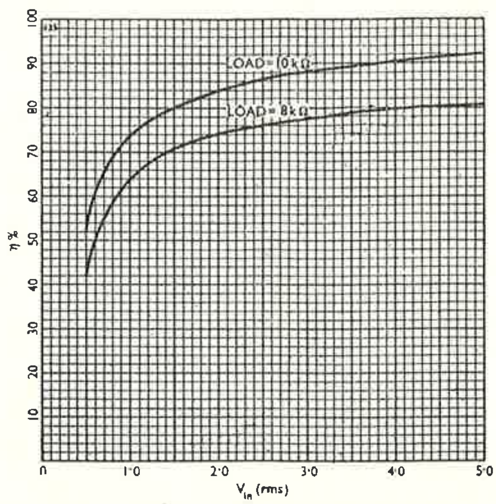
GEX45/1
Colour code: Red/Yellow/Green with Brown wire.
Medium impedance rectifier for all purposes. Turnover voltage greater than 75V. Current at +1V greater than 5 mA. Current at –50V less than 0.8 mA.

GEX55/1
Colour code: Red/Green/Green with Brown wire.
High impedance rectifier for all purposes. Turnover voltage greater than 75V. Current at +1V greater than 1 mA. Current at –50V less than 0.2 mA.

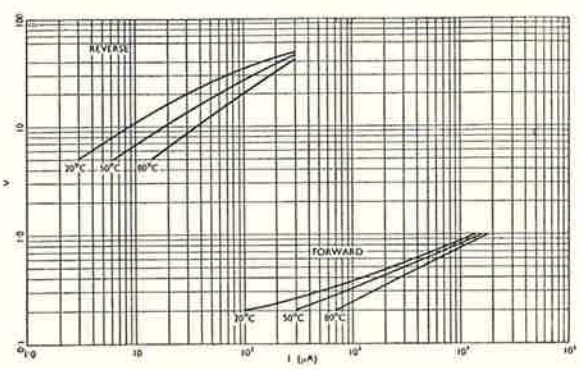
LOW RESISTANCE TYPES

GEX64
Colour code: Red/Blue/Yellow.
Very low impedance mixer. Typical applications are telephony modulator in multi-channel systems and meter rectifier. Available in groups matched for forward current at +0.3V in the range 5 to 15 mA. The comparatively high capacitance of 30 $\mu\mu$F limits the effective operating frequency in high impedance circuits.

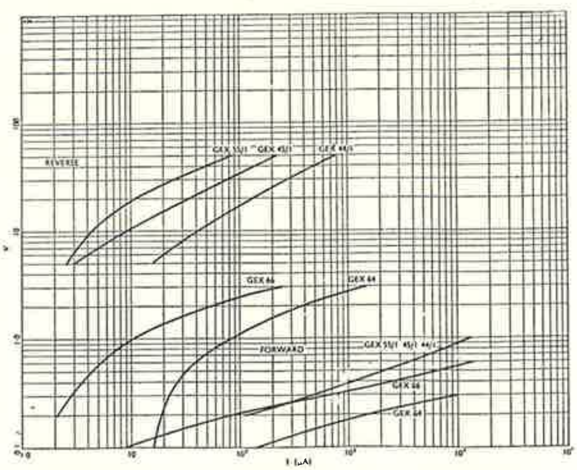
GEX66
Colour code: Red/Blue/Blue.
V-H-F mixer for use up to 1,000 Mc/s. In the T.V. range up to 100 Mc/s the noise as a mixer is no greater than that from the cartridge type silicon mixer. Efficiency is good and noise fairly low up to 1,000 Mc/s and there is considerable response at 10,000 Mc/s. Average current at +0.5V is 6 mA. Average reverse current at –1V is 15 μA.



Typical rectification efficiency curve of GEX 35.



Typical variation of characteristic curve with temperature, GEX 45/1.



Typical characteristic curves at 20°C.

GEX69
Colour code: Red/Blue/White.
Lower efficiency version of GEX66.

CLICKLESS KEYING USING VR TUBES

By Mack Seybold

Tube Department, Radio Corporation of America, Harrison, New Jersey.

When tuning the C-W bands the inescapable conclusion is that too many transmitters could use a good key click filter. Here is an entirely new approach employing VR-type tubes that is guaranteed to lick the most stubborn kind of click.

When the 20-metre amateur band was reopened in '46, I rigged up a transmitter using a grid-leak biased 829-B in the output stage. In order to prevent excessive dissipation in this push-pull beam power amplifier when the doublers in the exciter unit were being tuned up, a low-current relay was placed in the control-grid circuit of the 829-B. The contacts of the relay opened the screen-grid supply line when excitation dropped below .7 mA. For phone work, this system behaved very nicely, but for c-w, it presented several problems.

First of all, cathode keying in the final stage was not satisfactory because of the time-delay characteristics of the grid-current actuated relay. Naturally, an open cathode circuit prevented grid current from flowing even when excitation was available, so the grid-current relay would not start to function until after the key in the cathode line was closed. This was not taking advantage of the main feature of cathode keying; namely, the simultaneous switching of plate, screen, and control grid circuits. Actually, it was the screen grid that was being keyed, because each time the cathode key was closed, the No. 1 grid and plate connections would be completed before the relay contacts could throw on the screen voltage. The obvious thing to do was to ground the cathode, and then key the screen directly.

The second problem was one of key clicks. Half-a-dozen different filters were tried in the screen-keying circuit, but none of them gave satisfactory control of the transients that produce key clicks. There may be in existence a filter that will handle this job, but I couldn't find a combination of capacitors, resistors, iron-core chokes, and r-f chokes that would give satisfactory performance.

It looked as though vacuum-tube keying would help the situation. A triode in series with the screen lead could swing the current from a few micro-amperes to full flow by keying a biasing potential at the triode grid. However, a control tube in this position operates with its bias-supply pack, heater supply, and key line several hundred volts positive with respect to ground. In addition, all of these components operate in the screen grid lead of the output stage, and, therefore, have excessive capacitance to ground when the rig operates on phone. The prospects for a series control circuit were none too bright.

Shunting the screen to ground through a vacuum tube is an alternative which avoids the main objections to the series circuit because all of the controls and supplies are operated from the ground reference level. That part is fine, but there is still one objection: a vacuum tube in a shunt system can never drop the screen voltage to zero. The higher the perveance[1] of the control tube, the nearer to zero one can get, but sufficient voltage drop still remains across the tube to let some signal through the keyed stage.

The closest approach to zero drop in shunt systems is obtained by the use of thyratrons. 2D21's and 2050's will give a voltage minimum of 8 to 10 volts, which appeared to be sufficiently low to do the job. With this in mind, I looked through the literature for applicable thyratron circuits. The trick in gas-discharge-tube circuits using a d.c. plate supply is to kick the plate negative when you want the tube to stop conducting. As soon as the gas stops ionizing, a negative potential on the control grid will prevent further current flow. Every time the tube is fired, however, plate current will continue to flow no matter how negative you make the grid, until the d.c. plate voltage is reduced to less than eight volts.

The circuits available to do this job either use two thyratrons or one thyratron with a time-delay network that loses about eight more volts. No matter which of the two types you choose, you end up with a rather complicated circuit and the screen grid voltage still can't hit zero.

At that point in the investigation I decided that there must be a simple and effective way of doing the job. I figured that the shunt system was the best approach, that it would be well to have a gas tube in the circuit because of the transient-damping time lag in ionizing and deionizing, and that the timing element in the system should be entirely the function of the key so that any speeds within reason could be used without having to adjust time-constant networks.

With these specifications in mind, the circuit practically developed itself. The vacuum tube in the shunt position would swing the screen voltage from 200 down to some minimum potential under the complete control of a key in the No. 1 grid circuit. All that was needed to bring the screen voltage down to zero was a gas tube in the circuit that would extinguish itself completely when the voltage drop across the shunt tube was at its minimum. It

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[1] Perveance is a measure of a tube's ability to conduct high current at low plate voltage.

is a well-known fact that the OA3/VR75 voltage regulator tube will deionize completely when the potential across it drops a few volts below 75. Similarly the glow in the OC3/VR105 and OD3/VR150 will be extinguished when the potentials fall a few volts below 105 and 140, respectively. Here are three tubes that need no heater supplies, that will conduct up to 40 mA of current, that will maintain a constant drop across themselves throughout a current range of from 5 to 40 mA, and, fortunately for our purpose, will stop conducting at a certain minimum potential.

Fundamental circuit

The circuit for keying, as developed, is shown in Fig. 1. When the key is down, the bias thereby applied to the control tube T_1 prevents it from conducting, leaving only the series dropping resistor, R_1; the gas tube, T_2; and the controlled tube, T_3, in the circuit. The supply voltage, minus the drops across R_1 and T_2, is the effective screen-grid potential applied to T_3, which permits T_3 to operate normally. When the key is up, bias to T_1 drops to zero, making T_1 conduct, and as a result, the voltage drop across T_1 becomes less than the ionizing potential for the VR tube, T_2, which makes the VR tube stop conducting. When the VR tube stops conducting, the supply voltage is completely removed from the screen grid of the r-f amplifier, T_3, and the transmitter then goes off the air.

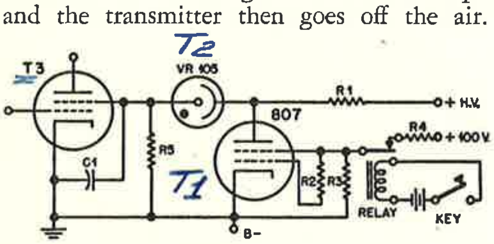


Fig. 1.—Fundamental keying circuit. See text for function of each component.

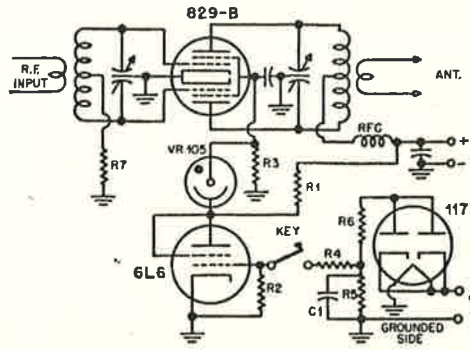
This procedure can be repeated as often as desired, as in c-w work; the rapidity of keying is limited only by the ionizing and deionizing characteristics of the VR tube. The limiting speed is much faster than one can read code. It probably would meet requirements for high-speed tape transmission.

In the circuit of Fig. 1, resistors R_2 and R_3 are of high value, and are present merely to maintain each grid at a potential near zero when keying potentials are removed. C_1 is a conventional r-f bypass capacitor.

Application in the 829-B transmitter

Before discussing further developments of this circuit, it would be perhaps worthwhile to examine the actual layout (Fig. 2) used in the 892-B transmitter of W2RY1. The protective relay mentioned at the beginning of the article is omitted because it is not a necessary component of this keying device.

The 117Z6, operated directly from the 117-volt a.c. line, furnishes the keying bias. Since practically no current flows through the key contacts, high values of resistance are used in the bias supply filter, making it possible to eliminate the ripple with a single 30 μF capacitor. About 150 volts of bias are available to bias the 6L6 control tube.



R1 — 10,000 ohms, 50 w.
R2, R3 — 0.25 meg., ½ w.
R4 — 50,000 ohms, ¼ w.
R5 — 0.1 meg., ½ w.
R6 — 100 ohms, ½ w.
R7 — 5,800 ohms, 2 w.
C1 — 30 μF, 150 working volts.
R-F components are conventional.

Fig. 2.—829-B final amplifier using Class-A keying control tube.

To protect the operator against shock from the bias supply filter capacitor, a 50,000-ohm resistor is placed in series with the key lead. If a keying relay is used, this resistor will not be necessary from the standpoint of operator protection, but should be included in order to reduce the 6L6 bias to 125 volts, which is the maximum rating of this tube for amateur service.

The selection of the proper tube for keying control is a matter of picking one with high perveance and a reasonably sharp plate-current cutoff. The 6L6, operated as a triode, has satisfactory characteristics with respect to both perveance and cutoff.

The value of resistor, R_1, is determined as follows: Subtract from the value of the high-voltage supply (600 v.) the VR tube drop (105 v.)

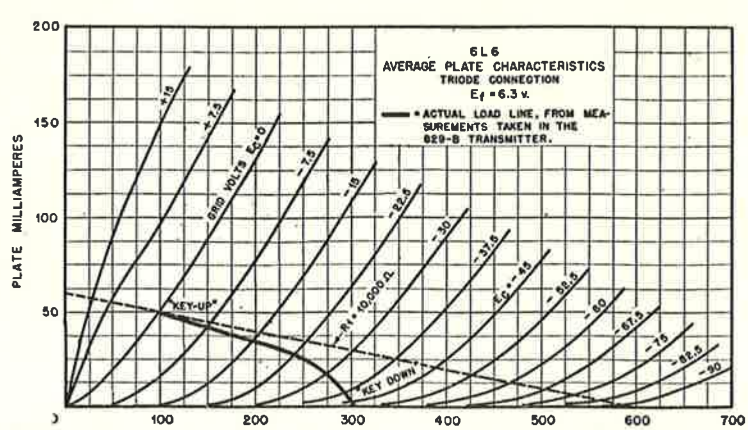


Fig. 3.—6L6 plate characteristics.

and the screen potential needed for operation of the 829-B (200 v.). The result is 295 volts for which the dropping resistor R_1 will be responsible. The screen current is 30 mA, so R_1 will be about 10,000 ohms.

To find out what happens at the control tube and R_1 when the key is up, draw a 10,000-ohm load line from the supply voltage (600 v.) point on the plate family of the triode-connected 6L6, Fig. 3. At the intersection of the zero-bias line with the load line, the value of the space current in the 6L6 will be found. The point should also indicate a tube voltage drop of 100 volts or less if the OC3/VR105 is to behave properly. The drop across R_1 will be at least 500 volts, which means that its dissipation in the key-up position will be

$$\frac{E^2}{R} = \frac{500^2}{10,000} = 25 \text{ watts.}$$

Therefore, a good conservative rating for R_1 would be 50 watts. The plate and screen of the 6L6 in the key-up position will be dissipating about 5 watts. The solid line on the plate family indicates the conditions through which the 6L6 passes throughout the keying cycle. Although the plate load line terminates at the potential of the high-voltage power supply, the operating voltage at the plate of the control tube does not exceed the screen potential of the 829-B by more than the drop across the VR tube.

If a c-w transmitter utilizing a power supply potential other than the 600 volts designated above is to be used, then the value of R_1 and the VR tube to be used can be determined in the same manner as for the 600-volt condition. Use the same 6L6 triode plate family and plot the new R_1 load line from the point representing the supply voltage to be substituted.

As for the behaviour of the circuit on the air, key clicks, thumps, etc., just aren't audible, yet it doesn't sound too soft, as would primary keying. The characters are extremely clean.

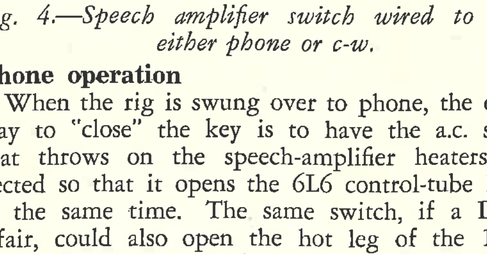


Fig. 4.—Speech amplifier switch wired to select either phone or c-w.

Phone operation

When the rig is swung over to phone, the easiest way to "close" the key is to have the a.c. switch that throws on the speech-amplifier heaters connected so that it opens the 6L6 control-tube heater at the same time. The same switch, if a DPDT affair, could also open the hot leg of the 117Z6 heater, inasmuch as the bias supply and control tube are not necessary when the final stage is to be operated in the "key-down" position all the time you are on phone. The OC3/VR105 and the screen resistor will carry on normally without the rest of the control circuit. Figure 4 shows the c-w-to-phone switching arrangement.

By the way, modulation of the common plate and screen circuit proceeds normally with the VR tube remaining in the circuit. Variation with modulation of the amount of ionization glow can be seen, but the VR tube has no detrimental effect upon phone operation of the rig.

Modifications of the circuit

Various applications of this new keying method are possible. Devices other than Class C amplifiers can, of course, be keyed. Wherever minimized switching transients are desired, this circuit has its advantages. Limitations as to the amount of current that can be handled are determined by the ratings of the gas tubes and control tubes available. In any event, the VR tubes discussed here will handle most of the screen-current requirements for amateur transmitters.

Other modifications of the circuit for screen keying of Class C r-f stages are possible. Several have been used at W2RYI. For instance, the 829-B application just described utilizes extremely low current in the keying line, but the control tube does not necessarily have to operate as a negative-bias affair. Many amateurs construct transmitters with a minimum number of power and bias supplies. If a power pack with 150 volts below ground is not available in the present rig, and if it is inconvenient to throw together the 117Z6 circuit described above, a positive potential obtained from existing equipment will serve well in the following modification of the system.

Instead of using a control tube that allows heavy current to flow at zero bias, a triode of the Class B type that is practically cut off with zero potential on the grid will do equally well. The current-conducting portion of the keying cycle is actuated by applying a positive potential to the control grid. Of course this system requires more current in the keying line than the negative-potential method, but the magnitude of current is of the order of 10 mA, which is even less than required by ordinary cathode keying in low-power transmitters. In addition, the keying line has very little inductance and capacitance to cause arcing difficulties, and the line is isolated from the r-f equipment, minimizing the possibility of the appearance of switching transients in the r-f signal.

Several different Class B tube types will work well in this application. The old 46 could do the job, but when a 2.5-volt filament supply is not available, it is more convenient to use a 6.3-volt type, particularly a heater-cathode type in order to prevent 50-cycle pick-up. The 807, connected as a Class B triode, behaves very well in this capacity. A plate family for the 807 with Class B connections is shown in Fig. 5, giving a load line for keying operations. Further data on the 807 in Class B service are available in the July-August 1949 issue of *Radiotronics*.

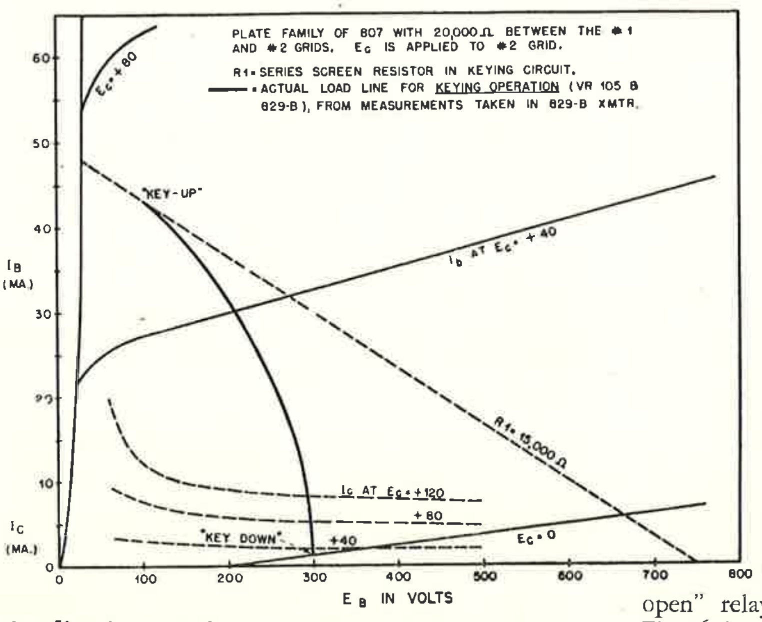
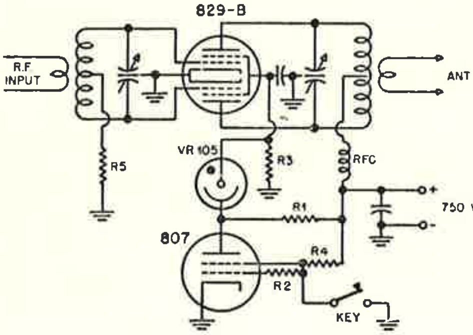


Fig. 5.—Plate family for 807.

Application of the 807 control tube

Figure 6 is the schematic diagram for positive-potential keying of the control tube. Again the 829-B is shown in the r-f amplifier stage. Calculations for the value of R_1 are similar to those used for the negative-potential keying circuit, except that there may be one or two milliamperes of current flowing through the control tube in the "key-down" position.



R1 — 15,000 ohms, 50 w.
R2 — 20,000 ohms, 2 w.
R3 — 0.25 meg., ½ w.
R4 — 85,000 ohms, 10 w.
R5 — 4,600 ohms, 2 w.

Fig. 6.—829-B final amplifier using 807 as keying control tube.

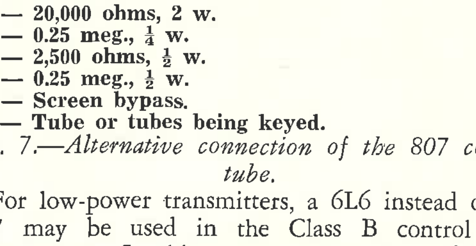
Selection of R_4 for power and resistance requirements is dependent upon conditions in both the open and closed-circuit positions of the key. The 750-volt connection requires about an 85,000-ohm resistor to produce a grid-driving voltage for the 807 control tube. The greatest dissipation from this resistor occurs in the key-down position, where the full 750-volt drop appears across it. A 10-watt resistor should take care of the 6.6 watts dissipated. The "key-up" position determines the resistance value of R_4; the grid-current curves of Fig. 5 give the necessary data. From 70 to 80 volts of grid drive produce about 8 mA of grid current, so the 670-volt drop through R_4 determines its 85,000-ohm value.

A positive potential from a lower-voltage power supply could be used to control the 807 if the value of R_4 is changed accordingly. For instance, if a + 200 volt connection is available for operation of the keying line, R_4 should be about 16,000 ohms. A 5-watt resistor would be large enough.

As a further practical requirement, it is recommended that a relay be used rather than a key because of the high potentials at the contacts. A "normally-open" relay as a direct substitute for the key in Fig. 6 is a good safe arrangement.

If a "normally-closed" relay is hanging around the shack waiting for a job, the circuit of Fig. 7 may be employed. This circuit permits series operation of the positive line. The dissipation rating of R_4 is dependent only upon the control-tube grid voltage and current requirements. Any supply source giving +100 volts or more may be used. Just be sure that R_4 is selected to produce enough voltage at the grid of the control tube to drive the plate current up the load line to the knee of the curve, or at least to a point where the potential drop across the control tube is low enough to extinguish the gas tube in the "key-up" position.

If deviation from the above values of R_1 and the high-voltage supply are used, plot a new load line on the plate family of the 807 control tube. Then select a driving voltage for the control tube grid that will swing the tube sufficiently but still keep the grid current at a low level.



Relay — "Normally-Closed".
R1 — See text.
R2 — 20,000 ohms, 2 w.
R3 — 0.25 meg., ¼ w.
R4 — 2,500 ohms, ½ w.
R5 — 0.25 meg., ½ w.
C1 — Screen bypass.
T3 — Tube or tubes being keyed.

Fig. 7.—Alternative connection of the 807 control tube.

For low-power transmitters, a 6L6 instead of the 807 may be used in the Class B control tube arrangement. In this case, the 807 curve of Fig. 5

is valid for the 6L6 because the two tubes have very similar characteristics when the 20,000-ohm resistor is connected between the No. 1 and No. 2 grids.

A great many amateurs are using a single 807 or a pair of 807's in the output stage. The only modification necessary to swing over to the VR-tube keying system is to change the value of the screen resistor according to the following formula:

$$\frac{E_{hv} - E_{vr} - E_{c2}}{I_{c2}} = R_1$$

where

E_{hv} = plate and screen supply voltage
E_{vr} = drop across the VR tube in volts
E_{c2} = operating screen potential
I_{c2} = operating screen current in amperes
R_1 = screen dropping resistor.

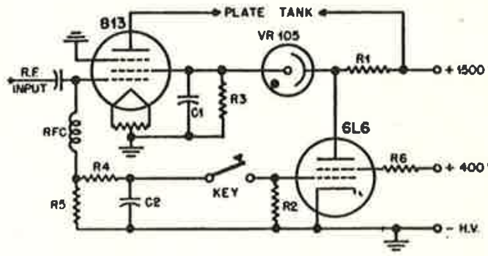
Either the positive- or negative-potential keying system can be used. The selection of control circuit components is made as described in the discussion of Figs. 2, 6, and 7, depending upon which system is chosen. When modifications of these systems are designed, it is recommended that the maximum ratings of each tube be studied so that operation of the tubes will be within ratings and will provide a normal service life. The control tube and VR tube can be mounted at any convenient place in the transmitter or power supply. If desired, the VR tube can be mounted horizontally behind a panel, with the top of the tube visible to the operator through a hole or jewel. When the VR tube is mounted this way, the ionization glow can be used as a visual keying indicator.

Control of high-power transmitters

The discussion thus far has been concerned with the keying of r-f amplifiers of the 150-watt size. Higher-powered rigs are also capable of being handled with the same circuits. At W2RYI, an 813 has been keyed in exactly the same way as the 829-B. Over 400 watts input has been keyed successfully in the 813 transmitter with one VR tube in the screen grid circuit. The VR tubes have a maximum current rating of 40 mA, so the 813 screen current can flow through the trigger circuit without exceeding the rating of the VR tube.

Among the first of the new keying circuits used for the 813 final was an arrangement containing an OC3/VR105, a 6L6 control tube connected as a pentode, and a 117Z6 bias supply. Later, a filter in the control-grid circuit of the 813 was used to provide a negative potential of 100 or more volts for keying the 6L6 pentode in the control-tube position. This eliminated the 117Z6 bias supply, and gave complete protection to the 813 from excitation failure. I was quite satisfied with this arrangement (Fig. 8), until I read the article by Richard M. Smith, W1FTX, in the February, 1947, issue of QST.

Smith, instead of filtering the bias produced by the 813 r-f driving current, used the potential directly to operate a control tube shunting the 813 screen grid. This method permits a keyed r-f signal to operate the final stage. I promptly took out my r-f filter and the VR tube and operated the final stage as prescribed by W1FTX. Using cathode bias resistors in two multiplier stages and keying the first doubler permitted multiple-stage keying without



R1 — 35,000 ohms, 100 w.
R2 — 0.5 meg., ¼ w.
R3 — 0.5 meg., ½ w.
R4 — 50,000 ohms, ½ w.
R5 — 7,500 ohms, 5 w.
R6 — 50,000 ohms, 5 w.
C1 — Regular r-f bypass.
C2 — 0.25 μF, 300 v.

Fig. 8.—Control-tube keying bias obtained from final amplifier grid current.

the using of any fixed bias supplies.

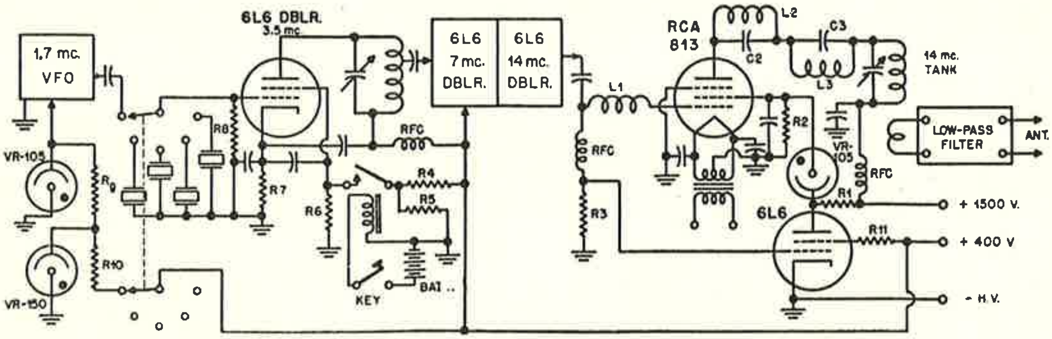
I put the VR tube back in the circuit, however, because of the superior key-click control and because of the ability of the VR system to reduce the 813 plate and screen current to zero during "key-up" periods. Zero plate current is a nice status during spaces in c-w work, especially if the final stage is being pushed to maximum ratings. More important, however, is the condition of signal leaking through from an unkeyed oscillator stage. If the final stage is not killed completely in the "key-up" position, some of the signal may get through to mar an otherwise perfect c-w transmission. The feature of Smith's circuit of utilizing the r-f switched control-tube bias was retained in my 813 transmitter. The results have been very satisfactory.

Practical circuits for the 813 transmitter

Fig. 9 shows the 20-metre transmitter line-up with v-f-o control. Most of the time, I use 250 watts input to the final, so the values given are the ones generally used at W2RYI.

The first doubler is the stage that is keyed. Screen keying is used there because it presents the least change of load to the v-f-o. Cathode keying would be more convenient inasmuch as low-potential leads could be brought out for direct switching, but each time the cathode circuit is opened, the load on the v-f-o drops out completely. If there are a number of isolation stages in the v-f-o separating the oscillator from a cathode-keyed stage, a changing load at that point will not cause chirping. Most v-f-o's have only one or two isolation stages, which is insufficient in many cases to give a crystal-like note. When screen keying is used at the first doubler, however, a single isolation stage between the oscillator and the keyed tube is adequate for chirpless c-w operation. T9X's predominate my report column in the log in spite of the fact that I usually ask for a critical analysis of the signal.

Eighty-metre crystals are occasionally used for frequency control at W2RYI. These crystals are switched in at the control grid of the first doubler,



R1 — 35,000 ohms, 100 w.
R2 — 0.5 meg., ½ w.
R3 — 7,500 ohms, 5 w.
R4 — 20,000 ohms, 5 w.
R5, R6 — 0.25 meg., ½ w.
R7 — 1,000 ohms, 10 w.
R8 — 0.1 meg., ½ w.

R9 — 1,250 ohms, 5 w.
R10 — 4,400 ohms, 20 w.
R11 — 50,000 ohms, 5 w.
L1 — 0.5 μH grid choke.
L2/C2, L3/C3 — 57, 71-Mc/s traps.
R-F components and bypass condensers are conventional.

Fig. 9.—14-Mc/s transmitter with keyed first doubler and OC3/VR105 control of final amplifier.

and the same multiple-tap switch disconnects the v-f-o. With a crystal between the No. 1 grid and ground, the stage operates as a standard pentode oscillator.

At one point in the study of key-click elimination, I also had a VR keying circuit in the first doubler screen line. Although it worked very nicely, a relay at the same point behaved quite well, so mechanical keying was retained in favour of simplicity.

The 813 transmitter was amply tested for keying-transient behaviour during April, 1947, when tests for television interference were run. After the harmonic radiation that interfered with television reception was suppressed and the picture was no longer spoiled by phone transmissions, c-w operation was checked. There were no indications whatsoever of keying transients in the picture or sound channels. By the way, all of the appendages to the r-f circuits in the 813 transmitter diagram are harmonic-suppression devices and have nothing to do with the keying circuits discussed in this article. They are included in the drawing in order to present the actual transmitter, but they also may serve as a reminder to those who have television interference problems to clean up the harmonic radiation first before tackling the keying transients.

The primary concern in the study of key clicks is the elimination of interference to all radio services, so no matter what methods of keying you use, a periodic search up and down the spectrum for possible spurious radiation is good operating practice. It is well worth the trouble, because it gives you the assurance that your transmitter is under control. A pleasant feeling of accomplishment comes, though, when the ham in the next block mentions the fact that he can copy DX perfectly within a few kilocycles of your own frequency.

RADIOTRON 6CL6

(Continued from page 155)

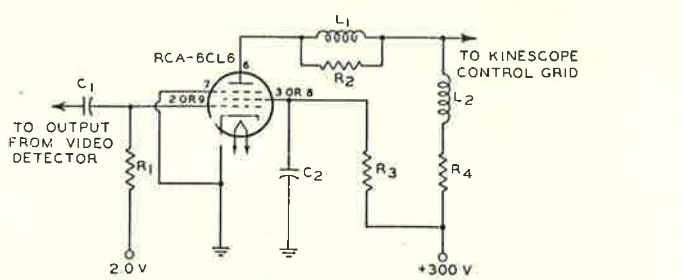
Maximum Circuit Values:

Grid-No. 1-Circuit Resistance:

For fixed-bias operation	0.1 max. megohm
For cathode-bias operation	0.5 max. megohm

OPERATING CONSIDERATIONS

The *maximum ratings* in the tabulated data for the 6CL6 are working design-centre maximums established according to the standard design-centre system of rating electron tubes. Tubes so rated will give satisfactory performance in equipment designed so that these maximum ratings will not be exceeded when the equipment is operated from a.c. or d.c. power-line supplies whose normal voltage including normal variations falls within ± 10 per cent. of line-centre voltage value of 117 volts.



C1: 0.1 μf, 400 volts
C2: 4 μf, 400 volts
L1: Peaking Coil, 180 μh
L2: Peaking Coil, 120 μh

R1: 100000 ohms, 0.5 watt
R2: 47000 ohms, 0.5 watt
R3: 24000 ohms, 2 watts
R4: 3900 ohms, 5 watts
non-inductive type

Fig. 1.—Typical Video Voltage Amplifier Circuit having Bandwidth of 4 Mc/s.

= 6AG7

RADIOTRON 6CL6

MINIATURE POWER PENTODE

TENTATIVE DATA

Radiotron-6CL6 is a power pentode of the 9-pin miniature type designed especially for use in the final video stage of television receivers. It is also useful as a wide-band amplifier tube in industrial and laboratory equipment.

Features of the 6CL6 include very high transconductance (11000 micromhos), low capacitances, and high output-current capability. Because of these features, it is possible to obtain a voltage gain of from 40 to 45 in wide-band video circuits. Providing high plate current at low plate voltages, the 6CL6 can supply sufficient peak-to-peak output voltage to drive large picture tubes with high efficiency and low amplitude distortion.

Separate base-pin connections for grid No. 3 and cathode permit the use of an unbypassed cathode resistor to provide degeneration without encountering parasitic oscillations which would result if the suppressor were internally connected to the cathode.

GENERAL DATA

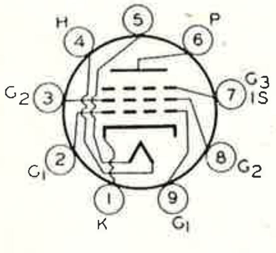
Electrical:

Heater, for Unipotential Cathode:		
Voltage (A.C. or D.C.)	6.3	volts
Current	0.65	ampere
Direct Interelectrode Capacitances (Without external shield):		
Grid No. 1 to Plate	0.120	$\mu\mu$F
Input	11	$\mu\mu$F
Output	5.5	$\mu\mu$F

Mechanical:

Mounting Position	Any
Maximum Overall Length	$2\frac{5}{8}''$
Maximum Seated Length	$2\frac{3}{8}''$
Length from Base Seat to Bulb Top (excluding tip)	$2'' \pm 3/32''$
Maximum Diameter	$\frac{7}{8}''$
Bulb	T-6-1/2
Base	Small-Button Noval 9-Pin (JETEC No. E9-1)

SOCKET CONNECTIONS
Bottom View



PIN 1: CATHODE
PIN 2: GRID NO. 1
PIN 3: GRID NO. 2
PIN 4: HEATER
PIN 5: HEATER
PIN 6: PLATE
PIN 7: GRID NO. 3, INTERNAL SHIELD
PIN 8: GRID NO. 2
PIN 9: GRID NO. 1

AMPLIFIER — Class A_1

Maximum Ratings, *Design-Centre Values:*

PLATE VOLTAGE	300 max.	volts
PLATE SUPPLY VOLTAGE	300 max.	volts
GRID-No. 3 (SUPPRESSOR) VOLTAGE	0 max.	volts
GRID-No. 2 (SCREEN) SUPPLY VOLTAGE	300 max.	volts
GRID-No. 2 VOLTAGE	See Rating Chart	
GRID-No. 1 (CONTROL-GRID) VOLTAGE:		
Negative bias value	50 max.	volts
Positive bias value	0 max.	volts
PLATE DISSIPATION	7.5 max.	watts
GRID-No. 2 INPUT	1.7 max.	watts
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode	90 max.	volts
Heater positive with respect to cathode	90 max.	volts
BULB TEMPERATURE (At hottest point on bulb surface)	200 max.	°C

Characteristics:

Plate Voltage	250	volts
Grid No. 3	Connected to Cathode at Socket	
Grid-No. 2 Voltage	150	volts
Grid-No. 1 Voltage	-3	volts
Peak A-F Grid-No. 1 Signal Voltage	3	volts
Zero-Signal D.C. Plate Current	30	mA
Max.-Signal D.C. Plate Current	31	mA
Zero-Signal D.C. Grid-No. 2 Current	7	mA
Max.-Signal D.C. Grid-No. 2 Current	7.2	mA
Plate Resistance (Approx.)	0.15	megohm
Transconductance	11000	μmhos
Grid-No. 1 Voltage (Approx.) for plate current of 10 μamp	-14	volts
Load Resistance	7500	ohms
Total Harmonic Distortion	8	per cent
Max.-Signal Power Output	2.8	watts

Typical Operation in 4-Mc/s Bandwidth Video Amplifier Circuit of Fig. 1:

Plate Supply Voltage	300	volts
Grid No. 3	Connected to Cathode at Socket	
Grid-No. 2 Supply Voltage	300	volts
Grid-No. 1 Bias Voltage	-2	volts
Grid-No. 1 Signal Voltage (Peak to Peak)	3	volts
Grid-No. 2 Resistor	24000	ohms
Grid-No. 1 Resistor	0.1	megohm
Load Resistor	3900	ohms
Zero-Signal Plate Current	30	mA
Zero-Signal Grid-No. 2 Current	7.0	mA
Voltage Output (Peak to Peak)	132	volts

(Continued on page 154)

New RCA Releases

RADIOTRON 19X8
TRIODE-PENTODE CONVERTER.

Type 19X8 is a multi-unit tube of the 9-pin miniature type containing a medium-mu triode and a sharp-cutoff pentode in one envelope. It is designed primarily for use as a combined oscillator and mixer tube in "transformerless" A-M/F-M receivers. The 19X8 has a 150-milliampere heater which permits series-string heater operation with other tubes having 150-milliampere heaters.

The pentode mixer unit of the 19X8 provides low grid-No. 1-to-plate capacitance as compared with a triode mixer and also has low output capacitance. The low value of capacitance between grid No. 1 and plate minimizes feedback problems often encountered in mixer circuits operating into high-impedance plate loads. The low value of output capacitance enables the tube to work into a high-impedance plate circuit with resultant increase in mixer gain.

The 19X8 offers versatility to designers of A-M/F-M receivers. In the A-M section, the pentode unit may be used as a pentode mixer to provide high gain; in the F-M section, the pentode unit may be used either as a pentode mixer or as a triode-connected mixer depending on signal-to-noise considerations. Because triode mixers have relatively low equivalent noise resistance, they are preferred for receiver designs which do not include an r-f stage. For receiver designs with an r-f stage, a pentode mixer not only provides higher gain but better performance because in such designs the noise introduced by the mixer is negligible. For both the A-M and the F-M sections, the triode unit of the 19X8 makes a satisfactory oscillator.

RADIOTRON 17JP4
KINESCOPE.

Type 17JP4 is a directly viewed, rectangular, glass picture tube for use in television receivers. It has a picture size of 14⅜″ x 11$\frac{1}{16}$″ with slightly curved sides and rounded corners.

The 17JP4 has a high-efficiency, white fluorescent screen on a faceplate made of Filterglass to provide increased picture contrast. The Filterglass faceplate incorporates a neutral light-absorbing material which reduces ambient-light reflections within the faceplate itself in a very much higher ratio than it reduces the directly viewed light of the picture. As a result, improved picture contrast is obtained.

The design of the 17JP4 features magnetic focus and magnetic deflection; an external conductive bulb coating which with the internal conductive coating forms a supplementary filter capacitor; and an ion trap gun requiring an external, single-field magnet.

RADIOTRON 10SP4
KINESCOPE.

Type 10SP4 is a directly viewed cathode-ray tube intended for monitor service in connection with theatre-television systems, industrial television equipment, and studio broadcast equipment. It has a picture size of 8″ x 6″ within the minimum-useful-screen area.

The 10SP4 features an electron gun utilizing an acceleration type of electron lens to provide high resolution and good uniformity of focus over the entire picture area. This gun design is in contrast to that utilizing the deceleration type of electron lens widely employed in television receiver picture tubes. Focus can be maintained automatically with variation in line voltage and with adjustment of picture brightness.

Other features of the 10SP4 include a Filterglass faceplate, a large relatively flat screen area in relation to tube diameter, and a metal-backed fluorescent screen which not only improves picture contrast and brightness but also eliminates the need for an ion-trap magnet.

RADIOTRON 6199
NEW MULTIPLIER PHOTOTUBE FOR PORTABLE SCINTILLATION COUNTERS.

Type 6199 is a new, small, 10-stage multiplier phototube of the head-on type intended for use in scintillation counters and in other applications involving low-level, large-area light sources. Because of its small size, the 6199 is especially suited for portable and fixed equipment where space considerations are important.

The spectral response of the 6199 covers the range from about 3000 to 6200 angstroms with a peak value at approximately 4000 angstroms. The 6199, therefore, is highly sensitive to the blue-rich light emitted by excited organic phosphors such as anthracene and inorganic materials such as thallium-activated sodium iodide.

Design features of the 6199 include a semi-transparent cathode having a diameter of 1¼″ on the inner surface of the face end of the bulb; a face with a flat surface 1″ in diameter to facilitate the mounting of flat phosphor crystals in direct contact with the surface; and 10 electrostatically focused multiplying stages.

The relatively large cathode area permits very efficient collection of light from excited phosphor crystals, such as are employed in scintillation counters. Because of the excellent optical coupling between phosphor and cathode, the scintillation pulses are larger in amplitude than the majority of the dark-current pulses and thus discrimination against the dark-current pulses is facilitated.

RADIOTRON 12AX4-GT
HALF-WAVE VACUUM RECTIFIER.

Type 12AX4-GT is a half-wave vacuum rectifier of the heater-cathode type designed primarily for use as a damper tube in horizontal deflection circuits of television receivers utilizing series-heater strings.

Designed with insulation between heater and cathode to withstand negative peak pulses between heater and cathode of as much as 4000 volts with a d.c. component up to 900 volts, the 12AX4-GT provides flexibility in choice of deflection circuits.