VINTAGE RADIO

By JOHN HILL

A look at valve substitutions

Contrary to popular belief, valves for domestic radio receivers are fairly easy to come by. Collectors usually have numerous types on hand and valves can still be bought from various vintage radio suppliers, either here in Australia or overseas.

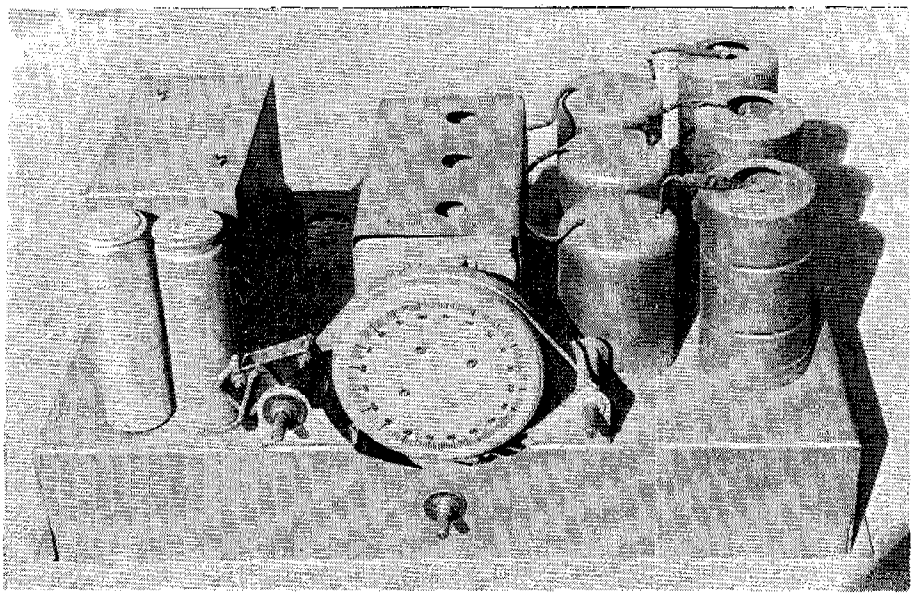
However, that statement only applies to the more common types. When one turns back the clock to the 1920s and early 1930s, then valve availability is not very good at all. Although some odd and obscure types can be procured from various sources, most early radio valves are hard to find and expensive to buy. What's more, secondhand valves are often the only ones available or affordable.

Domestic radios went "electric" from about 1927 onwards. Prior to that, they were battery operated almost without exception. The popular receivers of those early AC days were of the TRF (tuned radio frequency) type, although the superhet was rapidly gaining on them.

AC valves were still in the developmental stage at that time and were subject to numerous changes. Not only was it early days for indirectly heated cathodes but a proliferation of new valve types was about to take place, with the development of many revolutionary valves only a year or so down the track. It was an interesting and exciting time for radio.

Many early AC valves had very short production runs before they were superseded by better designs. It is these odd valve types that may have been in vogue for only 12 months or so that are the hard ones to find today – simply because there were never many of them made in the first place.

On the other hand, more common valve types such as the 5Y3, 6A8, 6U7, 6B6 and 6V6 (a popular line-up for many 5-valve superhets) were used extensively for at least 15 years. Whether new or secondhand, such valves must be easier to obtain than a valve that was superseded almost immediately it went into service.



A TRF chassis from the early 1930s. Receivers of this type often used AC valves such as types 24, 35, 47 & 80. These are all 2.5V valves except for the 80 which is a 5V type.

Directly heated cathodes

Although the majority of early AC valves were designed with indirectly heated cathodes, some retained their battery valve ancestry and had directly heated cathodes in the form of a heavy, oxide-coated filament. In most instances, these direct heated types were confined to rectifiers and output valves such as the 80, 45, 47, 2A3, etc.

Obtaining a cathode connection on a directly heated cathode requires that a centre-tapped resistor be connected across the valve filament, or that the filament be fed from a separate transformer winding having a centre tap. The cathode connection is made to the centre tap. This arrangement is necessary to minimise mains hum.

Valve substitution

When restoring an old radio receiver, one often finds that some of the valves are either missing or in need of replacement. If the restorer has the necessary valves, he is indeed fortunate. If he hasn't, then he must find a suitable substitute if the set is to work again.

The substitution of unobtainable valves with more common types will solve most problems the vintage radio restorer may encounter. However, an old receiver with more modern valves doesn't quite look the part and there is nothing quite like having the right replacements. But if the choice is either an inoperative receiver or one that works, then the latter is the better alternative.

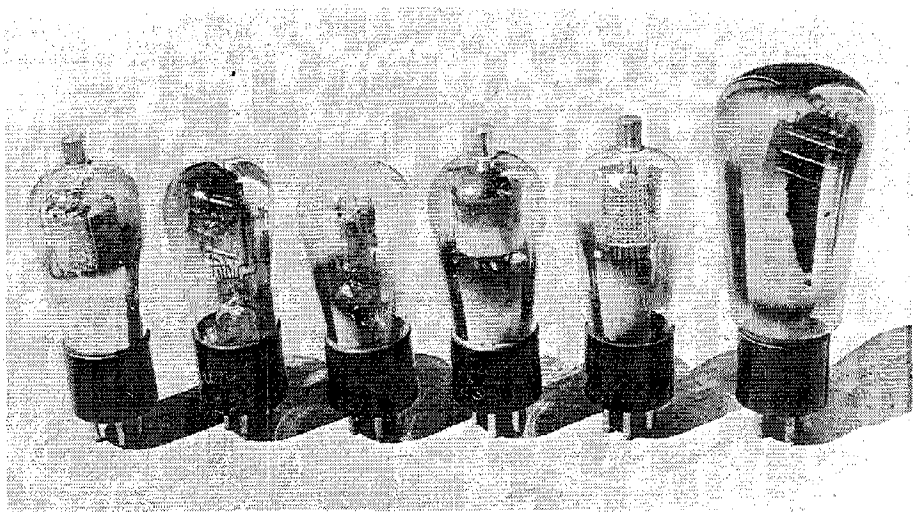
This brings us to the purpose of this month's Vintage Radio column – the substitution of valves now long forgotten and unobtainable.

TRF receivers

Around 1930, a number of TRF and regenerative receivers used the following valves apart from the 80 rectifier: 24, 24A, 27, 35, 45 and 47. All were 2.5 volt valves. Other receivers could have used European type valves with 4V heaters. Such valves may have been E442, E415, E424 and C443.

One often confusing aspect of early American valves is that a 45 output valve, for example, may be marked 245, 345 or with some other numerical prefix which apparently identifies the manufacturer. As far as the valve type is concerned, the first digit is ignored and the valve is referred to as a type 45.

The 24 and the 24A type valves can be considered as being the same apart from the fact that the 24A has a faster warm up time. Many early AC valves had quite prolonged warm-up periods.



A few early AC valves (from left): 24, 26, 27, 35, 51 and E406. Table 1 lists equivalent & possible substitute types for these & a wide range of other types.

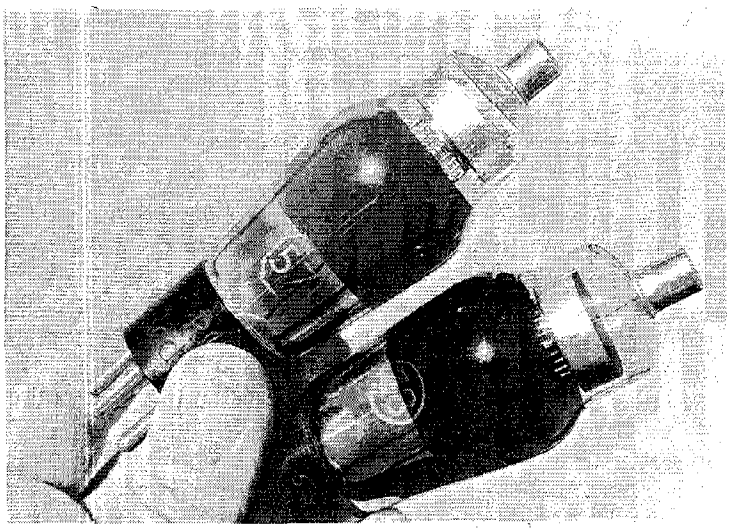
The rapid warm-up feature was developed to suit the direct coupling audio system, which enjoyed a (mercifully) brief popularity. A complex bias arrangement allowed the output valve grid to be connected directly to the driver valve plate but suffered from the complication that the output valve was deprived of bias while the driver stage was warming up. The type 24A was designed to overcome this problem.

There are also physical differences in the appearance of these two valves, with the 24A looking the more modern of the two. The older 24 has the bulbous glass envelope that characterised many early valves. The shape alone is good reason for wanting original replacements. A valve shield, whether needed or not, will help disguise a ring-in valve.

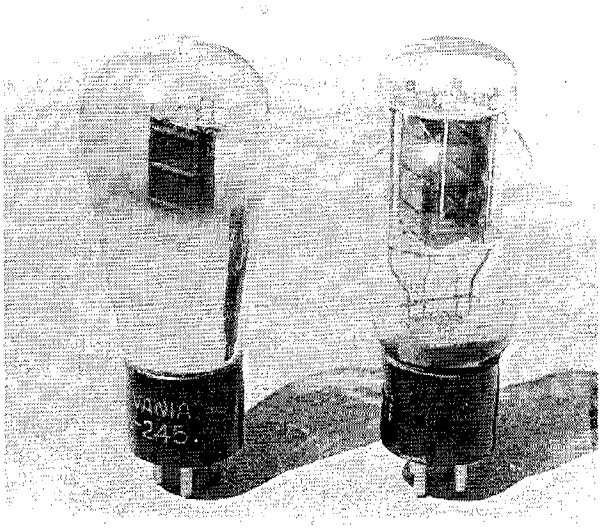
The 24 and 24A are radio frequency tetrodes and were used in many TRF and regenerative detector receivers in the very early 1930s. The 24A is still available new from local suppliers and at the time of writing costs around $10.

If a suitable replacement cannot be found, a 57, 6C6 or 6J7 could get one out of trouble. The 57 is a 2.5V radio frequency pentode and would require a different valve socket and slight wiring modifications. A 6C6 or 6J7 replacement would also require a 6.3V transformer for the valve heater.

The 35 is a close relative to the 24,



These type 57 & 58 radio frequency pentodes can be used to replace the older type 24 & 35 valves respectively. A new valve socket and minor wiring changes are all that are required. The 57 can also be used in other ways – see text.



The 2A3 (right) can be used as a substitute for the 45, the main drawback being its more modern appearance. Output triodes were quite popular during the early 1930s.

FIG.1: VALVE SUBSTITUTION CHART

VALVE	EQUIVALENT	POSSIBLE SUBST.	VALVE	EQUIVALENT	POSSIBLE SUBST.
2A3		45	6B7	6B7S	6G8, 6B8
2A5		42, 6F6	6B8	6G8*	
2A6		75, 6B6, 6SQ7	6BA6	EF93	
2A7		6A7, 6A8	6BD7	EBC80-81	
2B7		6B7, 6B8	6C6		6J7, 6SJ7
24	24A	57	6D6	78	6U7, 6K7
24A	24	57	6F6		6V6, 6AG6, EL33
26		27, 56, 57	6G8	6B8*	
27	56	57	6H6	EB34	
35	51	57*, 58	6J7		6U7*, 6K7*, 6SJ7
41		42	6J8	ECH33-35	6K8, 6A8
42		41	6K7	6U7	
45		2A3	6K8	6J8, ECH33-35	6A8
47		2A5	6M5	EL80	
51	35	57*, 58	6N8	EBF80, 6AD8	
55		85	6Q7	6B6, 6SQ7	
56	27	57	6SJ7	6SK7*	
57	58*	6C6, 6J7	6SQ7		6B6, 6Q7
58	57*	6D6, 6U7	6U7	6K7	
59		2A5	6V6		6F6, EL33, 6AG6
75		6B6, 6SQ7	EL33		6V6, 6F6, 6AG6
78	6D6	6U7, 6K7			
6A7		6A8	**RECTIFIERS**		
6A8		6K8, 6J8, ECH33-35	280	80	80S, 83V
6AD8	EBF80, 6N8		80	280	80S, 83V
6AG6		6V6, EL33	5Y3		5V4, 5Z4
6AN7	ECH80		5V4		5Z4, 5Y3
6AQ5	EL90		6V4	EZ80	
6AV6	6AQ6, EBC91		6X4	EZ90	
6B6	6Q7	6SQ7	6X5	EZ2, EZ35	

Note 1: valves listed under "equivalent" should interchange without modification. Those listed under "possible substitute" may require a valve socket change, a different heater voltage and alterations to some component values before they will work properly.
Note 2: * sharp & remote cut-off types may not interchange satisfactorily in some cases.

being a variable mu version. It is also available new for approximately the same price as the 24A.

A defunct 35 can be replaced with a 58, 6D6 or 6U7 which would also require a valve socket change and small wiring modifications. If using a 6D6 or 6U7 as a replacement, a 6.3V heater transformer is again required.

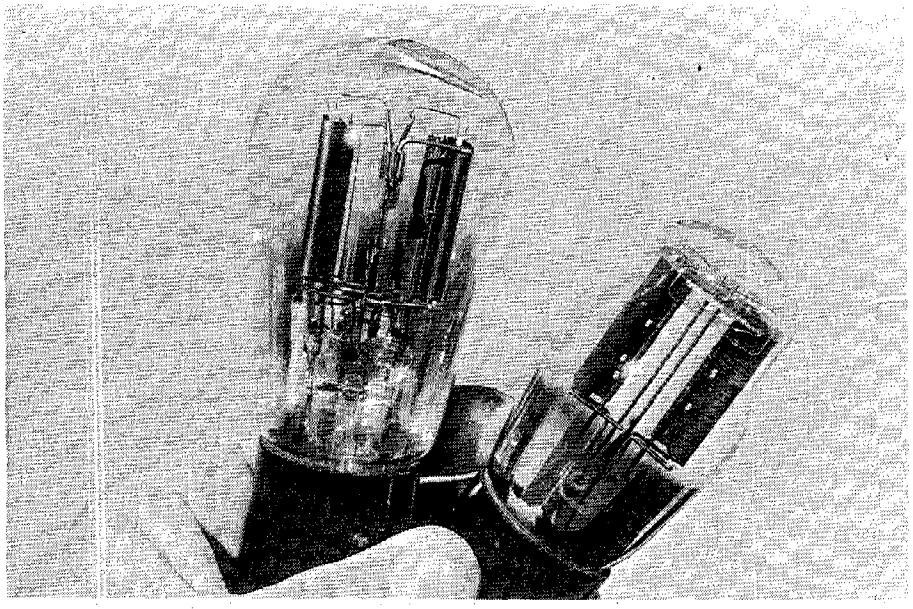
The 27 triode was used extensively in early AC receivers and was employed as a detector or first audio stage in most instances. It was also used as an oscillator in some old superhets.

A type 56 can be substituted for the 27 and will plug into the existing socket without modifications. A 57 connected as a triode can also he substituted (screen, suppressor and plate all tied together), although in this case a socket change is required.

A direct-heated output triode such as the old 45 can be replaced with other similar valves, the 2A3 being the most logical choice. Failing this, many triode-connected output pentodes could be suitable replacements. A 2A5 would be convenient because of its 2.5V heater.

There is no convenient equivalent for a 47 output pentode and perhaps the best way out of this problem is to substitute a 2A5 once again. A valve socket change would be all that is necessary and the 2A5 should perform better than the original output valve.

Another 2.5V valve of interest is the 59, a valve which is occasionally found in the output stage of some early 1930s superhets. The 59 is an unusual valve in that it has two heaters instead of one. This odd construction characteristic has a distinct ad-



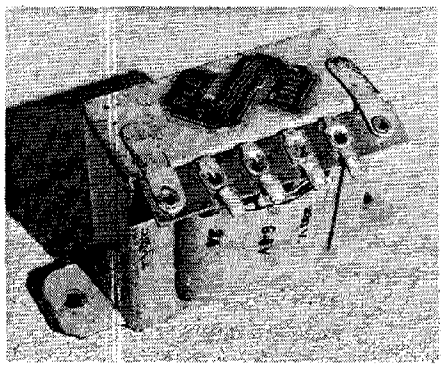
This photograph shows a 280 (left) and an 80. The shape of the glass envelope alone makes the older valve far more appealing.

vantage in that the valve continues to operate reasonably well should one heater element burn out.

Once more, the good old 2A5 is the logical substitute for a defunct 59 and requires nothing more than a socket change.

The old 26 (a very early AC triode) is a difficult one to replace. This particular valve is likely to show up in some of those pressed steel TRFs of American manufacture. As far as AC valves are concerned, the 26 is a bit of an orphan for it has a 1.5V directly heated cathode.

This valve was an attempt to use a directly-heated cathode in the audio driver stage, as well as the output stage. The low voltage, high current, heavy duty filament was designed to have maximum thermal storage, to minimise fluctuations in cathode emission at mains frequency. As far as is known, it was the only such attempt and appeared only briefly.



A 6.3V heater transformer makes it easy to convert a set from 2.5V to 6.3V operation. The heater transformer supplies the 6.3V valves while the original transformer continues to supply the rectifier filaments and high tension.

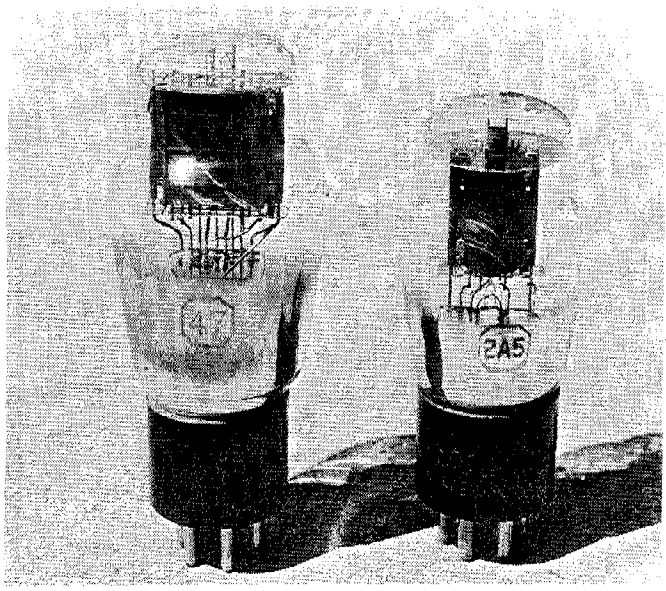
It is not uncommon to find the 1.5V 26 lined up with 2.5V valves and a 5V rectifier. Finding a replacement power transformer for such a set can be a problem.

Unfortunately, there is no equivalent or even a close substitute for a 26. If you are stuck with this one, the best way out of the problem is to fit a 2.5V triode such as a 27 or 56, or a triode connected 57. This will require a new valve socket and the heater will have to be connected to the 2.5V winding of the power transformer, assuming it can carry the extra load (up to 1.75A in the case of a 27).

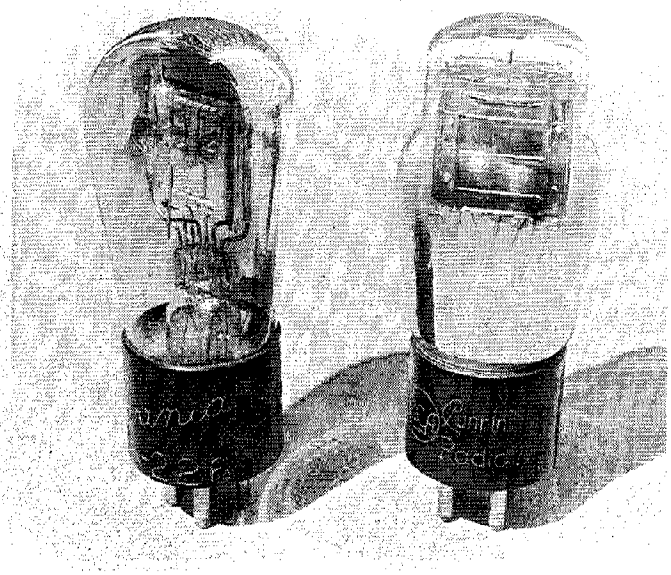
Although many of the early superhets used valves similar to those used in TRF receivers, the more common types encountered are as follows: 55, 57, 58, 59, 2A5, 2A6, 2A7 and 2B7. Many of these 2.5V valves carried on through to the octal series and if, for example, a replacement for a type 58 cannot be found, a 6D6 or 6U7 is exactly the same valve apart from having a different heater voltage and base configuration.

European valves

Those previously mentioned European valves present a few headaches and may have to be replaced with



There is no direct equivalent for a 47 output pentode. However, a socket change and a 2A5 will do the job just as well.



A pair of 26s. The one on the right is of more recent manufacture and lacks the visual appeal of the original version with its bulbous glass envelope.

appropriate 2.5V valves. The conversion will need to include a voltage dropping resistor to reduce the 4V heater supply to 2.5V. If valves other than the 2.5V series are used (eg, 6.3V), then a separate heater transformer will have to be installed to supply the higher voltage.

Equivalents vs. substitutes

One point that should be remembered is that very few valves have direct equivalents. An equivalent can be interchanged without modification, whereas a substitute may require a socket change, a different heater voltage, or changes to the circuit.

This latter requirement may take the form of a screen or cathode resistor with a different value to the original, or additional wiring to convert a pentode valve to a triode.

A substitute output valve may require a different output transformer. Also, some substitute valves may overload the power transformer; eg, if a 3-amp rectifier is used to replace a 2-amp unit.

There are many ways of getting out of valve trouble and a study of Fig.1 may help solve a particular valve substitution problem. Although it may not be a complete list of suitable replacements, they are ones I have tried or have learned about from other sources. Fig.1 also includes substitutes additional to those earlier types discussed in the text.

Odd heater voltages

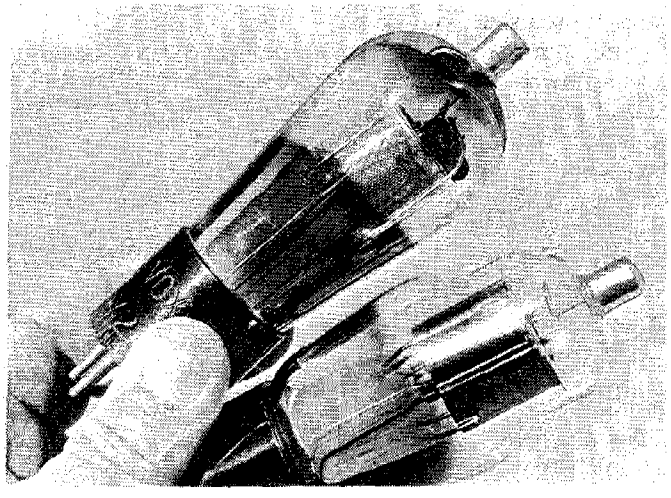
Finally, a few thoughts about providing odd heater voltages for replacement valves. If a mains-type transformer is not readily available, or is unduly large and difficult to mount, it is worthwhile considering the auto transformer.

The auto transformer is a single winding, with tappings for appropriate voltages. Typical would be a single winding tapped at 2.5V and 6.3V. The 2.5V tap could be connected to an existing 2.5V heater supply, while 6.3V would be available at the other tap.

Construction is quite simple, no mains connection is involved, and most enthusiasts could wind their own. An old speaker transformer core, with the air gap removed, is ideal. Use heavy gauge wire, 18 or 16 SWG, and work to a design figure of between five and 10 turns per volt. Tappings are made in the form of a small twisted loop. The transformer will, of course, step down as well as step up.

Two words that vintage radio restorers should be familiar with are substitution and improvisation. Finding suitable replacement valves for old receivers is just part of the "fun" of vintage repairs.

Working out suitable replacement valves is not usually difficult, although this approach is often unacceptable to the purist who insists that the radios in his collection be original. However, tracking down the original parts in not always practicable and we often have to make do with other arrangements. **SC**



A type 24 and its improved version the 24A. The more modern looking 24A has a faster warm-up time but apart from that they're virtually identical.