BRIMARIZE SECTION

This section is written especially for the Service Engineer, to help him to select a satisfactory replacement valve for one that is obsolete or unobtainable.

A brief guide to the correct Brimarizing procedure is followed by a general consideration of the problem, particular reference being made to certain cases where conflicting requirements tend to cause confusion. The section closes with a list of tried and tested substitutions involving minor circuit changes.

Brimarize Procedure

1. Check valve function.

Determine whether the valve is being used normally, or for some special function. R.F. Pentodes are often used as frequency changers or as L.F. Amplifiers, whilst certain triode-pentodes and heptodes can be employed as I.F. and L.F. amplifiers simultaneously. In the latter case, Brimarizing may require two valves.

2. Check the heater rating.

In A.C. receivers the heater voltage is the important parameter whilst A.C./D.C. sets require the correct heater current rating. In car radios, both voltage and current may be important.

3. Check the base.

Valves with identical characteristics are often available in two base ranges. It may be more convenient to change the valve socket rather than make extensive circuit alterations.

4. Check the operating voltages and currents.

These must not exceed the maximum specified ratings for the valve nor should the receiver power supply be overloaded.

5. Check Valve Performance.

The sensitivity of a set fitted with A.V.C. or operated well within the Service Area may be reduced by 6db or so without noticeable change in performance. This is approximately equivalent to a 2 : 1 change in conversion or mutual conductance per valve. Reduced power output may be nullified by fitting a loud speaker of high flux density.

NOTES ON BRIMARIZING

VALVE HEATERS

In A.C./D.C. and some A.C. receivers where several valves are connected in series, heater current is the important characteristic, slight differences in heater voltage being absorbed in the other valves and in the mains resistor. Where the voltage difference exceeds 5 per cent of the mains voltage, however, it is advisable to alter the value of this resistor. When a line cord is used which carries the H.T. current to the receiver, the total value of current flowing including H.T. must be employed in the calculation for resistance.

Receivers without barretters or voltage tappings often give trouble in areas where the mains supply is on the low side (200 volts) or on the high side (250 volts). It is good practice to fit a tap on such receivers so as to provide the correct heater current at the nominal mains voltage of the locality.

Too low a current will cause premature loss of emission in rectifiers and output valves where these are used at maximum cathode ratings. Frequency changers tend to stop oscillating and this may cause the set to cease functioning during certain times of the day. Valves used for resistance coupled amplifiers or where very low ratings are employed may often be operated successfully at reduced heater currents.

Too high a heater current will cause premature heater failure, or heater-cathode leakage which may cause hum in the receiver. A secondary effect caused by excessive cathode temperature is grid emission. When this occurs on R.F. pentodes, gradual loss of gain results whilst in output valves an increase of distortion is noticeable a few minutes after "switch-on." Grid emission may be checked by inserting a 50 micro-amp. meter in series with the earthy end of the grid leak of the valve. A few micro-amps. will often be sufficient to cause trouble.

In normal A.C. mains receivers with parallel connected valve heaters, a substitute valve must have the same heater voltage rating, differences in current being of small importance. An exception occurs in the case of certain obsolete rectifying valves having a very low heater current. Substitution by a modern type may cause excessive voltage drop in the transformer winding. Provided the H.T. current drawn by the receiver is well within the rating of the new valve, however, a drop of 10 per cent in heater voltage will not seriously shorten its life. For 6 volt car radios and 12 volt receivers employing 12 volt valves the same considerations apply as for A.C. receivers.

Many 12 volt receivers employ series-connected pairs of 6 volt valves, connected directly across the battery. In these cases, both heater voltage and current are important. Current differences may be balanced by fitting the correct value of resistor across the heater drawing the lower current.

SOCKET CHANGES

When socket changes and rewiring are involved the positioning of the leads is of importance. Heater leads must be kept clear of grid connections, whilst the control grid and anode connections of R.F. valves must be placed well apart or instability will result. Single ended valves are particularly prone to trouble from this cause.

Replacement of a valve having a top anode connection by one having a top cap grid requires special care. The new top cap connection is best brought from the top of the coil can, the old anode connection being withdrawn and brought out from the bottom. This will avoid the necessity of employing a long length of screened lead which besides increasing the capacity of the tuned circuit, usually has a very poor power factor, resulting in loss of gain.

OPERATING CONDITIONS

The substitute valve may require a lower or higher screen voltage for optimum results, a change of bias or optimum load may also be advisable. Always ensure that the voltages and currents are within the maximum ratings given in the valve data sheet. Note that a valve may give satisfactory services in circumstances widely varying from the published operating conditions provided the maximum ratings (including anode and screen dissipations) are not exceeded.

FREQUENCY CHANGERS

The older types of octodes and heptodes are interchangeable but it should be noted that the newer specialized types which have no oscillator anode cannot be used for replacement without considerable circuit modification. Valves of

this type include the 1R5, 6BE6 and 6SA7. Type 6SA7 may be replaced by type 6K8GT together with slight wiring changes, in sets without a short wave band.

Triode-heptodes and triode-hexodes are interchangeable when used for frequency conversion. The triode-heptode employs a suppressor grid to increase the conversion impedance and so reduce the I.F. transformer damping. This feature is achieved in types 6K8GT and 12K8GT by the addition of confining plates.

The triode-pentode used with cathode injection is conveniently replaced by a pentagrid or triode-hexode of more modern design. A change in value of screen grid and oscillator anode resistors will usually be necessary, to ensure that the valve ratings are not exceeded.

Early sets employing H.F. tetrodes as self-oscillating frequency changers may be Brimarized by the use of a modern H.F. pentode of the "sharp cut-off" type. Vari-mu valves are not usually satisfactory owing to their lower conversion factor. Note that the metallizing on 5 pin valves is connected to cathode and in this circuit will be at R.F. potential. If instability results, a clear type should be used or a 7 pin type substituted and its metallizing earthed.

A Heptode used with a separate oscillator valve may usually be replaced by a modern type of triode-hexode, the oscillator anode connection being taken to cathode.

Always re-align the receiver after substitution of the frequency changer. Whistles present after re-alignment may be due to excessive oscillation and this may be reduced by inserting a resistor of 1,000 ohms or so in series with the oscillator grid coil of the appropriate wave band.

Strength of oscillation may be measured by inserting a 0.5 mA D.C. meter in the earthy end of the oscillator grid leak. The approximate peak heterodyne voltage may be obtained by multiplying the reading in milliamps by 1.2 and by the value of grid leak in thousands of ohms. The optimum value of grid current or heterodyne voltage is usually given in the valve ratings. In most receivers the figure will be achieved only at certain parts of the band, tolerances of $\pm$ 50 per cent usually being satisfactory. Too low a value will cause greatly reduced gain.

H.F. PENTODES

Substitution by a modern type may cause instability. Check that internal shields, suppressor grids, etc., which are brought out to base pins are properly earthed and that the metallizing connection, if any, is making good connection to the metallizing. A resistance of a few ohms in this lead may be sufficient to cause feedback. Make sure that the wiring is properly arranged and that the anode and grid leads are well apart. If the new valve gives much higher gain than the old type it may be necessary to reduce the screen voltage or increase the bias to preserve stability.

A.F. AMPLIFIERS

A slight change in gain of this stage is usually permissible. Adjustment of the anode load will enable the output to be varied quite widely. Note that the anode resistor is effectively in parallel with the grid leak of the following valve for purposes of stage gain calculation.

A transformer coupled L.F. amplifier usually employs a valve with a low or medium amplification factor. If a resistance capacity coupled stage is to be substituted a valve having a higher amplification factor should be employed, R.C. coupling data is included for all suitable valves in the Brimar Valve Manual.

If data for operation of a pentode amplifier is not available, a good guide is to arrange the anode voltage to be 40 per cent of the H.T. supply and the screen voltage 25 per cent. The cathode resistor should be adjusted to give 1.25–2.0 volts bias.

OUTPUT VALVES

In sets employing no intermediate A.F. stage the use of a high slope power valve is essential. Substitution by a valve having a low slope will result in overloading of the I.F. stage before full loud speaker volume is obtained. Where an A.F. stage is fitted, the difference in power sensitivity between the two types is not usually apparent. If the new valve calls for more bias, check that the by-pass condenser is still working within its rating and replace if necessary.

Class AB2 and Class B stages are often best replaced with valves working under Class " A " conditions when the original valve types are no longer available. Note that valves which are similar when used as tetrodes or pentodes may no longer be equivalent when connected as triodes (grid 2 joined to Anode). In these cases, screen dissipation is usually the limiting factor.

POWER OUTPUT AND OPTIMUM LOAD

Power outputs are often deceptive particularly at higher volume levels. A power change of 2 to 1 is but 3db, a change of 2db being only just discernible to the average person. Substitution of the old loudspeaker by a new type can more than compensate for a change of 3db.

The optimum load specified in the valve data is always a compromise between power output and harmonic distortion. The rated speech coil impedance holds only for a particular frequency, usually 400 c.p.s. At other frequencies the impedance may be from ten to twenty times higher. Perfect matching is thus only possible with a resistive load. Provided the output valve is working well within its rating, however, the distortion arising from mismatching is usually considerably less than that which occurs in the loudspeaker itself or in its output transformer.

The optimum load for one set of valve ratings will not hold for another. Where two alternative tappings on the transformer are available at nearly the correct load, always choose that giving the lower figure.

If the rated impedance of a speech coil is unknown, a good guide is to take 1.4 times the D.C. resistance.

Harmonic distortion in valves is specified as the percentage of the voltage of the fundamental. The power distortion is much less, 10 per cent voltage distortion being equal to only 1 per cent power distortion.

RECTIFIERS

The replacement of a rectifier even by one of the identical type requires certain precautions. The filter condensers should be checked before the new valve is fitted. The modern valve may be more efficient than its old counterpart and will deliver a higher output voltage. If the set has seen considerable service, the reservoir condenser should be replaced and if possible the smoothing condenser also.

Always use an indirectly heated rectifier where the output valve is of the indirectly heated type.

Procedure

1. Check heater rating. In A.C./D.C. receivers, in which a separate heater transformer has not been used, the heater current must be correct. Where there is an increase in current from the transformer winding ensure, that the socket does not cause excessive voltage drop.

2. Check the base.

3. Check tube dimensions. The tube to be used may be larger than that formerly employed or if changing to a wide-angle tube the neck dia. will be greater.

4. Check screen contour. Change to a flat-faced tube may involve modifications of the mask.

5. Check the operating voltages and currents. These should be in accordance with the ratings given for the new tube. When changing to an aluminized tube (other than C12D) from a non-aluminized tube, increased E.H.T. will usually be required.

6. Check scanning requirements. Change from 55° scanning angle tube to a wide-angle tube, will involve complete rebuilding of the time base and E.H.T. circuits and different scanning components. Suitable circuit data is available on request. Change from triode to tetrode will involve additional H.T. voltage supply. Use of a flat-faced tube may involve changes to deflector coils to eliminate defocusing or pin cushion distortion.

Due to the changes in the neck of the tube, some shadowing may occur at the corners of the picture. This may usually be eliminated by the use of a small permanent magnet, such as an ion-trap magnet mounted near the base.

7. Check focus requirements. Change from non-aluminized tube to an aluminized tube, or from tetrode to triode, or from 55° scanning angle to wide angle, will involve change of permanent magnet focus unit or of focus coil current. Due to dimensional changes the position of the focus unit may have to be changed.

8. Check whether ion-trap magnet is required.

9. If an external coating is available on the new tube it should be connected to the chassis and the original E.H.T. reservoir condenser disconnected.

As an example of the above procedure the substitution of the Brimar C12D for the obsolete type C12A will be considered.

	C12A	C12D	Notes.
Heater ratings	2.0 v., 1.4 A	2.0 v., 2.5 A	This increase of current should be within the capacity of the transformer winding. Check voltage at pins.
Base	English octal	International octal	Pin connections to be changed also. Refer to base diagrams in manual.
Dimensions	C12D approx. 1½ in. longer than C12A		Longer leads to socket may be required, in addition to any changes to back panel of cabinet.
Screen Contour	Round-Faced Tube	Flat-Faced Tube	Modification to mask may be necessary.
Operating voltages	No change		
Scanning requirements	Due to change in face contour, change of deflector coil may be necessary, but this depends upon the components involved.		
Focus requirements	No change in coil current or permanent magnet		The focus assembly may have to be moved about ½-¾ in. nearer the back of the chassis.
Ion-trap magnet	None required		

SUBSTITUTION LIST OF AMERICAN TYPES

Many of the following types have identical characteristics except for the type of base or slight differences of base connections. Others require a slight modification to the receiver.

AMERICAN TYPE	BASE TYPE	BRIMAR TYPE	BASE TYPE	REMARKS
1A5GT	Octal	1C5GT	Octal	Increased filament current
1A7GT	Octal	1LA6	Loctal	No top cap
		1AC6	B7G	Increase screen and oscillator anode resistors. Increased gain
1C5GT	Octal	1S4	B7G	
		3S4	B7G	Parallel filaments
1H5GT	Octal	1LH4	Loctal	No top cap
1LA4	Loctal	1A5GT	Octal	
1LA6	Loctal	1A7GT	Octal	Top cap lead
1LB4	Loctal	1A5GT	Octal	See Brimarize Sheet No. 25
1LC5	Loctal	1N5GT	Octal	Top cap lead
1LC6	Loctal	1A7GT	Octal	Top cap lead
1LD5	Loctal	1S5	B7G	
1LG5	Loctal	1T4	B7G	
1LH4	Loctal	1H5GT	Octal	Top cap lead
		1LD5	Loctal	Screen supply. See Brimarize Sheet No. 21
1LN5	Loctal	1N5GT	Octal	Top cap lead
		1T4	B7G	
1N5GT	Octal	1LN5	Loctal	No top cap
1P5GT	Octal	1N5GT	Octal	Direct replacement
1Q5GT	Octal	3V4	B7G	Parallel filaments
1S4	B7G	3S4	B7G	Change connections
1T5GT	Octal	1A5GT	Octal	Reduced power output
1U4	B7G	1L4	B7G	Direct replacement
1V	U.X.4	6X5GT	Octal	A.C. receivers
		25Z4G	Octal	A.C./D.C. recievers
*2A5	U.X.6	42	U.X.6	Change heater voltage
*2A6	U.X.6	75	U.X.6	Change heater voltage
*2A7	U.X.7	6A7	U.X.7	Change heater voltage
*2B7	U.X.7	6B7	U.X.7	Change heater voltage
3A4	B7G	3D6	Loctal	Increased filament consumption

AMERICAN TYPE	BASE TYPE	BRIMAR TYPE	BASE TYPE	REMARKS
3Q4	B7G	3V4	B7G	Change connections
3Q5GT	Octal	3V4	B7G	
		3Q4	B7G	
5T4	Octal	5U4G	Octal	Direct replacement
5W4	Octal	5Y3GT	Octal	Increased filament consumption
5X3	U.X.4	80	U.X.4	Check R.M.S. input
		5V4G	Octal	
5X4G	Octal	5U4G	Octal	Change connections
5Y4G	Octal	5Z4G	Octal	Change connections
5Z3	U.X.4	5U4G	Octal	
6A6	U.X.6	6N7GT	Octal	
6A7	U.X.7	6A8G	Octal	
6AB7	Octal	6SG7	Octal	Direct replacement
		6BA6	B7G	
6AC7	Octal	6AM6	B7G	Reduced sensitivity
6AF5G	Octal	6J5G	Octal	Increase bias voltage
6AG5	B7G	6AU6	B7G	Restricted frequency range
6AH7	Octal	6SN7GT	Octal	A.C. receivers
		12AU7	B9A	
6AM5	B7G	6AQ5	B7G	Change connections
6AQ6	B7G	6AT6	B7G	A.C. receivers
		12AT6	B7G	A.C./D.C. receivers
6AR5	B7G	6AQ5	B7G	Higher heater current
		6BW6	B9A	Higher heater current
6B5	U.X.6	6N6G	Octal	
		42	U.X.6	Add bias resistor
		6F6G	Octal	Add bias resistor
6B6G	Octal	6Q7G	Octal	Direct replacement
6B7	U.X.7	6B8G	Octal	
6C5G	Octal	6J5G	Octal	Direct replacement
6C6	U.X.6	77	U.X.6	Direct replacement
		6J7G	Octal	Earth pin 1
6D6	U.X.6	78	U.X.6	Direct replacement
		6U7G	Octal	
6E5	U.X.6	6U5/6G5	U.X.6	Lower sensitivity
		6U5G	Octal	Lower sensitivity
6F5	Octal	6Q7GT	Octal	Change connections See Brimarize Sheet No. 9
6F8G	Octal	6SN7GT	Octal	Change connections

AMERICAN TYPE	BASE TYPE	BRIMAR TYPE	BASE TYPE	REMARKS
6G5	U.X.6	6U5/6G5	U.X.6	Direct replacement
		6U5G	Octal	
		6G5G	Octal	
6G6G	Octal	6AK6	B7G	
6H6G/GT	Octal	6AL5	B7G	
6J8G	Octal	6K8G	Octal	Direct replacement
6K5G	Octal	6Q7G	Octal	Remove wires on pins 4 & 5
6K6GT	Octal	6V6GT	Octal	Higher heater current
6L5G	Octal	6J5GT	Octal	A.C. or 6 volt sets only
6N6G	Octal	6B5	U.X.6	
		6F6G	Octal	Fit bias resistor
6P5G	Octal	6J5G	Octal	Increase bias
6P7G	Octal	6F7	U.X.7	
6P8G	Octal	6K8G	Octal	Reduced gain. See Brimarize Sheet No. 7
6Q6G	Octal	6Q7G	Octal	Connect pin 4 to cathode
6R6G	Octal	6K7G	Octal	Change connections
6S7	Octal	7B7	Loctal	
6SA7	Octal	6BE6	B7G	
6SF5	Octal	6Q7GT	Octal	Change connections
6SF7	Octal	6B8GT	Octal	Change connections
6SG7	Octal	6BA6	B7G	
6SH7	Octal	6AU6	B7G	
6SJ7	Octal	6BR7/8D5	B9A	Reduced heater current
		6J7GT	Octal	Change connections
6SK7	Octal	7B7	Loctal	Reduced heater current
		6K7GT	Octal	Change connections
6SQ7	Octal	6Q7GT	Octal	Change connections
		7B6	Loctal	
6SR7	Octal	6R7G	Octal	Change connections
6SS7	Octal	7B7	Loctal	
		6K7GT	Octal	A.C. sets. Change connections
		12K7GT	Octal	A.C./D.C. sets. Change connections
6ST7	Octal	7C6	Loctal	
		6Q7GT	Octal	A.C. sets. Change connections
		12Q7GT	Octal	A.C./D.C. sets. Change connections
6U5/6G5	U.X.6	6U5G	Octal	
		6G5G	Octal	
6U7G	Octal	6K7G	Octal	Direct replacement
6ZY5G	Octal	6X5G	Octal	Increased heater current
7A4	Loctal	6J5GT	Octal	Increased heater current
7A6	Loctal	6AL5	B7G	A.C. sets only
7A7	Loctal	6K7GT	Octal	

AMERICAN TYPE	BASE TYPE	BRIMAR TYPE	BASE TYPE	REMARKS
7A7	Loctal	7B7	Loctal	Reduced heater current
7A8	Loctal	6A8GT	Octal	Increased heater current
7B5	Loctal	7C5	Loctal	Increased heater current
		6V6GT	Octal	Increased heater current
7B6	Loctal	7C6	Loctal	Reduced heater current
7B8	Loctal	6A8GT	Octal	Top cap connection
7C5	Loctal	6V6GT	Octal	
7C6	Loctal	7B6	Loctal	Increased heater current
7C7	Loctal	6BR7/8D5	B9A	
7F7	Loctal	6SL7GT	Octal	
7J7	Loctal	7S7	Loctal	Direct replacement
7N7	Loctal	6SN7GT	Octal	
7Q7	Loctal	6SA7	Octal	
		6BE6	B7G	
7Y4	Loctal	6X5GT	Octal	Increased heater current
12A7	U.X.7	18	U.X.6	Add metal rectifier. See Brimarize Sheet No. 1
12B8GT	Octal	6K7GT & 6AT6	Octal B7G	Fit B7G socket for 6AT6 triode section
12SA7	Octal	12BE6	B7G	
12SF5	Octal	12Q7GT	Octal	Change connections
12SG7	Octal	12BA6	B7G	
12SJ7	Octal	12J7GT	Octal	Change connections
		6BR7/8D5	B9A	A.C./D.C. receivers
12SK7	Octal	12K7GT	Octal	Change connections
12SQ7	Octal	12Q7GT	Octal	Change connections
12Z3	U.X.4	25Z4G	Octal	A.C./D.C. receivers
14A7 (12B7)	Loctal	7B7	Loctal	A.C./D.C. receivers
14B6	Loctal	7C6	Loctal	A.C./D.C. receivers
14B8	Loctal	12A8GT	Octal	
14F7	Loctal	12SL7GT	Octal	
14J7	Loctal	14S7	Loctal	Direct replacement
14N7	Loctal	12SN7GT	Octal	
14Q7	Loctal	12SA7	Octal	
		12BE6	B7G	
25A7G	Octal	25A6G	Octal	Fit metal rectifier DRM1B See Brimarize Sheet No. 2
25B8GT	Octal	12K7GT & 12AT6	Octal B7G	Fit B7G socket for 12AT6 triode section
25Y5, 25RE	U.X.6	1D6	U.X.6	Half wave rectifier only
25Z5	U.X.6	1D6	U.X.6	Half wave rectifier only
25Z6	Octal	25Z4G	Octal	Half wave rectifier only
32L7GT	Octal	25L6GT	Octal	Fit rectifier type SB3 or DRM1B. See Brimarize Sheet No. 17

AMERICAN TYPE	BASE TYPE	BRIMAR TYPE	BASE TYPE	REMARKS
35A5	Loctal	35L6GT	Octal	
35RE	U.X.6	1D6	U.X.6	Half wave rectifier only
35Y4	Loctal	35Z4GT	Octal	Dial lamp inoperative
35Z3	Loctal	35Z4GT	Octal	
35Z5GT	Octal	35Z4GT	Octal	Dial lamp inoperative
		35W4	B7G	
36	U.X.5	6J7G	Octal	See Brimarize Sheet No. 11
37	U.X.5	76	U.X.5	Direct replacement
39/44	U.X.5	6K7G	Octal	See Brimarize Sheet No. 11
40Z5GT	Octal	35Z4GT	Octal	Fit Brimistor type CZ2
45Z5GT	Octal	35Z4GT	Octal	Fit Brimistor type CZ2
41	U.X.6	6K6GT	Octal	See Brimarize Sheet No. 16
		6V6GT	Octal	Increased heater current
42	U.X.6	6F6G	Octal	
43	U.X.6	25A6G	Octal	
45	U.X.4	2A3	U.X.4	See Brimarize Sheet No. 12
45Z3	Octal	DRM1B	—	Alter mains resistor
47	U.X.5	2A3	U.X.4	See Brimarize Sheet No. 12
50A5	Loctal	50L6GT	Octal	
50B5	B7G	50C5	B7G	Change connections
*53	U.X.7	6N7GT	Octal	Change heater voltage
*57	U.X.6	6C6 or 77	U.X.6	Change heater voltage
*58	U.X.6	6D6 or 78	U.X.6	Change heater voltage
70L7GT	Octal	35L6GT	Octal	Metal rectifier required. See Brimarize Sheet No. 3
75	U.X.6	6Q7G	Octal	
77	U.X.6	6J7G	Octal	Earth pin 1
78	U.X.6	6K7G	Octal	
79	U.X.7	6N7GT	Octal	Increased current drain
80	U.X.6	5Y3G	Octal	
83V	U.X.4	5V4G	Octal	
84/6Z4	U.X.5	6X5GT	Octal	Increased heater current
85	U.X.6	6R7G	Octal	Change bias
117L/M7GT	Octal	DRM1B	—	See Brimarize Sheet No. 15
117N7GT	Octal	DRM1B	—	See Brimarize Sheet No. 15
117P7GT	Octal	DRM1B	—	See Brimarize Sheet No. 15
117Z3	Octal	DRM1B	—	Alter mains resistor
117Z6GT	Octal	DRM1B	—	See Brimarize Sheet No. 14
2151	U.X.6	18	U.X.6	Reduced power output

TELETUBES

TUBE TYPE	SUB-STITUTE	NEW SOCKET	OTHER INFORMATION
C12A	C12D	Octal	Approx. 1½ in. longer. I_h increased to 2.5 amps. For additional information see page 240

* These valves are of the 2.5 volt type and require the addition of a small transformer before substitution of the 6.3 volt equivalent. This transformer may be auto-wound, from 2.5 volts to 6.3 volts or a double wound type operating direct from the mains supply.