Vintage Radio

by PETER LANKSHEAR

Australia's most popular mantel radio

Home construction was an important aspect of the valve era of radio, and a mainstay of *EA*'s predecessors *Wireless Weekly* and *Radio and Hobbies*. Often overlooked by collectors of historic radios, some of these projects produced classics that have an important place in radio history. Many influenced later commercial design.

Recently I was delving into one of my treasure chests (also known as junk boxes) and came across the 50-year-old remnants of a 'Little General' — the first mains powered receiver that I ever made. It had seen plenty of service before having most of its parts 'borrowed' for other projects. Looking it over I realised that here was a neglected classic, worthy of a place in any historic collection.

What *is* a classic receiver? The term 'classic' has been borrowed from art and literature, to imply a combination of such features as popularity, suitability for intended purpose, adequate performance, innovation and trend setting.

In April 1940, then *Radio & Hobbies* Editor John Moyle published an article about a small mantel receiver that was to become a classic. John's 'Little General', as he called his compact receiver, was just about the ultimate in simple superhets. It used only four valves including rectifier, and a handful of components.

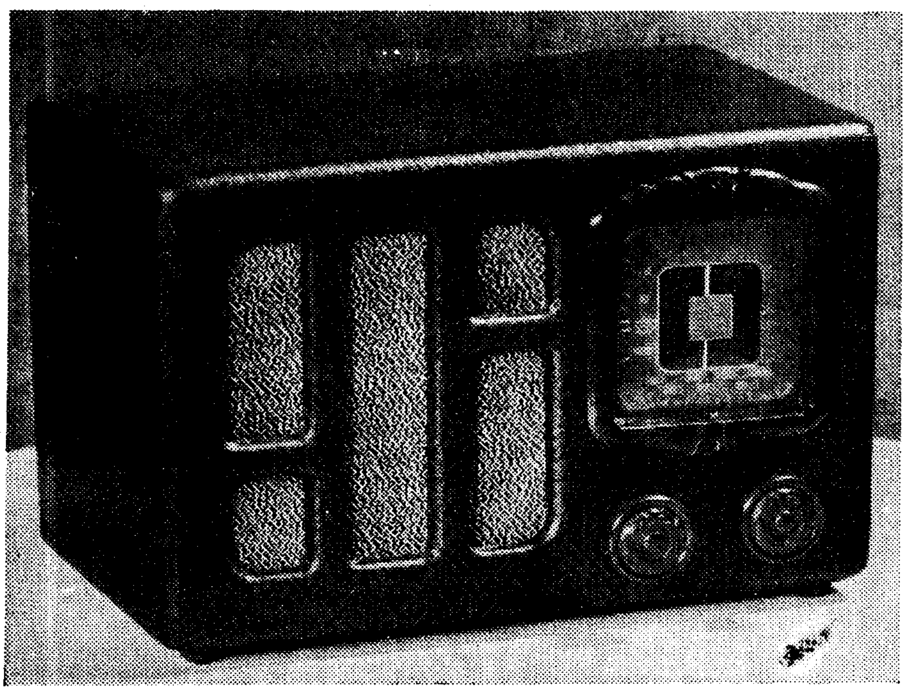
By 1940 the standard circuit for a small mantel receiver had become well established as having a converter, IF stage, diode detector, and an audio stage driving a power amplifier capable of several watts of audio. Indeed, the same chassis was often used for larger table receivers, and even consoles.

In the intended type of service, typically for bedside or kitchen listening to local stations at a modest volume level, much of the audio amplification and power of these receivers was wasted. At the same time, residual hum, noticeable at low listening levels and exacerbated by high audio gain, was often a problem.

As discussed in the July 1991 column, Australian manufacturers frequently resorted to reflexing as a way of reducing size and saving a valve, but the component count was high and performance was often compromised.

Some manufacturers, including Australia's Healing, Lekmek and National Radio had realised that eliminating the first audio stage was a practical way of producing a simple and docile receiver that was adequate for many applications.

European valve manufacturers had produced sensitive power pentodes including the PENA4, AL3 and EL3, EL3G, EL33, KT61 and 6AG6G which were suitable for these receivers. A similar valve, the EBL1 even included a pair of diodes with this type of service in mind. However, all these valves had heavy filament currents, were bigger than the standard 6F6G and 6V6G and by 1940 had become practically unprocurable.



John Moyle's original Little General, housed in a smart little leatherette-covered wooden cabinet. Many constructors made their own chassis and cabinet.

No frills

Why bother to compromise receiver performance for the sake of a valve and a few components? One reason was cost. It may surprise younger readers used to purchasing transistors for less than a dollar to learn that in 1940, a typical receiving valve cost more than a year's subscription to *Radio & Hobbies*! Another benefit from simplification was reliability. Anyone who has had much to do with repairing valve receivers will confirm that two very unreliable components eliminated by dispensing with the first audio stage were the anode resistor and its coupling capacitor.

Although the elimination of the first audio stage was a major step, John

Moyle contended that further simplification was worth striving for. Furthermore, he contended that the usual audio power capability of several watts was quite unnecessary for the intended type of service. He felt that a 'no frills' miniature superhet using the absolute minimum of parts and with the output valve restricted to a power of a watt or so would provide adequate performance, and that its simplicity and economy would appeal to many constructors who otherwise would be reluctant to tackle a mains powered receiver. Home constructors frequently started with small battery powered receivers and graduated to mains power only with caution.

One significant factor in reducing complexity and the number of small components was the elimination of automatic gain control (AGC), which is not essential for local station listening. Another was the use of a single resistor for screen and oscillator voltage supply. The final design was indeed simple, using only five fixed resistors, the customary two filter capacitors, and only seven paper and mica capacitors.

Apart from the use of a variable cathode bias resistor as a volume control, the first two stages of the Little General were conventional, with a 6K8G converter valve and 6G8G double diode remote cutoff pentode serving as IF amplifier and detector. The third valve was a ubiquitous 6V6G, biased sufficiently to reduce the anode current to about 25mA and limiting audio output to about a watt. HT rectification was by a trusty 80, with filtering provided by the field magnet winding of a 5" electromagnetic loudspeaker.

Immediate success

The immediate popularity of the Little General proved John Moyle's ideas to be correct, surpassing his most optimistic expectations as to its success. Although tens of thousands of kitsets were purchased by the more affluent home builders, many other Little Generals (like mine) were made from parts acquired, salvaged or scrounged from various sources.

As an indication of the Little General's continuing popularity, for the next decade variations on the theme were regularly featured in *R&H*. The first modification came a few months later in October 1940. To provide a bit more gain for difficult locations, the 6G8G was replaced by a 6F7 triode pentode operating as an IF amplifier and grid leak detector.

By now, loop aerials were standard for portable radios, and proving to be a practical proposition for mantel sets in good

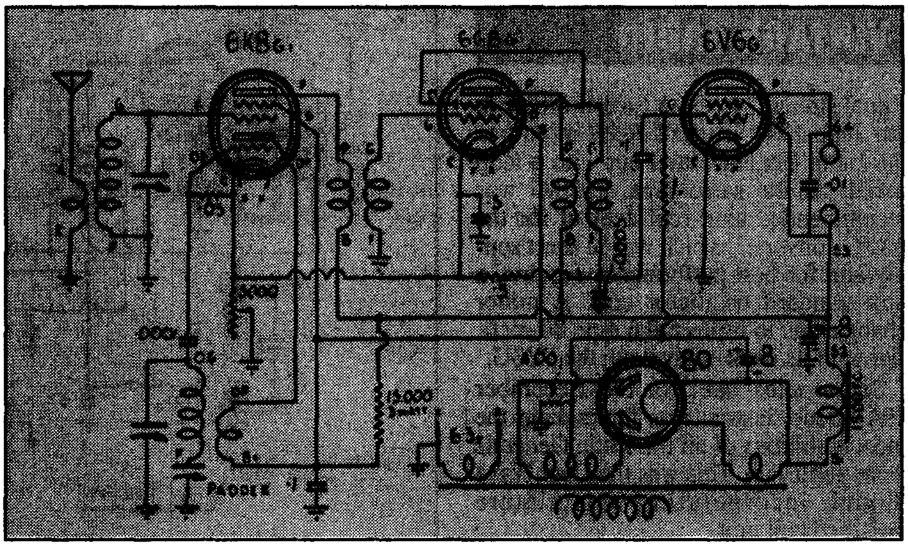


Fig.1: The circuit of John Moyle's original April 1940 Little General. It was just about the ultimate in superhet simplicity.

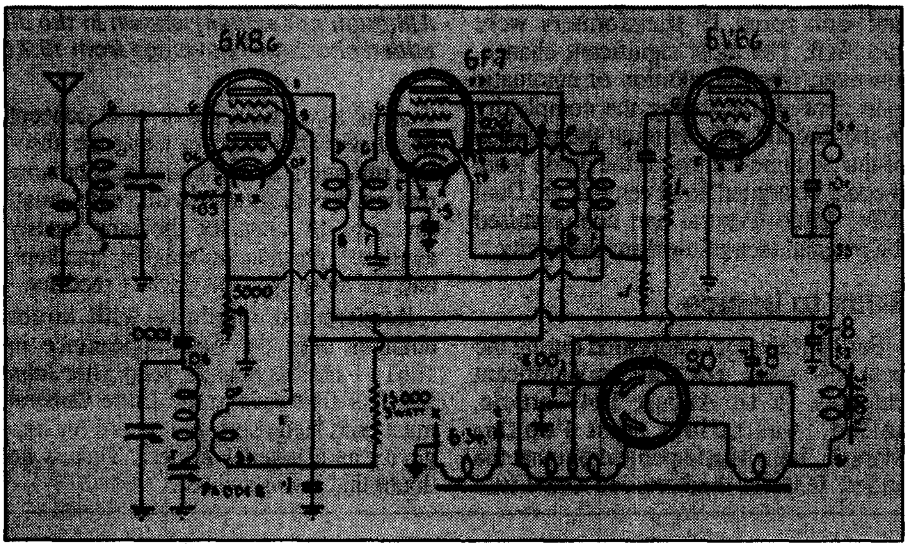


Fig.2: Despite the success of the original, there were requests for more gain. So in October 1940 John obliged with this version using a grid-leak triode detector.

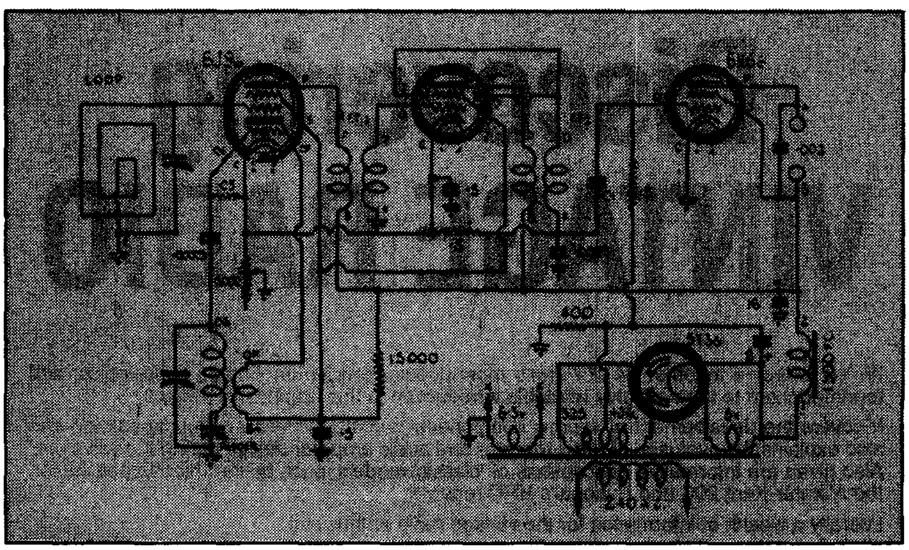


Fig.3: In the June 1941 issue, the original circuit was adapted to use a loop aerial. Minor changes included using a 6J8G converter and an octal 5Y3G rectifier.

signal strength areas. A further article in the June 1941 issue of *R&H* described the Little General fitted out with a loop aerial. At the same time, a 6J8G was recommended as a replacement for the 6K8G converter, which was in short supply and for best performance required a non-standard oscillator coil. A minor change was to replace the type 80 rectifier with its octal equivalent, the 5Y3G.

Six months later, in the December 1941 issue, instructions for making the most ambitious of all the Little Generals were published. This was the Dual Wave model, incorporating a miniature switched coil unit.

To cope with the weaker signals common in shortwave reception, a high gain Philips type EBF2G IF amplifier valve, and iron-cored IF transformers were specified. The most significant change, however, was the addition of automatic gain control, increasing the complexity of the circuit, and changing the position of the volume control to the diode load. It could be argued however, that the Dual Wave Little General had compromised the original idea of ultimate simplicity.

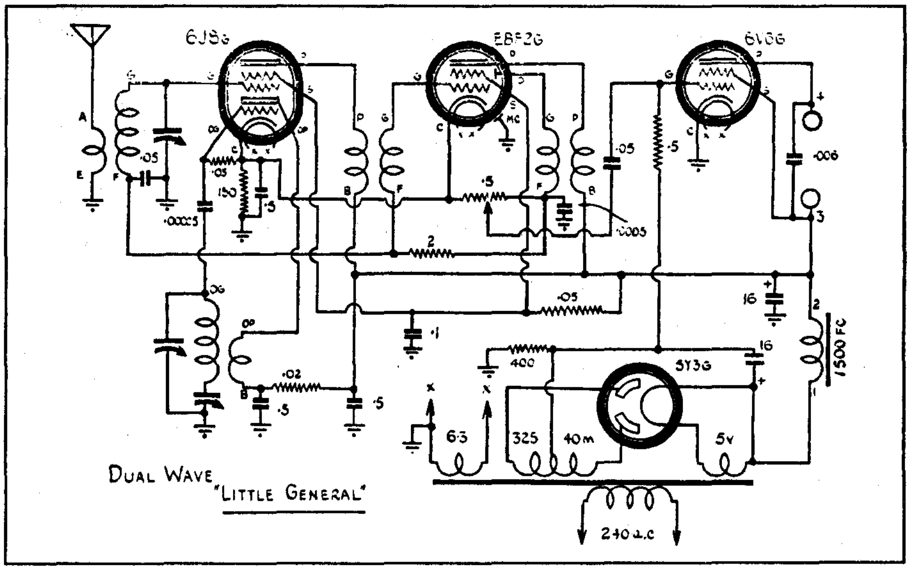


Fig.4: The basic circuit of the dual-wave version described in December 1941. Offering bandswitching and AGC, it was the most ambitious of the series. Although not actually shown in the circuit, a Crown or RCS bandswitching unit added shortwave coverage from 13.7 to 40 metres (22 - 7MHz).

Back to basics

Further references appeared during the next few years, but with no significant changes. In an August 1947 article, called 'Australia's most Popular Mantel', John Moyle pointed out that the added features had moved the Little General away from the original concept of a basic little receiver using the absolute minimum of components. John now revived the original circuit, with small revisions to cater for the now readily available permanent magnet speakers, and the more efficient 6X5GT rectifier.

Resurrected regularly with minor changes until the final appearance in 1961 — no less than 21 years after John Moyle's first article, the Little General must hold some sort of a record for longevity as a popular project. There's no doubt that it was a classic.

Build your own?

Considering the large number of Little Generals built over the years, it would be surprising if there have not been many survivors — although bear in mind that non-kitset versions may not be immediately recognisable. In many cases rebuilding to working order should not be a problem.

However, there is another way of becoming the proud owner of one of these classics. Why not build one yourself, from scratch?

There is a growing interest in creating homebuilt radios and amateur equipment from old plans and components. Unlike copies of commercial models, which at best are only replicas, hobby designs using original parts can be considered as being authentic, and the Little General with its simplicity of construction is ideal for this type of project.

Although there were several firms supplying Little General kitsets, there were no 'official' components. Most collectors accumulate an assortment of 'junkers' — chassis that are beyond redemption. These can often provide all the essential major components, especially a dial mechanism, tuning capacitor, aerial and oscillator coils and IF transformers. Most small power transformers will be suitable, and chassis are readily made with the aid of a few hand tools. The only other major items of hardware are a 5" loudspeaker and output transformer.

Next month we will provide detailed instructions for building your own genuine 1947 'Little General'. ❖

Vintage Radio

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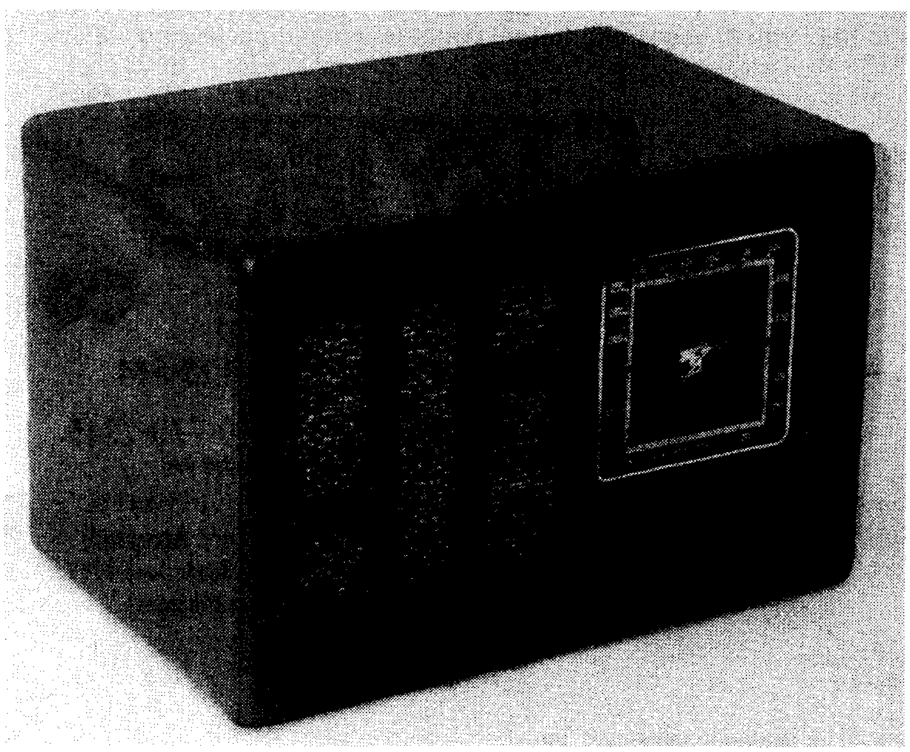
Building your own classic radio

In the last column we traced the history of John Moyle's 'Little General', in its time Australia's most popular mantel receiver. So many were made over a period of about 20 years that the remains of many (possibly unrecognised) must still be in existence. A bit of hunting around may unearth the remnants of one, which could be restored or rebuilt without too much trouble. But the design is so uncritical that in many instances, you could assembly your *own* Little General — from parts salvaged from a junk box, or from receivers considered not worth restoring.

There is a unique satisfaction in making your own electronic equipment, the more so if it is built from scratch. This is evident from the space given over to home construction during the valve era, by magazines such as our predecessor *Radio and Hobbies* — which each month published several constructional articles, ranging from simple one valve battery operated receivers to complex high performance radiograms.

Readers who grew up with these projects could now enjoy the nostalgia of restoring or making a Little General; for others this could be a good project with which to sample valve radio construction. Naturally, the ideal would be to have a Little General to restore; but failing that, building one from salvaged parts is a practical proposition.

Although any of the various versions described last month could be made, the 1947 model was chosen as it used a readily available permanent magnet (PM) speaker and yet retained the 'no frills' circuit of the original Little General. If the benefits of AGC are desired, the circuit of the Dual Wave version published in last month's column could be used with little additional complication.



A Little General built 50 years on. Billed as 'Australia's most popular mantel', John Moyle's design set new standards of simplicity and compact size.

Selecting the parts

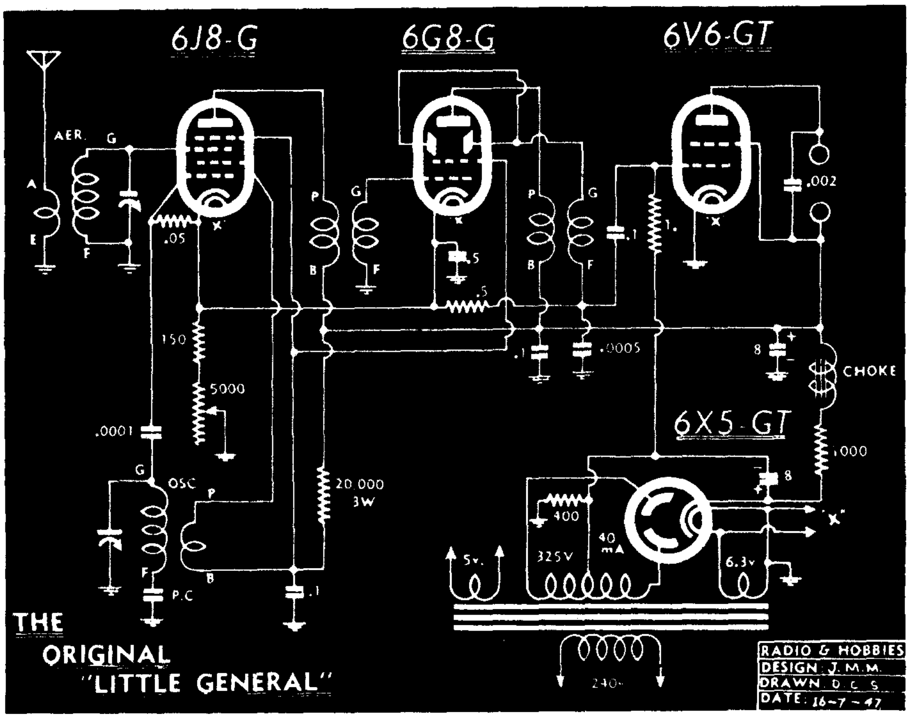
The most critical components are the dial and its associated two gang tuning capacitor, and the aerial and oscillator coils. Although original kitsets used RCS and Crown 3" dials, any small dial would be satisfactory. The set illustrated uses a 4" Companion unit. A dial from a small mantel set or even a knob with a scale would do at a pinch.

Provided that there are two tuned windings, just about any 450 - 470kHz IF transformers can be used. Permeability tuned or iron cored types are preferable, but not essential. Naturally, all components and windings should be carefully checked to make sure that they are intact. Take care to note the connections of the IF transformers. Reversal of one winding will cause a serious loss of gain because of the reliance upon both magnetic and capacitive coupling.

The remaining major items are a small power transformer and a 5" speaker. If an original Little General is being restored, the power transformer and loudspeaker is not likely to present a problem. Most power transformers salvaged from receivers would be suitable, but obviously should not be too large.

HT winding voltages are not critical, anywhere between 200V and 330V being acceptable. Voltages higher than 330V were common with electromagnetic (EM) speakers, but require input filter capacitors with a peak voltage rating higher than the 450 volts normally available today.

Assuming that a matching power transformer and speaker are not available, a PM speaker is the best choice and easiest to find. It is convenient but not essential to have the output transformer mounted on the speaker.



The 1947 version differed very little from the 1940 original, as suggested by the title on its schematic. The main differences were an added 150 ohm RF bias resistor, a 0.1uF HT bypass cap, an indirectly heated rectifier and a permanent magnet speaker — which in turn made it desirable to use an HT filter choke.

PARTS LIST: 1947 LITTLE GENERAL

1 Chassis
[illegible]
1 Power transformer, 40mA minimum
[illegible]
Knobs, tagstrips, wire, screws, nuts etc.

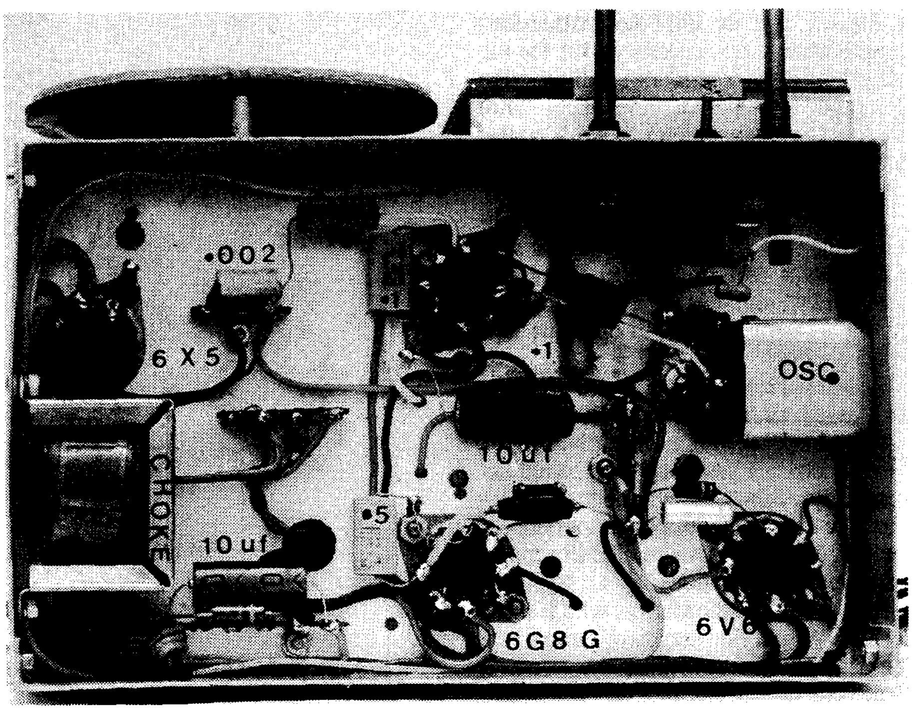
Filtering options

The original version used a 325V transformer and a 2500 ohm field winding on the EM speaker. At 40mA drain, the HT would have been 250 volts. In the 1947 model, the same power transformer was used in combination with a small filter choke and a 1000 ohm resistor, implying a choke resistance of about 1500 ohms. However, most small chokes have a resistance of about 500 ohms.

With transformers rated at a voltage of 250 or less, no resistor is necessary. But assuming a 500 ohm choke and 40mA HT drain, add about 25 ohms of series resistance for each volt above this. Thus for a 270 volt transformer, an additional 500 ohms would be suitable, and for 325 volts, the resistor should be about 2000 ohms. These resistors would need to have a rated dissipation of at least 5 watts, and in the latter case preferably 10W.

Now that compact high value electrolytic capacitors are available, resistive filtering would be a practical proposition. A pair of 32uF capacitors and a filtering resistor of 1000 ohms should be used for transformers with HT windings of less than 270 volts. Above this voltage add 500 ohms to the values shown above. If necessary, a choke can be wound on an old output transformer core using the method described for output transformers in this column for March 1991. Of course a secondary winding is unnecessary — just fill the bobbin with the fine wire.

As the octal valve series was large, there are several alternatives for each socket, with the more common types



The underside layout is not critical, and was quite different in each of the various models. One advantage we have today is the smaller size of modern capacitors.

given in the parts list. Other frequency converters that work well are types OM10, 6A8-G and 6D8-G. A later alternative IF valve intended for this type of service was the 6AR7-GT, but it has different socket connections from the recommended types.

The 6V6 proved to be very satisfactory for the output stage. An alternative, used by many manufacturers of receivers of this type, is one of the European high gain pentodes — examples being the KT61, 6AG6-G and EL33 or EL3NG. If one of these valves is used, the bias resistor (from the centre-tap of the HT winding to ground) should be changed to 220 ohms. As John Moyle pointed out, although these valves have twice the sensitivity of a 6V6, in practice the difference is hardly worthwhile and they have the disadvantage of being large and requiring twice the heater current of a 6V6.

Two popular types of rectifier are suitable. First choice is the indirectly heated 6X5-GT or EZ35. Originally an 80 was used and if the power transformer has a 5.0 volt winding, the octal equivalent 5Y3-G or -GT could be used, but their filament power consumption is double that of a 6X5-GT. The receiver illustrated uses the 5.0 volt winding for the 6.3 volt pilot lamps, which consequently do not regularly burn out.

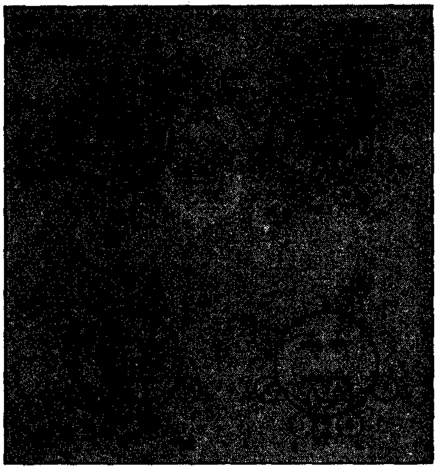
Chassis making

Construction commences with making a chassis, and in 1947 no instructions would have been necessary. But for the benefit of today's readers I will describe the procedure. Aluminium sheet 1mm thick is the easiest metal to work, and it is a good idea to ask the supplier to guillotine the sheet exactly to size.

The chassis plan gives the original dimensions, but first check that your substitute parts will fit. Collect the major components together for a benchtop trial layout — remembering to open the tuning capacitor!

The power transformer and the dial unit used in the unit pictured were slightly larger than those by John Moyle, and the chassis has been lengthened accordingly. Although with modern capacitors the chassis depth could be reduced, the original depth was retained to maintain cabinet proportions.

Now mark out the chassis with a sharp scriber. With a fine hacksaw, remove the metal to be cut away at the corners. Don't use tinsnips as they produce a bent edge — all too obvious in the finished chassis. Folding the sides requires a vice



Here are the base connections for the four valves shown in the schematic, to save you having to look them up. From top left (clockwise) are the 6J8, the 6G8, the 6X5 and the 6V6.

and some angle iron. First, with short lengths of angle in the vice, and, working off their ends, carefully line up the scribed marks and bend the tabs at the ends of the sides at right angles. Note that they are set back by the thickness of the metal.

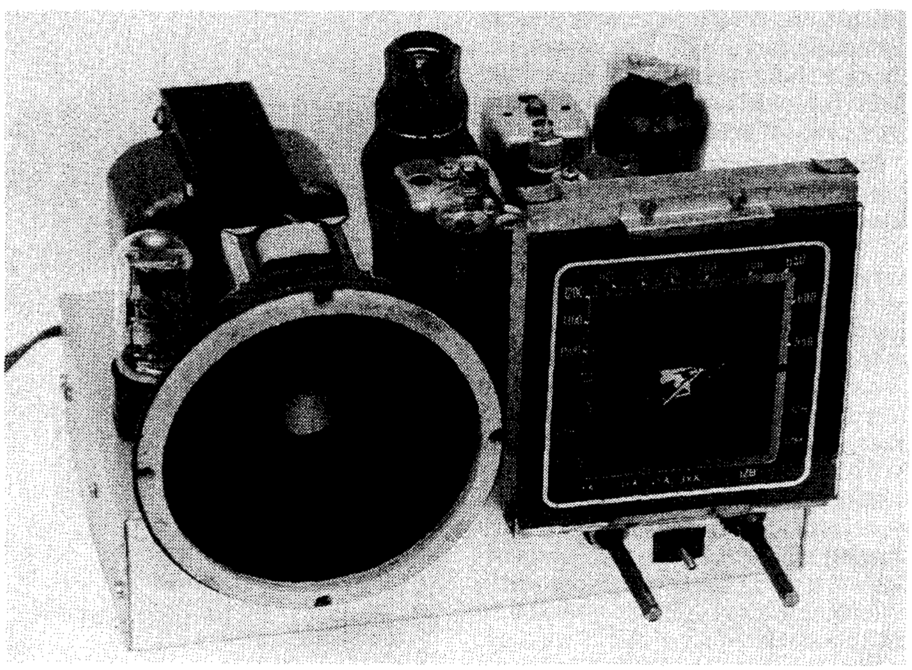
Now, after centring a longer length of angle over the rear jaw of the vice, cut another piece of angle iron to be a few millimetres shorter than the sides of the chassis and position it against the front jaw of the vice. Clamp the chassis with the bending mark in line with the edges of the angle irons. With the aid of a piece of wood (100mm by 50mm is ideal) behind the projecting part of the chassis, carefully fold the chassis forward to form a right-angled bend. Use a hammer on the wood to make the bend as sharp as possible — but NEVER hammer directly on the metal, or unsightly dents will result. Repeat this procedure with the other side and then, with another suitable length of angle iron in front, bend the ends — taking care that the tabs fit inside. Square the chassis up and secure each tab with a screw and nut.

Chassis punch

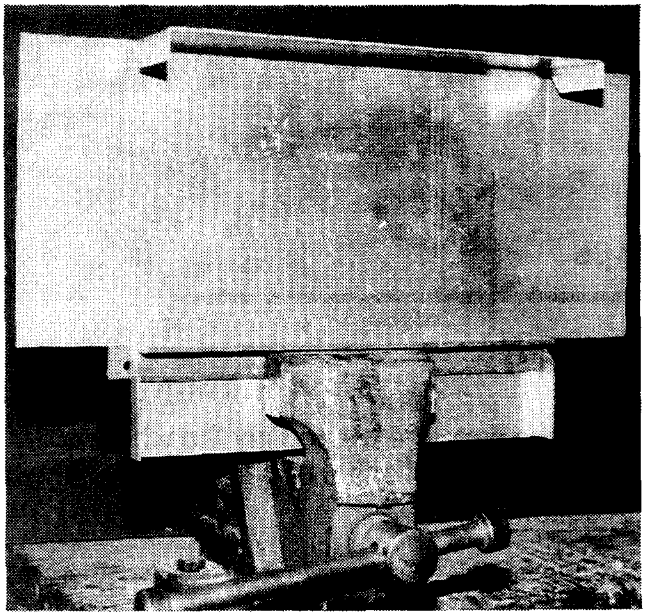
The chassis is now ready for mounting the components. The tools required are minimal, but one tool that will save a lot of work in cutting the valve socket holes is a hole punch consisting of a matching socket and cutter pulled together by a threaded bolt. These are available in various sizes, often from electricians' suppliers, and the 30mm diameter size is suitable for older valve sockets, including octals. Use rubber grommets where power transformer and mains leads pass through the chassis.

To allow for the thickness of a baffle, mount the loudspeaker back about 3mm from the front line of the dial glass. Depending on the speaker's shape, it may be necessary to provide a small cutout at the front edge of the chassis.

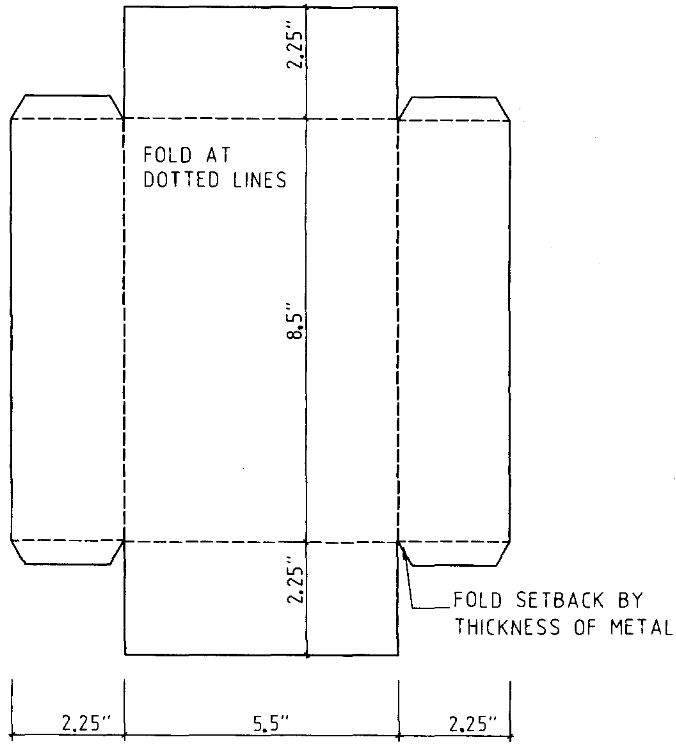
There is nothing critical about the wiring, but keep grid and anode leads as short as possible. Support each end of



The completed chassis. A similar layout was used for all versions, with exact dimensions and orientation dependent on the size of the main components. 6G8-G and 6B8-G IF valves require shielding — this chassis uses a 'goat' type shield (centre rear), which John Moyle also used in the original.



Above: Folding the chassis with two lengths of angle iron in the vice — the front piece being a few millimetres shorter than the side being bent. At right are the dimensions for the original 1940 chassis, which may need to be varied to suit your components.



wire ended components, using tag strips if necessary. To cater for shielded valves, earth pin 1 of all sockets.

Making the cabinet

Complete the project by making a simple cabinet. I have not given any dimensions, as these will depend on the size of the finished chassis. Allow 10mm or so clearance for easy fitting. For the sides, top and bottom use 10mm plywood, but 5mm is best for the front. With a fretsaw or fine coping saw cut out the speaker and dial openings before assembling. Well-fitted butt joints, pinned and glued, are quite sufficient to make a very sturdy box. Round the edges with sandpaper.

The original cabinets were covered with upholstering fabric known by names such as 'Leatherette' or 'Rexine'. Fortunately, equivalents are still used for car head linings. For a nominal charge, a co-operative car upholsterer covered my cabinet with an offcut of a mid-brown liner used for Commodore cars.

A convenient mount for the speaker grill fabric is a piece of heavy cardboard sub baffle, with a cutout to line up with the speaker cone. Stain or paint the cardboard black. Cut the cloth to be a bit larger than the baffle and stretch it out on a flat surface, holding the edges down with cellulose tape. Lightly coat the surface of the cardboard with PVA glue and lay it on the cloth, leaving a weight on it for an hour or so. Too much glue will bleed through the cloth. The cloth can then be trimmed to the edges of the baffle, which can then be fastened inside the cabinet with short screws. Secure the chassis in the cabinet with a long bolt, through a hole near the rear of the centre of the chassis — lining up with a matching hole in the bottom of the cabinet.

How it performs

John Moyle's assertion that for everyday listening, conventional receivers had excess audio gain is vindicated by this little receiver. Performance is more than adequate for urban locations, and with a few metres of outside aerial it is capable of trans- Tasman night time reception. The only practical difference from five-valve sets is that the volume control is used over more of its range.

Aurally the Little General compares more than favourably with its modern counterparts. Mine has recently performed well in keeping me in touch with the world during house painting, gardening and concrete laying sessions — just the type of service that John Moyle had in mind for his outstandingly successful creation. ❖